OWL SWD OPERATING

THE OFFICE SWD-1

FSP Analysis

Eddy Co., NM

Luis Canales
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September 25, 2020

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FIGURES

TABLES

1.0 OVERVIEW

The following report by Lonquist & Co. addresses the requested Fault Slip Potential (FSP) analysis on behalf of OWL SWD Operating for The Office #1 SWD permit request.

2.0 KEY ELEMENTS

1. Structure maps on the tops of the proposed injection formation, centered on the proposed well location.
2. Two structural cross sections annotated with the top proposed injection formation and injection interval: one oriented along the strike of the proposed formation and the other perpendicular to the strike of the proposed formation.
3. Maps include an aerial extent greater than a radius of 5.6 miles centered on the proposed The Office location.
4. FSP modeling using Stanford Center for Induced and Triggered Seismicity (SCITS) software.
    a. Model Area of Interest (AOI) with radius of 9.08 Km
    b. Model input includes known subsurface fault locations with faults segmented to a maximum length of 3 Km.
    c. Two models run for each known fault (four models) with year-end at least 20 years into the future (Figure 1).
        i. First model run includes all permitted injection well volumes (obtained from DrillingInfo) in the AOI plus the proposed injection well
        ii. Second model run includes only the proposed injection well.

3.0 Executive Summary

The location of OWL The Office SWD #1, the selected 15 injection wells, and faults in Eddy County, New Mexico are shown on Figure 1. The Office SWD #1 permit application is targeting the Devonian-Fusselman formations at a measured depth of 13,500' to 14,050' (Figure 2).

The FSP models included utilize Woodford and Basement level fault traces documented by the Texas Bureau of Economic Geology (BEG) Integrated Synthesis of the Permian Basin http://www.beg.utexas.edu/resprog/permianbasin/gis.htm.

The Woodford fault traces cut the highest, in a stratigraphic sense, within the AOI (Figure 3).

In our opinion injection fluids will be confined to the Devonian-Fusselman formation which are approximately 2000 ft above basement rock. None of the FSP models run utilizing these fault traces, proposed injection interval reservoir properties, and surrounding fluid injection data, demonstrated evidence these faults would slip.

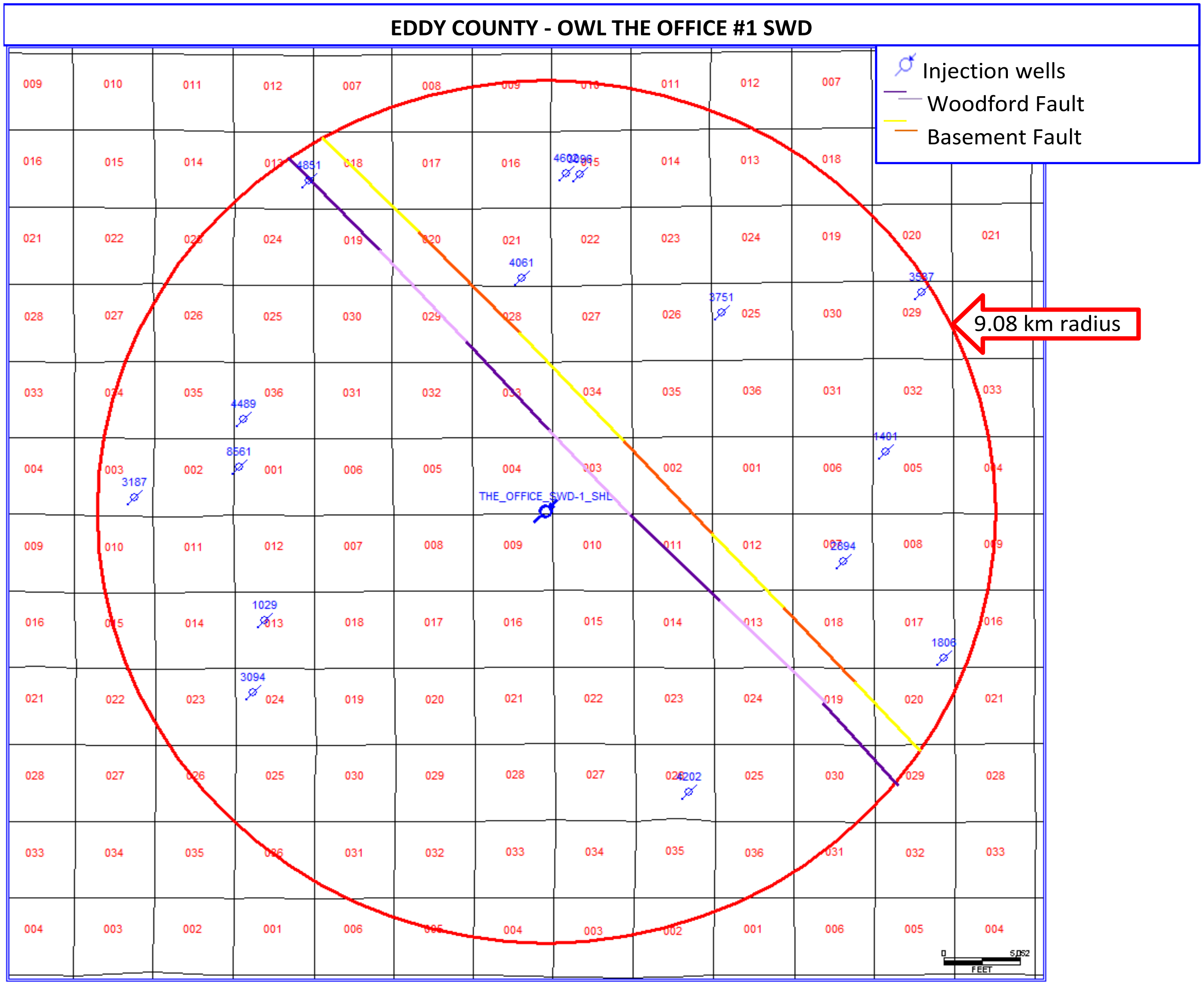
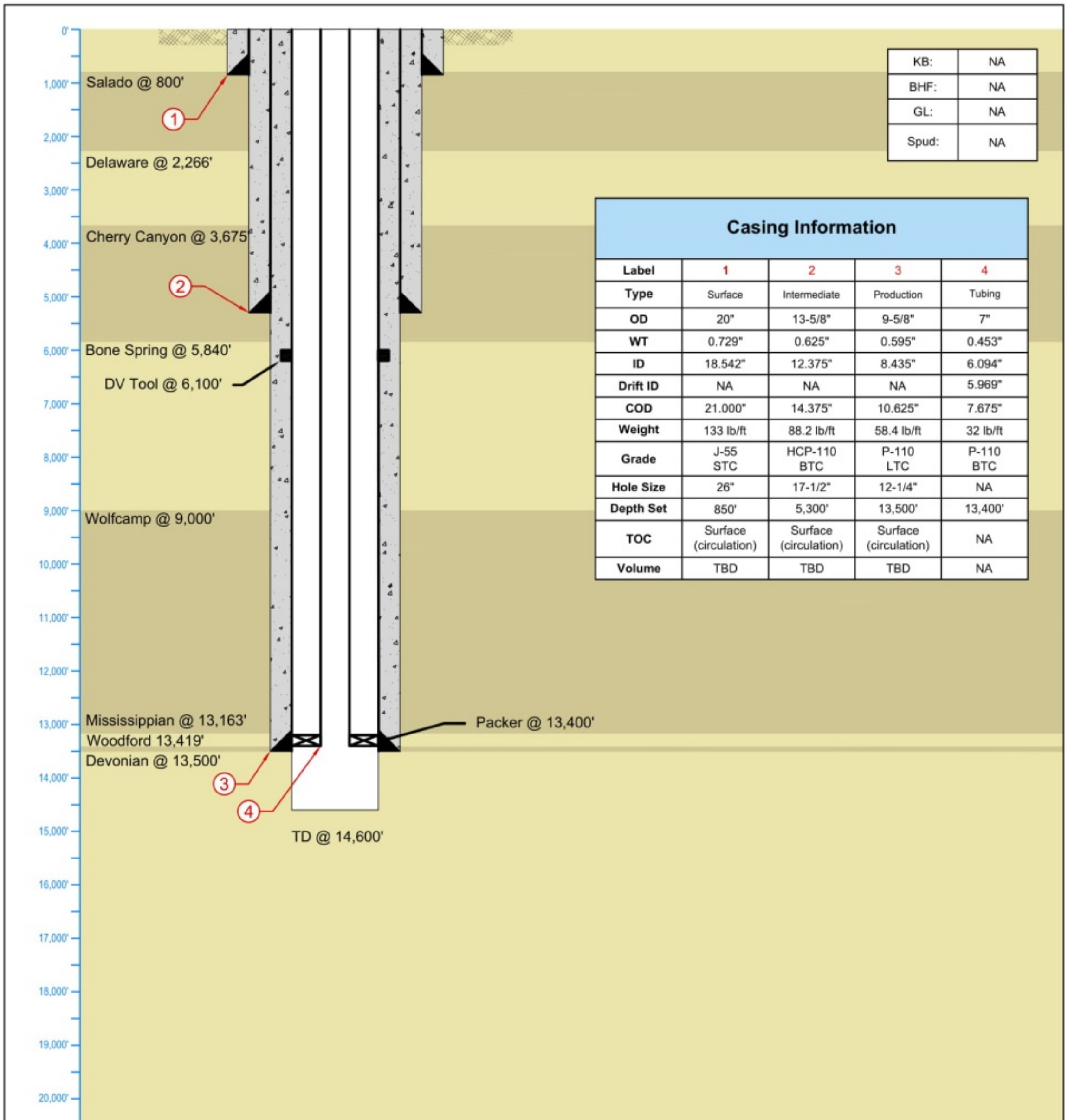


Figure 1 - Proposed OWL location, and FSP analysis AOI.



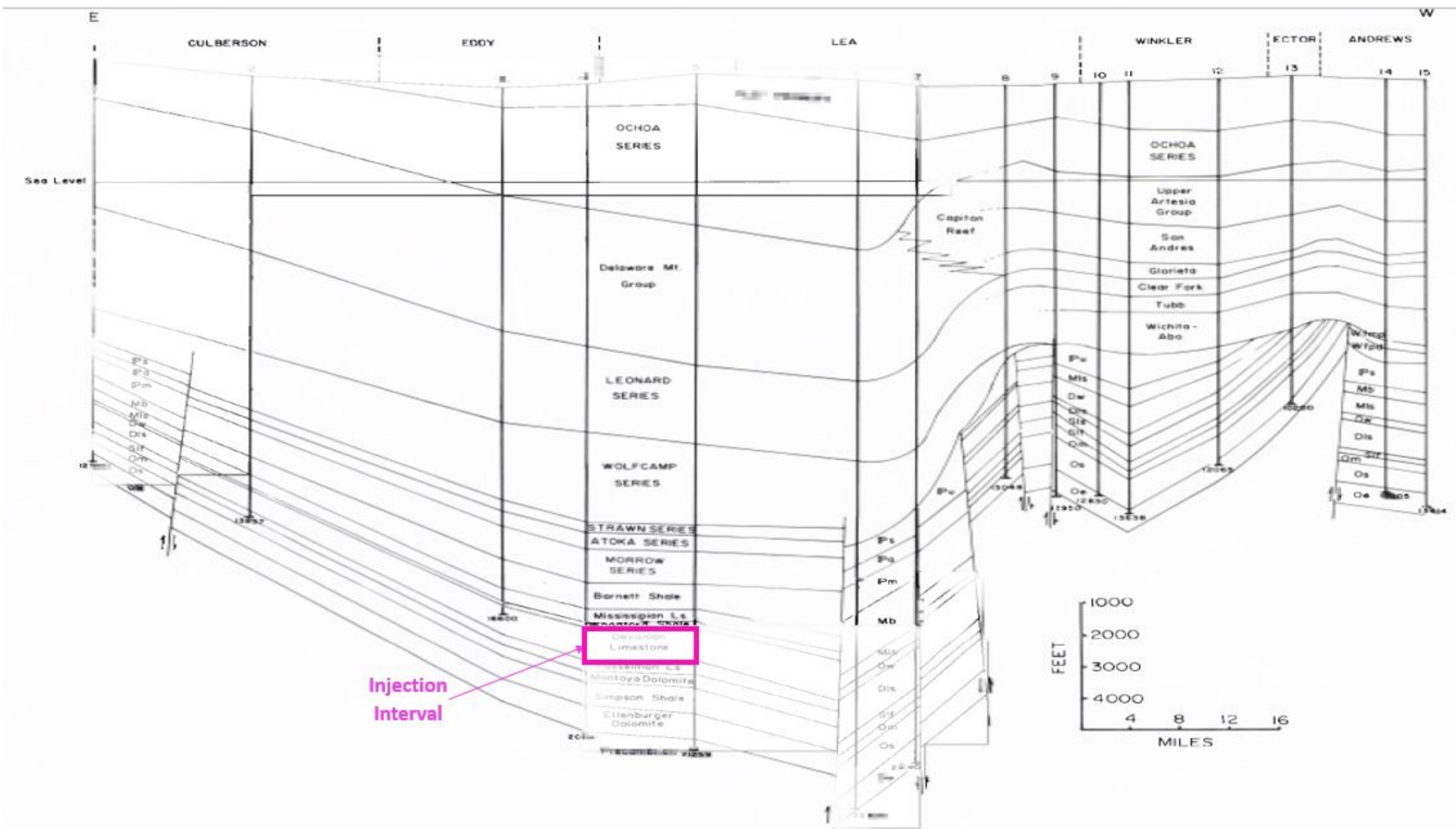
KB:	NA
BHF:	NA
GL:	NA
Spud:	NA

Casing Information

Label	1	2	3	4
Type	Surface	Intermediate	Production	Tubing
OD	20"	13-5/8"	9-5/8"	7"
WT	0.729"	0.625"	0.595"	0.453"
ID	18.542"	12.375"	8.435"	6.094"
Drift ID	NA	NA	NA	5.969"
COD	21.000"	14.375"	10.625"	7.675"
Weight	133 lb/ft	88.2 lb/ft	58.4 lb/ft	32 lb/ft
Grade	J-55 STC	HCP-110 BTC	P-110 LTC	P-110 BTC
Hole Size	26"	17-1/2"	12-1/4"	NA
Depth Set	850'	5,300'	13,500'	13,400'
TOC	Surface (circulation)	Surface (circulation)	Surface (circulation)	NA
Volume	TBD	TBD	TBD	NA

LONQUIST & CO. LLC PETROLEUM ENGINEERS | ENERGY ADVISORS HOUSTON | CALGARY AUSTIN | WICHITA | DENVER	OWL SWD Operating, LLC	The Office SWD No. 1 - Proposed	
	Country: USA	**State/Province:** New Mexico	**County/Parish:** Eddy
	Location:	**Site:**	**Survey/STR:** Sect 10, T-25S, R-27E
	API No:	**Field:**	**Well Type/Status:** SWD
Texas License F-9147	**State ID No:**	**Project No:**	**Date:** 3/28/2019
12912 Hill Country Blvd, Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	**Drawn:** WHG	**Reviewed:** RH	**Approved:** SLP
	Rev No: 8	**Notes:**	

Figure 2 - Injection Target: Devonian



(NM Geological Society Guidebook, 31st Field Conference))

Figure 3 - Delaware Basin generalized cross section.

4.0 Geologic Overview

The proposed The Office SWD 1 well is located in Eddy County, New Mexico on the northern side of the Delaware Basin.

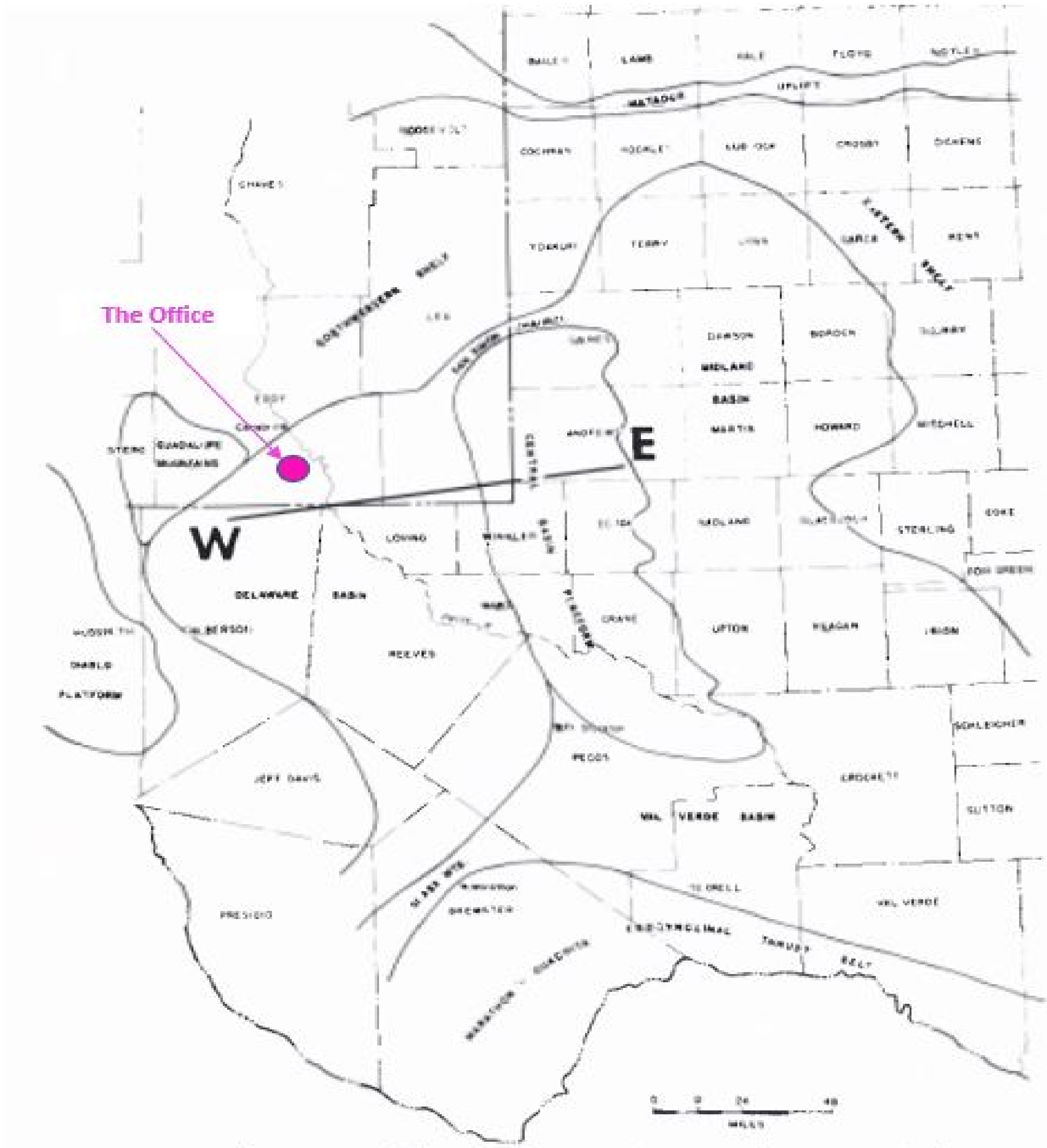


Figure 1. Index map of the study area showing location of the geologic cross-section.

Figure 4 - Index map of West Texas geologic provinces with the location of proposed Office SWD (Keller, 1980)

KELLER, HILLS and DJEDDI

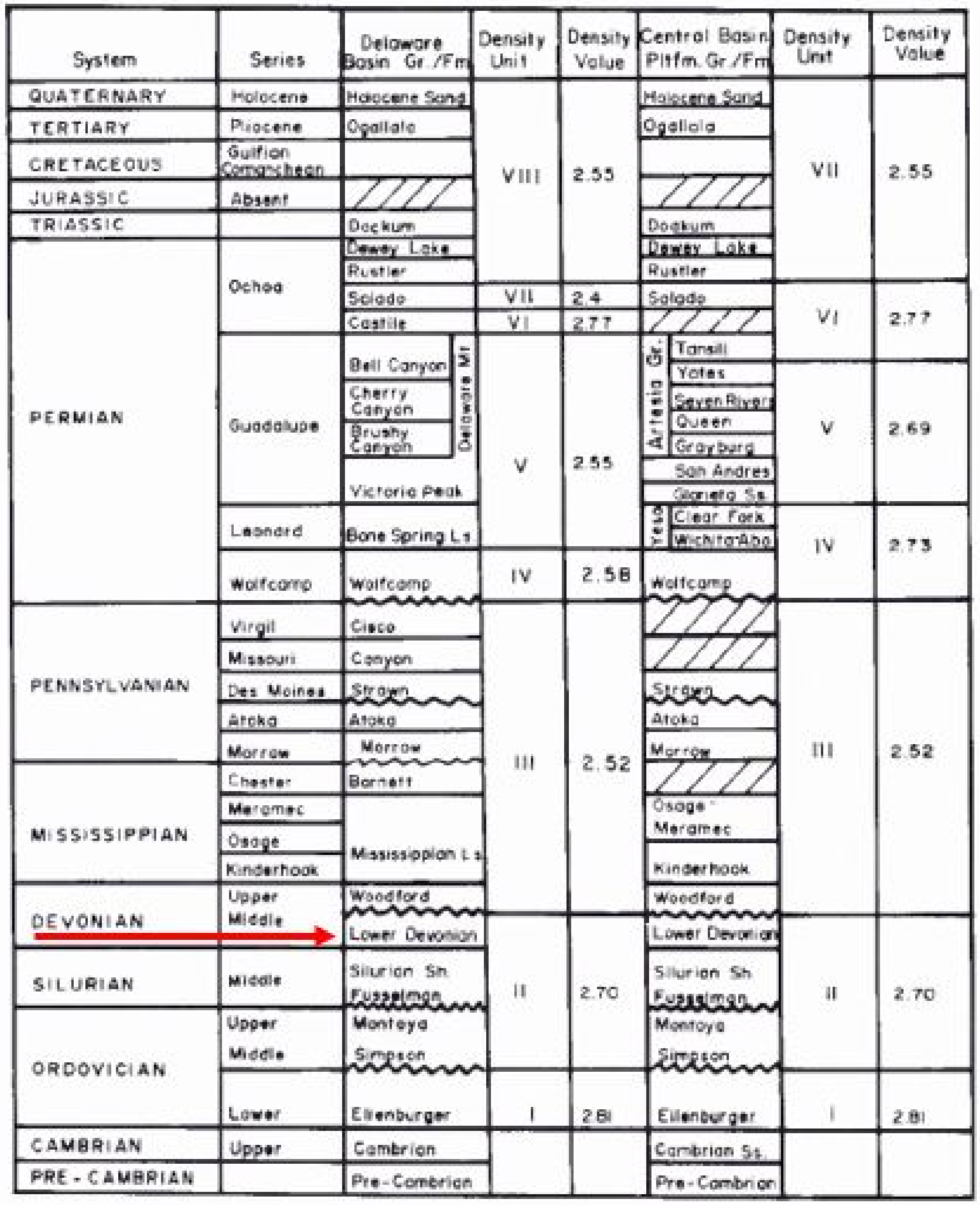


Figure 2. Generalized stratigraphic column of West Texas and southeastern New Mexico. After T. J. Jones (1965) and J. M. Hills (1972).

Figure 5 - Stratigraphic column of the Delaware Basin.

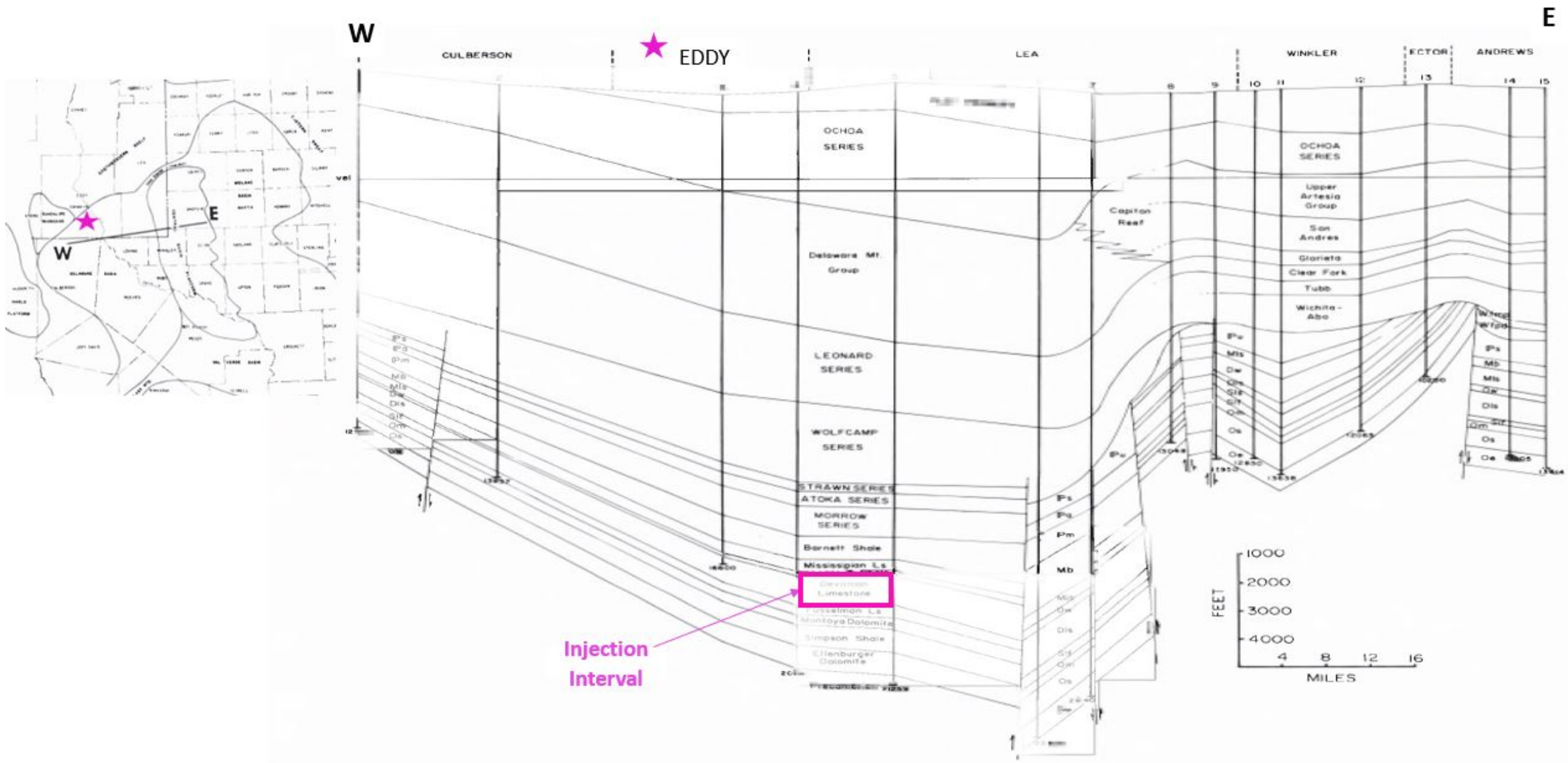


Figure 6 - Published Regional Cross Section, annotated with key formations (Keller, 1980)

The geologic maps and cross sections which follow are in keeping with these regional studies. The proposed injection interval in the Devonian section is proximal to the Woodford and Basement fault traces utilized in this FSP analysis

