Vista Disposal Solutions, LLC

Fault Slip Potential Analysis

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OCD Case 20801, 20803,20804,20805
October 3, 2019
Vista Disposal Solutions
Exhibit 7

1

FSP Methodology

- 2 FSP areas (100 square miles each) in southeast New Mexico located to include all proposed Vista SWDs.
- Exact geologic conditions of the FSP areas are unknown.
- Two scenarios modeled for each FSP area, using low and high injection zone thickness, based on nearby geophysical logs.
- Scenario 1 uses active SWDs, approximate pending SWD locations, and 200 ft injection zone thickness within injection interval.
- Scenario 2 uses active SWDs, approximate pending SWD locations, and full Devonian-Silurian injection interval.
- Each scenario modeled over 25 years. Stress gradients and pore pressure gradients derived from published papers (Snee and Zoback 2018).
- Reference depth, injection interval thickness, porosity, and permeability derived from nearby geophysical logs penetrating the injection interval (New Mexico OCD 2019, see appendix).
- No mapped or known sedimentary or Precambrian faults in the 100 square mile area of review for FSP area 1. Two mapped Precambrian faults in the 100 square mile area of review for FSP area 2. (USGS 2019, Ruppel et al 2005, and Wilson 2018).
- Mapped Precambrian faults are assumed to penetrate upwards into the Devonian-Silurian for the purpose of modeling only. Mapped faults are only known to exist within the Precambrian basement (Ruppel et al 2005).
- Random faults generated for FSP area 1 using strike and dip consistent with known high-angle normal faulting regime in southeast New Mexico (USGS 2019, Snee and Zoback 2018).
- Advanced geological parameters derived from well logs and confirmed with previous expert testimony in the region (Reynolds 2019).

Methodology Justification

- Previous modeling efforts did not include approximate pending SWD locations.
- Due to low cumulative injection volume within the area of review in previous models, unrealistically low geologic conditions (5% porosity, 10 md permeability, and 100 ft injection zone thickness) were used to conservatively simulate pore pressure changes at fault surfaces.
- In order to accurately model the area of review with pending SWDs included, geological parameters have been increased (10% porosity, 100 md permeability, and 200-1,250 ft injection zone thickness) to more realistic values which can allow for the increased cumulative injection volume within the Devonian-Silurian injection interval.
- All geological parameters used are substantiated by nearby geophysical logs which penetrate the Devonian-Silurian injection interval (see Appendix).
- Nearby geophysical logs show at least 200 ft of good porosity zone within the Devonian-Silurian injection interval.
- The exact depth of this good porosity zone within the Devonian-Silurian interval varies between wells, therefore it is most realistic to assume the pore pressure contributions from the large number of wells being modeled will be distributed across the entire Devonian-Silurian interval.
- Scenario 1 (200 ft injection zone thickness) represents all contributed pore pressure, from SWDs within the areas of review, acting on the same 200 ft section of the Devonian-Silurian interval.
- Scenario 2 (1,250 ft injection zone thickness) represents all contributed pore pressure, from SWDs within the areas of review, distributed across the entire Devonian-Silurian interval.