5.0 Geologic Mapping

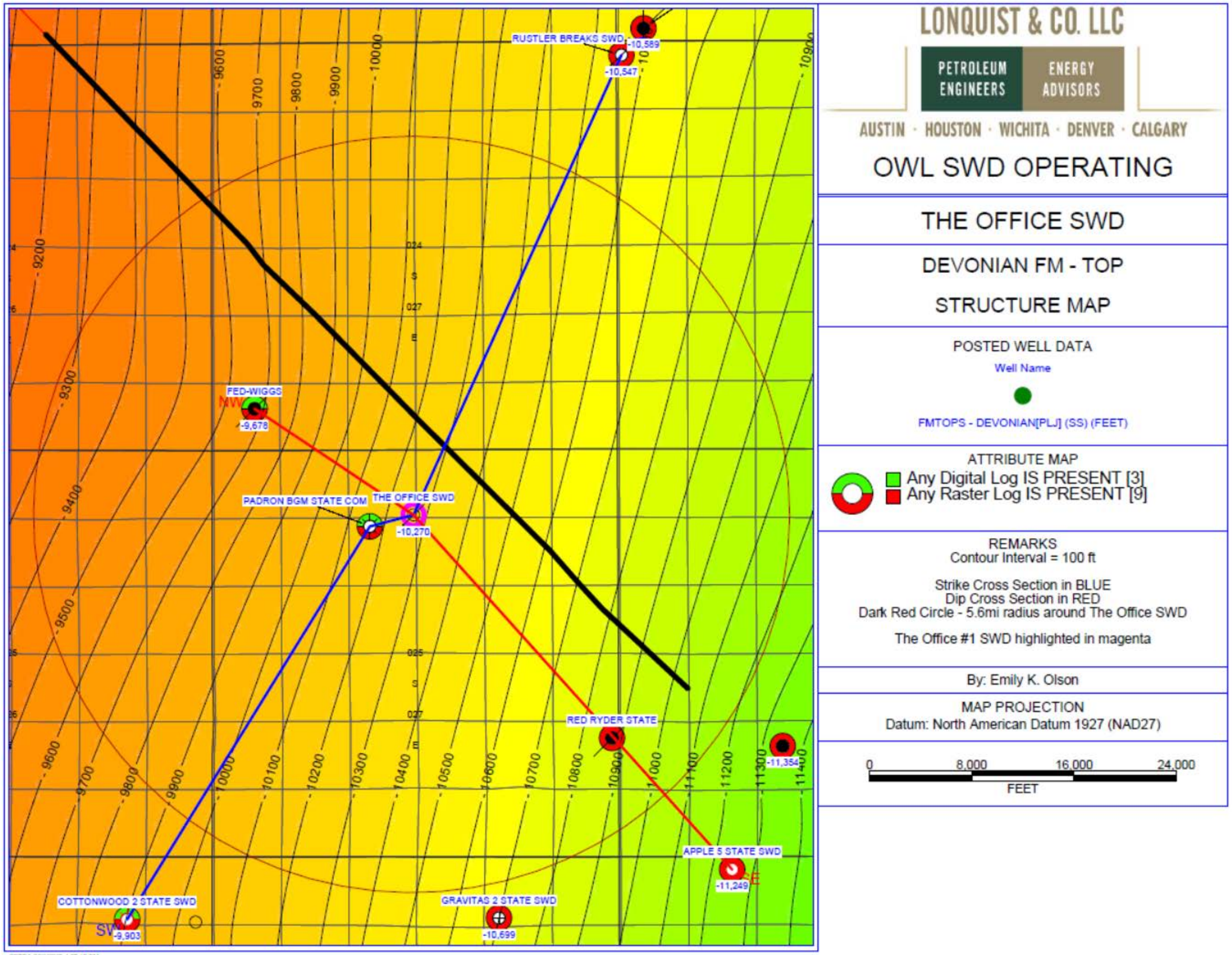


Figure 7 - Structure Top of Devonian

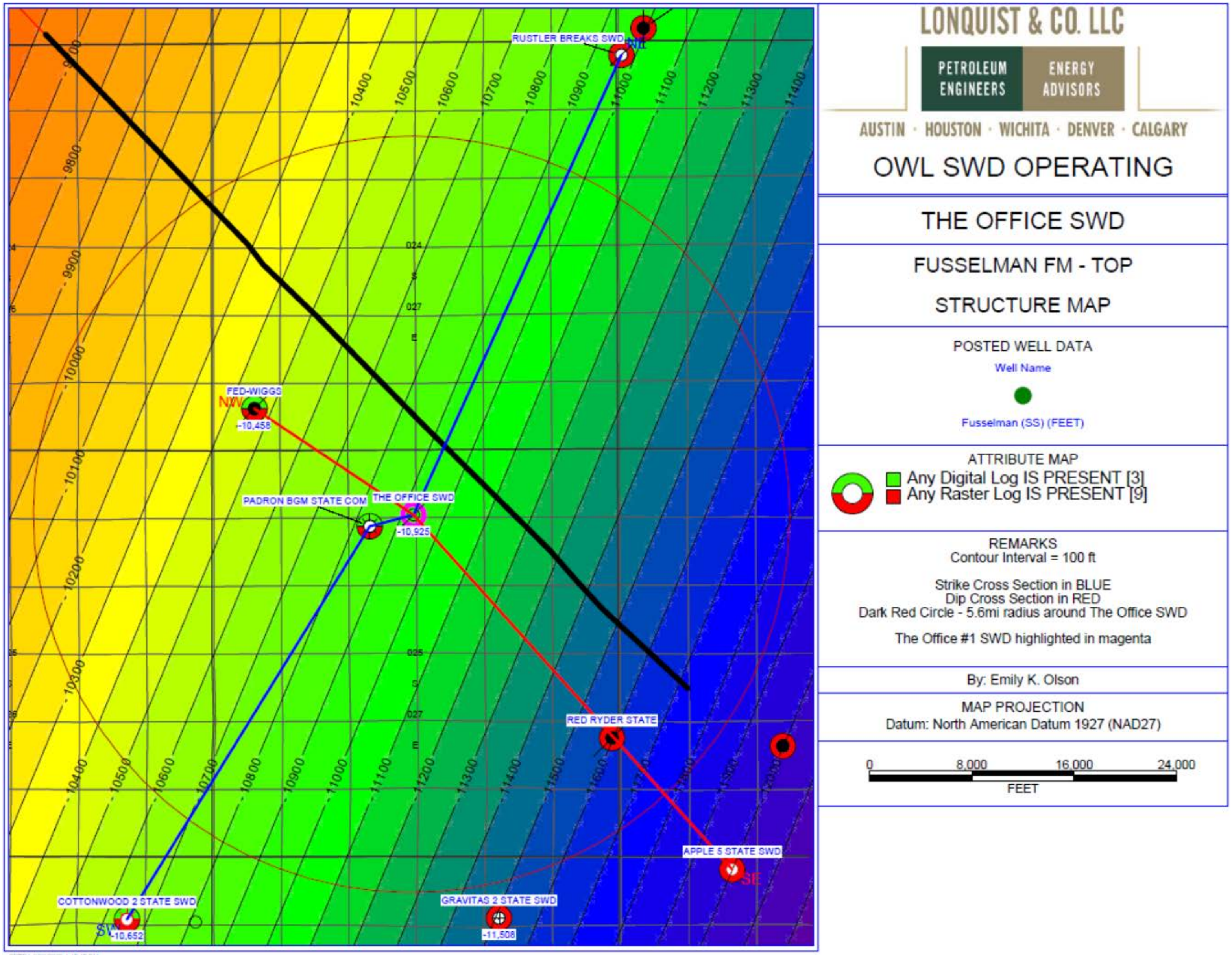


Figure 8 - Structure Top of Fusselman

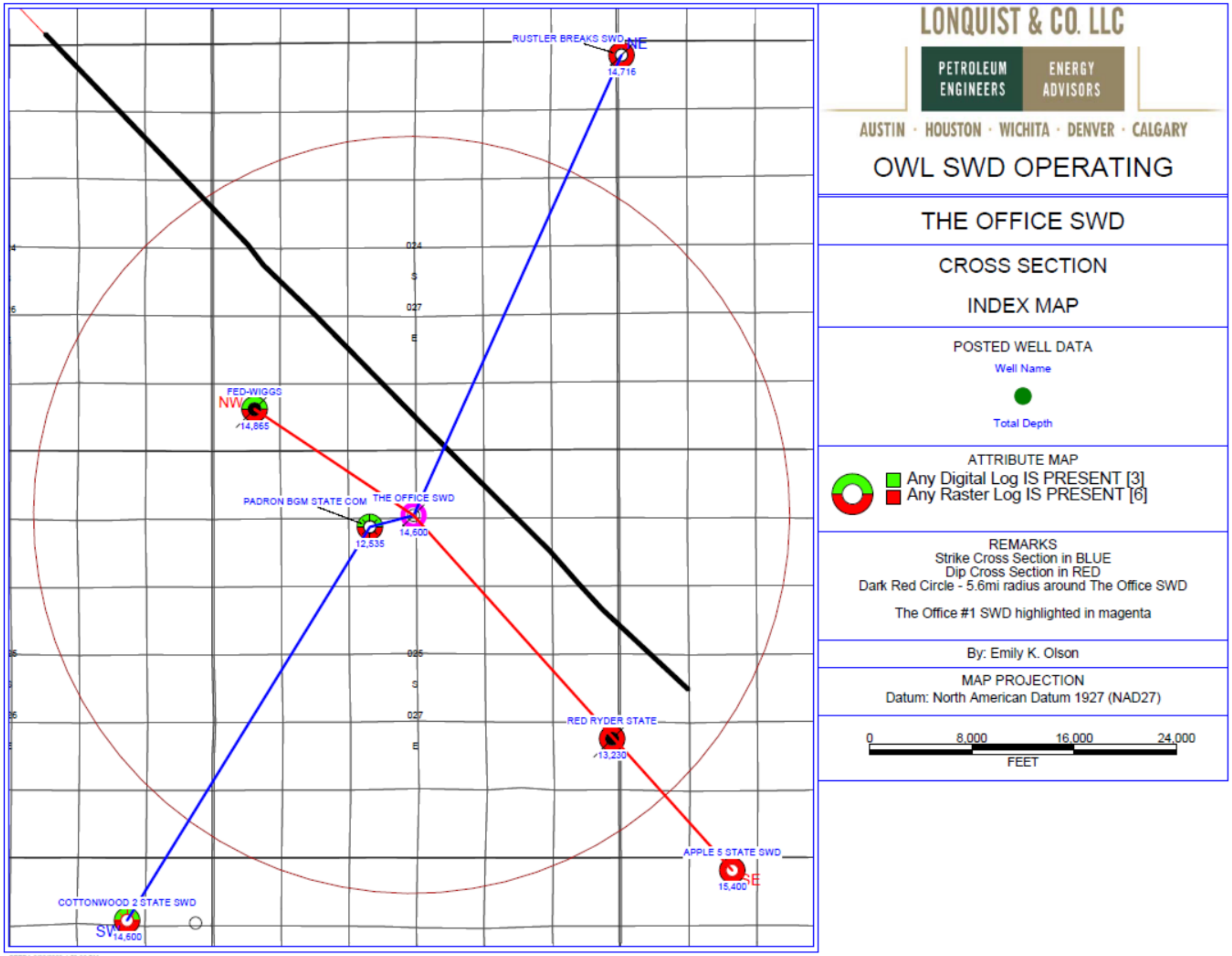


Figure 9 - Cross section locator map

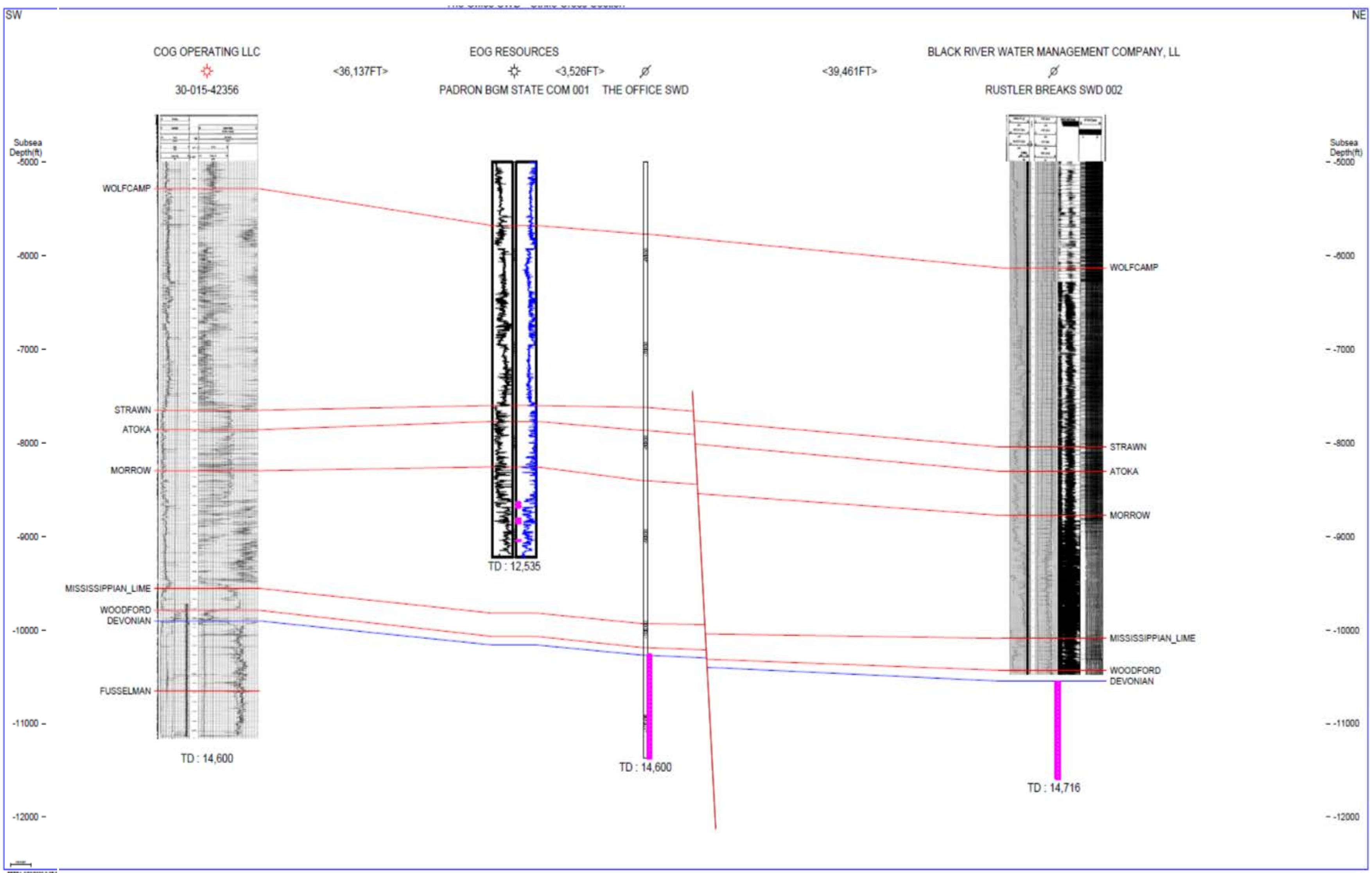


Figure 10 - Structural Cross Section – Strike. Proposed injection interval in pink.

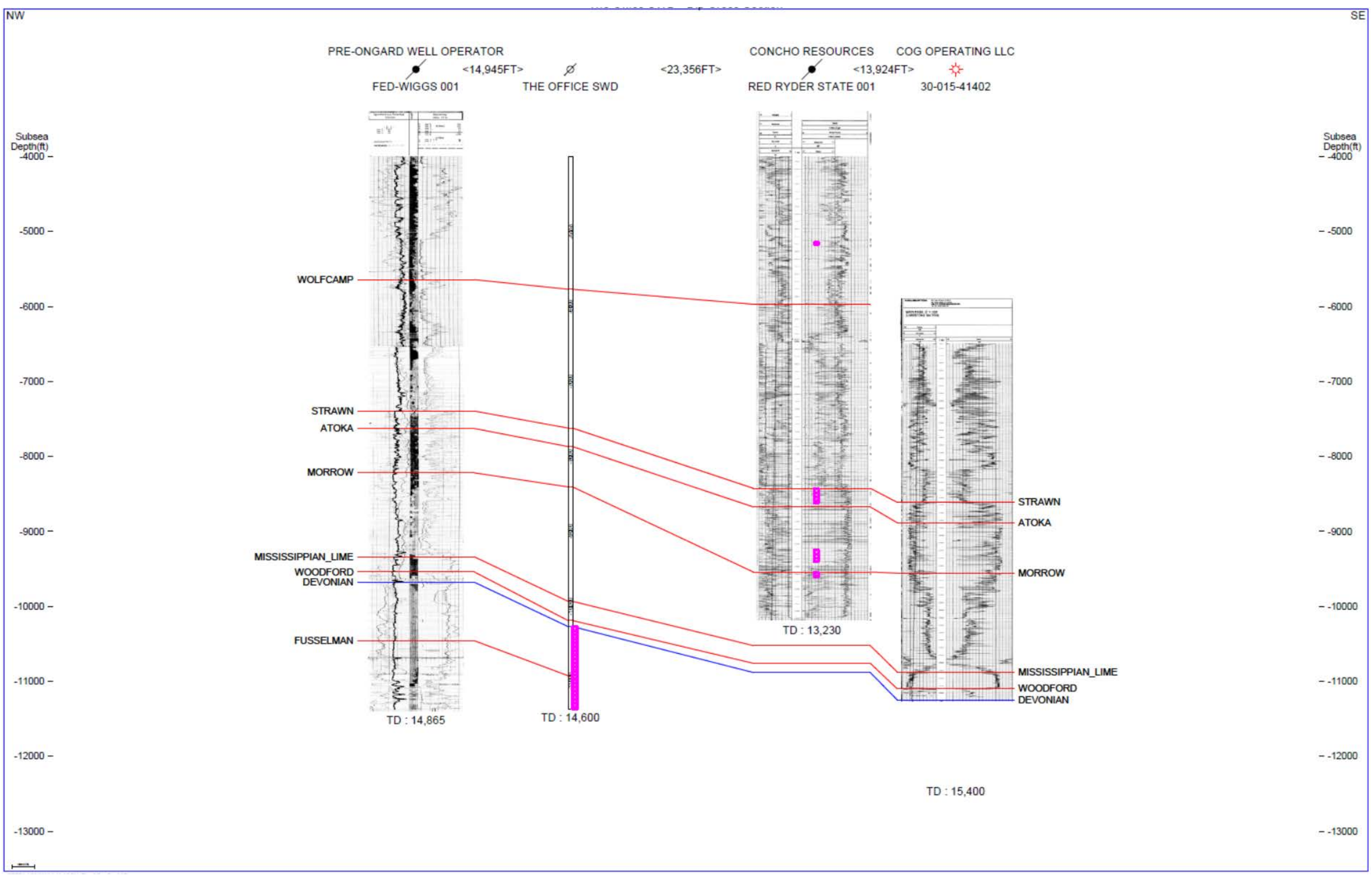


Figure 11 - Structural Cross Section – Dip. Proposed injection interval in pink.

6.0 FSP Analysis MODEL 1 – Woodford Faults - All injectors

SCITS software (v 2.0) was used for the Fault Slip Potential (FSP) analysis.

Analysis includes:

- Fluid injection history from DrillingInfo within the 9.08 Km AOI.
- Proposed rates for the The Office SWD #1.
- Proposed injection interval reservoir parameters and average depth.
- Local stress information, pressure gradients.
- Known fault locations within AOI, with faults segmented to a maximum length of 3 Km.

Two FSP models were run, including year-end analysis 20 years into the future.

- Model #1: includes all permitted injection wells in the AOI plus the proposed injection interval (16 wells total).
- Model #2: includes only the proposed injection interval.

In summary, the proposed fluid injection does not significantly increase the risk that these "buried" faults will slip.

Figure 13 shows the location of existing fluid injection wells and the proposed The Office SWD #1 in relation to faults documented within the AOI. Woodford fault traces are from the BEG Integrated Synthesis of the Permian Basin database (Figure 15).

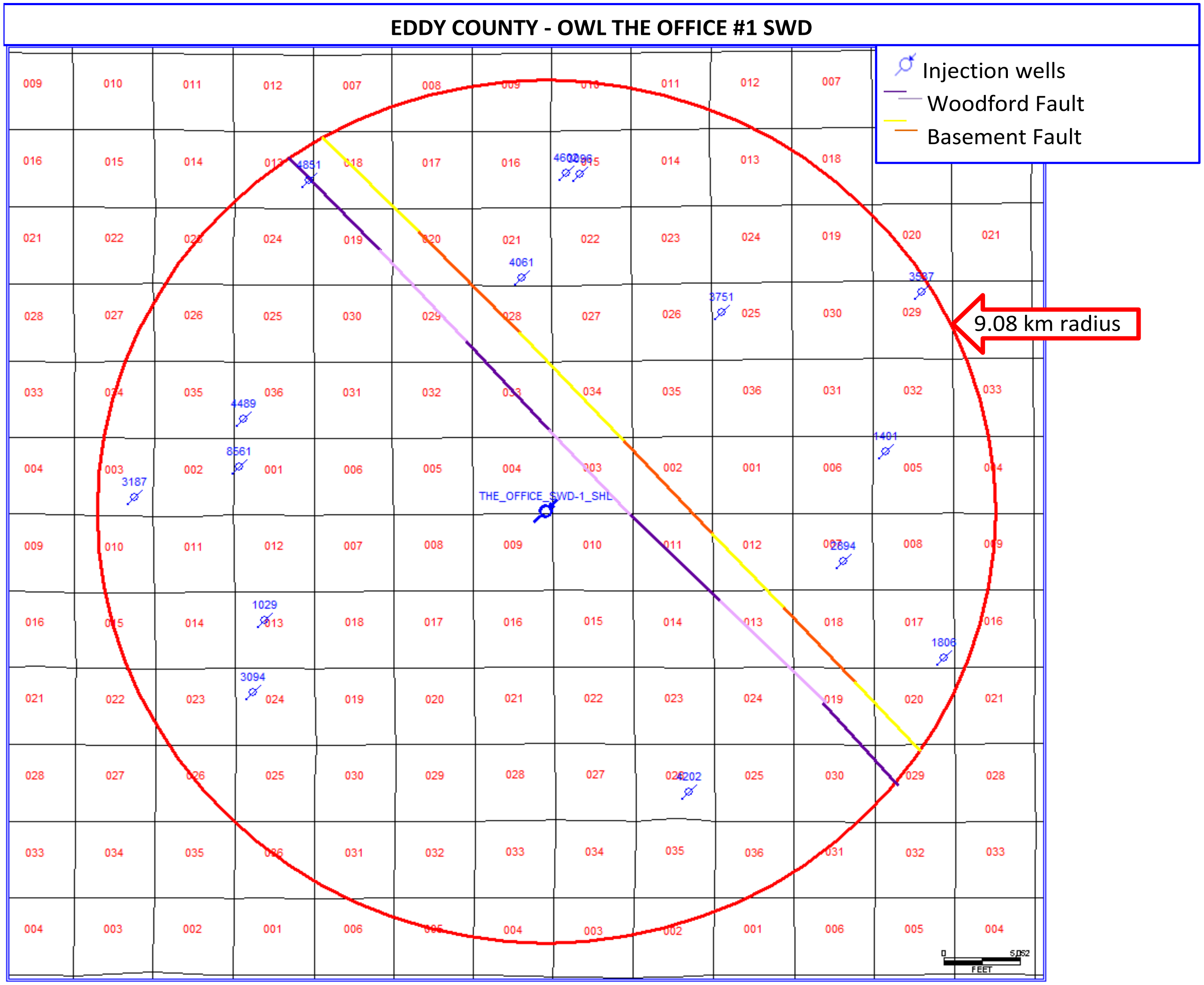
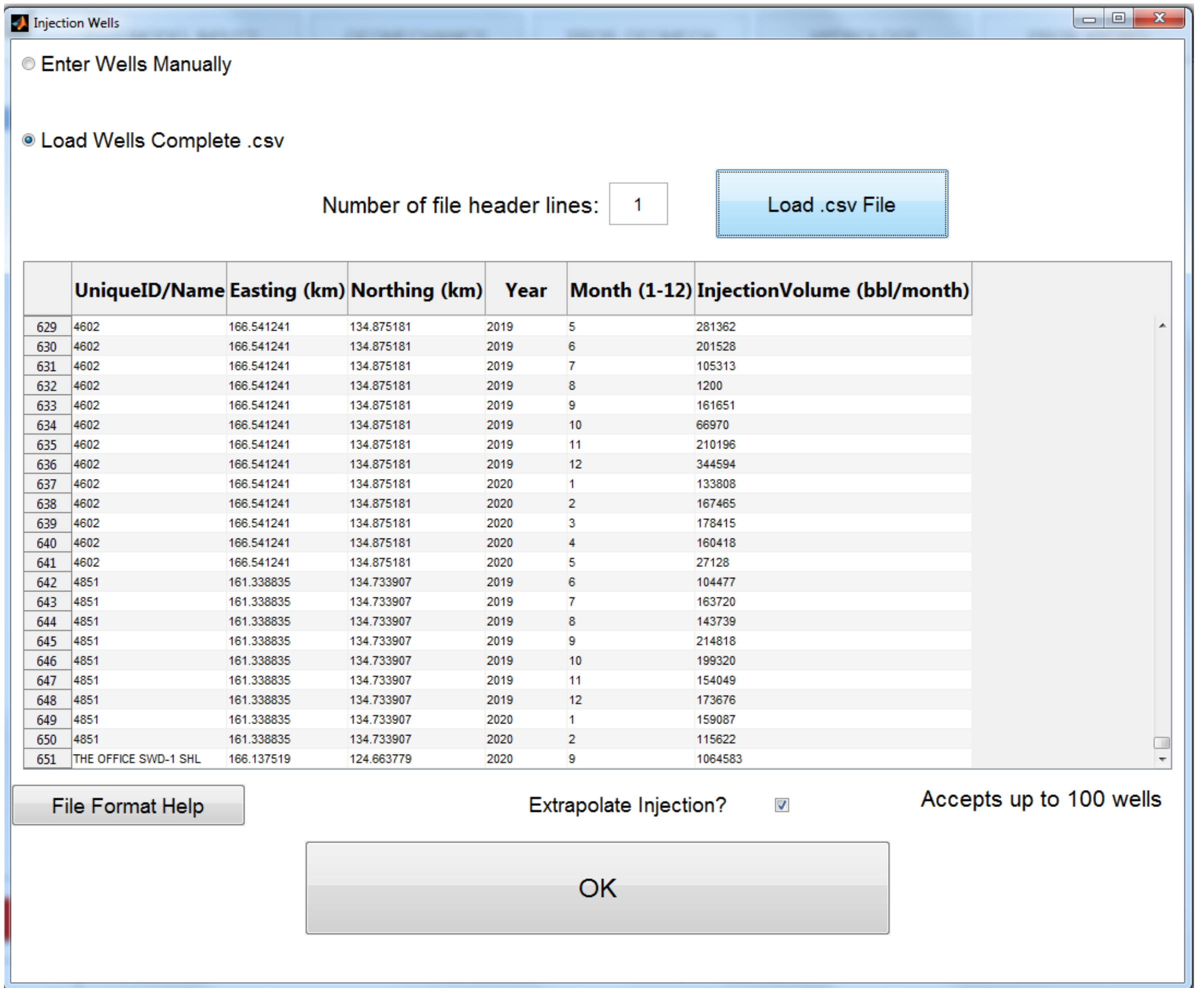


Figure 12 - OWL FSP Analysis Injection Well

Partial View of 16 Wells



	UniqueID/Name	Easting (km)	Northing (km)	Year	Month (1-12)	InjectionVolume (bbl/month)
629	4602	166.541241	134.875181	2019	5	281362
630	4602	166.541241	134.875181	2019	6	201528
631	4602	166.541241	134.875181	2019	7	105313
632	4602	166.541241	134.875181	2019	8	1200
633	4602	166.541241	134.875181	2019	9	161651
634	4602	166.541241	134.875181	2019	10	66970
635	4602	166.541241	134.875181	2019	11	210196
636	4602	166.541241	134.875181	2019	12	344594
637	4602	166.541241	134.875181	2020	1	133808
638	4602	166.541241	134.875181	2020	2	167465
639	4602	166.541241	134.875181	2020	3	178415
640	4602	166.541241	134.875181	2020	4	160418
641	4602	166.541241	134.875181	2020	5	27128
642	4851	161.338835	134.733907	2019	6	104477
643	4851	161.338835	134.733907	2019	7	163720
644	4851	161.338835	134.733907	2019	8	143739
645	4851	161.338835	134.733907	2019	9	214818
646	4851	161.338835	134.733907	2019	10	199320
647	4851	161.338835	134.733907	2019	11	154049
648	4851	161.338835	134.733907	2019	12	173676
649	4851	161.338835	134.733907	2020	1	159087
650	4851	161.338835	134.733907	2020	2	115622
651	THE OFFICE SWD-1 SHL	166.137519	124.663779	2020	9	1064583

Figure 13 - FSP injection well input Model 1

Woodford Fault segments

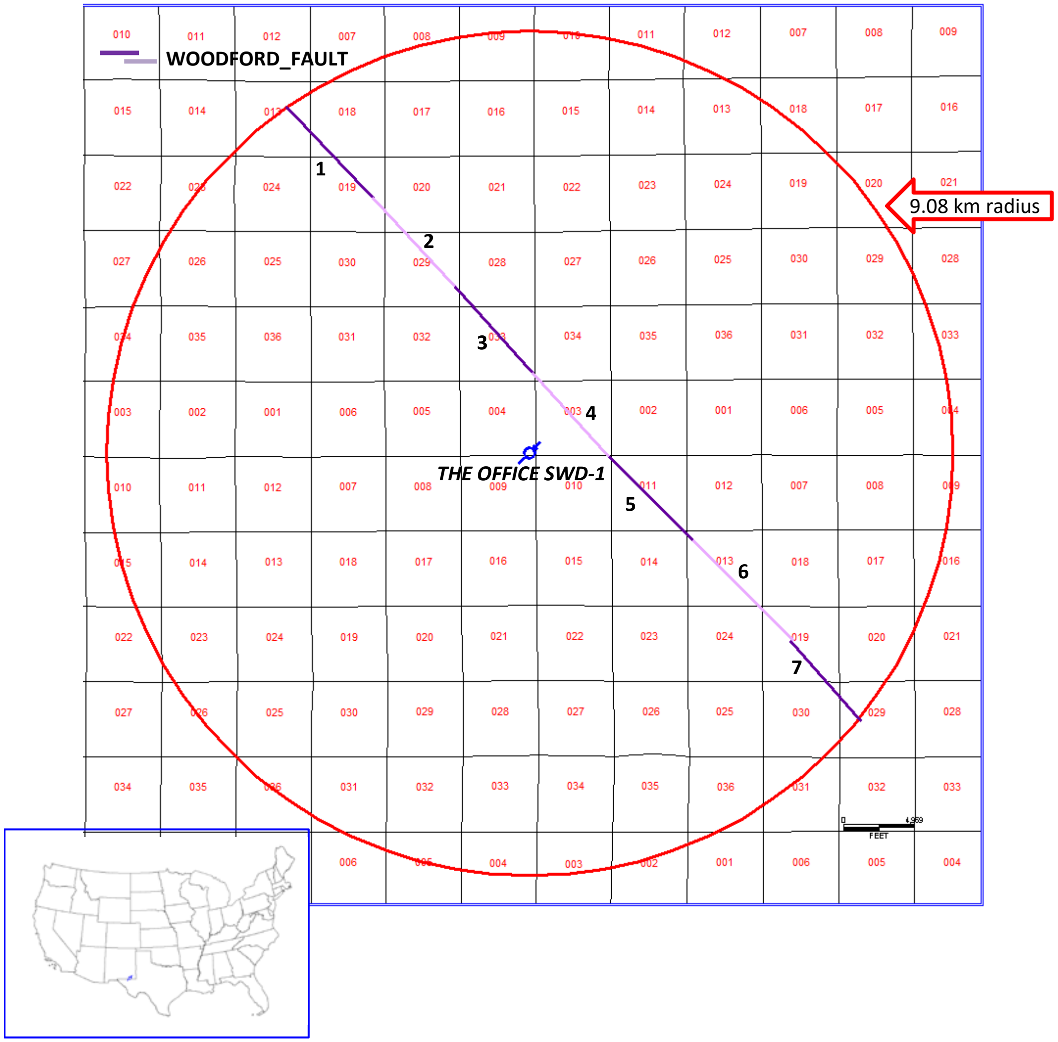
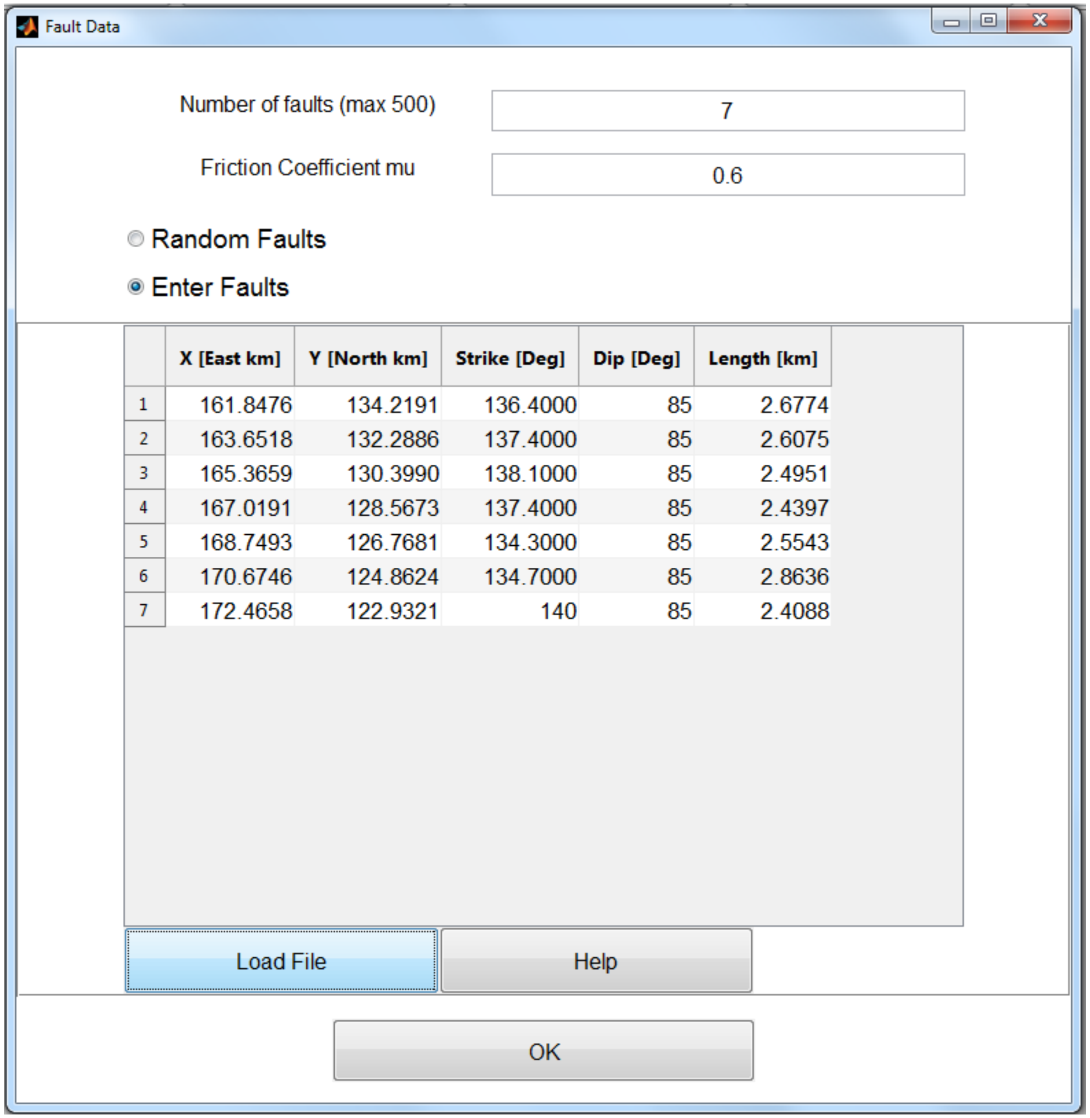