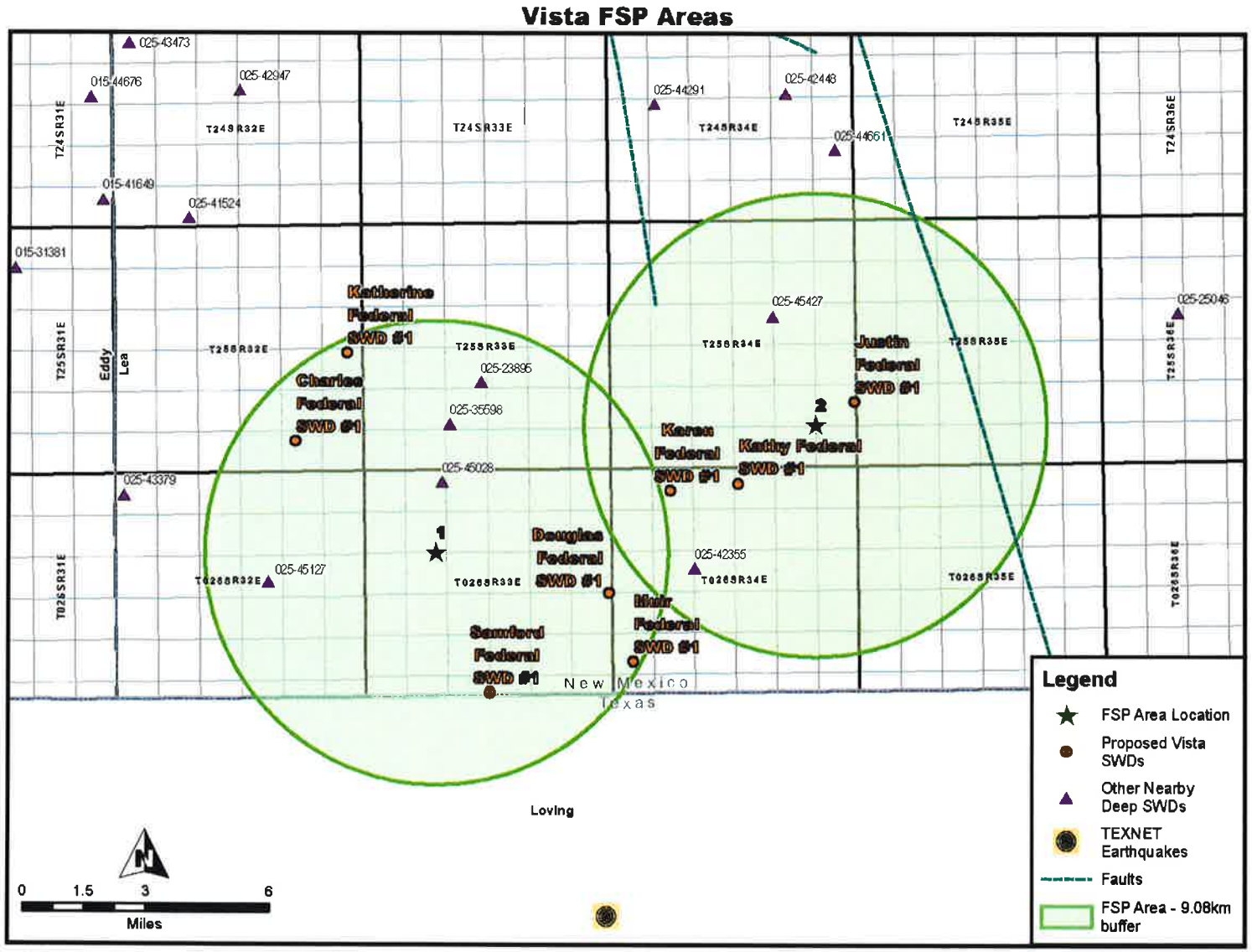
Parameters

Parameter	Value	Source
Vertical Stress Gradient (psi/ft)	1.1	Snee and Zoback (2018)
Horizontal Stress Direction (degrees azimuth)	75	Snee and Zoback (2018)
Reference Depth (ft)	17,500-17,900	Well Logs NMOCD (2019)
Initial Reservoir Pressure Gradient (psi/ft)	0.44	Snee and Zoback (2018)
A Phi	0.7 (normal faulting)	Snee and Zoback (2018)
Friction Coefficient	0.7	Snee and Zoback (2018)
Thickness with High Porosity (ft)	200-1,250	Well Logs NMOCD (2019)
Porosity (%)	10	Well Logs NMOCD (2019)
Permeability (mD)	100	Well Logs NMOCD (2019)
Fault Strike Minimum (degrees)	140	Snee and Zoback (2018)
Fault Strike Maximum (degrees)	190	Snee and Zoback (2018)
Fault Dip Minimum (degrees)	50	Snee and Zoback (2018)
Fault Dip Maximum (degrees)	90	Snee and Zoback (2018)
Density (kg/m^3)	1000	ALL Research and Reynolds (2019)
Dynamic Viscosity (Pa*s)	0.0003	ALL Research and Reynolds (2019)
Fluid Compressibility (Pa^-1)	4.70E-10	ALL Research and Reynolds (2019)
Rock Compressibility (Pa^-1)	8.70E-10	ALL Research and Reynolds (2019)

Injection Data

- 5 deep class II injection wells active in 2019 within 2 areas of review (see appendix).
- No active deep class II injection wells within included Texas region (TX RRC 2019).
- Monthly average injection rates calculated from injection start-date through July 2019 (see appendix).
- Chevron Maelstrom Federal SWD #001 (80,000 bpd) and NGL Sidewinder Federal SWD #001 (50,000 bpd) assumed to inject at proposed maximum rates.
- Pending SWD locations assumed to inject at 40,000 bpd.
- 8 proposed Vista SWDs within 2 areas of review.
- Proposed Vista SWDs assumed to inject at proposed maximum rate of 30,000 bpd.