Figure 14 - Woodford Fault segments (7) used in FSP Analysis Models 1 and 2

Partial View Woodford Fault Segments



	X [East km]	Y [North km]	Strike [Deg]	Dip [Deg]	Length [km]
1	161.8476	134.2191	136.4000	85	2.6774
2	163.6518	132.2886	137.4000	85	2.6075
3	165.3659	130.3990	138.1000	85	2.4951
4	167.0191	128.5673	137.4000	85	2.4397
5	168.7493	126.7681	134.3000	85	2.5543
6	170.6746	124.8624	134.7000	85	2.8636
7	172.4658	122.9321	140	85	2.4088

Figure 15 - FSP Fault input for Models 1 and 2

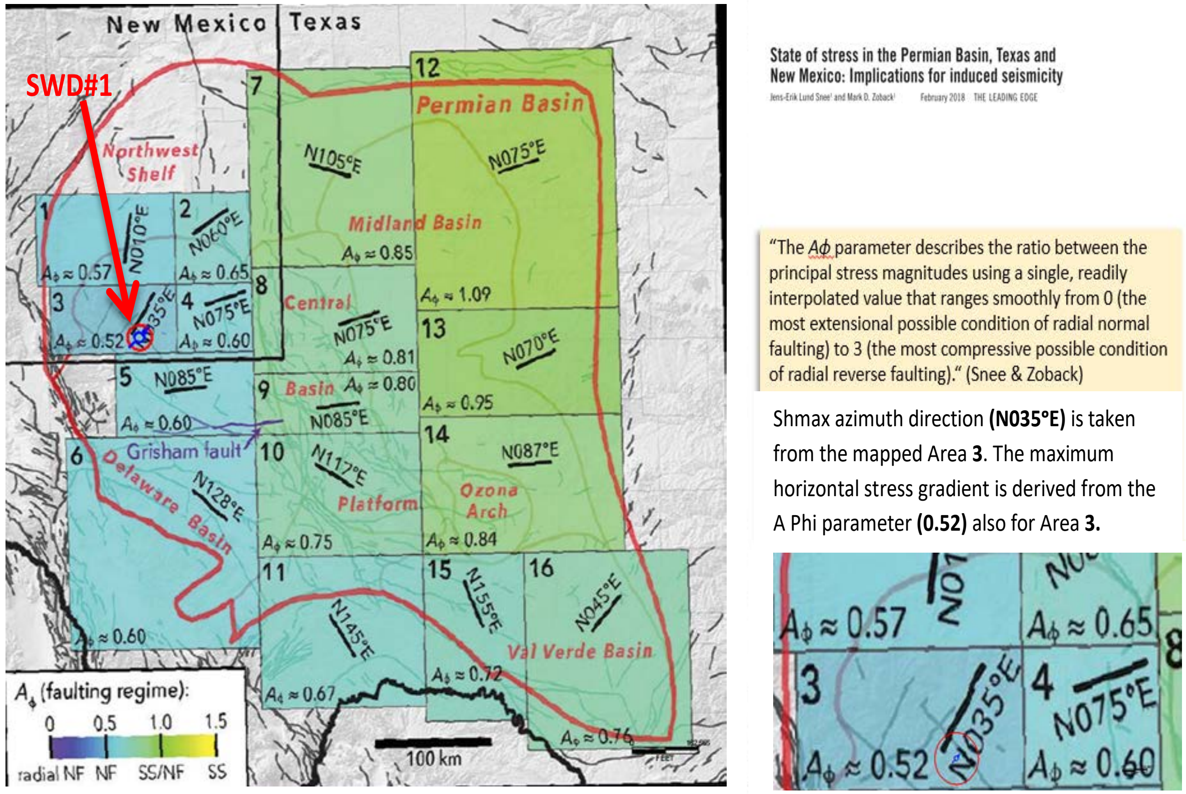


Figure 16 - Local Stress Parameters used (Snee and Zoback, 2018) Models 1 thru 4

Shmax azimuth direction (N035°E) is taken from the mapped Area **3** corresponding to this FSP analysis published by Snee and Zoback (Figure 17). The maximum horizontal stress gradient is derived from the A Phi parameter (0.52) also for Area **3**.

The same stress parameters are used for all models (1-4).

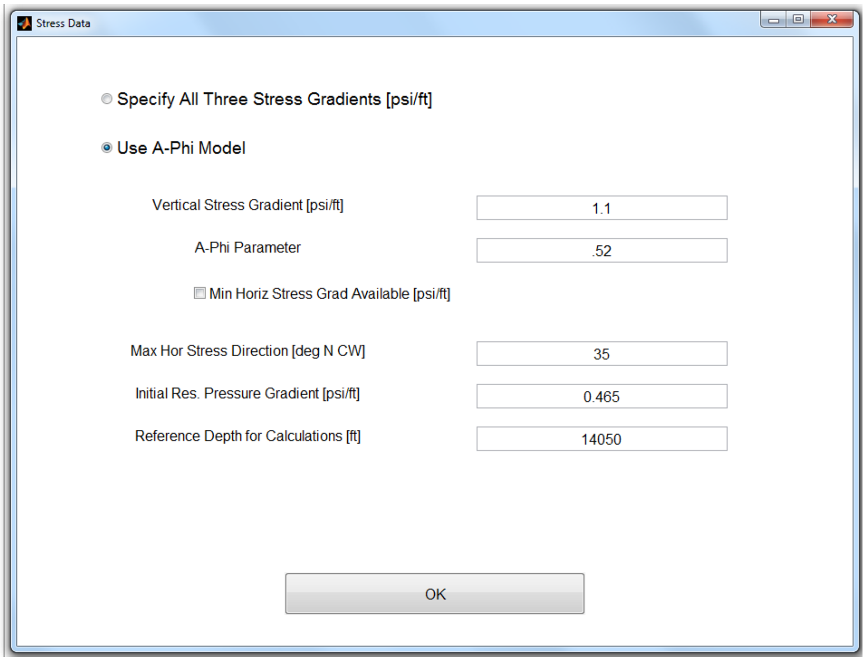


Figure 17 - FSP Stress & Reservoir depth input Models 1 thru 4

The following reservoir parameters were utilized for the AOI as input to FSP models 1 thru 4.

Backup information for these parameters is included in Appendix 2.

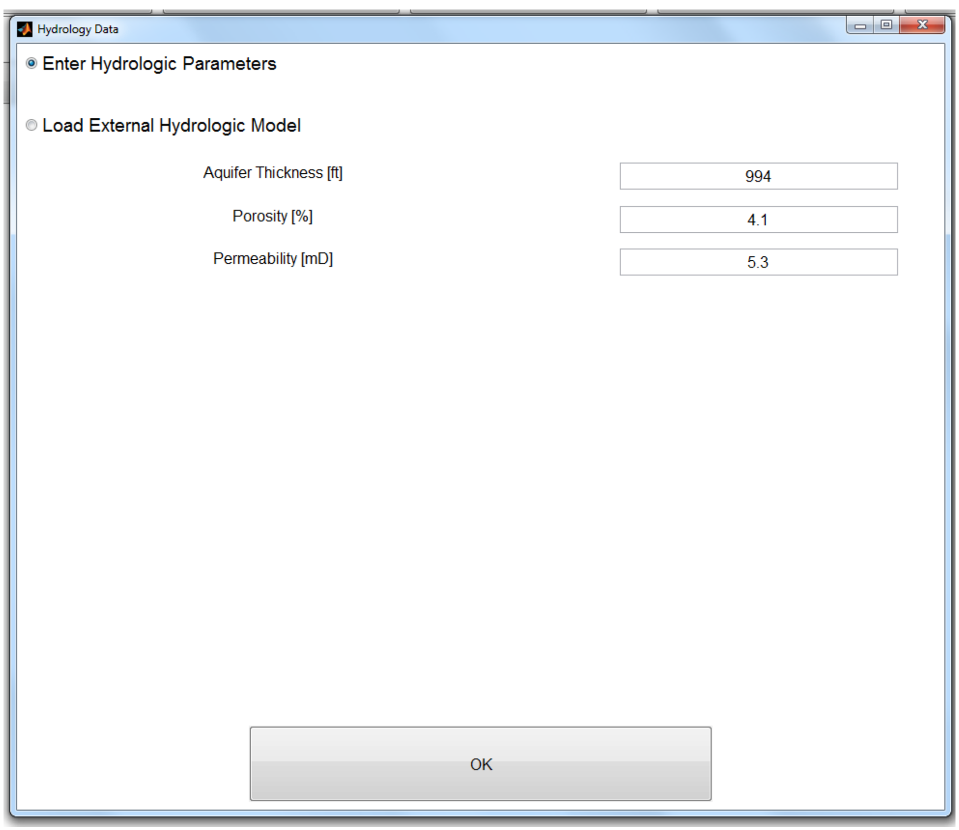


Figure 18 - Injection Interval (reservoir parameters) FSP Input Models 1 thru 4

Model 1 – Woodford

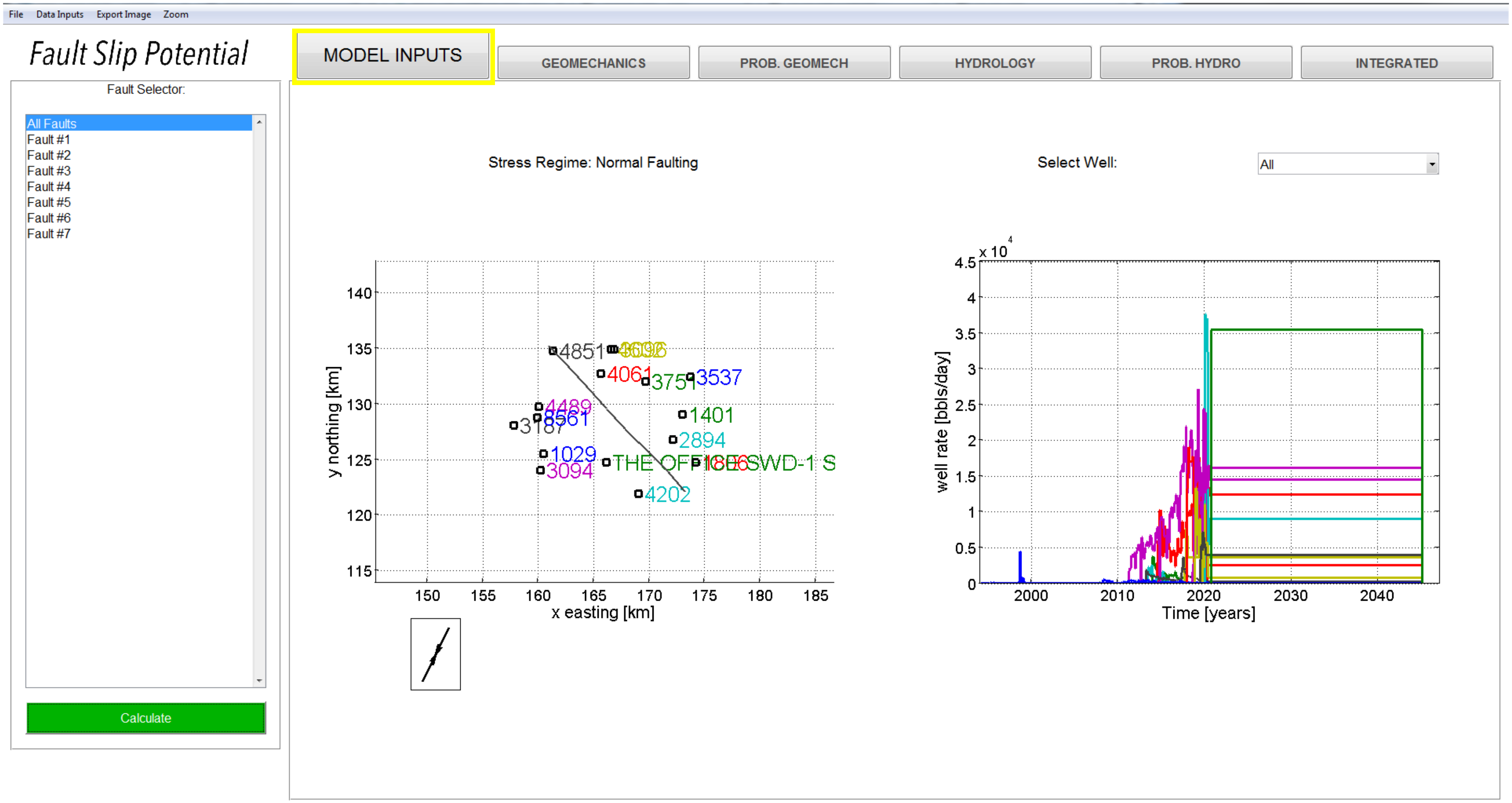


Figure 19 - FSP Model 1 Input: 16 injectors and 7 Woodford fault segments

Model 1 & 2

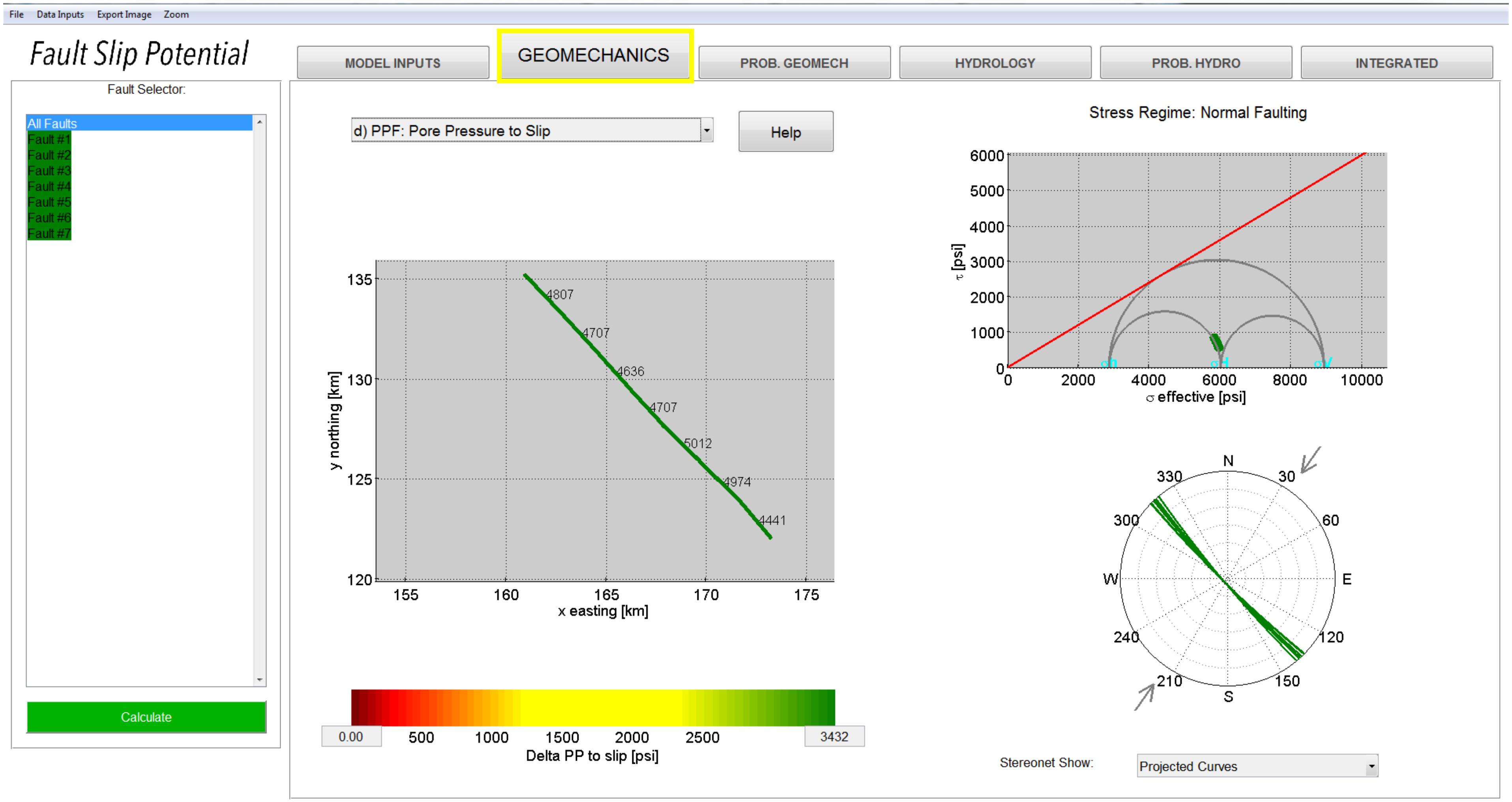


Figure 20 - FSP Geomechanics Tab, Model 1 and 2

Demonstrates pore pressure to slip (psi) for each fault segment, direction of SHmax, and a Mohr diagram with frictional slip line shown in red. Faults are colored by their horizontal distance to slip according to the color scale.

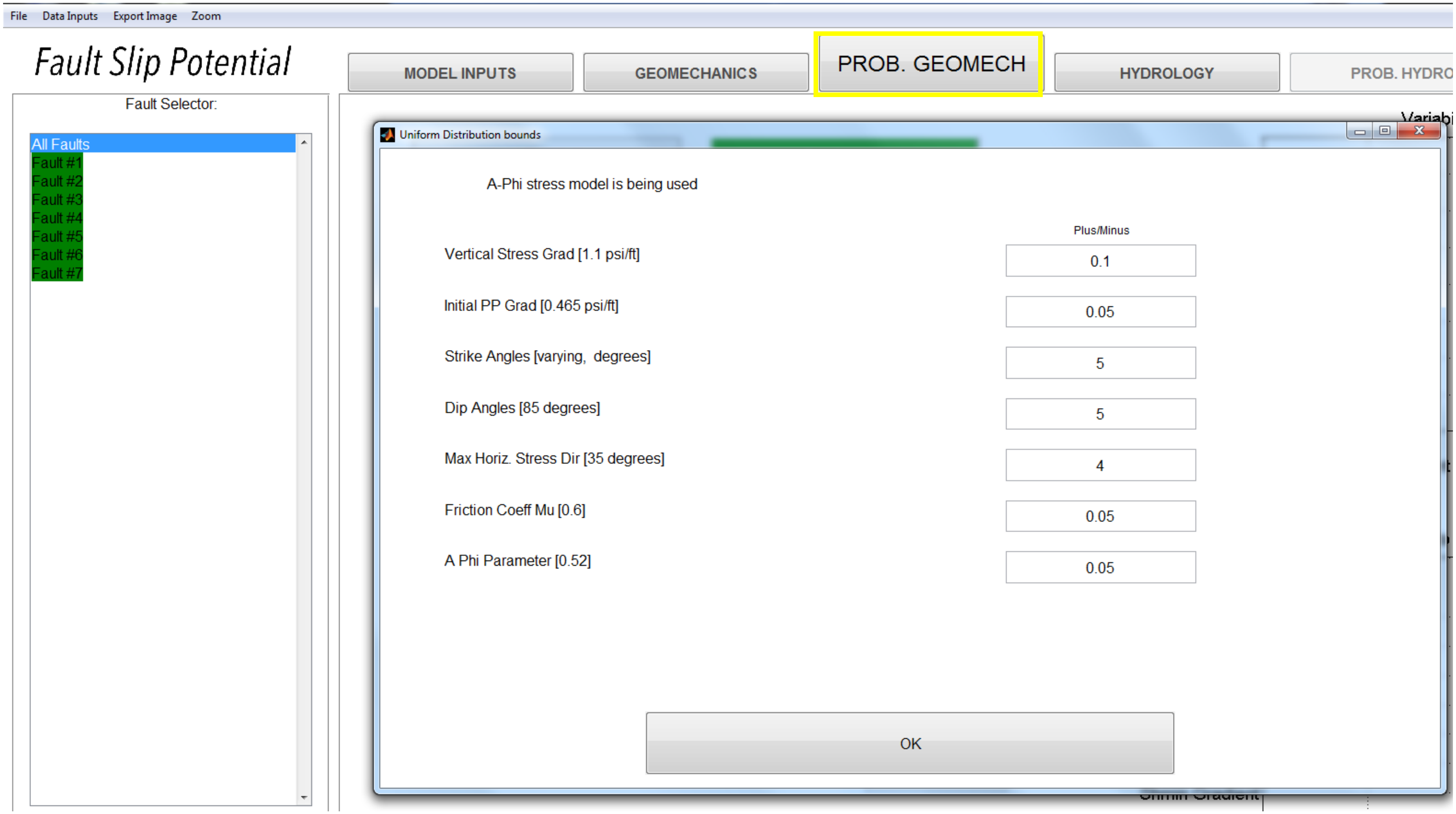


Figure 21 - Input for Probabilistic Geomechanics Tab

The FSP program performs a probabilistic Monte Carlo analysis based on user specified variability of input parameters for both Geomechanical and Hydrology calculations.

Model 1 & 2

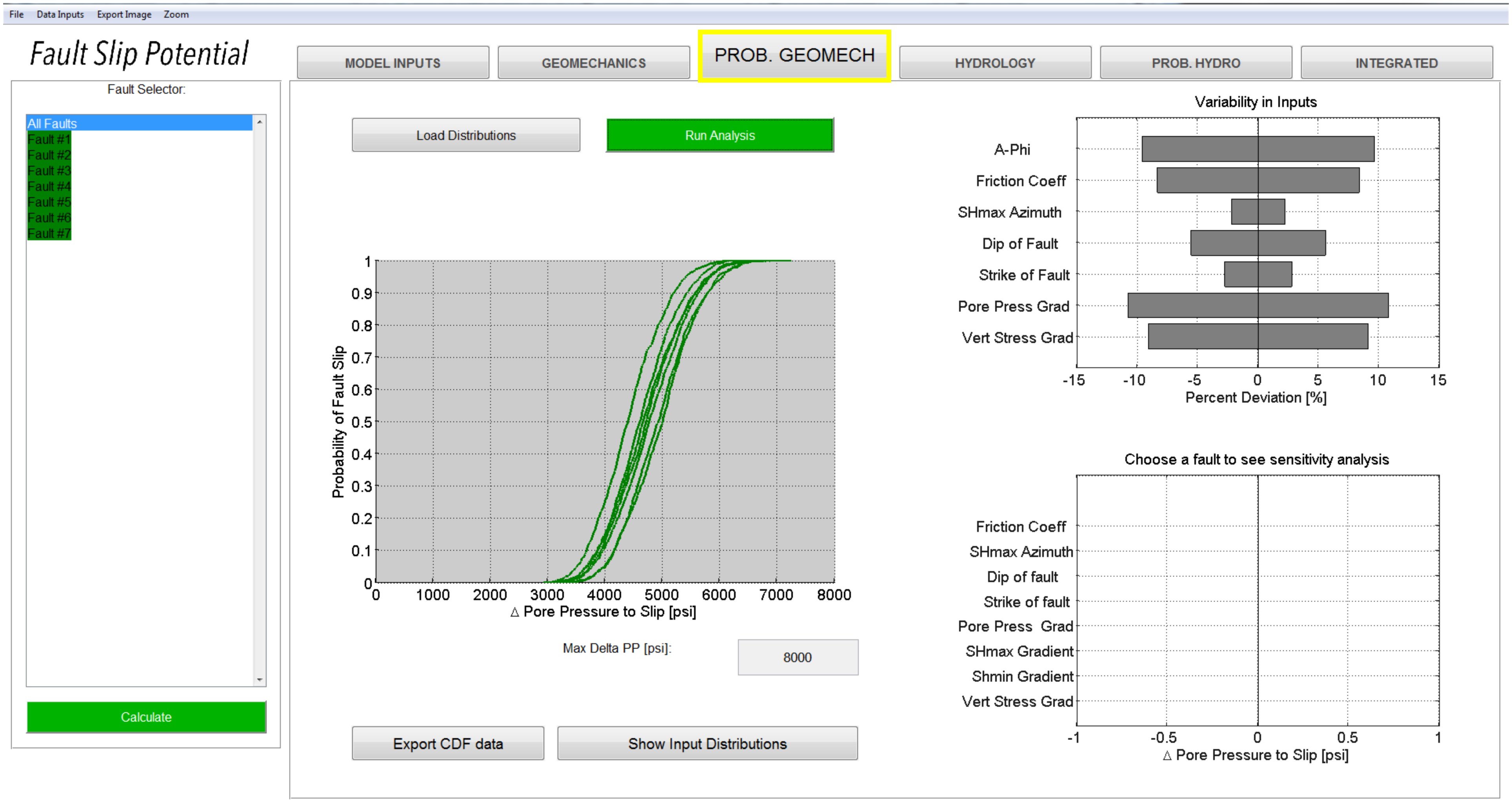


Figure 22 - FSP Probabilistic Geomechanics Tab, Model 1 and 2

Propagates the relative uncertainties through the model, producing a distribution of pore pressures to slip.

Model 1 – Initial conditions before OWL The Office #1 well is completed

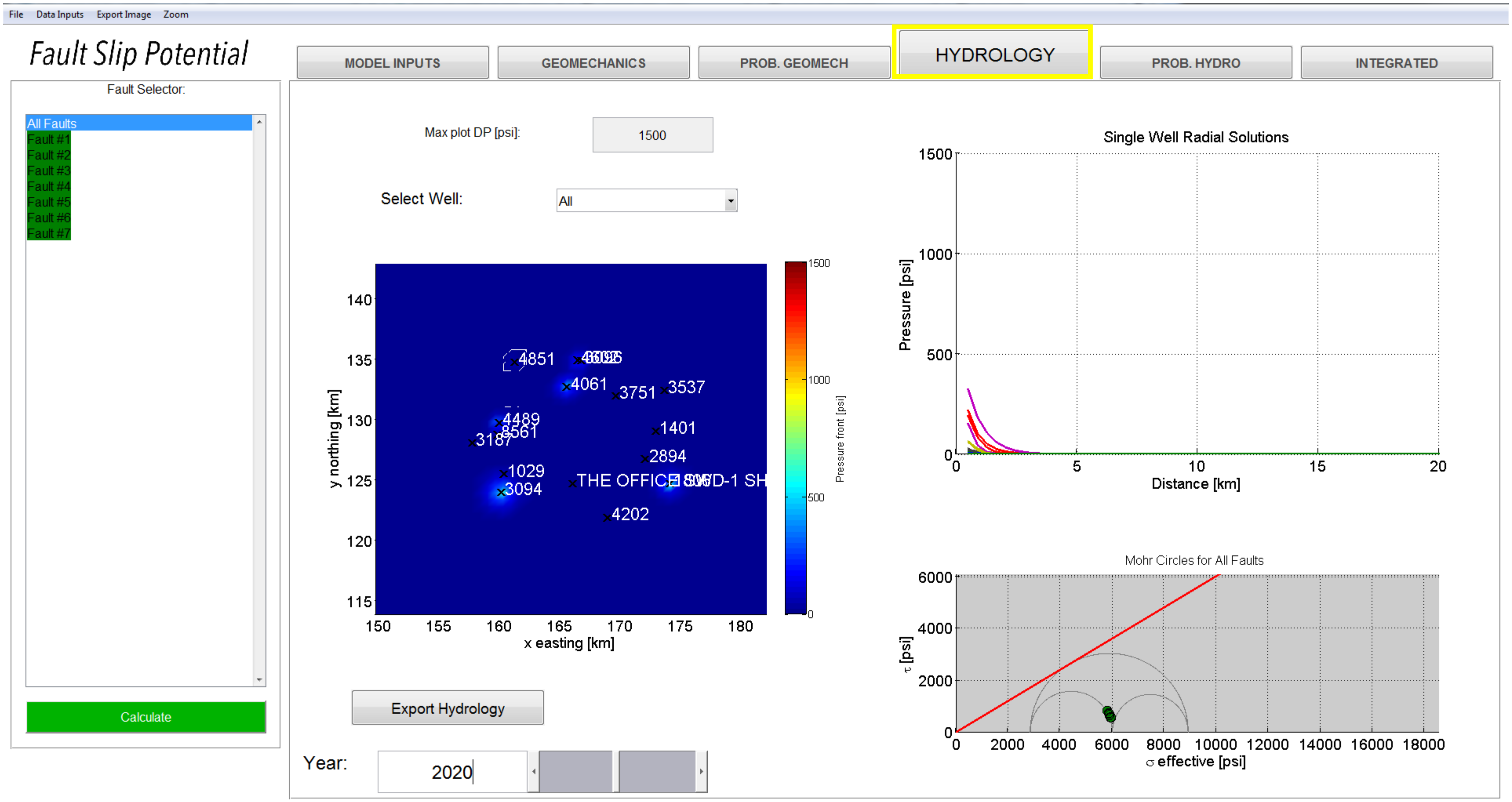


Figure 23 - FSP Hydrology Tab Before Proposed Completion

Demonstrates pressure change as a function of distance from each of the 16 injection wells in Model #1.