FSP Areas



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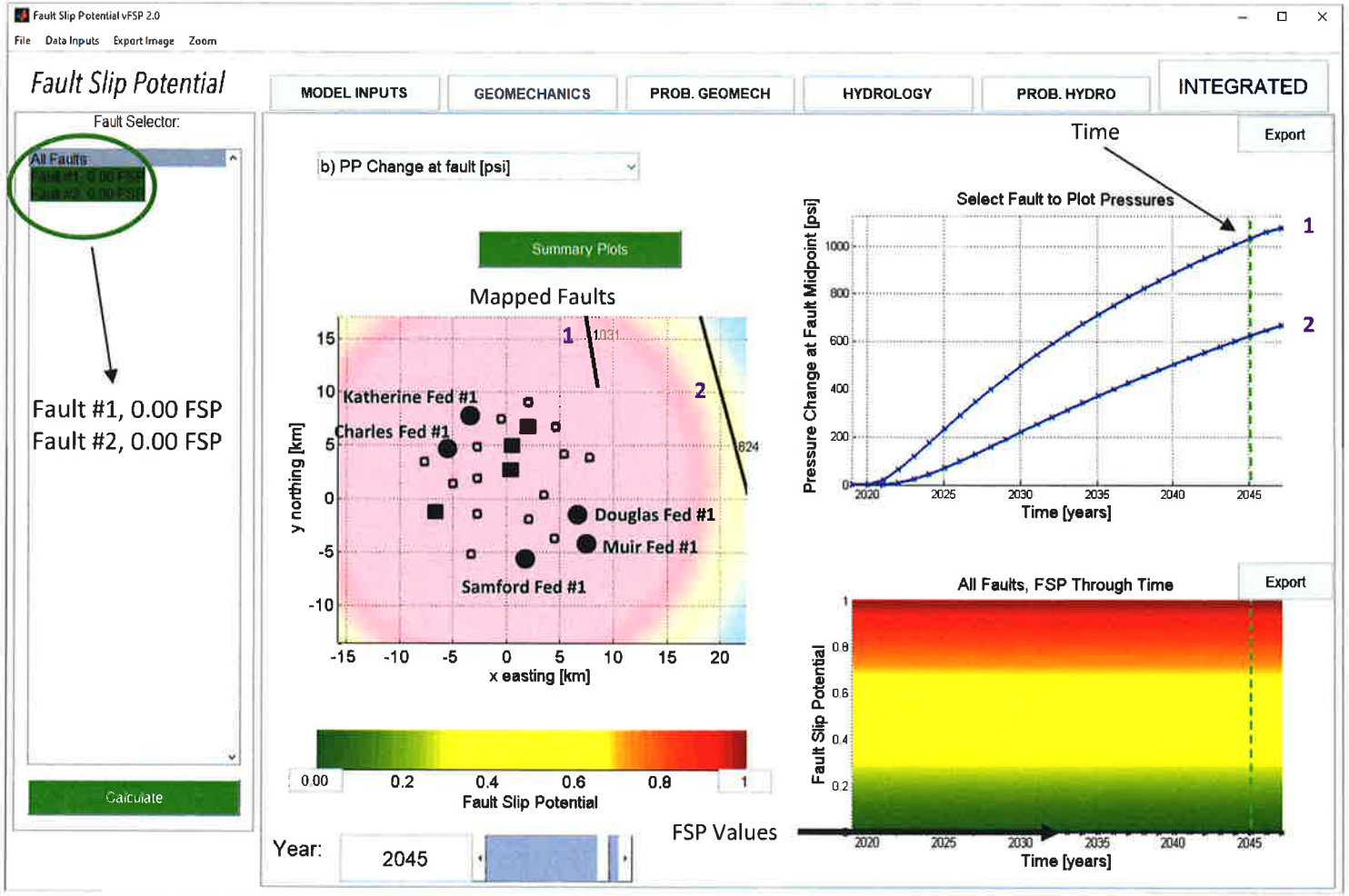
FSP After 25 Years - Area 1 - Scenario 1A

Mapped Faults – Outside 100 Square Mile AOR



Parameters

Estimated Porosity
10%

Estimated Permeability
100 mD

Estimated Injection Interval
17,500 – 18,750 ft

Estimated Thickness with High (10%) Porosity
200 ft

Mapped Faults

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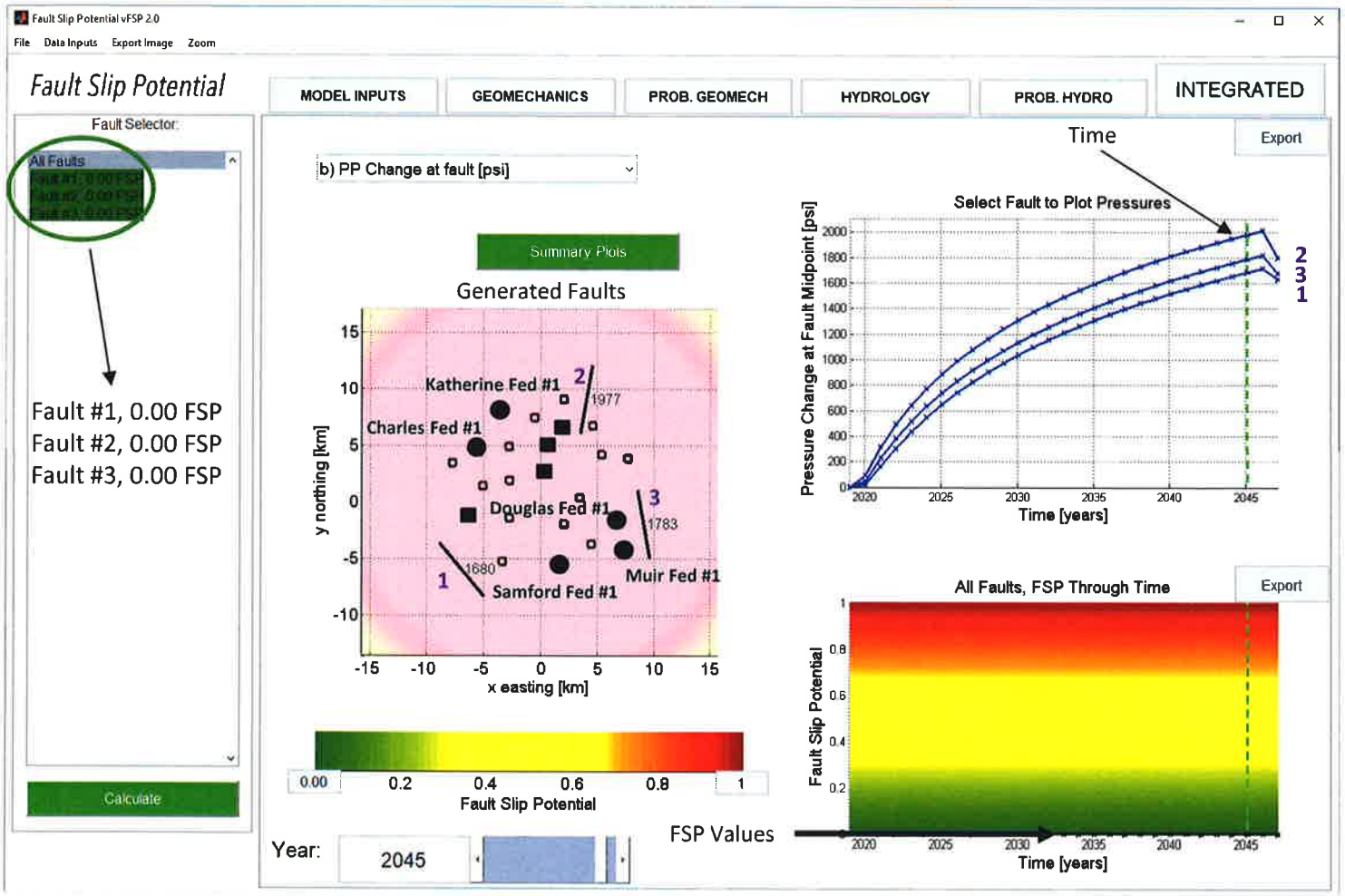
● = Proposed Vista SWDs
■ = Active Deep SWDs
□ = Approximate Pending Deep SWD Locations