Model 1 - Conditions in 2041 after OWL The Office #1 well is completed.

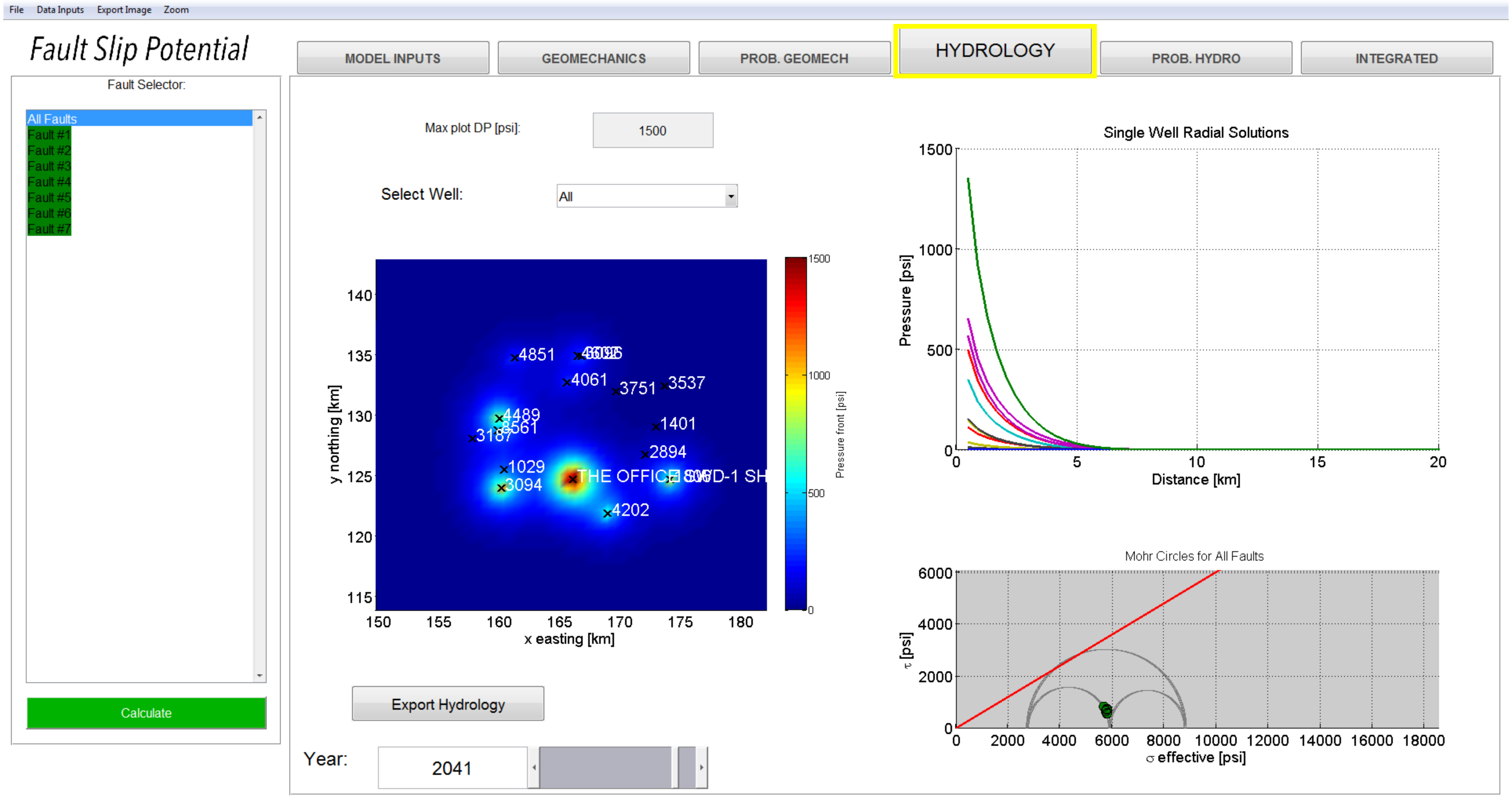


Figure 24 - Model 1 FSP Hydrology Tab

Projecting pressure changes away from each injector 20 years after OWL completion.

Probabilistic analysis input utilized for this internal radial flow-based model

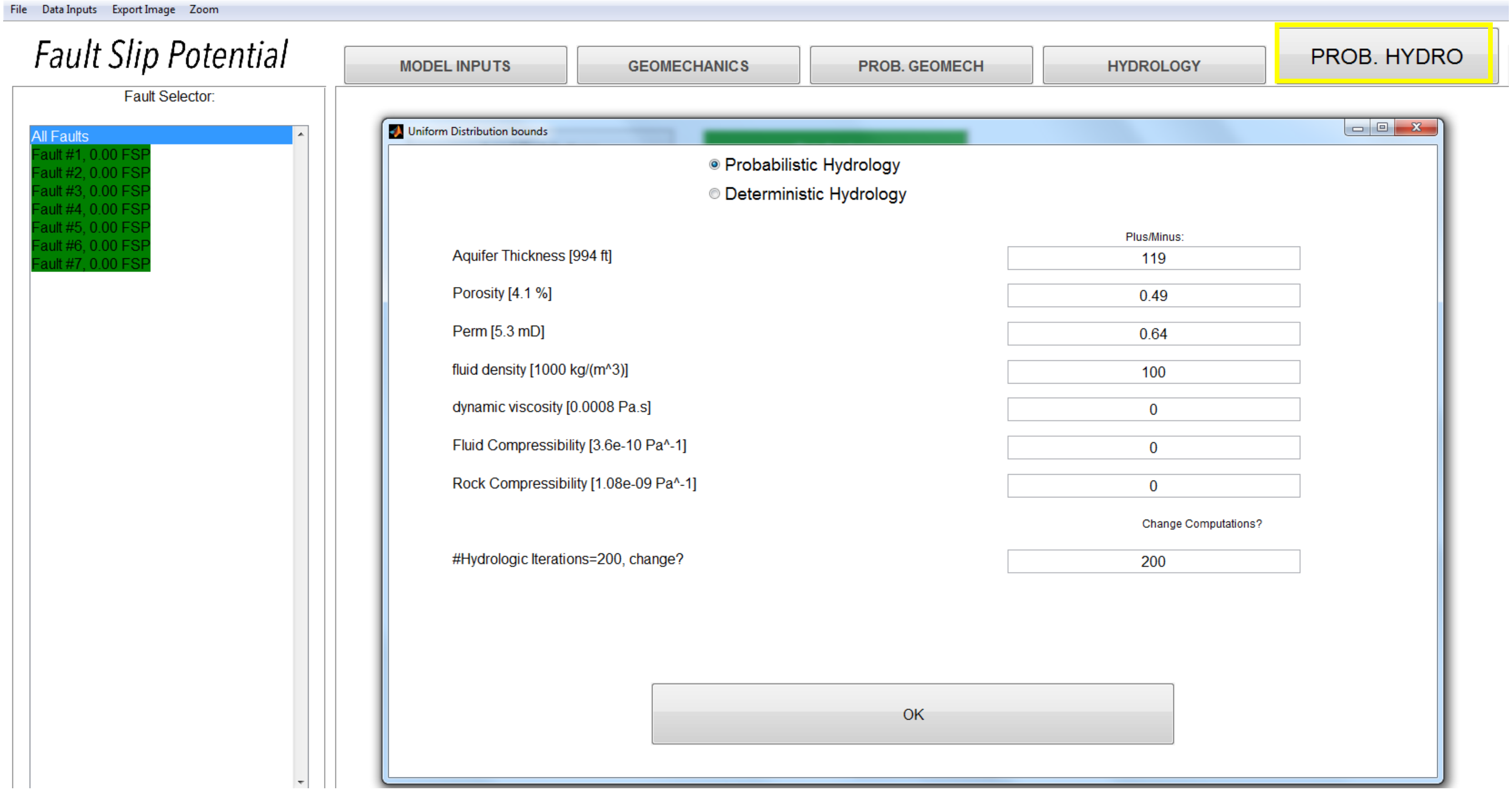


Figure 25 - Probabilistic Hydrology tab parameters Models 1 - 4

Model 1 – Initial Conditions before OWL The Office #1 is completed

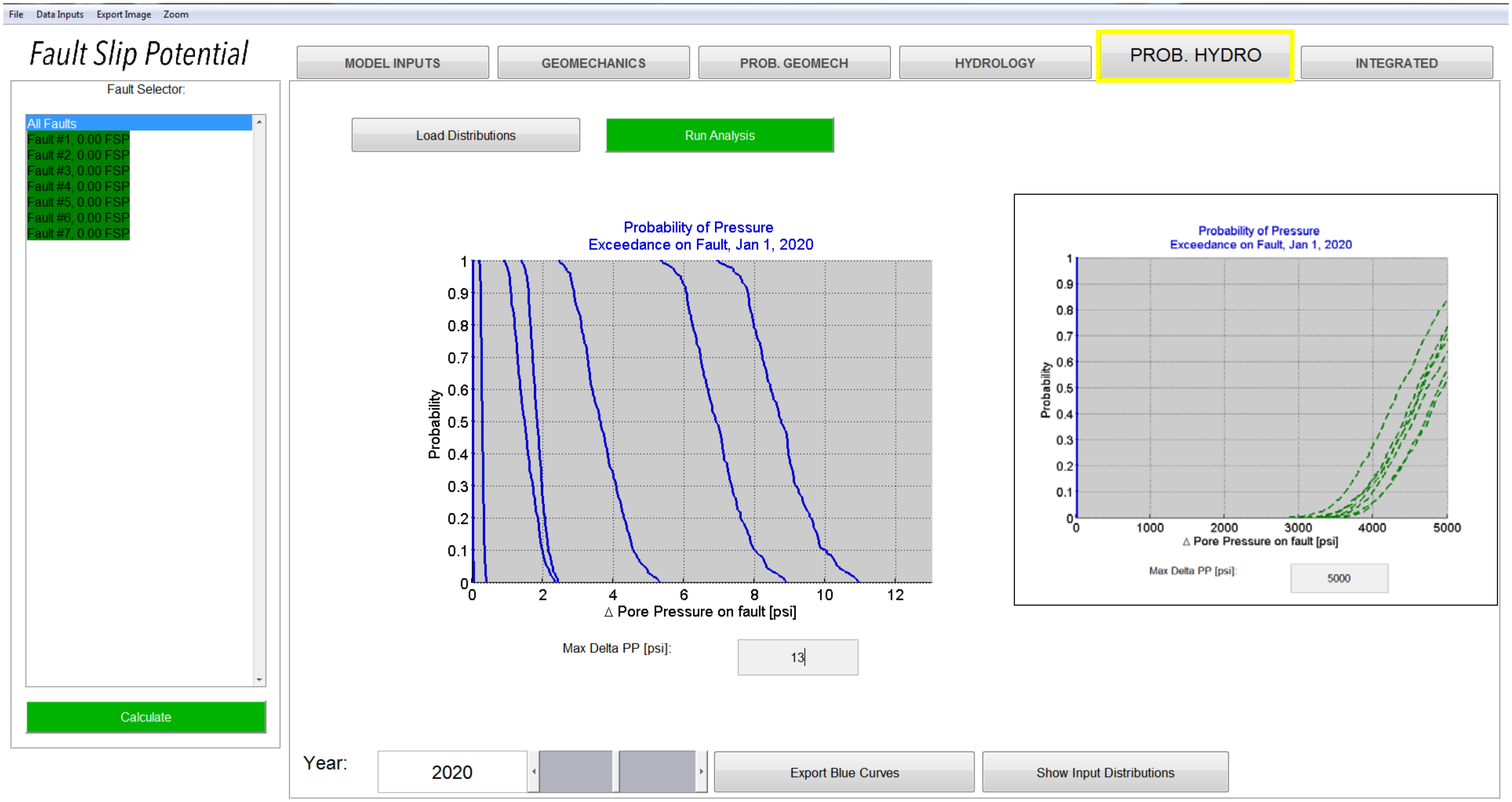


Figure 26 - Model 1 Probabilistic Hydrology tab before completion

The Probabilistic Hydrology tabs combine hydrology with the Probabilistic Geomechanical cumulative distribution function (CDF) of the pore pressure to slip.

Model 1 – Conditions in 2041 after OWL The Office #1 well is completed

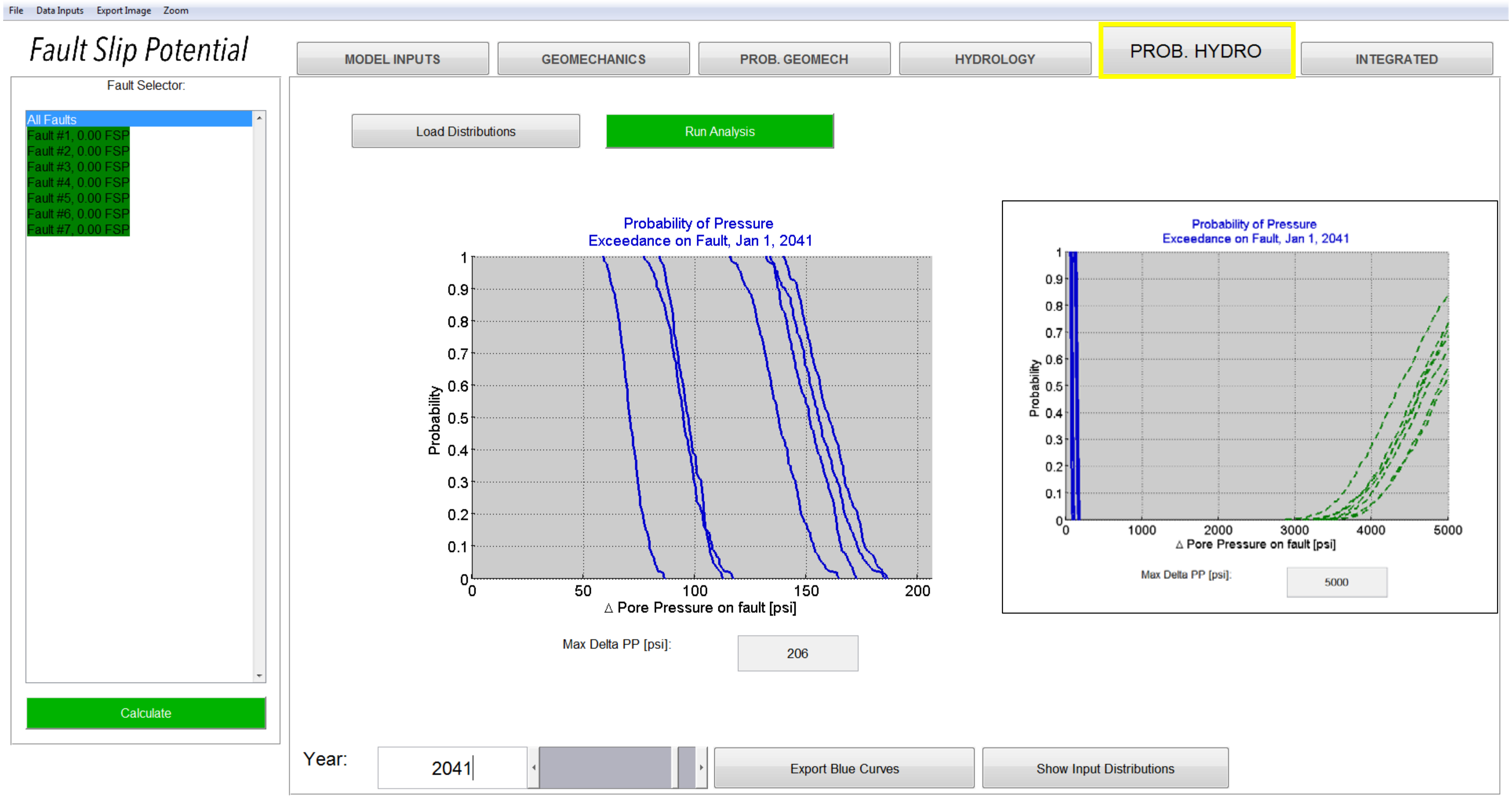


Figure 27 - Model 1 Probabilistic Hydrology tab 20 years after OWL completions

The following integrated tabs show the combined results of probabilistic geomechanics and hydrology models run for all 7 Woodford fault segments.

Model 1 – Initial Conditions before OWL The Office #1 well completed

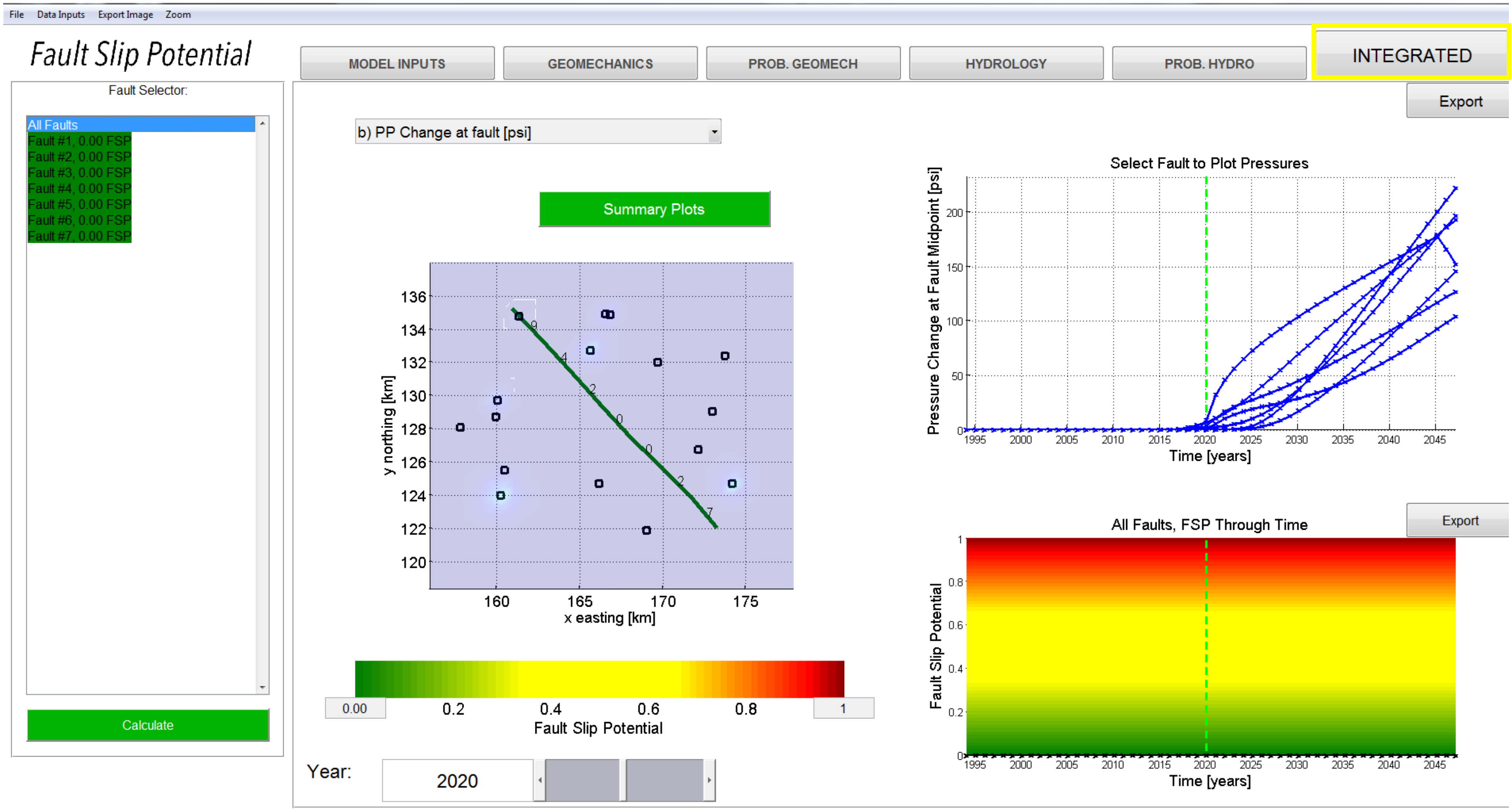


Figure 28 - Model 1 Integrated Tab, Initial Conditions before OWL well is completed.

Pore Pressure change (psi) is posted for each fault segment.

Model 1 – Initial Conditions before OWL The Office #1 well completed

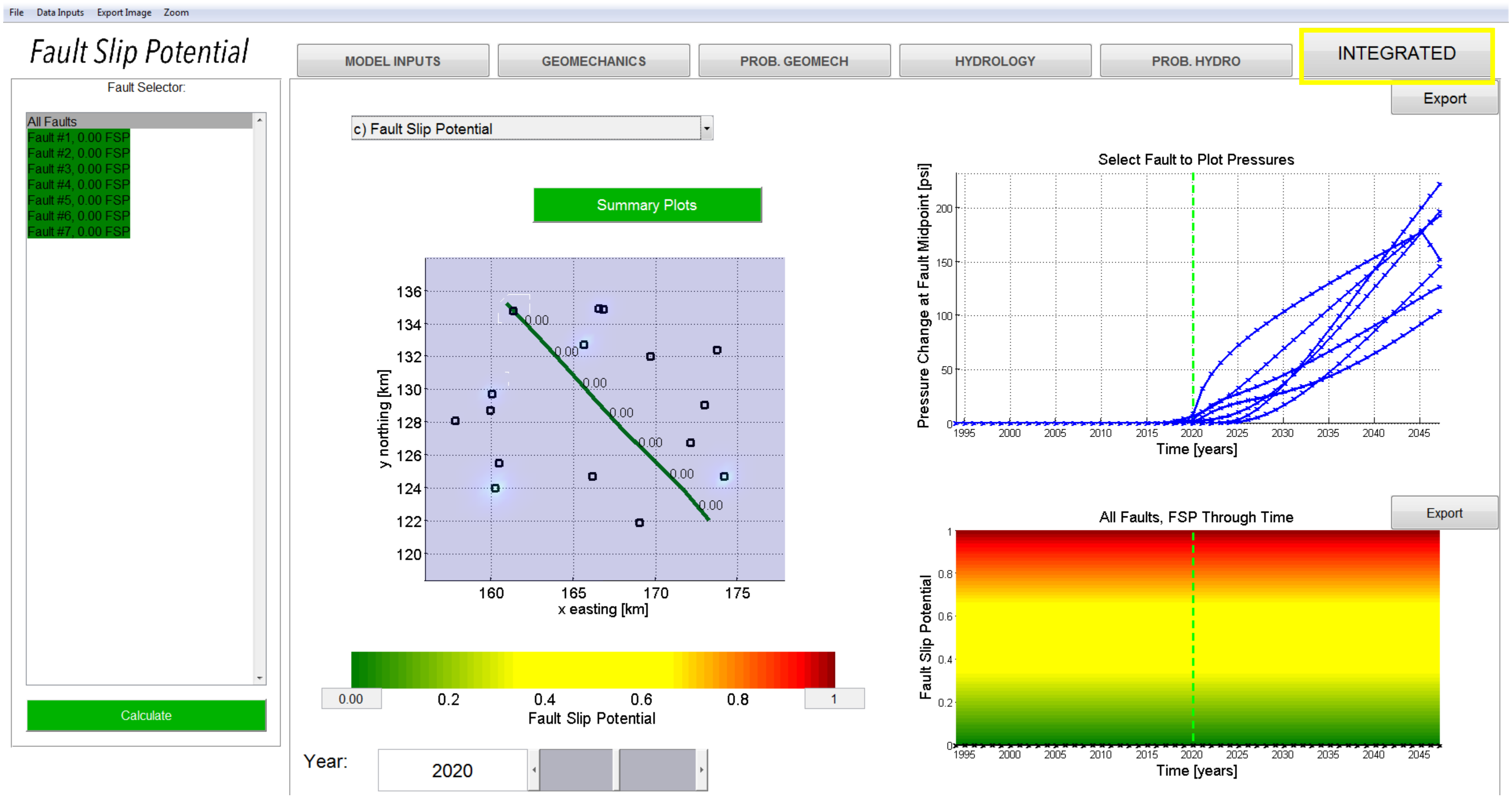


Figure 29 - Model 1 Integrated Tab, Initial Conditions

Fault Slip Potential for each fault segment is posted in percentage.

Model 1 – Conditions in 2041 after OWL The Office #1 well is completed

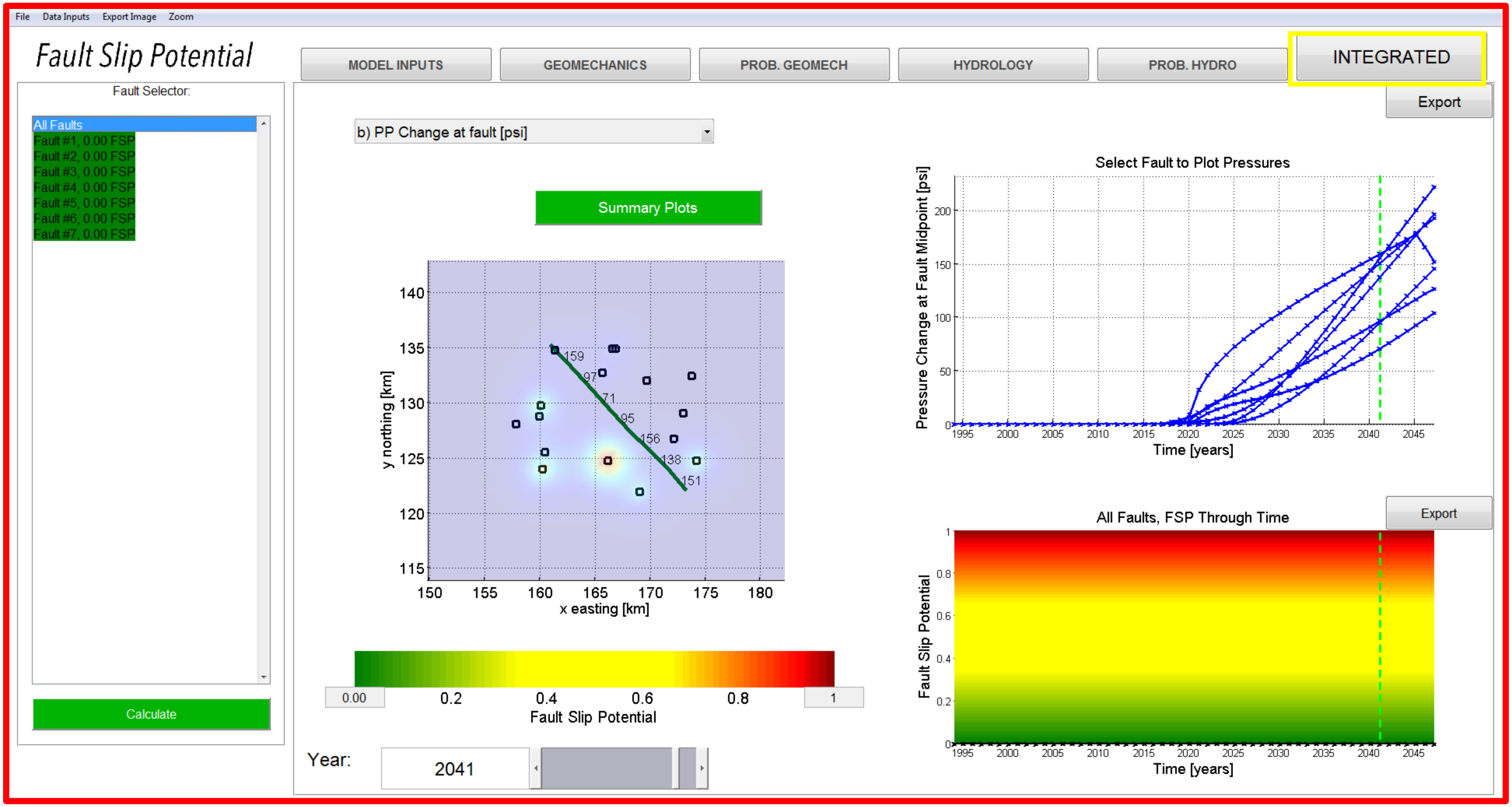


Figure 30 - Model 1 Integrated tab: 20 years after completion.

Pore Pressure change (psi) is posted for each fault segment.

Model 1 – Conditions in 2041 after OWL The Office #1 well is completed

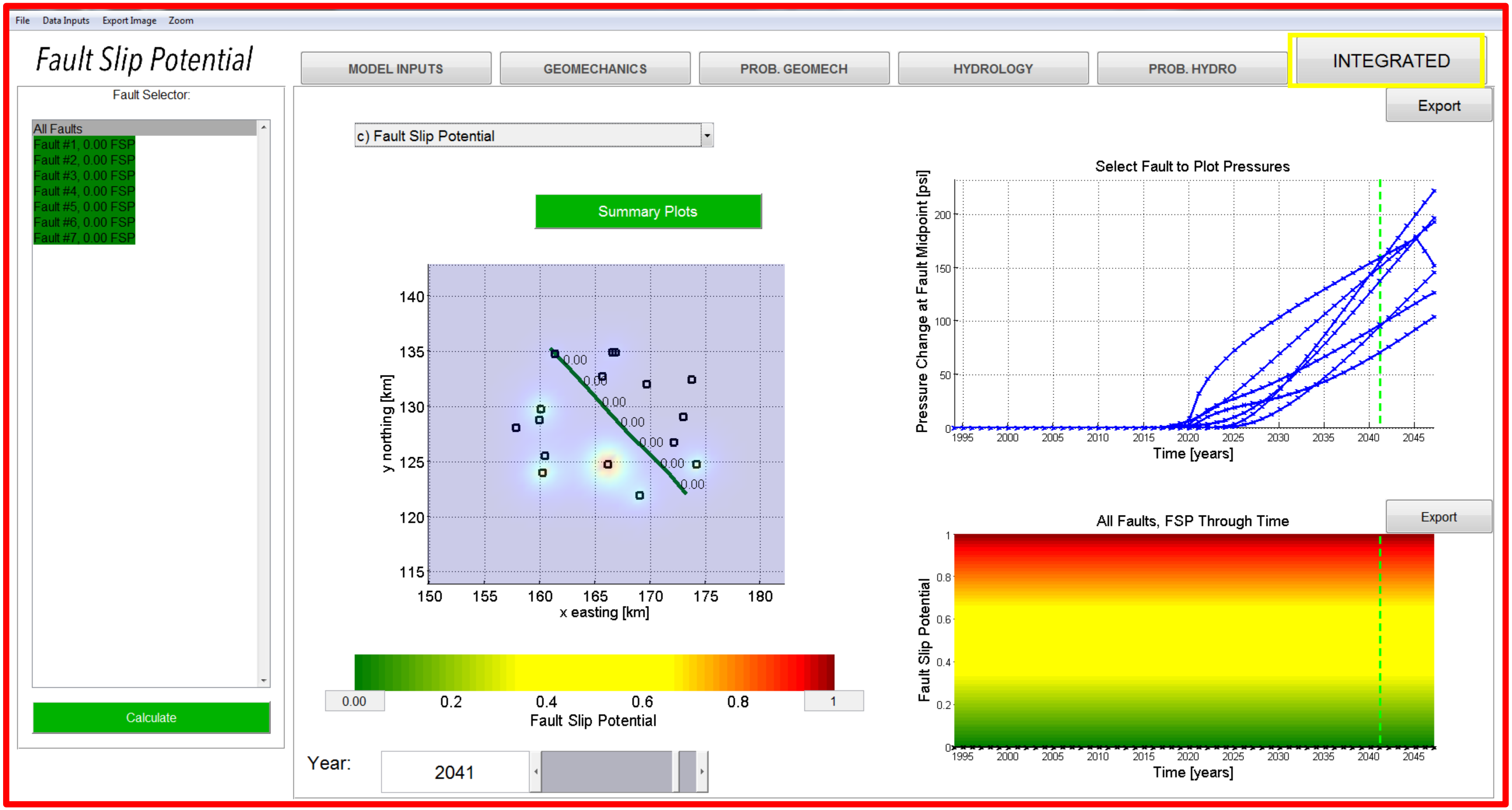


Figure 31 - Model 1 Integrated Tab, 20 years after completion

Fault Slip Potential for each fault segment is posted in percentage.