FSP After 25 Years - Area 1 - Scenario 1B

Generated Faults– Inside 100 Square Mile AOR



Parameters

Estimated Porosity
10%

Estimated Permeability
100 mD

Estimated Injection Interval
17,500 – 18,750 ft

Estimated Thickness with High (10%) Porosity
200 ft

Generated Faults

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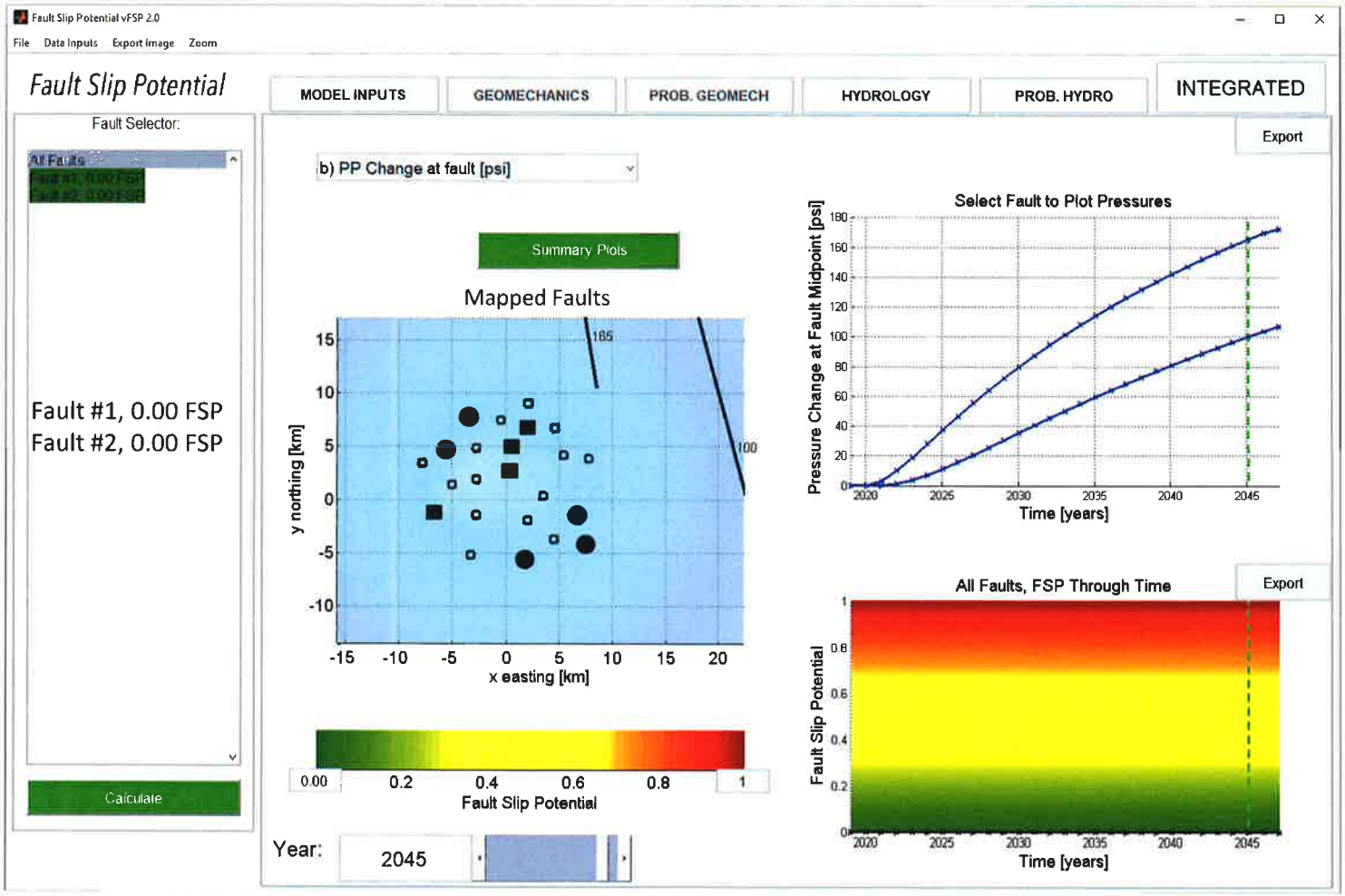
● = Proposed Vista SWDs
■ = Active Deep SWDs
□ = Approximate Pending Deep SWD Locations

FSP After 25 Years - Area 1 - Scenario 2A

Mapped Faults – Outside 100 Square Mile AOR



Parameters

Estimated Porosity
10%

Estimated Permeability
100 mD

Estimated Injection Interval
17,500 – 18,750 ft

Estimated Thickness with High (10%) Porosity
1,250 ft

Mapped Faults

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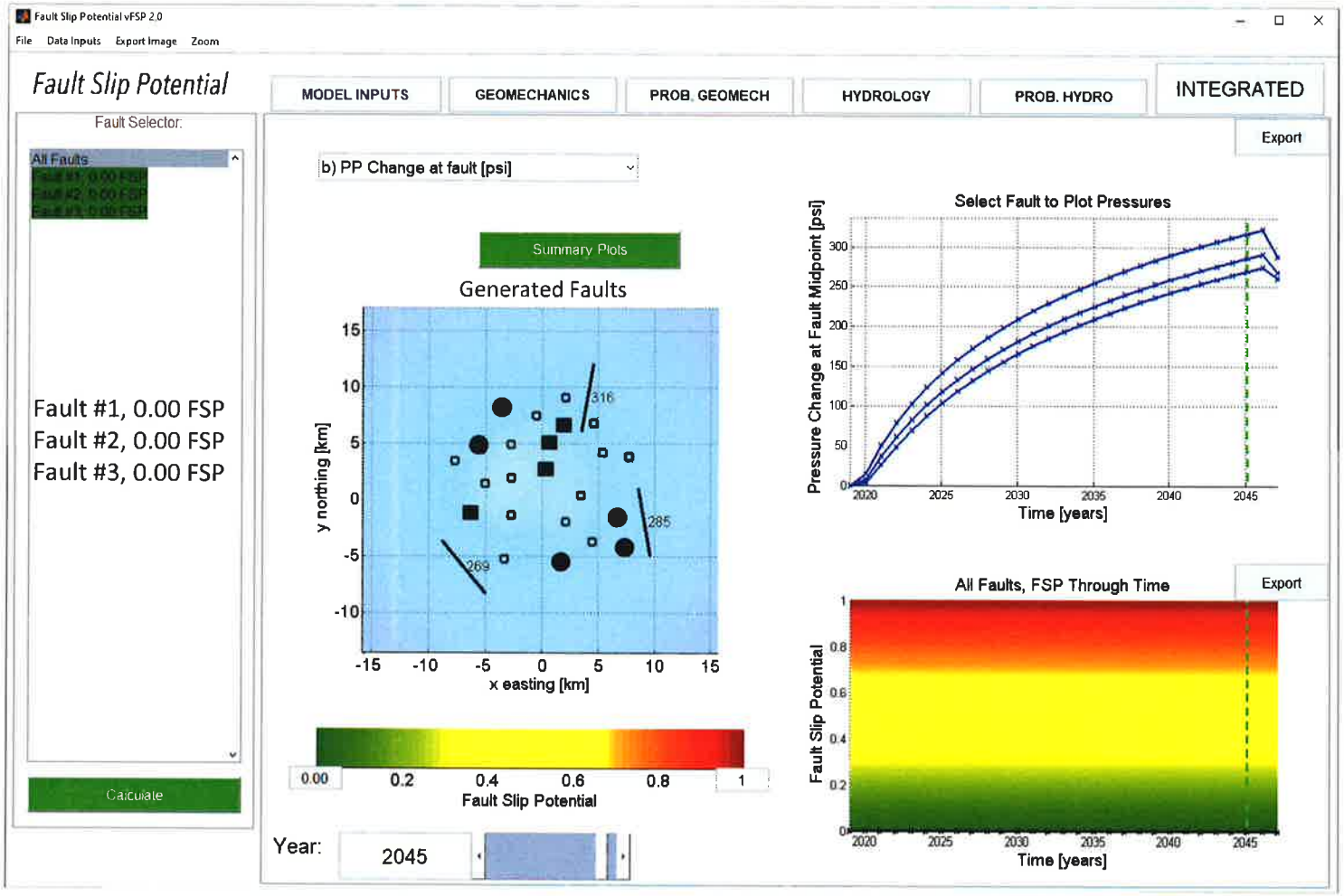
● = Proposed Vista SWDs
■ = Active Deep SWDs
□ = Approximate Pending Deep SWD Locations