7.0 FSP Analysis MODEL 2 – Woodford Faults - only The Office #1 SWD

Model #2 only incorporates the proposed OWL System completions with proposed rate for The Office #1 SWD (maximum injection rate of 35,000 barrels per day = 1,064,583 barrels per month).

All other parameters remains consistent as Model #1 i.e. faults, stress regime, reservoir, and probabilistic parameters. Below is the only change regarding Model #1 with respect to injector data.

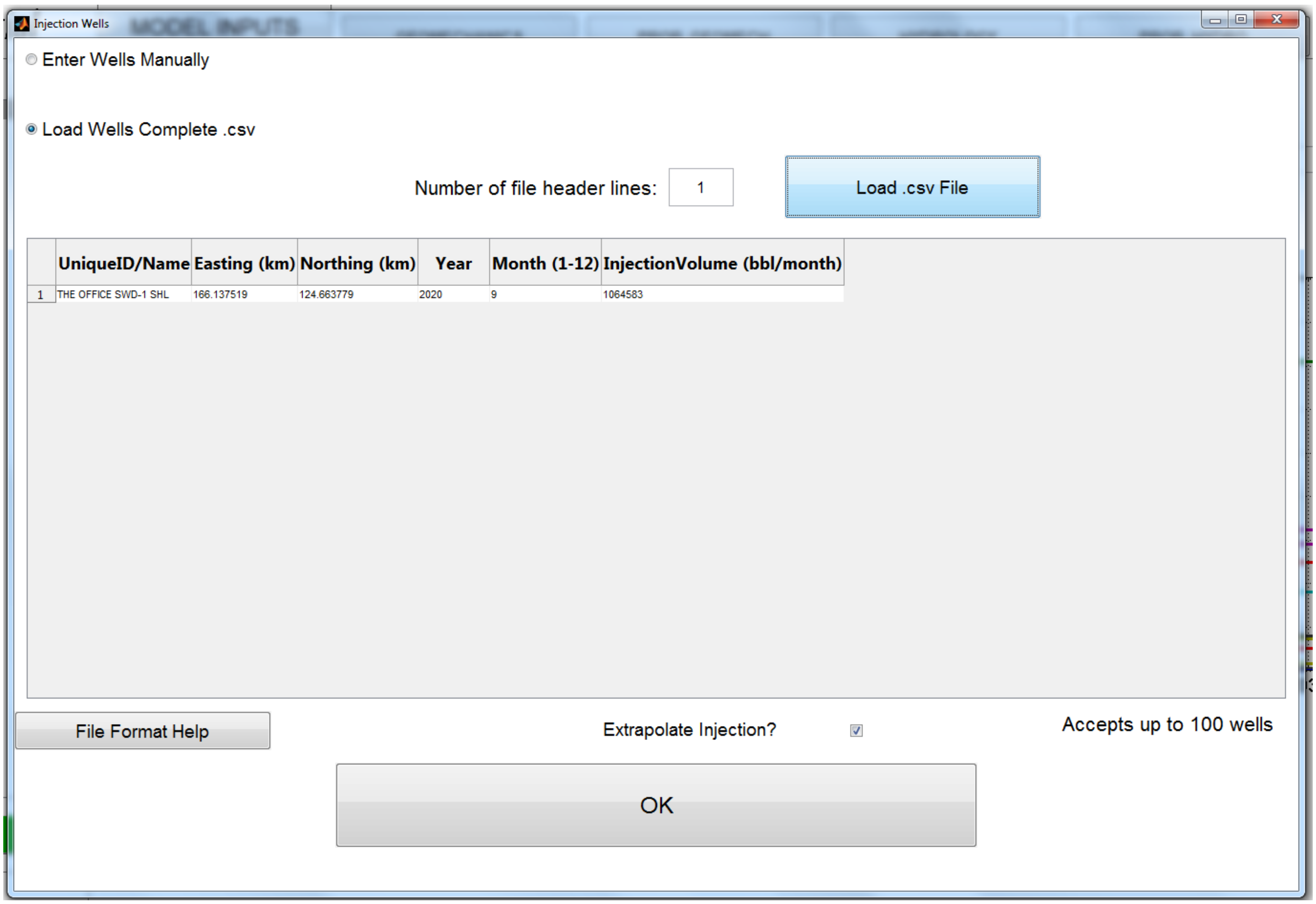


Figure 32 - Model 2 Injector Input

Model 2 - Woodford

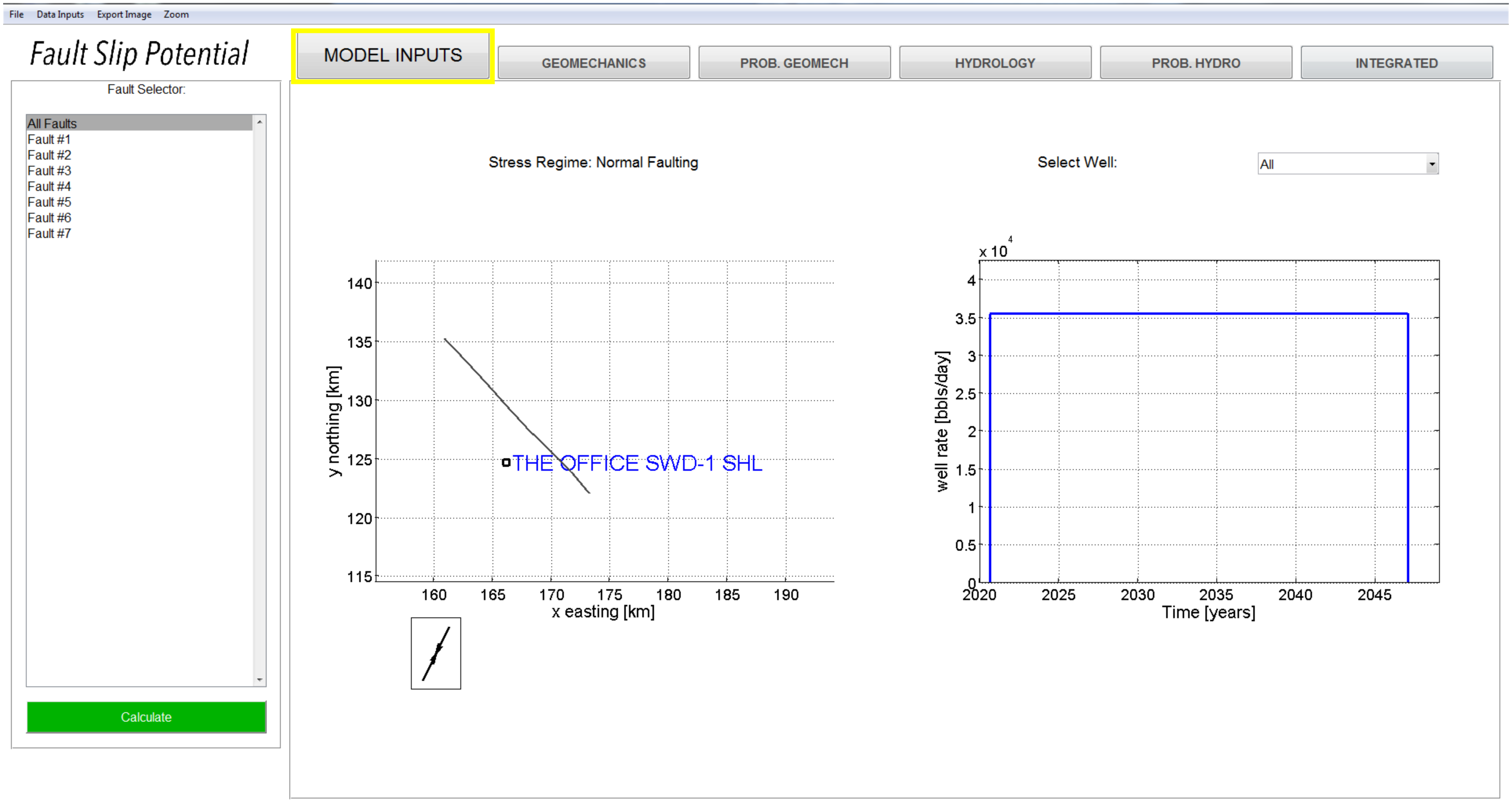


Figure 33 - Model 2 Inputs Tab

The following FSP result tabs are for the second model which includes only the proposed injection well.

Model 2 – Initial conditions before OWL The Office #1 well is completed

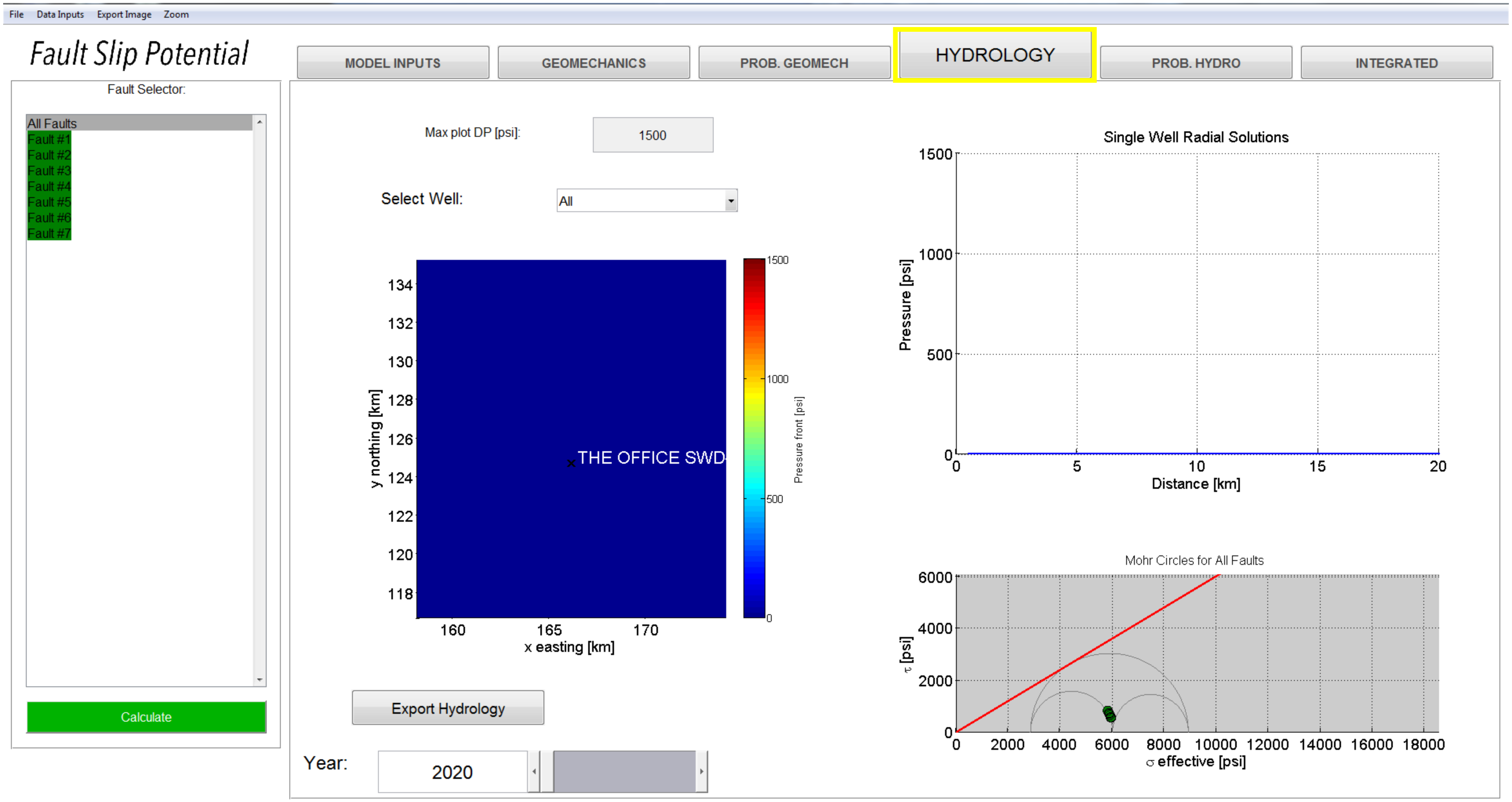


Figure 34 - Model 2 Hydrology Tab, Initial Conditions

Model 2 - Conditions in 2041 after OWL The Office #1 well is completed.

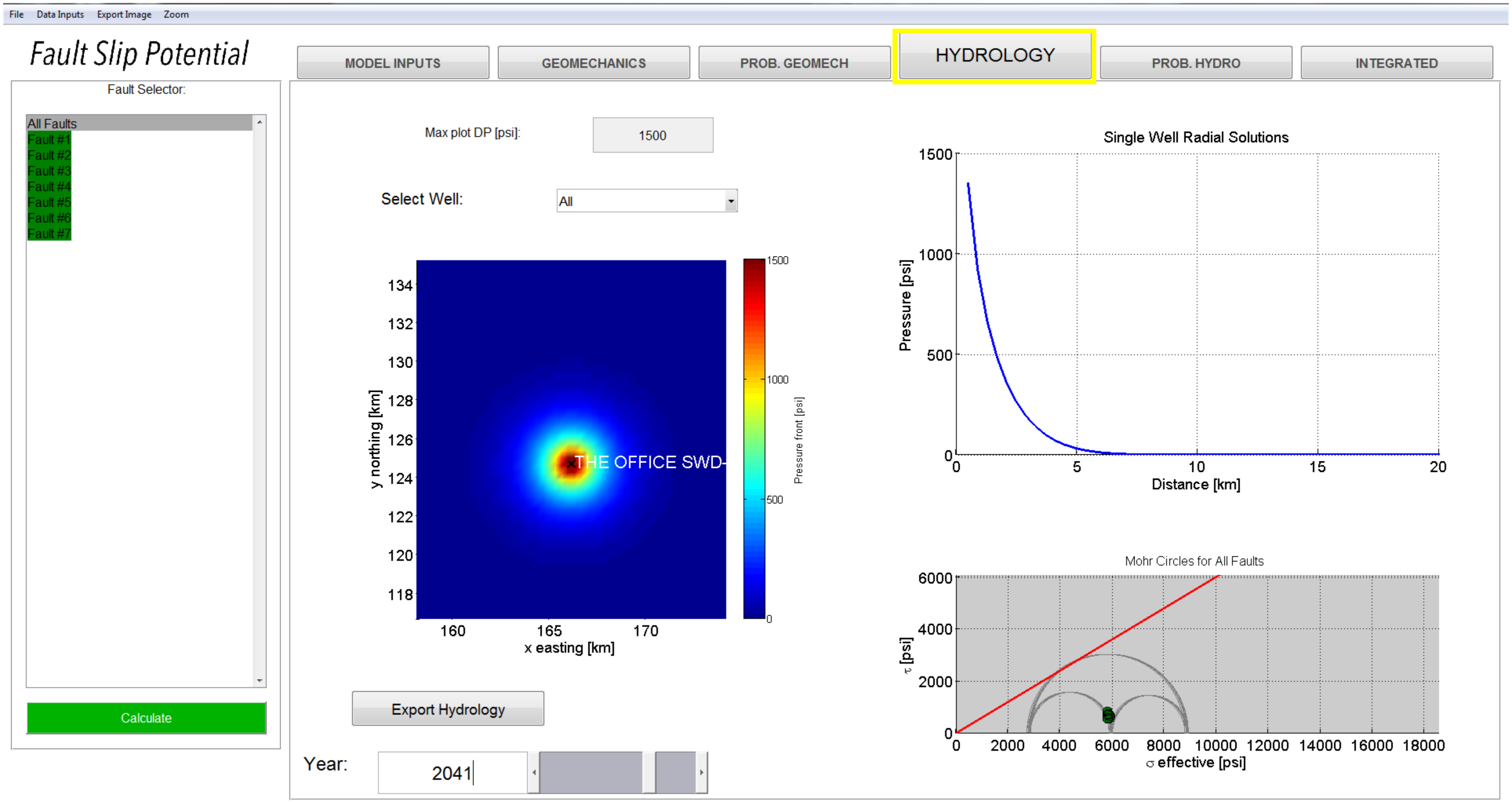


Figure 35 - Model 2 Hydrology Results, 20 years after Completion

Model 2 – Initial Conditions before OWL The Office #1 is completed

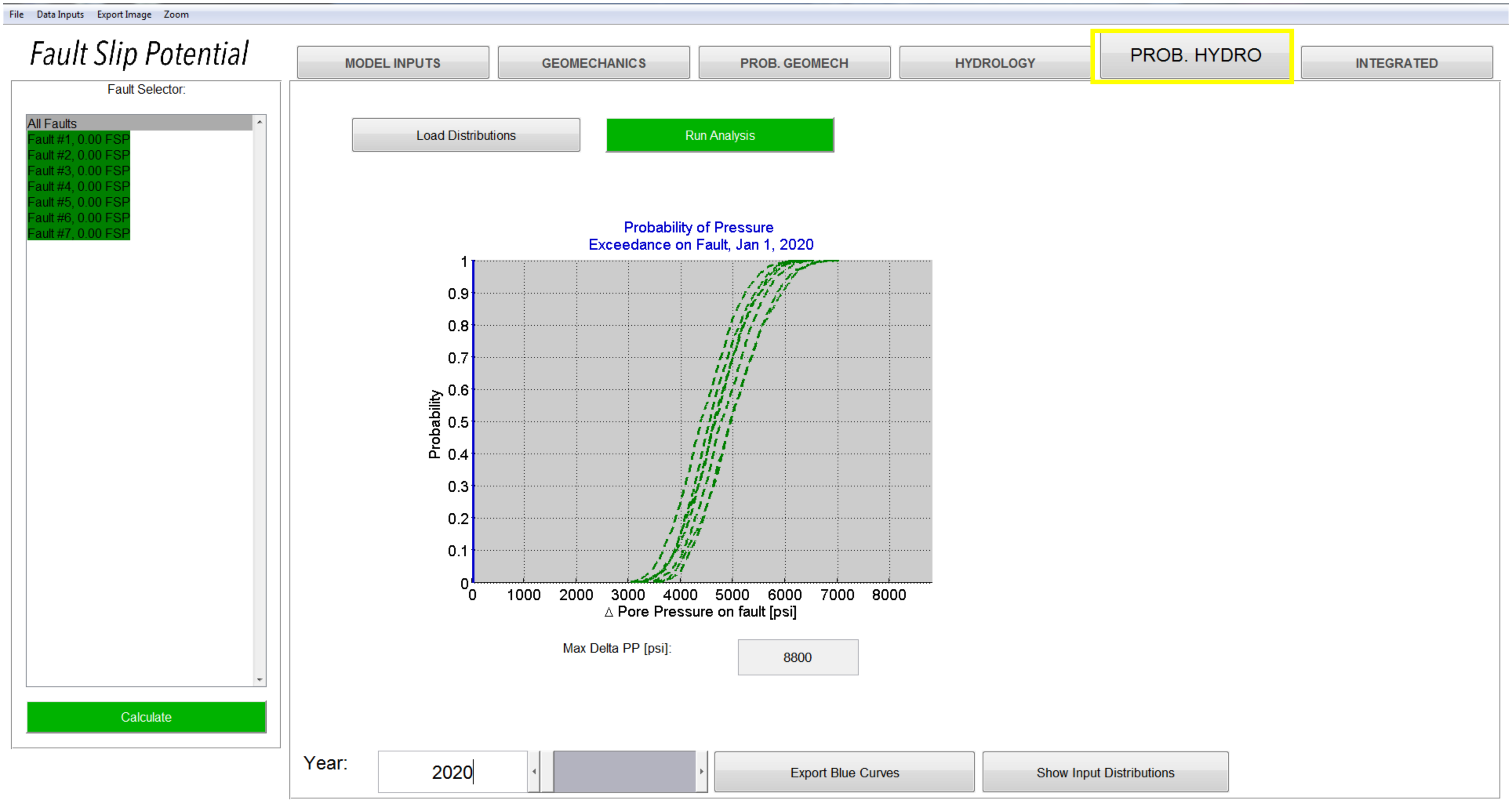


Figure 36 - Model 2 Probabilistic Hydrology Results Tab, Initial Conditions

Model 2 – Conditions in 2041 after OWL The Office #1 well is completed

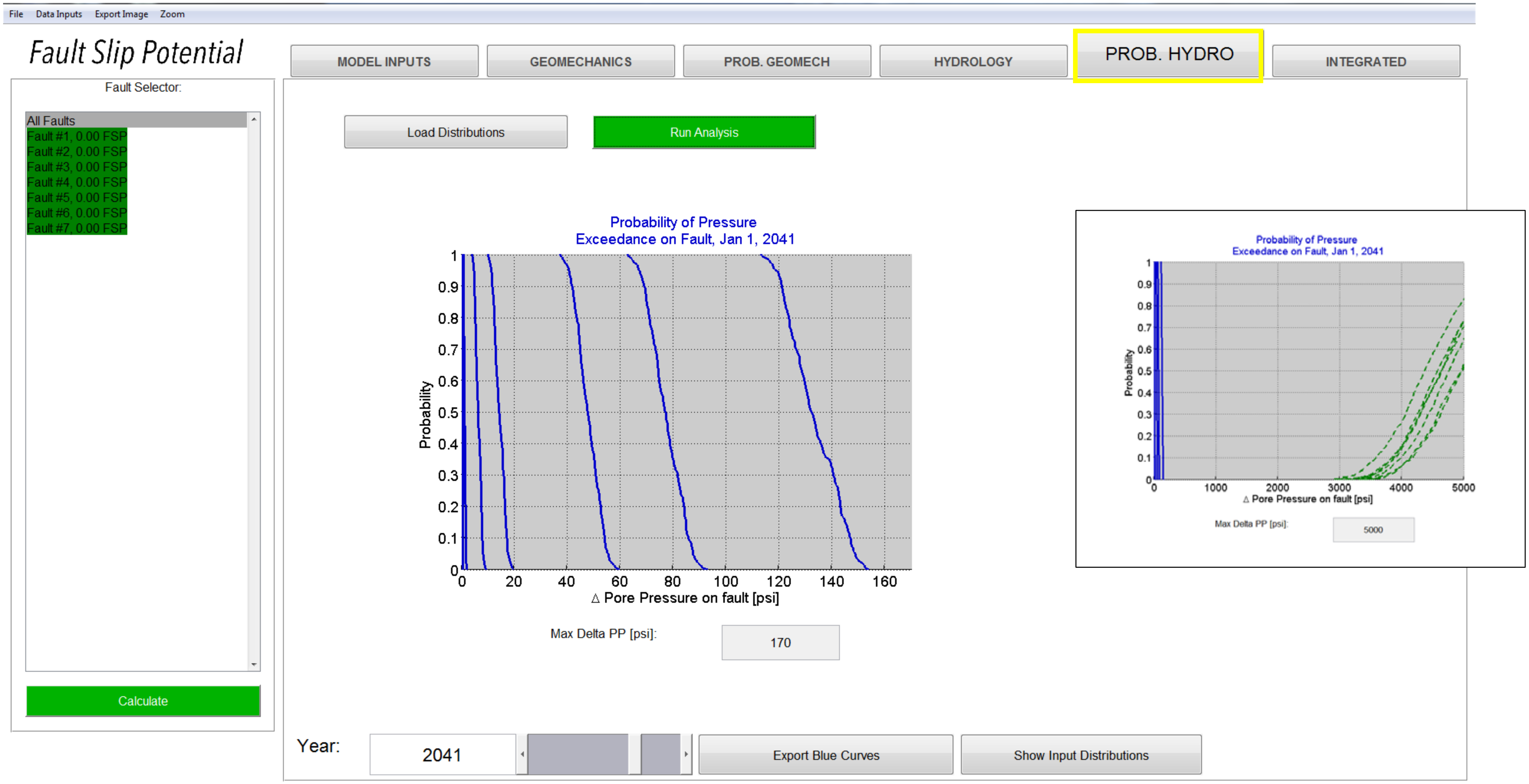


Figure 37 - Model 2 Probabilistic Hydrology Results Tab 20 years after completion

Only includes OWL proposed injector, held constant at the permitted rate.

Model 2 – Initial Conditions before OWL The Office #1 well completed

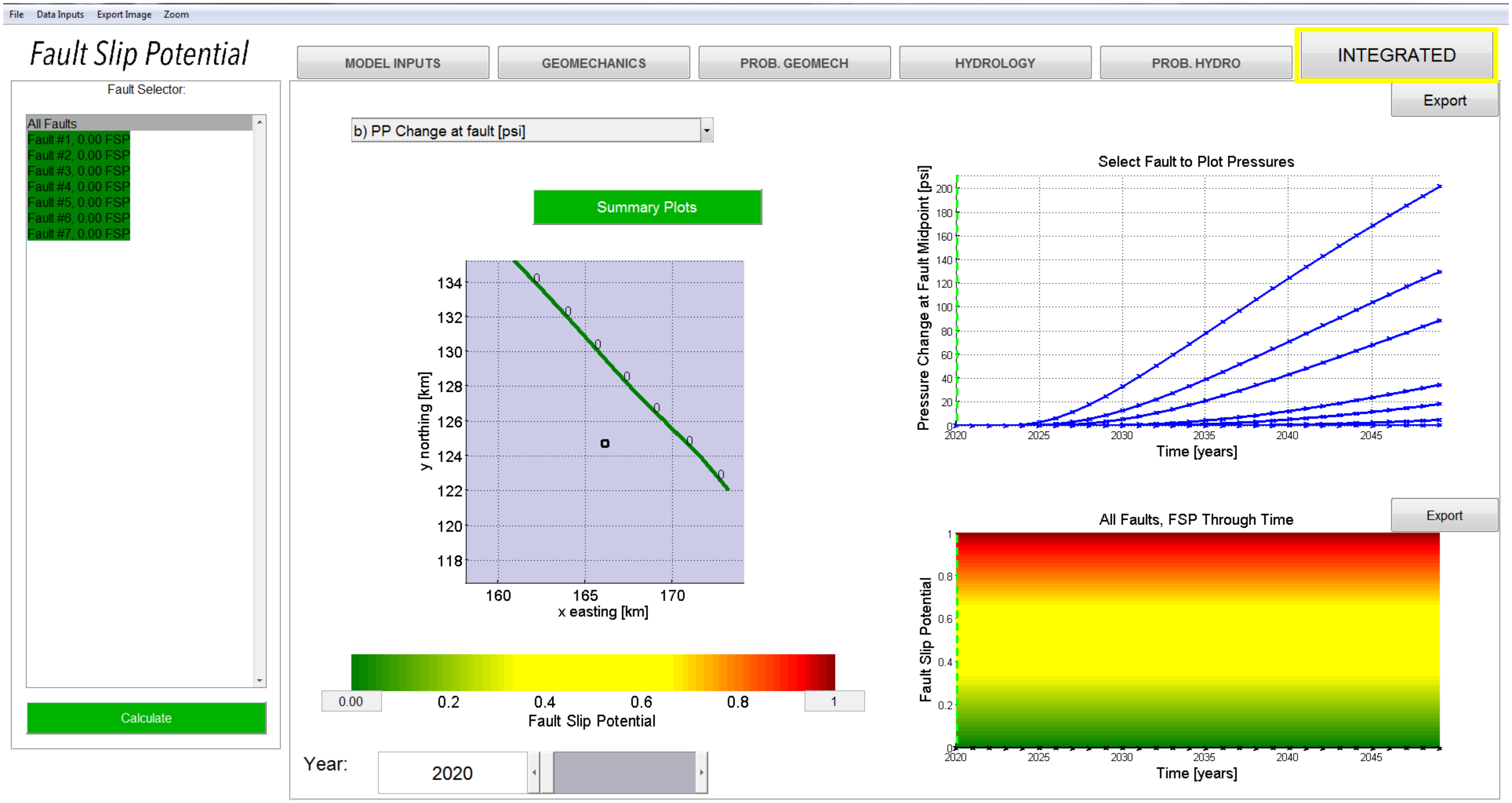


Figure 38 - Model 2 Integrated Results Tab, Initial Conditions

Pore Pressure change (psi) is posted for each fault segment.