FSP After 25 Years - Area 1 - Scenario 2B

Generated Faults – Inside 100 Square Mile AOR



Parameters

Estimated Porosity
10%

Estimated Permeability
100 mD

Estimated Injection Interval
17,500 – 18,750 ft

Estimated Thickness with High (10%) Porosity
200 ft

Generated Faults

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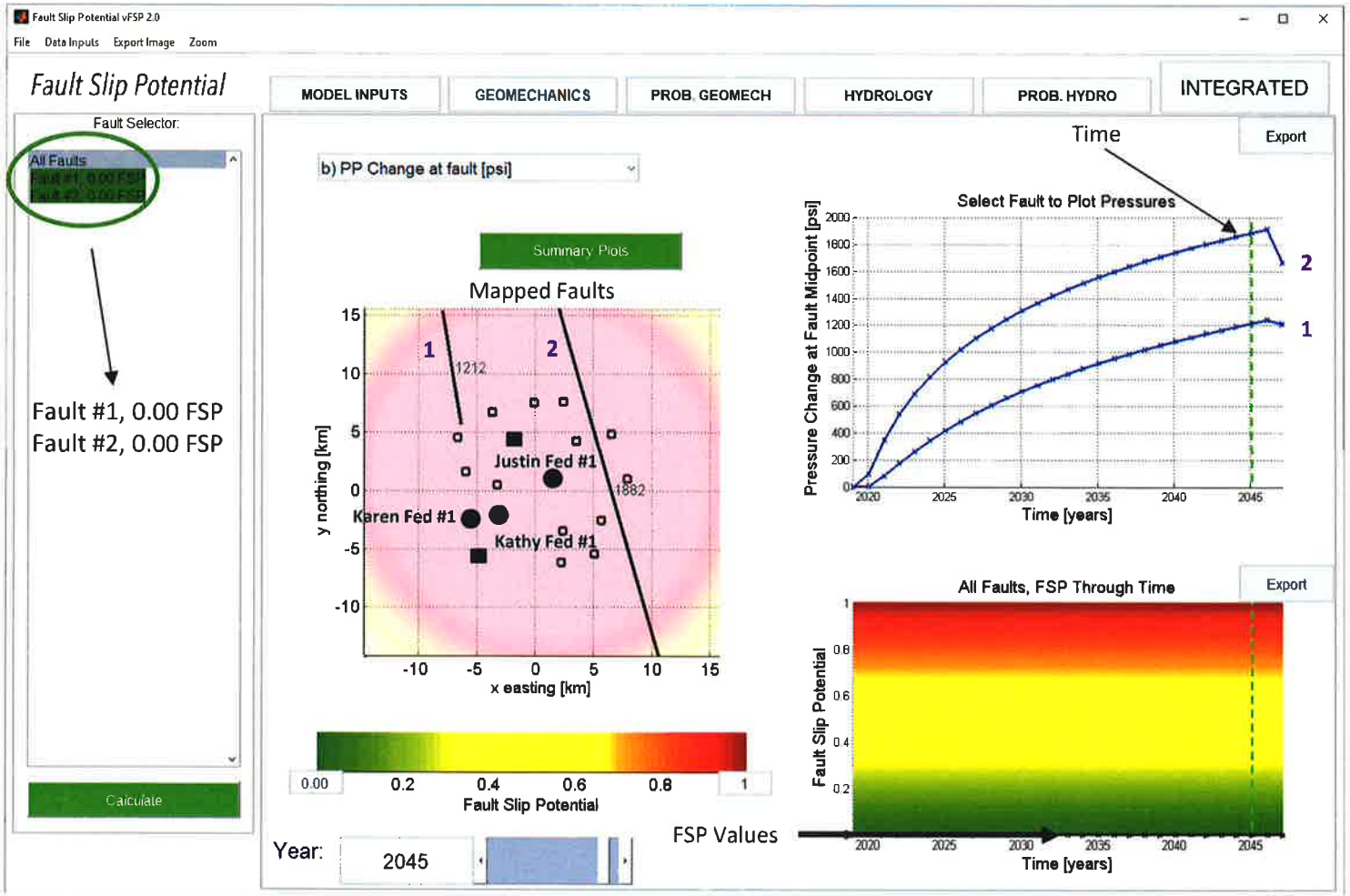
● = Proposed Vista SWDs
■ = Active Deep SWDs
□ = Approximate Pending Deep SWD Locations

FSP After 25 Years - Area 2 - Scenario 1

Mapped Faults – Inside 100 Square Mile AOR



Parameters

Estimated Porosity
10%

Estimated Permeability
100 mD

Estimated Injection Interval
17,900 – 19,150 ft

Estimated Thickness with High (10%) Porosity
200 ft

Mapped Faults

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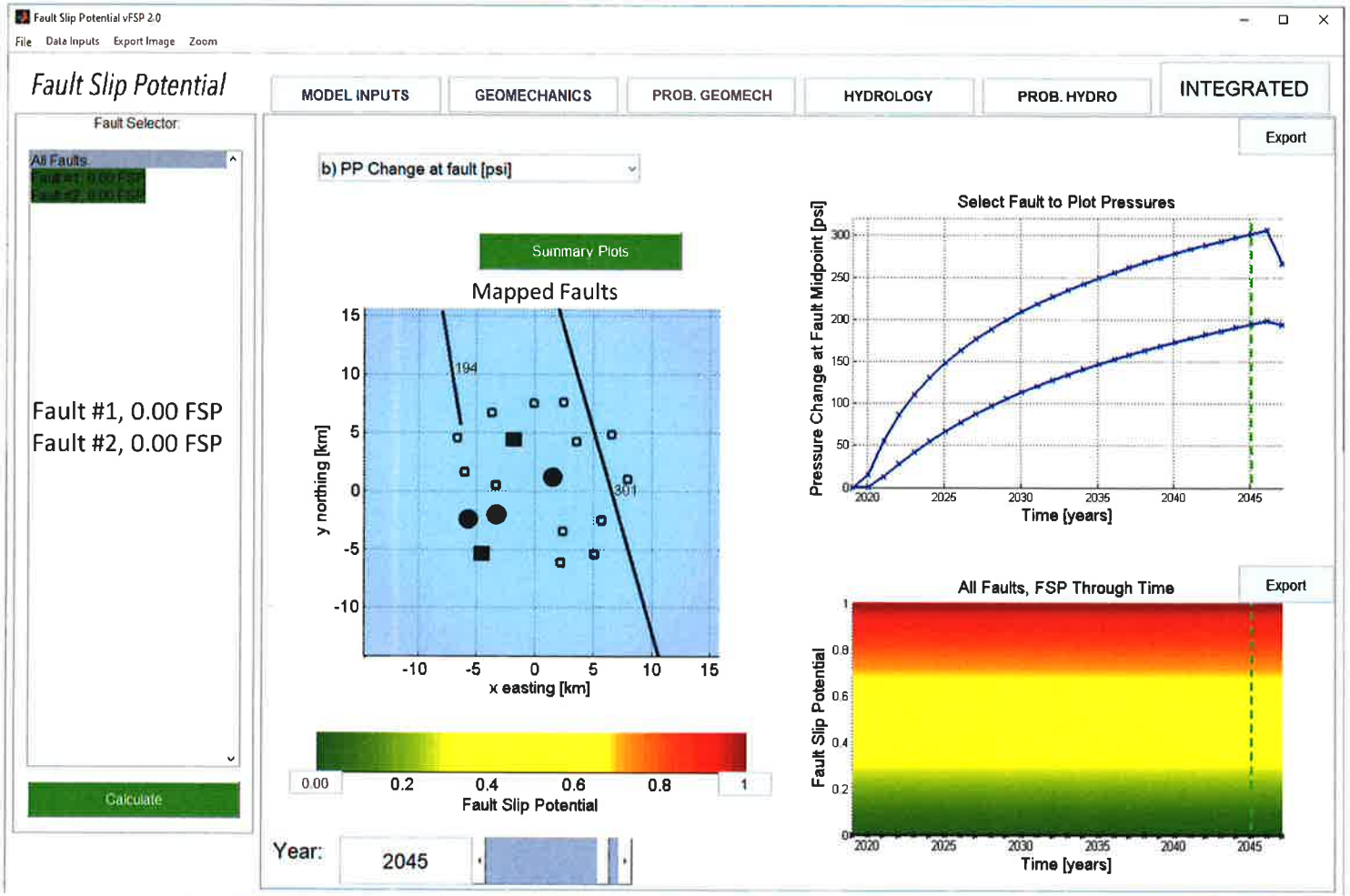
● = Proposed Vista SWDs
■ = Active Deep SWDs
□ = Approximate Pending Deep SWD Locations

FSP After 25 Years - Area 2 - Scenario 2

Mapped Faults – Inside 100 Square Mile AOR



Parameters

Estimated Porosity
10%

Estimated Permeability
100 mD

Estimated Injection Interval
17,900 – 19,150 ft

Estimated Thickness with High (10%) Porosity
1,250 ft

Mapped Faults

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● = Proposed Vista SWDs
■ = Active Deep SWDs
□ = Approximate Pending Deep SWD Locations

Conclusions

- There are two mapped Precambrian faults in the 100 square mile review of FSP area 2, which each show FSP of 0.00 over 25 years in both geologic scenarios.
- Faults generated for FSP area 1, consistent with known high-angle normal faulting regime in southeast New Mexico, all show FSP of 0.00 over 25 years in both geologic scenarios.
- In area 1 scenario 1, for FSP on one generated fault to reach 0.01 after 25 years, all five proposed Vista SWDs must inject at 105,000 bpd.
- In area 2 scenario 1, for FSP on one mapped fault to reach 0.01 after 25 years, all three proposed Vista SWDs must inject at 495,000 bpd.
- Known faults in southeast New Mexico do not align with the horizontal stress field and are not likely to slip.
- FSP modeling through 25 years, with injection rates that are likely overestimated, shows no risk of potential fault slip in the areas of review.
- These areas present little to no risk for injection induced seismicity.

References

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U.S. Geological Survey. "Faults." https://earthquake.usgs.gov/hazards/qfaults/ (Accessed June 24, 2019)

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Wilson, Scott J. 2018. "Affidavit of Scott J. Wilson, Amended Applications of NGL Water Solutions Permian, LLC for Approval of Saltwater Disposal Wells in Lea County, New Mexico." New Mexico Oil Conservation Division Case No, 16438 and Case No. 16440.

Reynolds, Todd. 2019. "FSP Analysis (Fault Slip Potential) Exhibits." New Mexico Oil Conservation Division Case No. 20313, Case No. 20314, and Case No. 20472.