Model 2 – Initial Conditions before OWL The Office #1 well completed

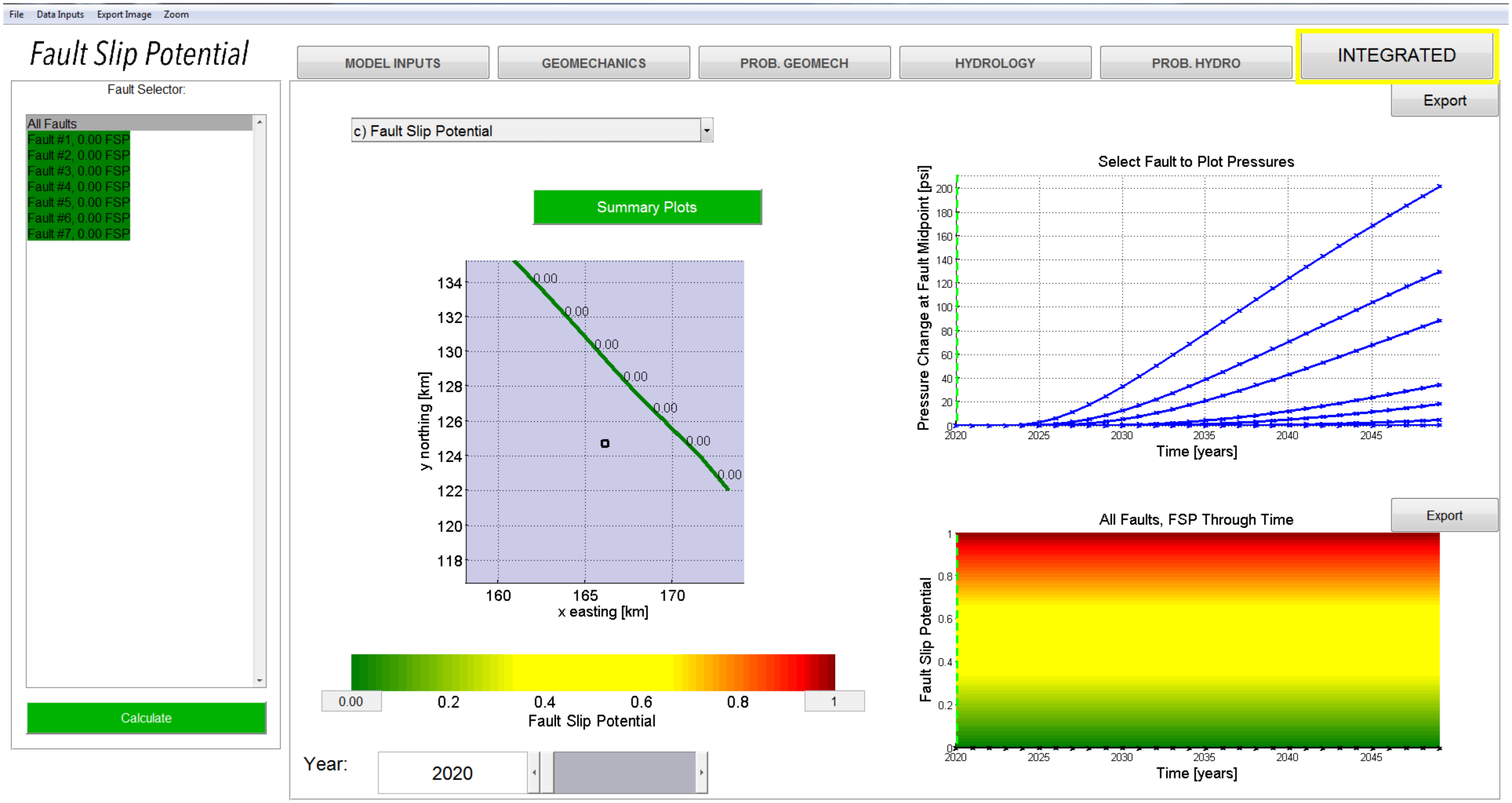


Figure 39 - Model 2 Integrated Results Tab, Initial Conditions

Fault Slip Potential for each fault segment is posted in percentage.

Model 2 – Conditions in 2041 after OWL The Office #1 well is completed

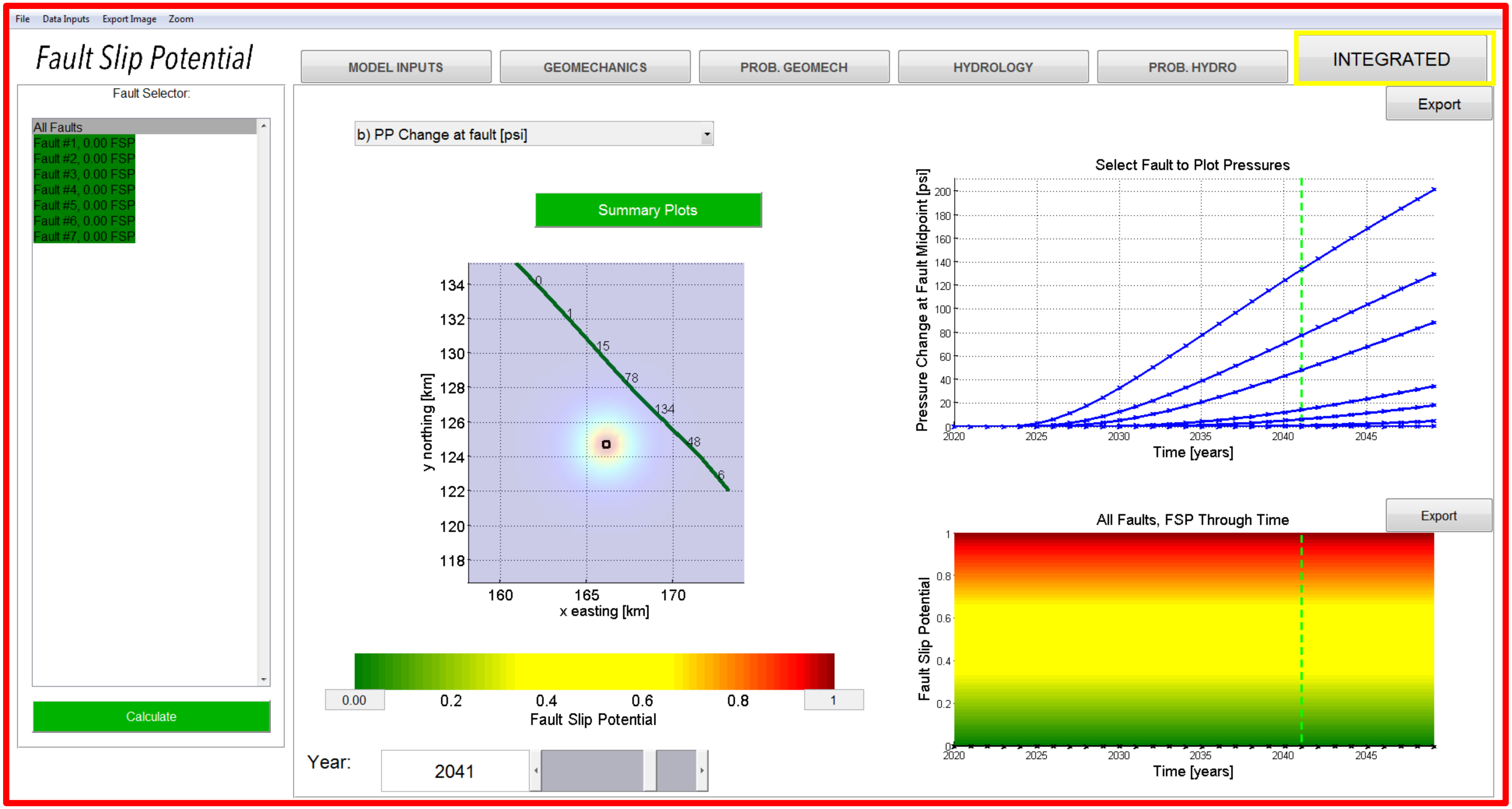


Figure 40 - Model 2 Integrated Results Tab, 20 years after completion

Pore Pressure change (psi) is posted for each fault segment.

Model 2 – Conditions in 2041 after OWL The Office #1 well is completed

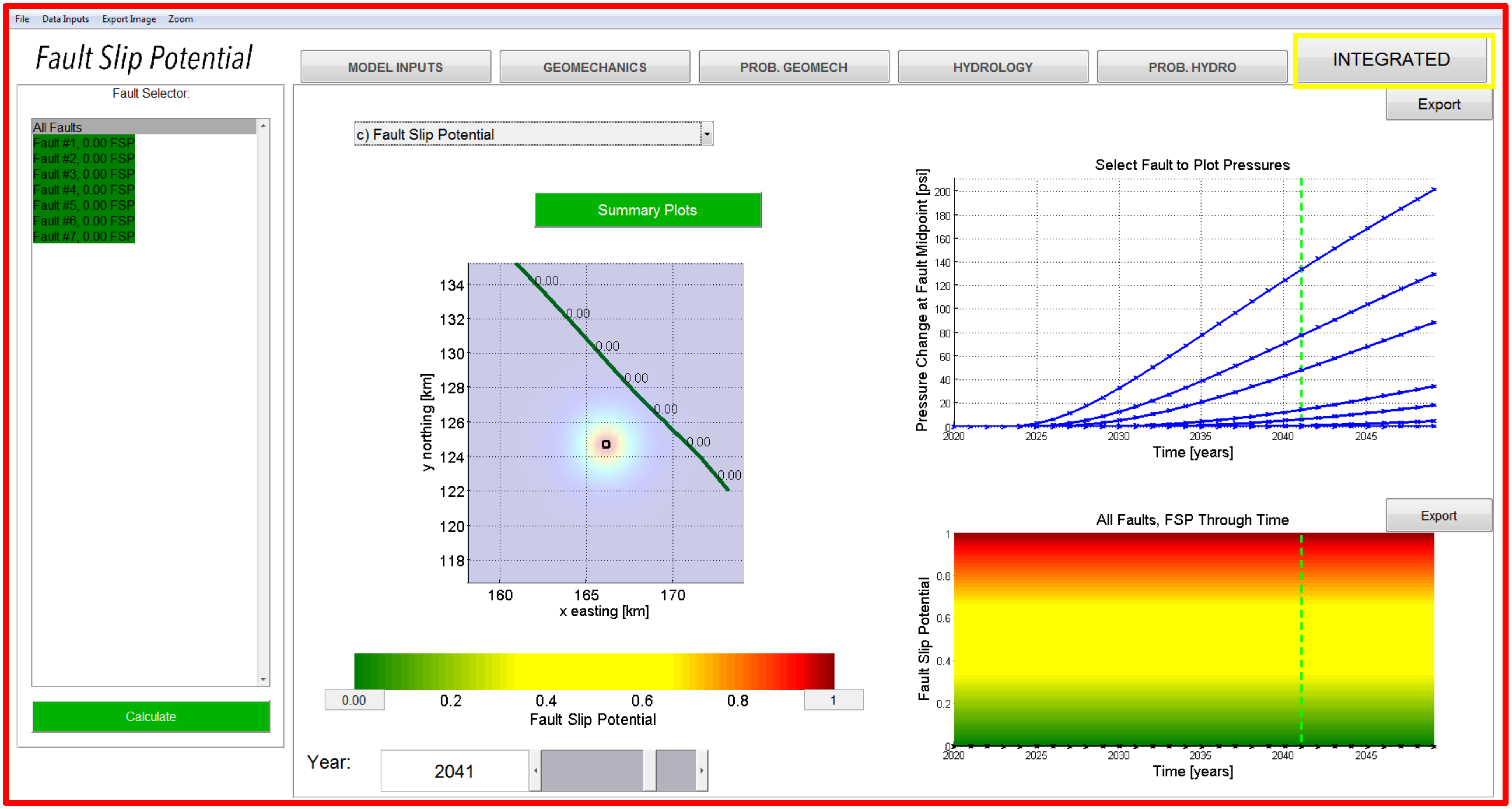


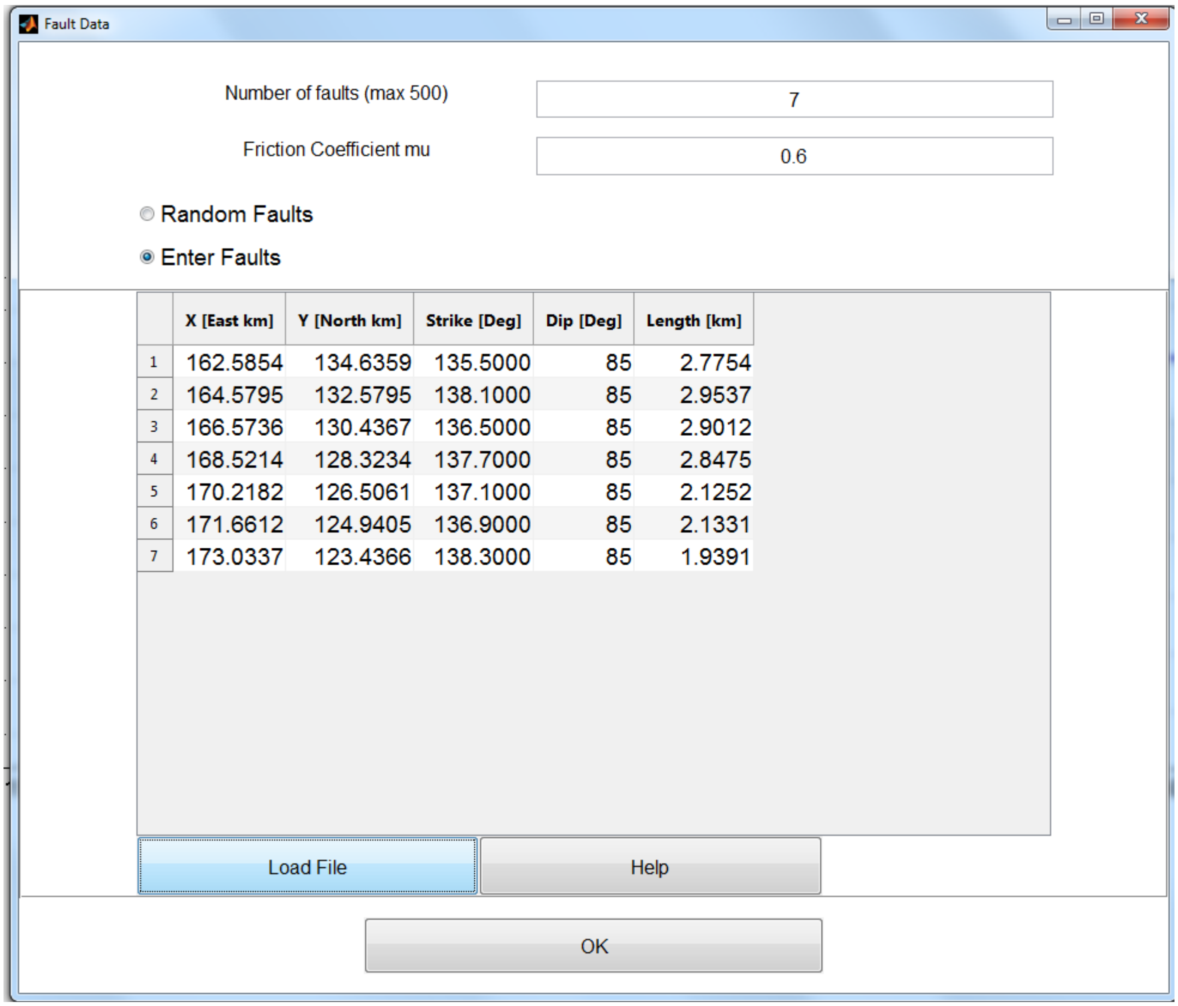
Figure 41 - Model 2 Integrated Results Tab, 20 years after completion.

Fault Slip Potential for each fault segment is posted in percentage.

8.0 FSP Analysis MODELS 3 and 4 – Basement Faults

Models #3 and #4 analyze Basement fault traces within the AOI, which utilize the same methodology as previous models. Input parameters for stress regime, reservoir, and probabilistic ranges are consistent with Models 1 & 2. Therefore, the following figures (43 to 52) illustrate the Basement fault traces used as input, and the FSP results tabs.

Model #3 incorporates all 16 injection wells, whereas Model #4 only uses the planned OWL well completion with proposed maximum injection rate.



Fault Data

Number of faults (max 500): 7

Friction Coefficient mu: 0.6

Random Faults

Enter Faults

	X [East km]	Y [North km]	Strike [Deg]	Dip [Deg]	Length [km]
1	162.5854	134.6359	135.5000	85	2.7754
2	164.5795	132.5795	138.1000	85	2.9537
3	166.5736	130.4367	136.5000	85	2.9012
4	168.5214	128.3234	137.7000	85	2.8475
5	170.2182	126.5061	137.1000	85	2.1252
6	171.6612	124.9405	136.9000	85	2.1331
7	173.0337	123.4366	138.3000	85	1.9391

Load File | Help

OK

Figure 42 - FSP Fault input for Models 3 and 4

Basement Fault segment

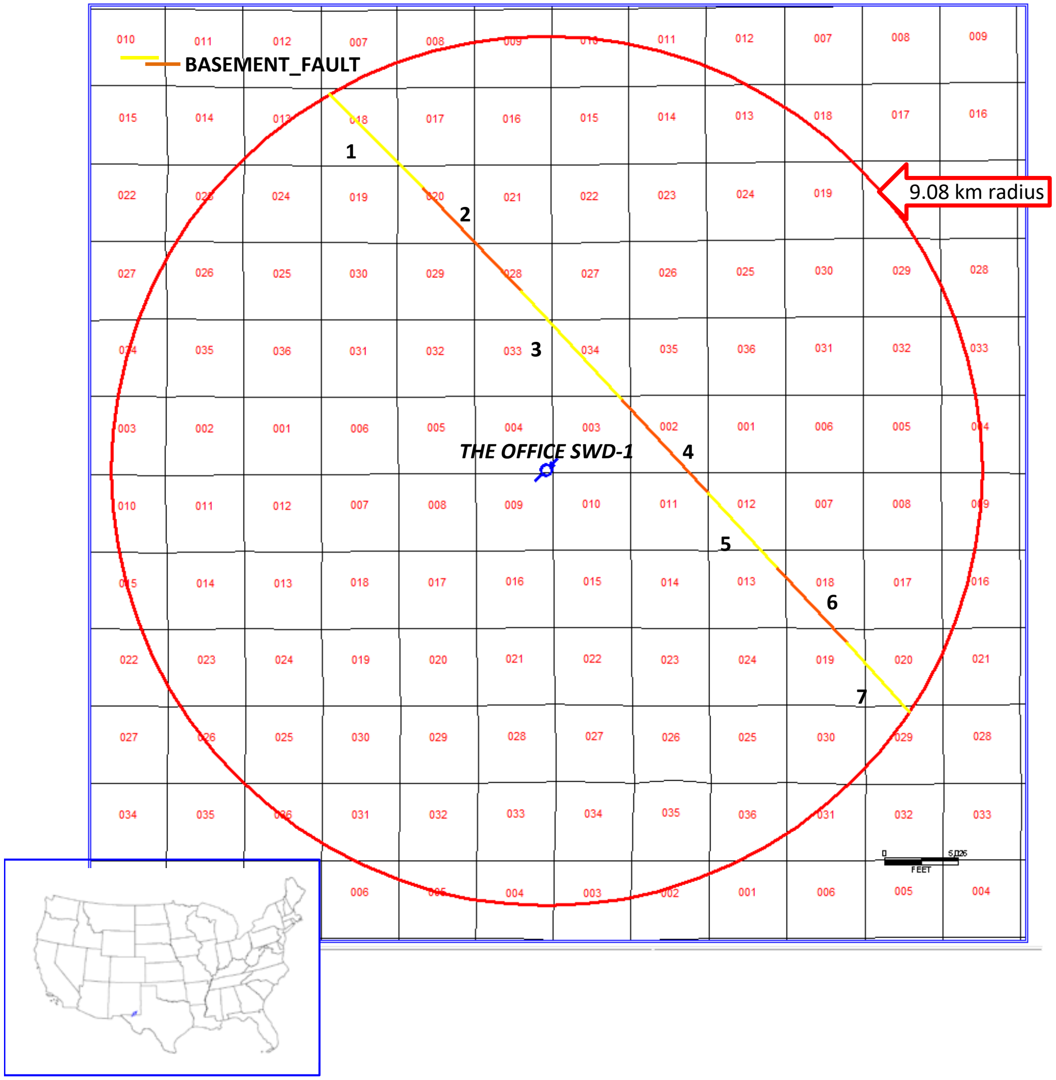


Figure 43 - Basement fault segments (7) used in FSP Analysis Models 3 and 4

Model 3 - Basement

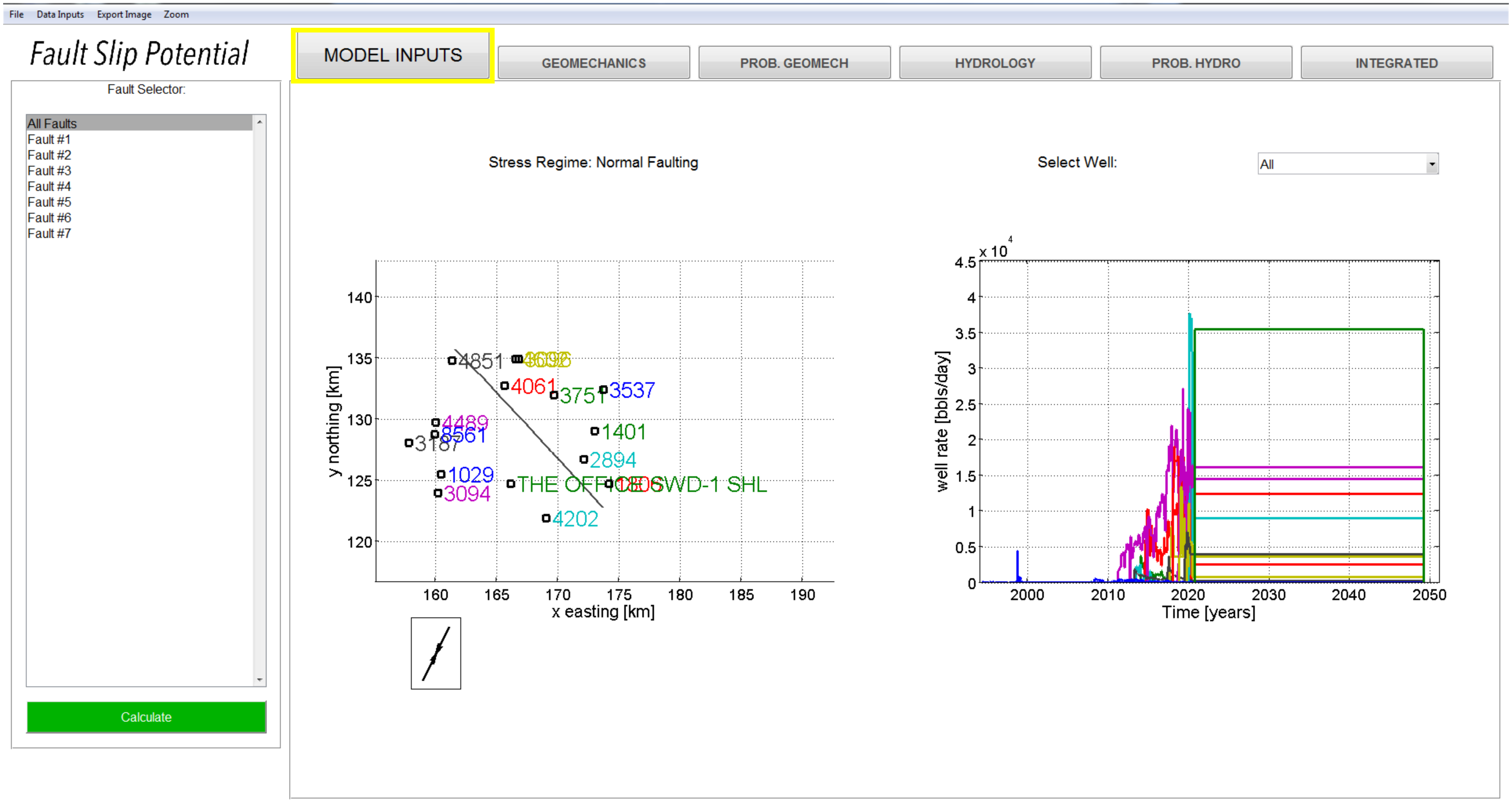


Figure 44 - FSP Model 3 Input: 16 injectors and 7 Basement fault segments

Model 4 - Basement

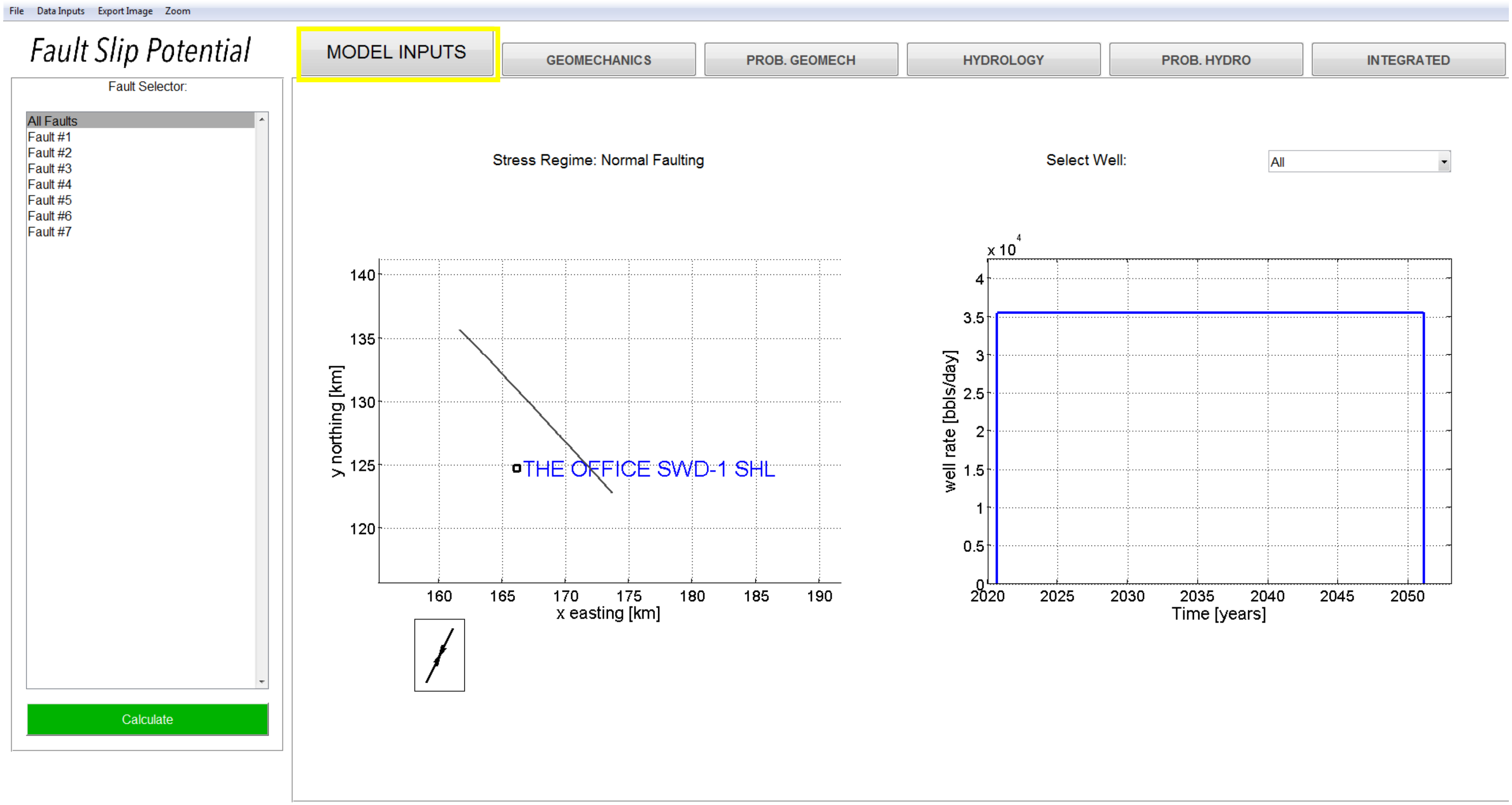


Figure 45 - FSP Model 4 Input: Only injector and 7 Basement fault segments

Model 3 and 4

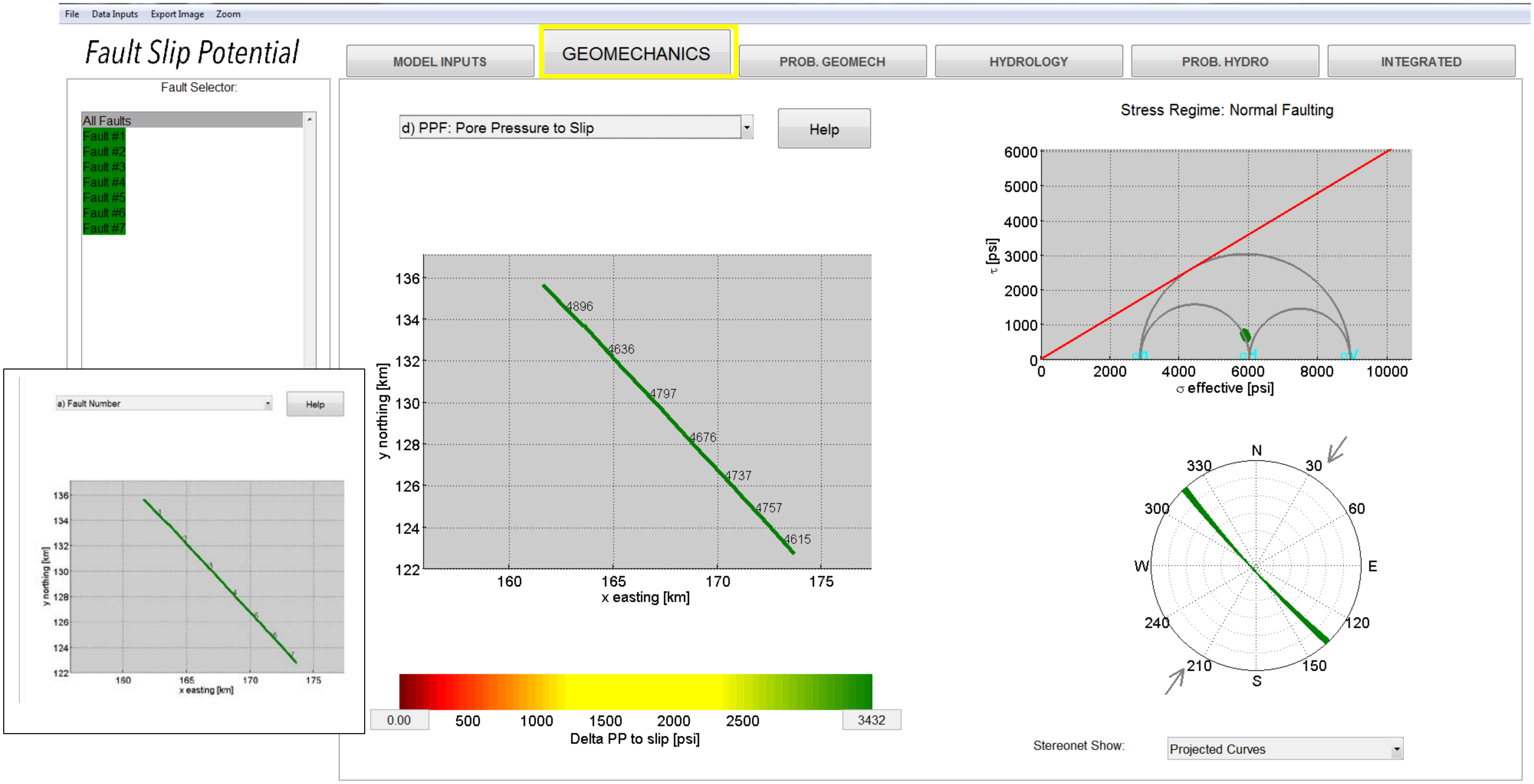


Figure 46 - FSP Geomechanics Tab, Model 3 and 4

Demonstrates pore pressure to slip (psi) for each fault segment, direction of SHmax, and a Mohr diagram with frictional slip line shown in red. Faults are colored by their horizontal distance to slip according to the color scale.