Appendix

Control Log Well Details and Nearby Deep SWDs Injection Data

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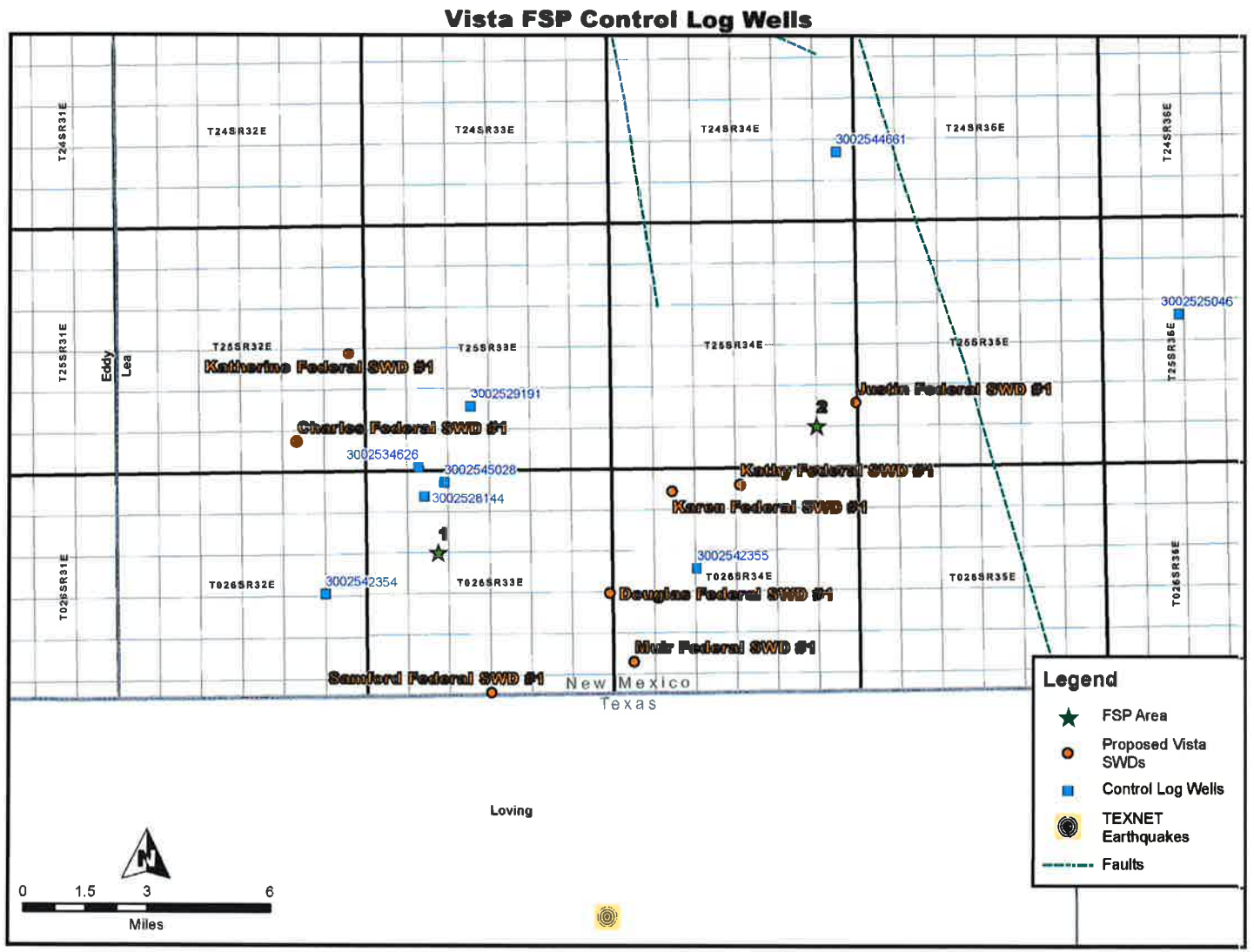
Control Log Wells



30-025-45028
Dev/Sil logged from 17,430' to 18,900' (partial)

30-025-42354
Dev/Sil logged from 17,730' to 18,675' (partial)

30-025-42355
Dev/Sil logged from 18,610' to 20,071' (complete)

30-025-28144
Dev/Sil logged from 17,446' to 17,600' (partial)

30-025-29191
Dev/Sil logged from 17,427' to 17,580' (partial)

30-025-34626
Dev/Sil logged from 17,448' to 17,665' (partial)

30-025-44661
Dev/Sil logged from 17,350' to 19,100' (complete)

30-025-25046
Dev/Sil logged from 15,381' to 16,972' (complete)

Note: More than 200 feet of good porosity within injection interval.

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Data Source: New Mexico OCD 2019

Nearby Deep SWD Injection Data

Vista - Deep SWDs Within FSP Areas				
FSP Area	API #	Well Name	Average Daily Injection Rate (BWPD)	Injection Start-Date
1	30-025-45028	Red Hills SWD #001 (Devonian-Montoya)	13,560	Dec - 2018
1	30-025-35598	Red Hills SWD #001 (Devonian)	893	Oct - 2001
1	30-025-23895	Vaca Draw Federal SWD #001	10,491	Jul - 2017
1	30-025-45127	Maelstrom Federal SWD #001	80,000*	N/A
2	30-025-45427	Sidewinder SWD #001	50,000*	Jul - 2019
2	30-025-42355	Rattlesnake 16 SWD #001	5,895	Dec - 2015

* Proposed maximum daily rates