Model 3 and 4

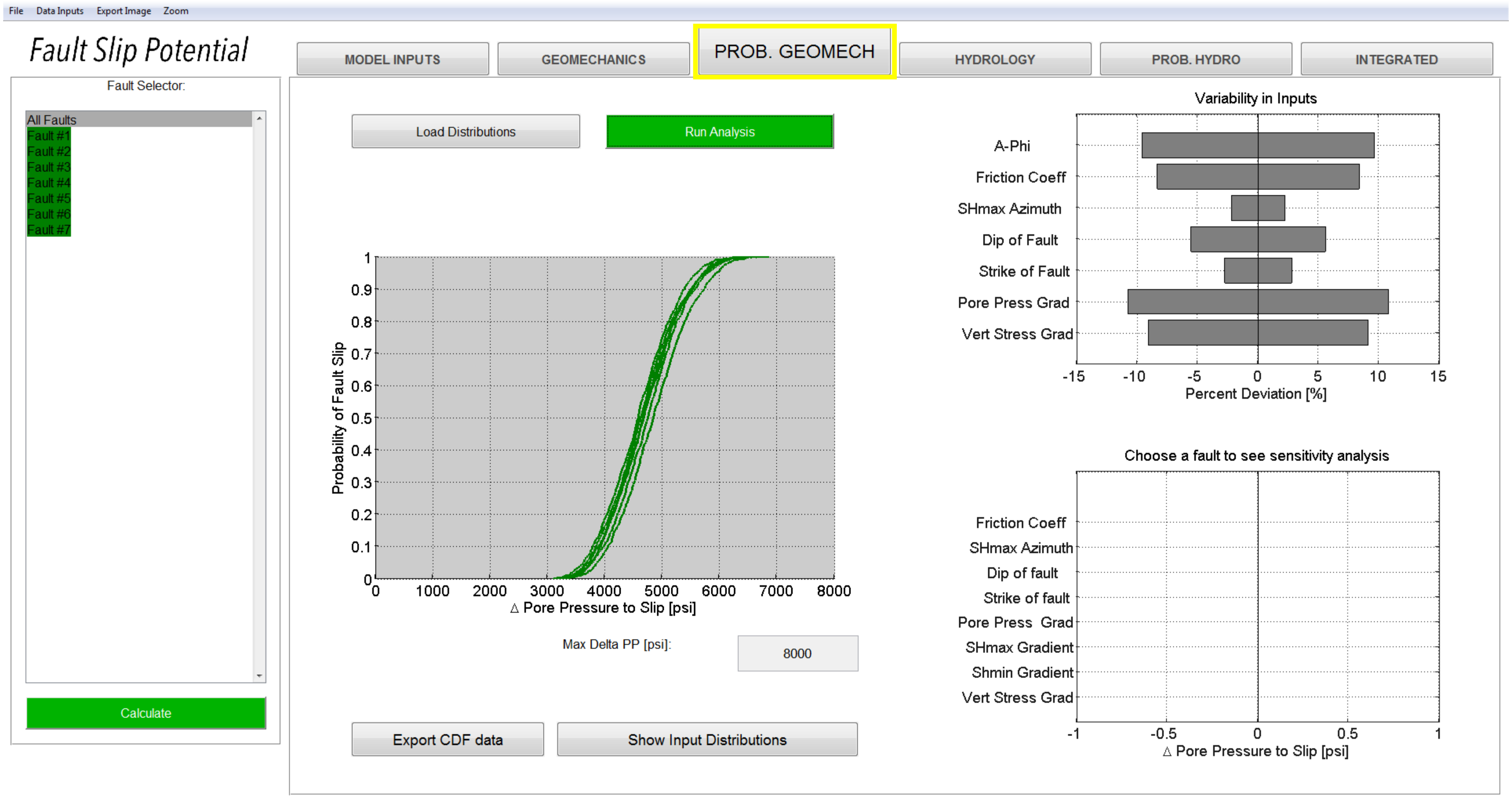


Figure 47 - FSP Probabilistic Geomechanics Tab, Model 3 and 4.

Propagates the relative uncertainties through the model, producing a distribution of pore pressures to slip.

The following integrated tabs show the combined results of probabilistic geomechanics and hydrology models run for all 7 Basement fault segments.

Model 3 – Initial Conditions before OWL The Office #1 well completed

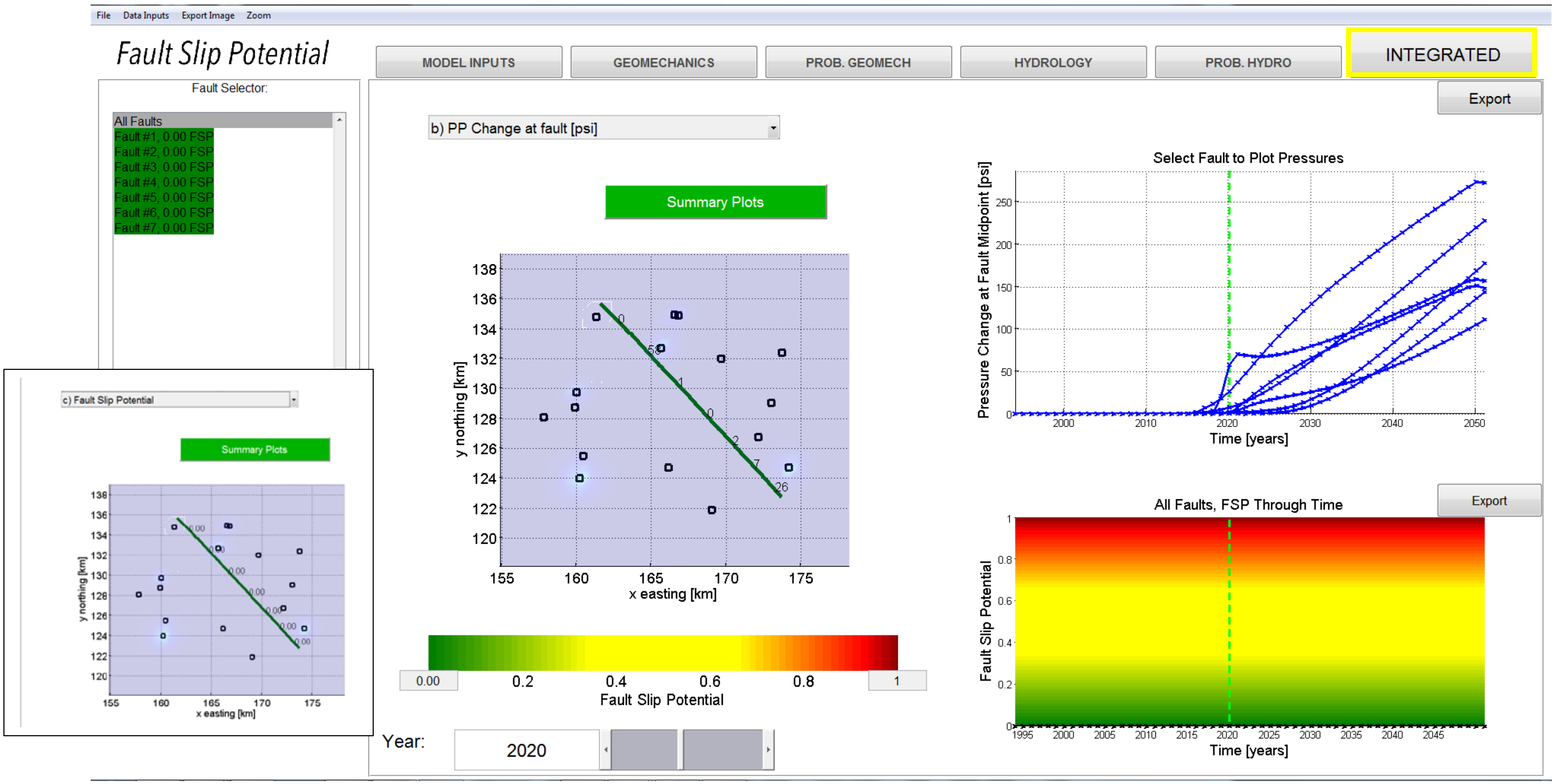


Figure 48 - Model 3 Integrated Tab, Initial Conditions

Pore Pressure change (psi)is posted for each fault segment

Model 3 – Conditions in 2041 after OWL The Office #1 well is completed

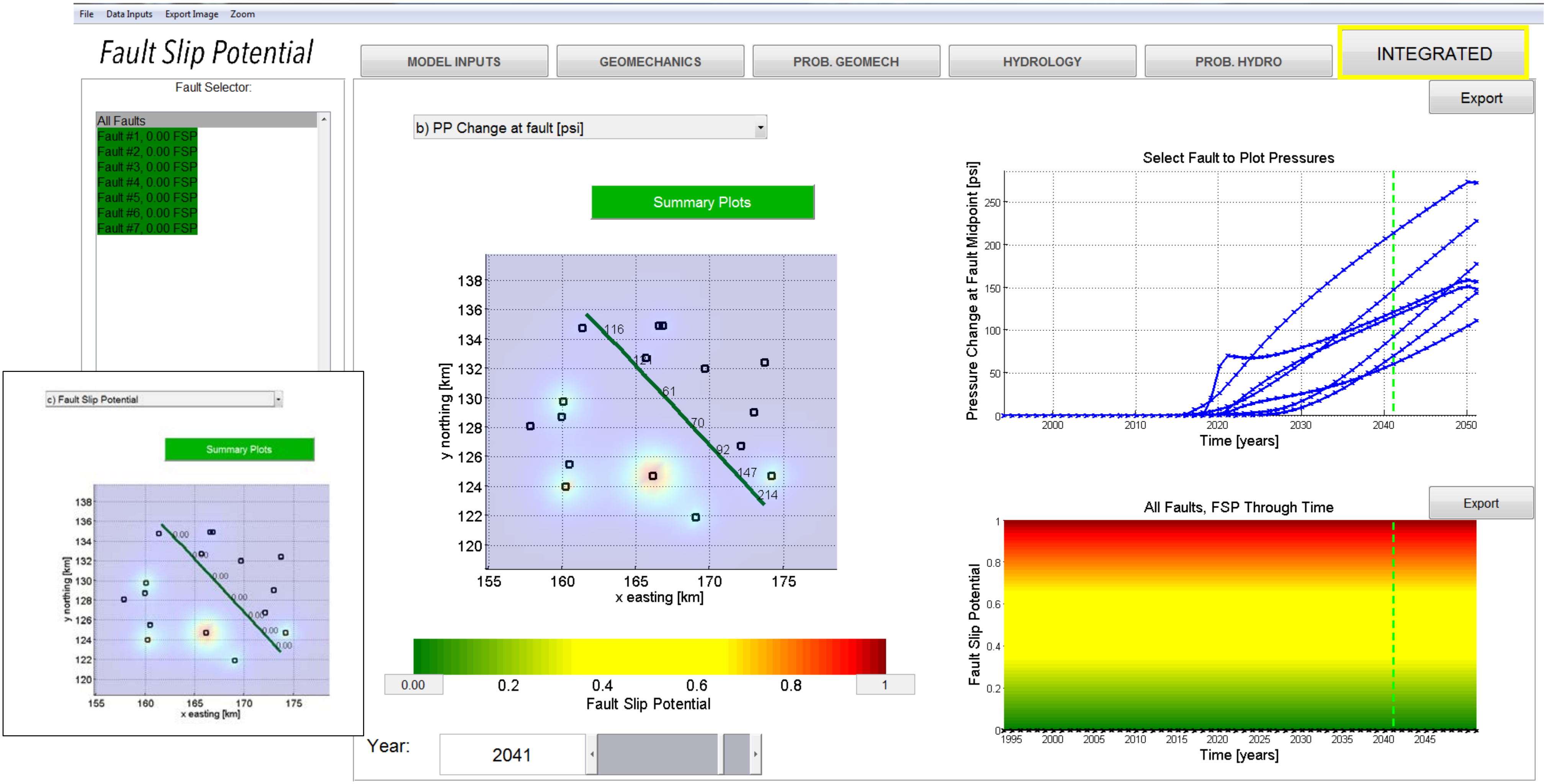


Figure 49 - Model 3 Integrated tab: 20 years after completion.

Pore Pressure change (psi)is posted for each fault segment

Model 4 – Initial Conditions before OWL The Office #1 well completed

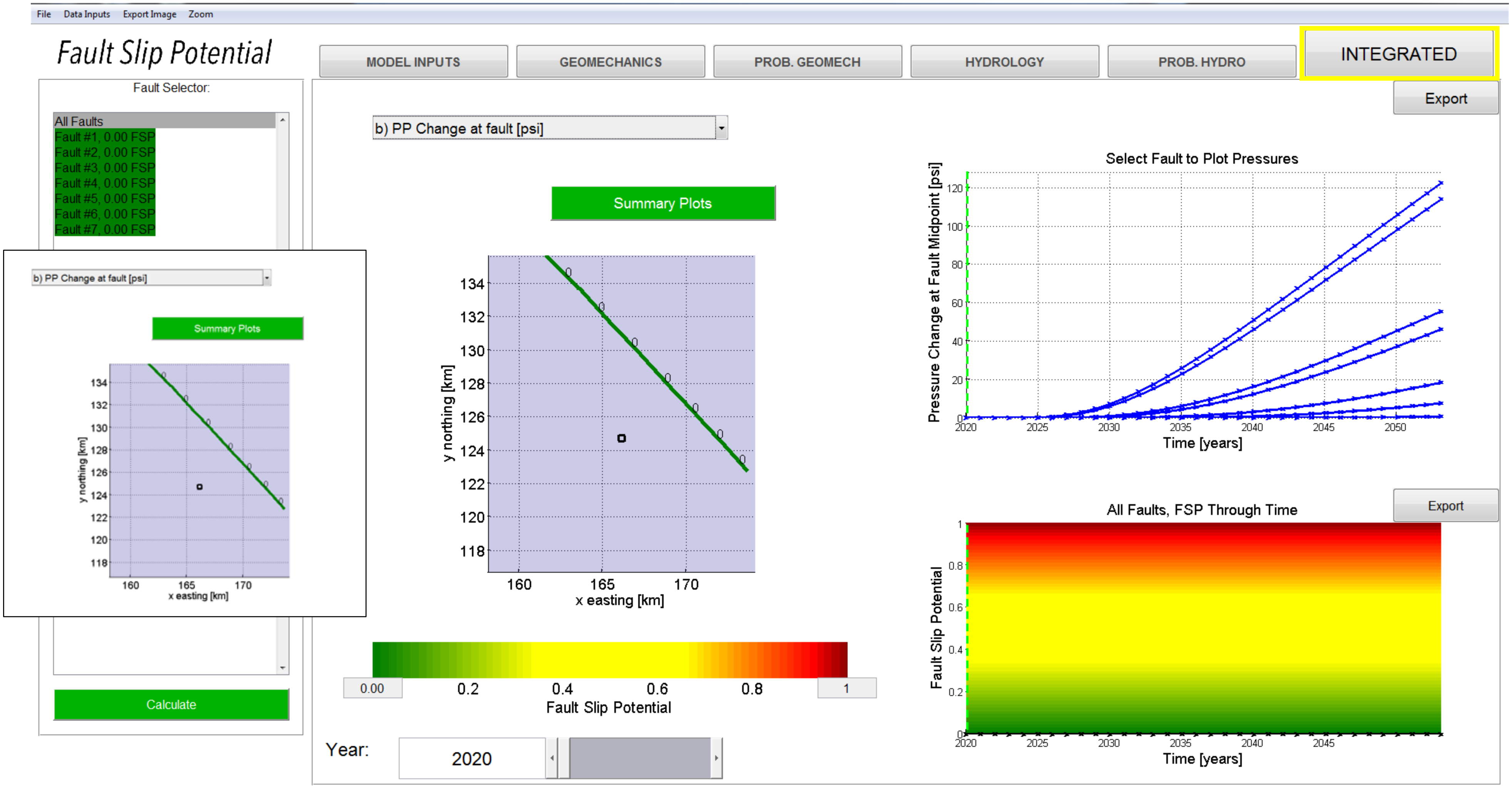


Figure 50 - Model 4 Integrated Tab, Initial Conditions

Pore Pressure change (psi) is posted for each fault segment

Model 4 – Conditions in 2041 after OWL The Office #1 well is completed

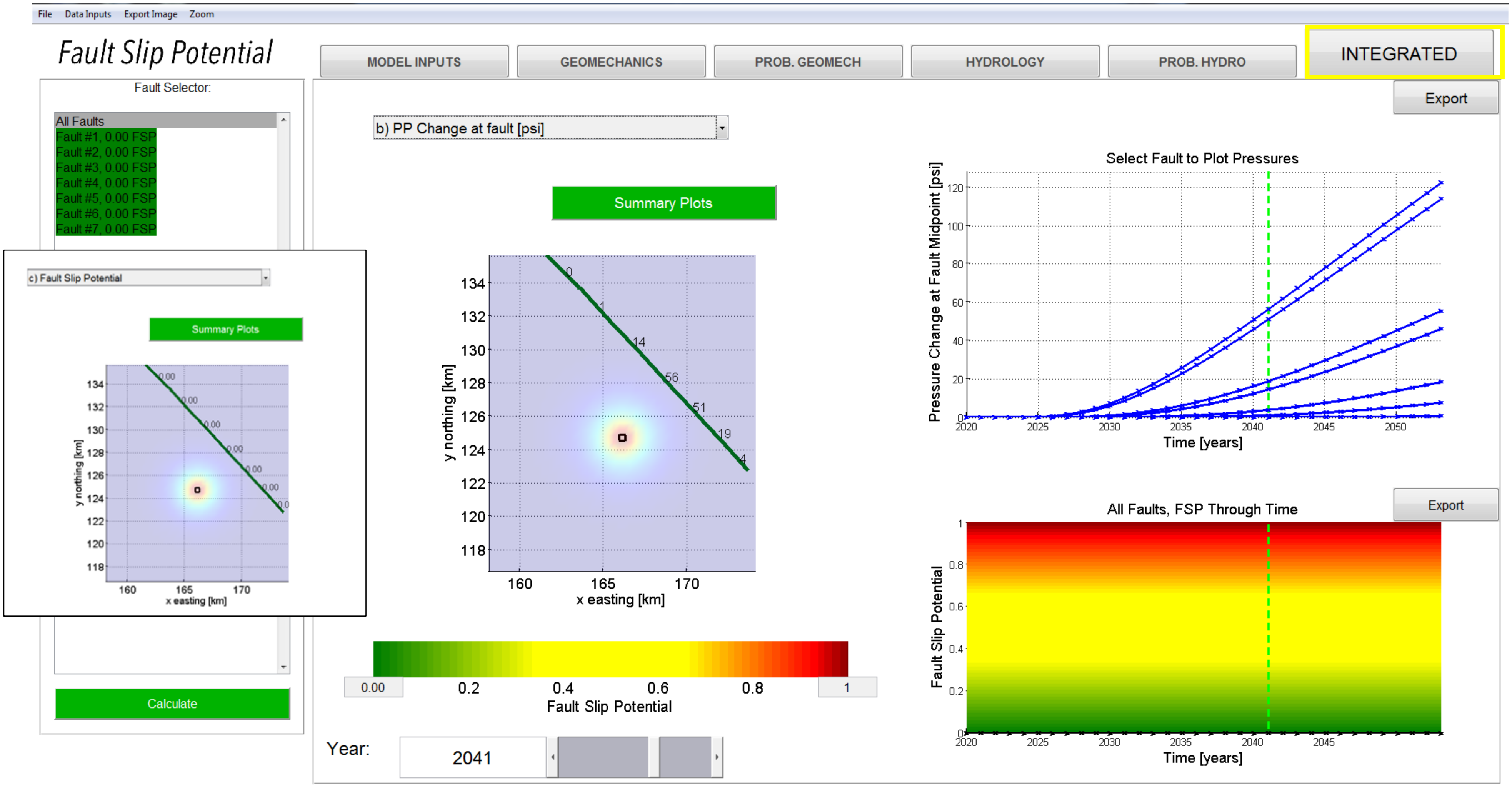


Figure 51 - Model 4 Integrated Tab, 20 years after completion

Pore Pressure change (psi) is posted for each fault segment

9.0 MODEL 1 FSP Analysis Results

Model 1 16 Injection Wells, incl OWL The Office #1 & Woodford faults					
Fault	**Pore Pressure to Slip**	**PP Change 2020**	**FSP 2020**	**PP Change 2041**	**FSP 2041**
1	4807	9	0.0	159	0.0
2	4707	4	0.0	97	0.0
3	4636	2	0.0	71	0.0
4	4707	0	0.0	95	0.0
5	5012	0	0.0	156	0.0
6	4974	2	0.0	138	0.0
7	4441	7	0.0	151	0.0

Table 1 - Model 1 FSP Results per fault segment

10.0 MODEL 2 FSP Analysis Results

Model 2 Only OWL The Office #1 & Woodford faults					
Fault	**Pore Pressure to Slip**	**PP Change 2020**	**FSP 2020**	**PP Change 2041**	**FSP 2041**
1	4807	0	0.0	0	0.0
2	4707	0	0.0	1	0.0
3	4636	0	0.0	15	0.0
4	4707	0	0.0	78	0.0
5	5012	0	0.0	134	0.0
6	4974	0	0.0	48	0.0
7	4441	0	0.0	6	0.0

Table 2 - Model 2 FSP Results per fault segment

11.0 MODEL 3 and 4 FSP Analysis Results

Model 3 **16 Injection Wells, incl OWL The Office #1 & Basement faults**					
Fault	**Pore Pressure to Slip**	**PP Change 2020**	**FSP 2020**	**PP Change 2041**	**FSP 2041**
1	4896	0	0.0	116	0.0
2	4636	5	0.0	121	0.0
3	4797	1	0.0	61	0.0
4	4676	0	0.0	70	0.0
5	4737	2	0.0	92	0.0
6	4757	7	0.0	147	0.0
7	4615	26	0.0	214	0.0

Model 4 **Only OWL The Office #1 & Basement faults**					
Fault	**Pore Pressure to Slip**	**PP Change 2020**	**FSP 2020**	**PP Change 2041**	**FSP 2041**
1	4896	0	0.0	0	0.0
2	4636	0	0.0	1	0.0
3	4797	0	0.0	14	0.0
4	4676	0	0.0	56	0.0
5	4737	0	0.0	51	0.0
6	4757	0	0.0	19	0.0
7	4615	0	0.0	4	0.0

Table 3 - Model 3 & 4 FSP Results per fault segment.

12.0 Recorded Seismicity

Between 1/1/1900 and 9/18/2020 **0 earthquakes** with magnitudes 2 or greater were recorded by **USGS** within the OWL FSP AOI.

Between 1/1/2017 and 9/18/2020 **0 earthquakes** with magnitudes 2 or greater were recorded by **TexNet** within the OWL FSP AOI.

Between 1/03/1962 and 10/1/2020 **0 earthquakes** with magnitudes 2 or greater were recorded by **MWTSO** within the OWL FSP AOI.

0 Earthquakes with magnitude of 2 or greater inside the Office FSP

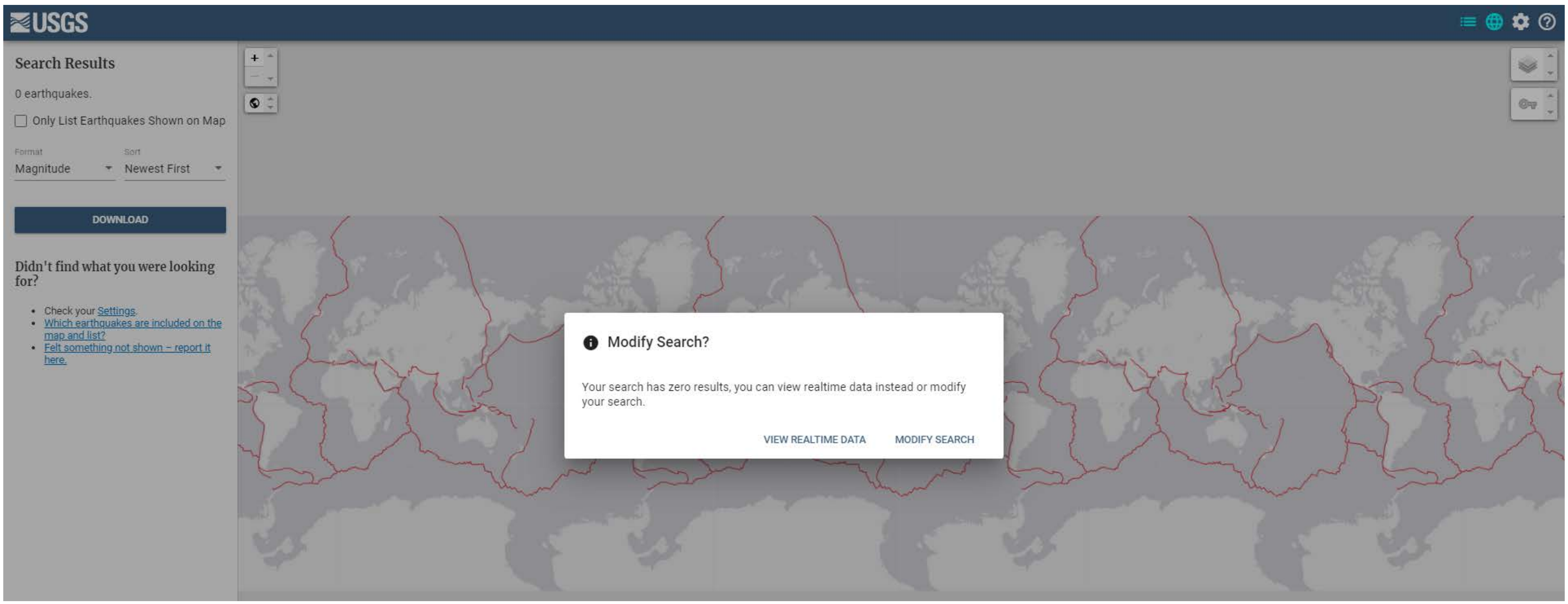


Figure 52 - USGS Earthquake catalog within OWL AOI

0 Earthquakes with magnitude of 2 or greater inside the Office #1 FSP ANALYSIS AREA

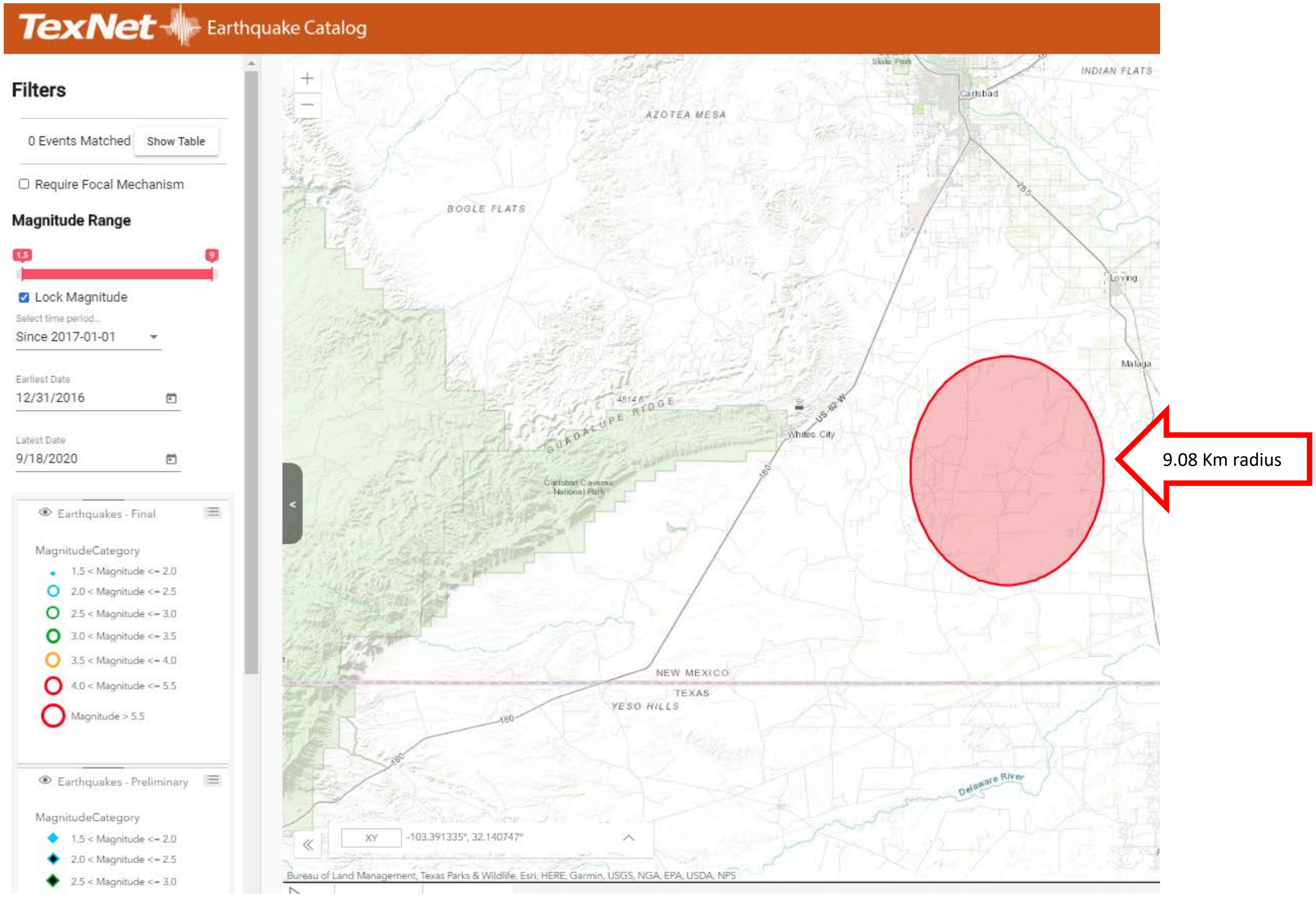


Figure 53 - TexNet Earthquake catalog within OWL AOI

0 Earthquakes with magnitude of 2 or greater inside the Office #1 FSP ANALYSIS AREA

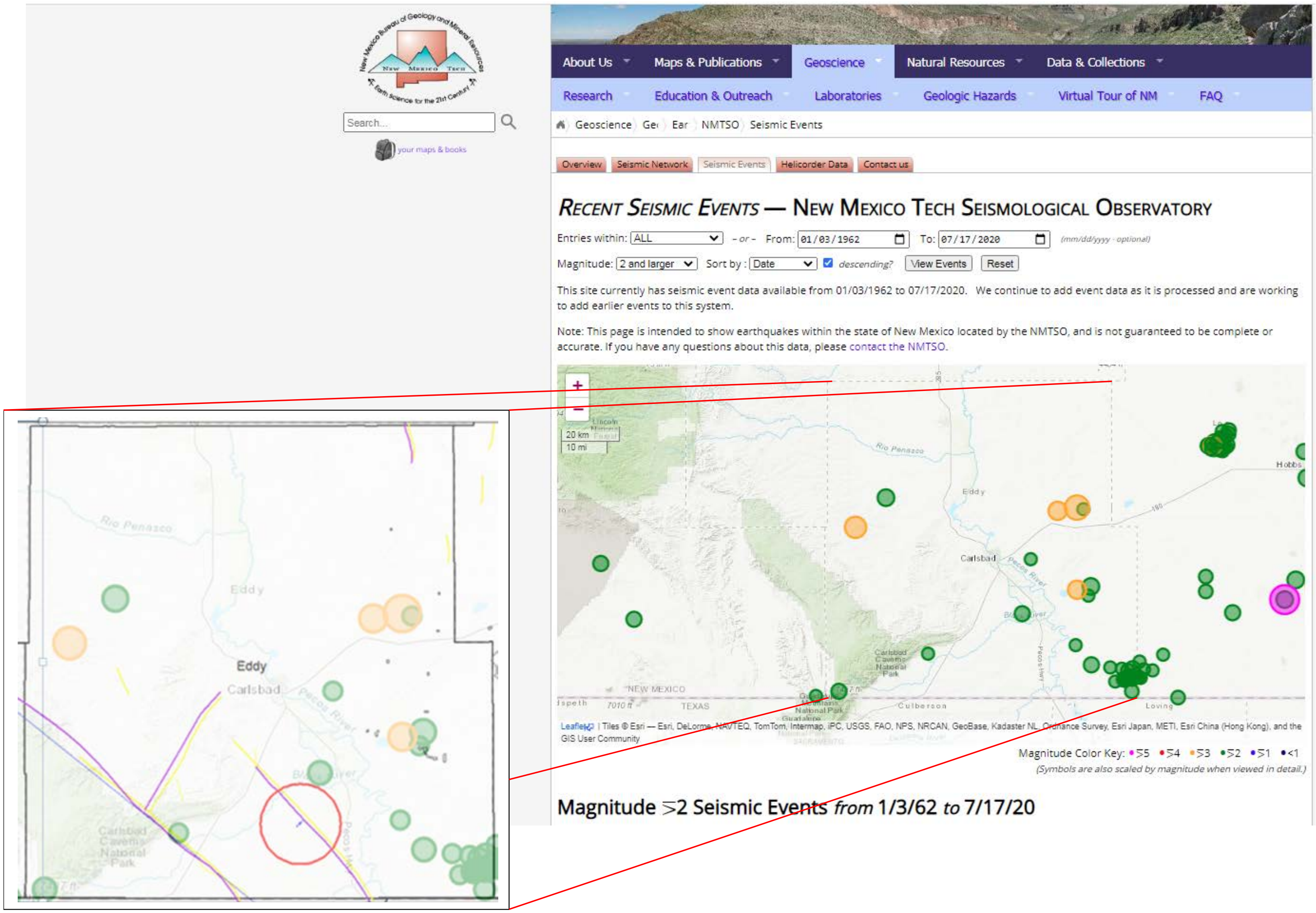


Figure 54 - MWTSO Earthquake catalog within OWL AOI

13.0 Conclusion

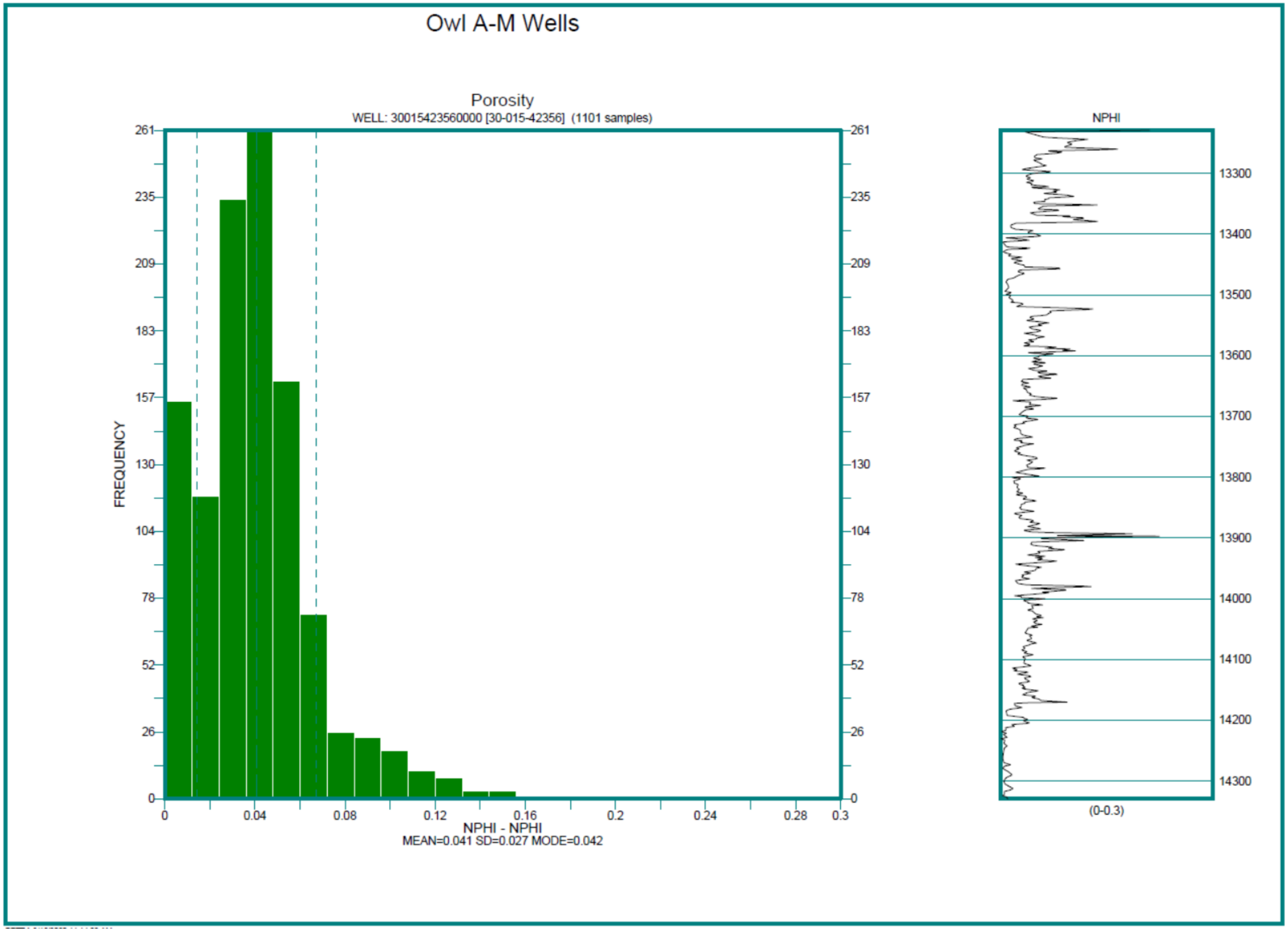
Four FSP models were run within the OFFICE #1 OWL AOI analyzing the following fault traces.

- Woodford
- Basement

Two models were run for each set of fault traces, the first included all injectors within the AOI (including the proposed OFFICE location) the second model per fault set only includes the proposed SWD well. The reservoir and stress parameters for the proposed Devonian injection interval do not increase the potential for the faults analyzed to slip.

In our opinion the proposed THE OFFICE SWD #1 injection well does not pose a risk of increasing seismicity within this FSP AOI.

Appendix 1 - Reservoir parameters backup



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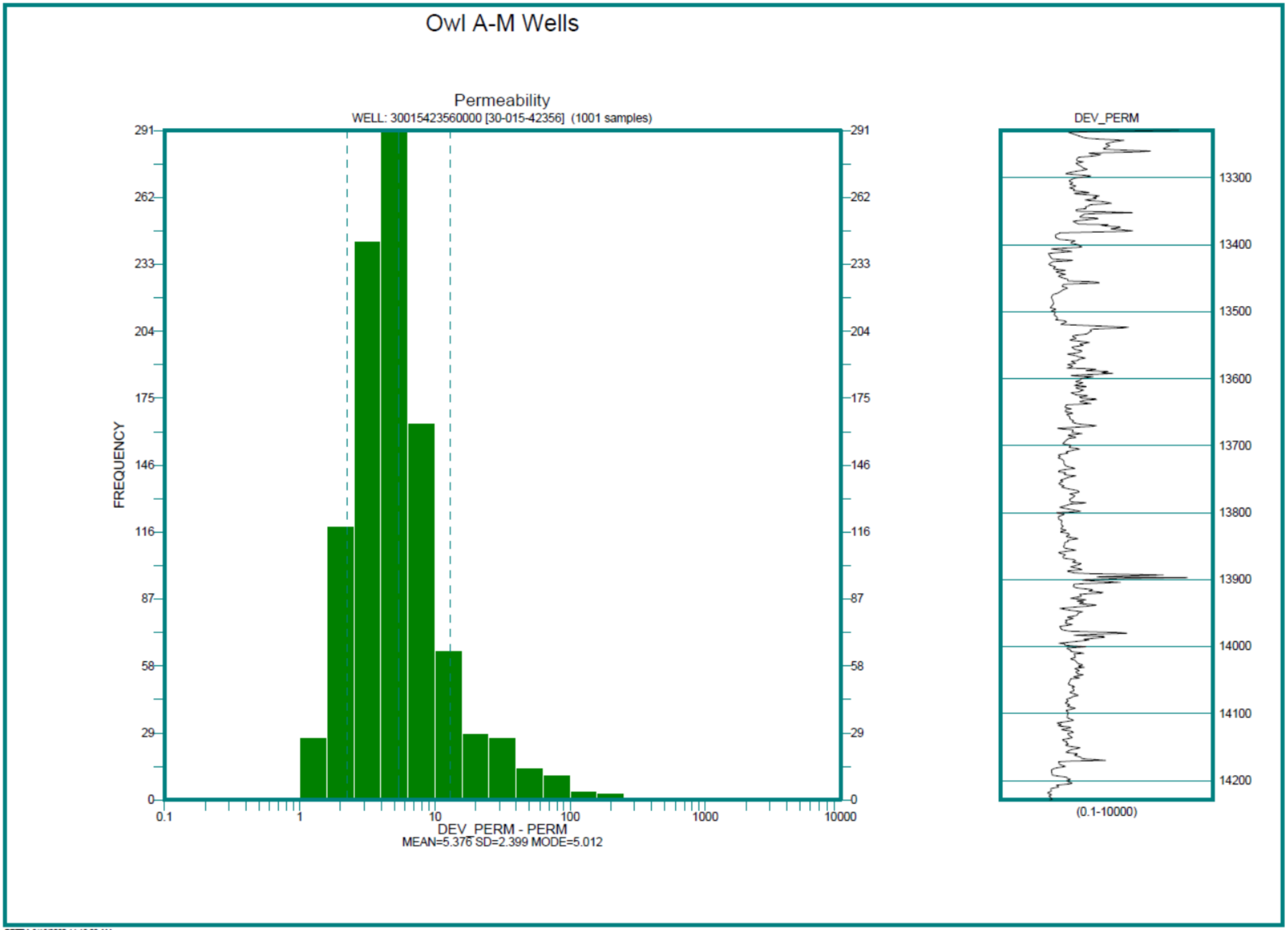
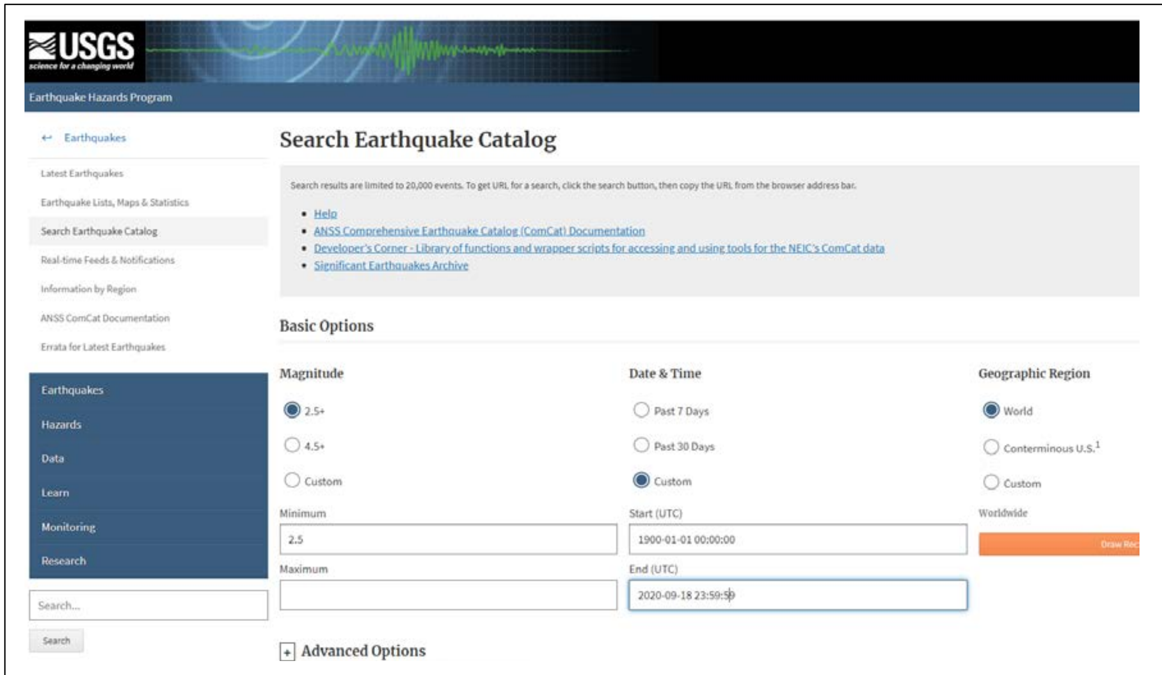
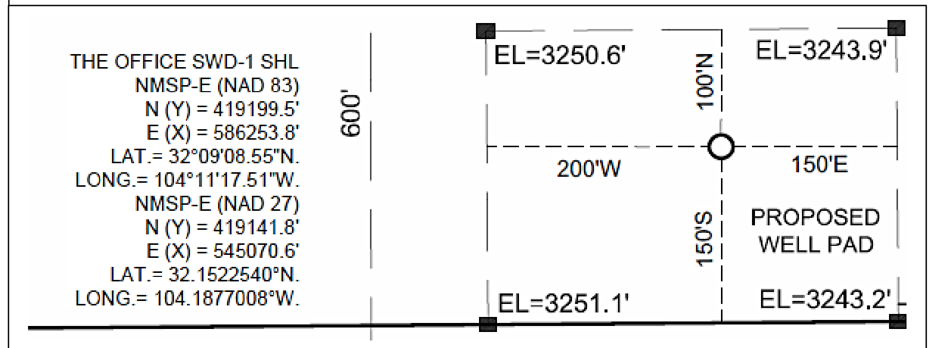
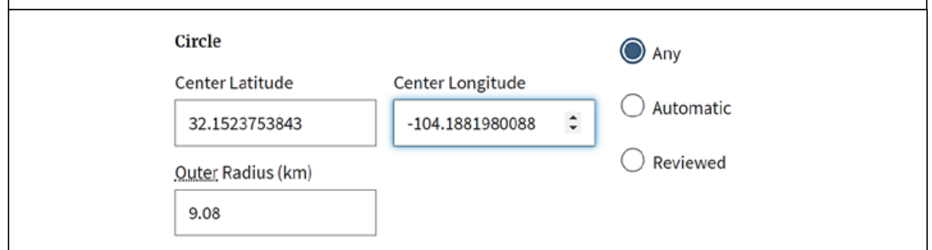

Owl A-M Wells
Permeability
WELL: 30015423560000 [30-015-42356] (1001 samples)
FREQUENCY
291
262
233
204
175
146
116
87
58
29
0
0.1
1
10
100
1000
10000
DEV_PERM - PERM
MEAN=5.376 SD=2.399 MODE=5.012
DEV_PERM
13300
13400
13500
13600
13700
13800
13900
14000
14100
14200
(0.1-10000)

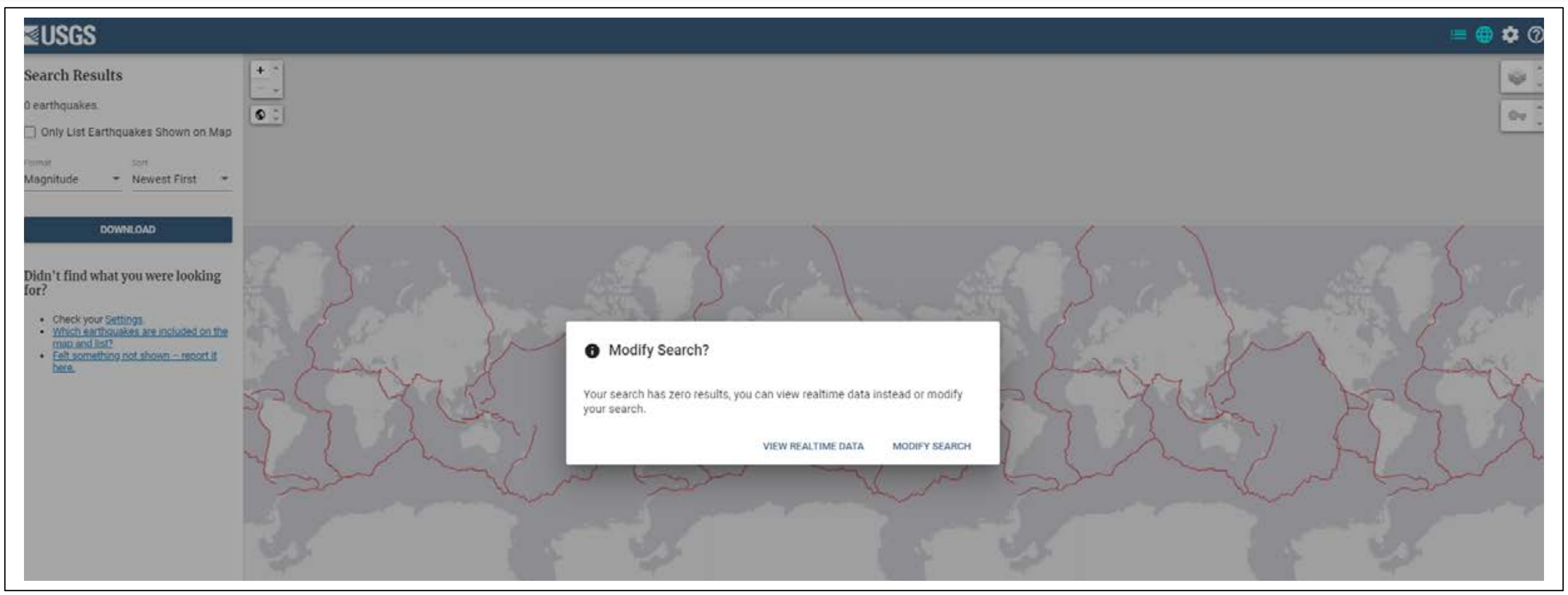
Appendix 2 - Earthquake backup

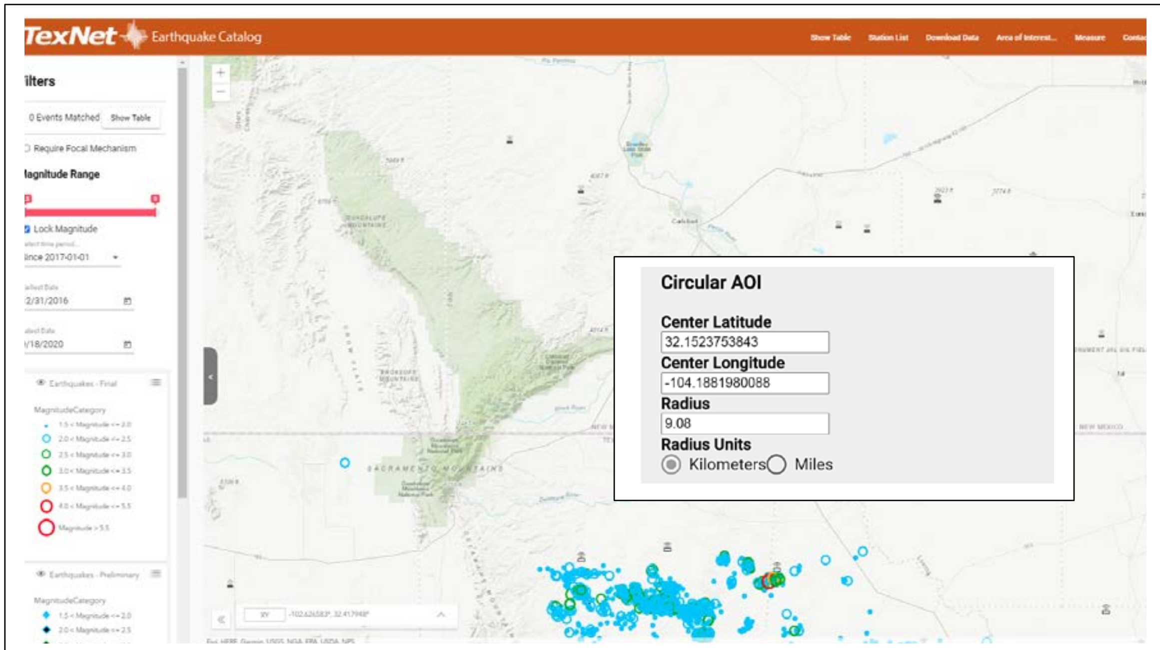


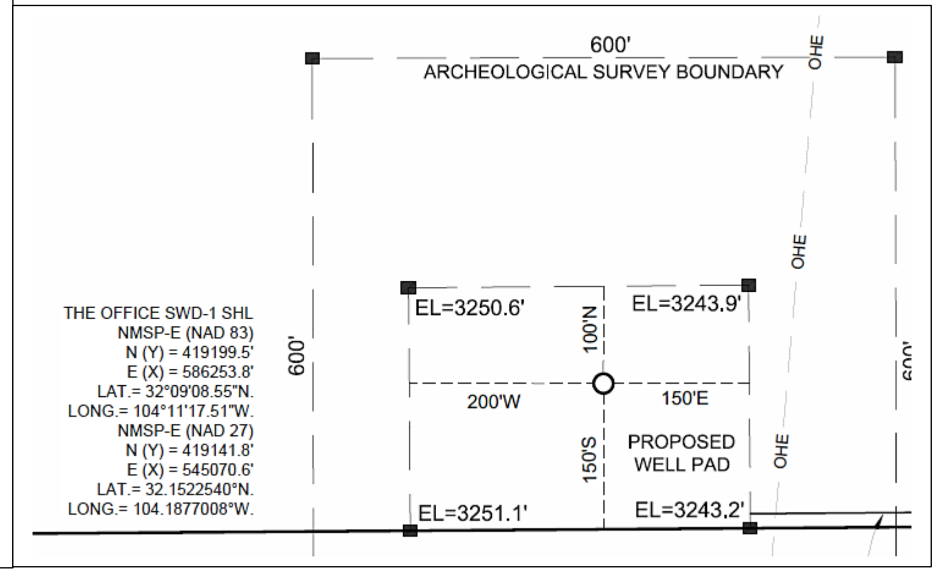




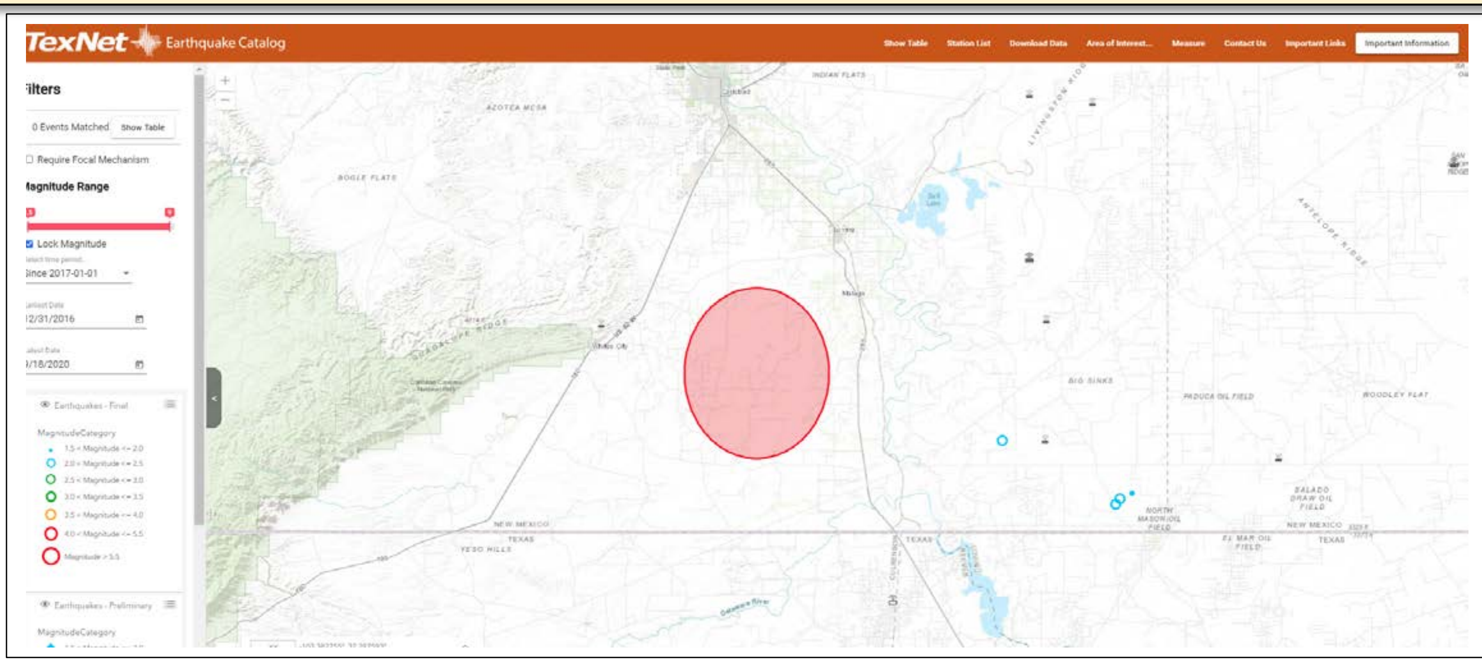
0 Earthquakes with magnitude of 2 or greater inside the Office FSP ANALYSIS AREA







0 Earthquakes with magnitude of 2 or greater inside the Office #1 FSP ANALYSIS AREA



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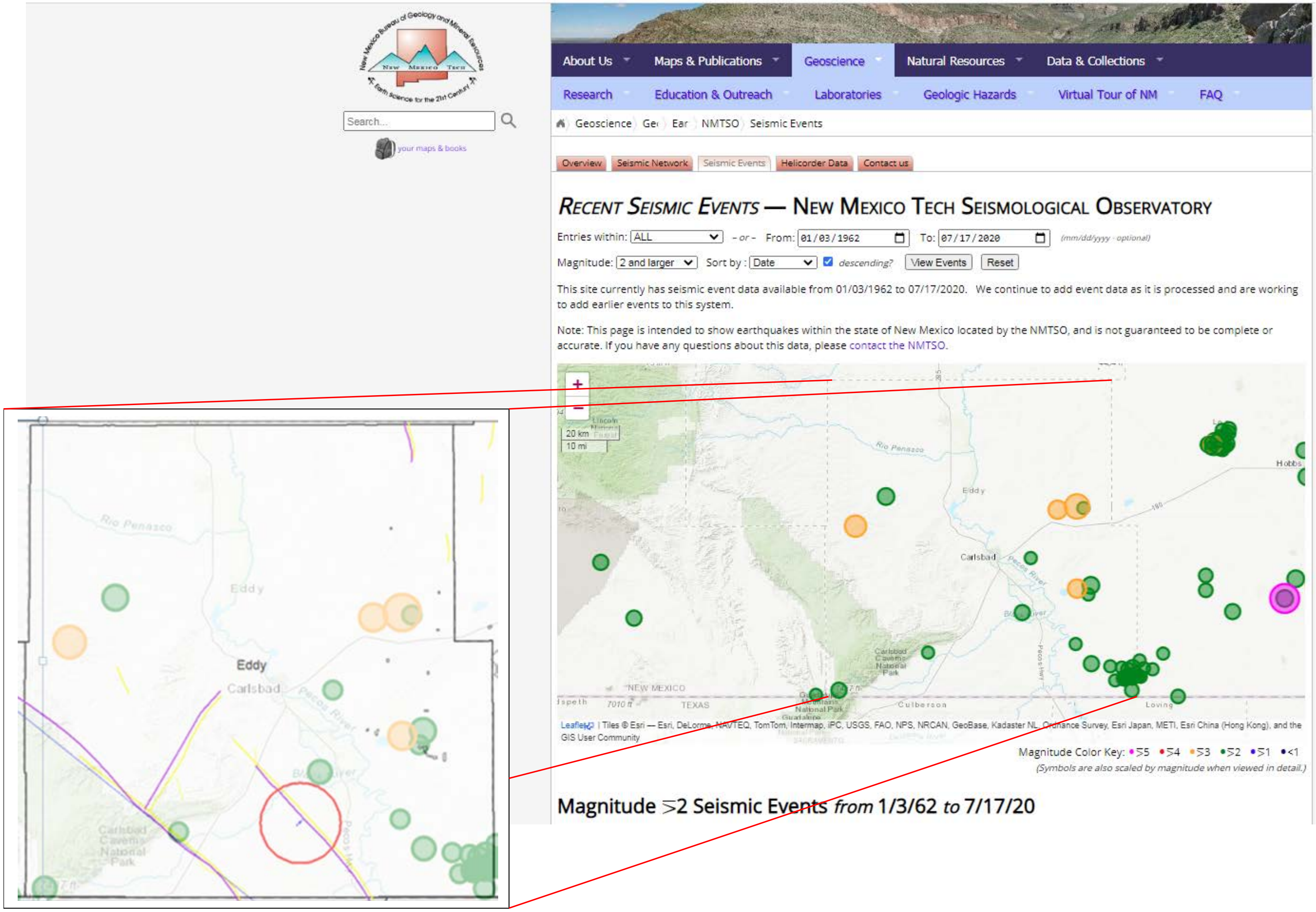
0 Earthquakes with magnitude of 2 or greater inside the Office #1 FSP ANALYSIS AREA



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Closest Earthquake is 2019-12-14 03:17:19.4, Lat 32.257, Long 104.138, Mag 2.59.