

June 23, 2011

Examiner Hearing in Case 14664



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Case No. 14664

**FRONTIER
FIELD SERVICES
Exhibit #4**

FRONTIER
field services, llc
southeastern oil and gas

Frontier's Witnesses at Today's Hearing

- ▶ **John Prentiss** - Maljamar Plant Manager
- ▶ **Alberto A. Gutiérrez, RG** - Geolex, Inc.



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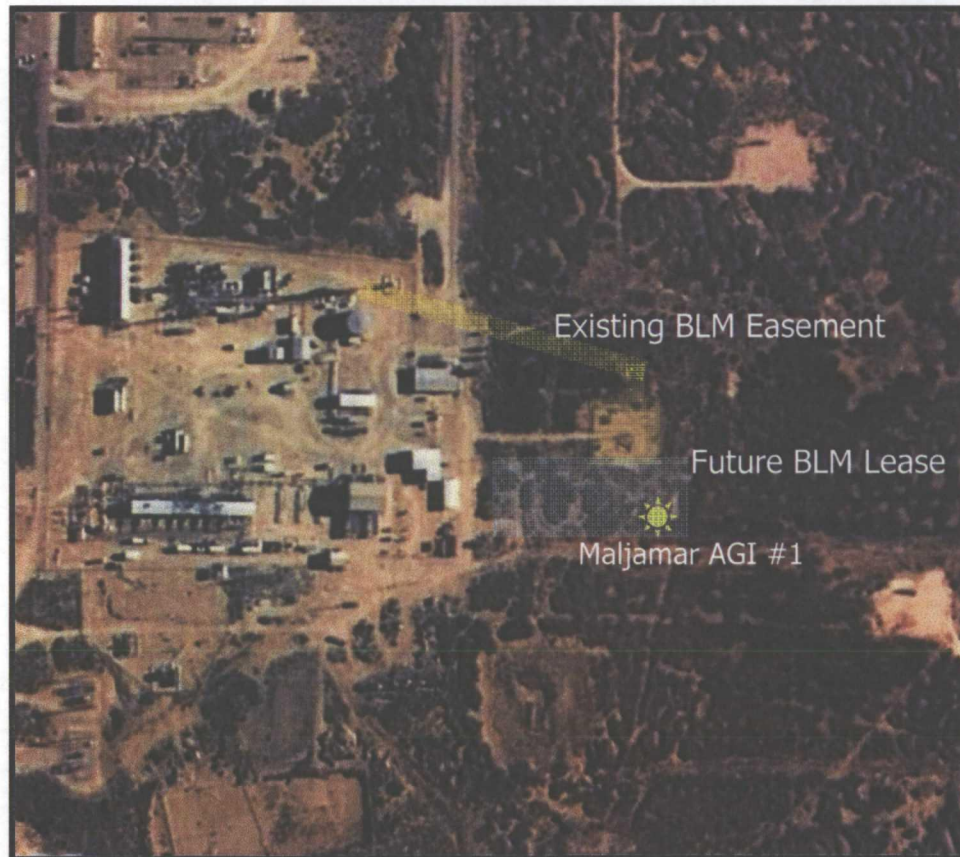
Presentation Goals

- ▶ Describe overall history and environmental benefits of Frontier's AGI project; gas plant operations and outline H₂S Contingency Plan – **John Prentiss**
- ▶ Describe relevant site geology and hydrogeology, system design, operation, analyses of anticipated effect on injection zone and all components of C-108 application and H₂S Contingency Plan – **Alberto A. Gutiérrez, RG**

Executive Summary

- ▶ Frontier is requesting authority to inject acid gas:
 - Into the Lower Wolfcamp Formation at a depth of approx. 9800 – 10000 feet and potentially also in the Lower Leonard Formation at a depth of approx. 9300 – 9550 feet.
 - At a maximum rate of 2.0 MMCFD and maximum operating surface pressure of 2973 psig.
- ▶ Twelve wells penetrate the Lower Wolfcamp and Lower Leonard zones within the one-mile radius area of review (six active wells and six plugged wells).
- ▶ All wells penetrating the proposed injection zones are properly plugged or completed effectively isolating the proposed injection zones.
- ▶ After considering the irreducible water content in the Wolfcamp reservoir, the entire area expected to be affected over 30 years of injection is less than 73 acres and a radius of approximately 0.19 mile from the well. This area would be even smaller if the Lower Leonard is also completed as an injection zone.

Proposed Location of Maljamar AGI #1



Injection Fluid Volume, Composition and Pressure Considerations

- ▶ Designed for 2 MMCFD acid gas to be injected at maximum rate
- ▶ Injected fluid composition is 12% H₂S, 88% CO₂, Trace hydrocarbons (C1-C6)
- ▶ Injected fluid compatibility determined through nearby injection experience and formation fluid analysis
- ▶ Maximum allowable operating pressure per NMOCD calculation guideline is 2973 psig at surface

History of Frontier's Maljamar AGI Project

- ▶ Changing field gas compositions in area require alternative to flaring of acid gas which is the current sulfur management system at the Maljamar Plant
- ▶ Well is to be located adjacent to the current location of the flare - immediately east of the plant. TAG line to well will tee off from existing line to flare.
- ▶ Well will be drilled as a vertical well and completed consistent with a proven AGI well design approved previously by NMOCD
- ▶ Geolex retained in December 2010 to evaluate AGI feasibility, update H₂S Contingency Plan and prepare application for injection resulting in application submitted on May 16, 2011
- ▶ Proposed injection reservoirs have been mapped and delineated with traditional geologic methods and enhanced by detailed 3-D seismic analysis
- ▶ Detailed mapping of reservoir and available well data assures that all wells within area of review are well protected and will not be affected by proposed injection
- ▶ H₂S Contingency Plan consistent with § 19.15.11 et. seq. NMAC submitted to NMOCD on May 10, 2011 and will be modified upon final design of AGI system and resubmitted for review and approval prior to commencing injection
- ▶ C-108 Application submitted to NMOCD on May 16, 2011
- ▶ All required parties have been individually noticed, legal notice was published on May 31, 2011 and hearing was set by NMOCD for June 23, 2011

Adjacent Operators and Surface Owner Notification and Notice

- ▶ Frontier's C-108 application details the full information needed to approve the drilling, completion and operation of an AGI well and was sent to adjacent operators and surface owners within 1 mile radius of proposed well via Certified Mail, Return Receipt Requested
- ▶ Notice of the application and the Examiner hearing was published in the *Hobbs News-Sun*
- ▶ No objections to Frontier's application have been submitted
- ▶ Adjacent operators and the BLM support the AGI project which will allow increased throughput and increase royalties paid to State of New Mexico while protecting fresh water resources and correlative rights
- ▶ NMOCD Environmental Bureau was provided H₂S Contingency Plan for current Maljamar Gas Plant on May 10, 2011
- ▶ After completion of the well and final design of surface facilities, the H₂S Contingency Plan will be modified and resubmitted for review and approval prior to commencing injection

What Are We Looking For in a Reservoir For CO₂ and Acid Gas Sequestration?

- ▶ Geologic seal to permanently contain gas
- ▶ Isolated from any fresh groundwater
- ▶ No effect on existing or potential production
- ▶ Laterally extensive, permeable, good porosity
- ▶ Excess capacity for anticipated injection volumes
- ▶ Compatible fluid chemistry

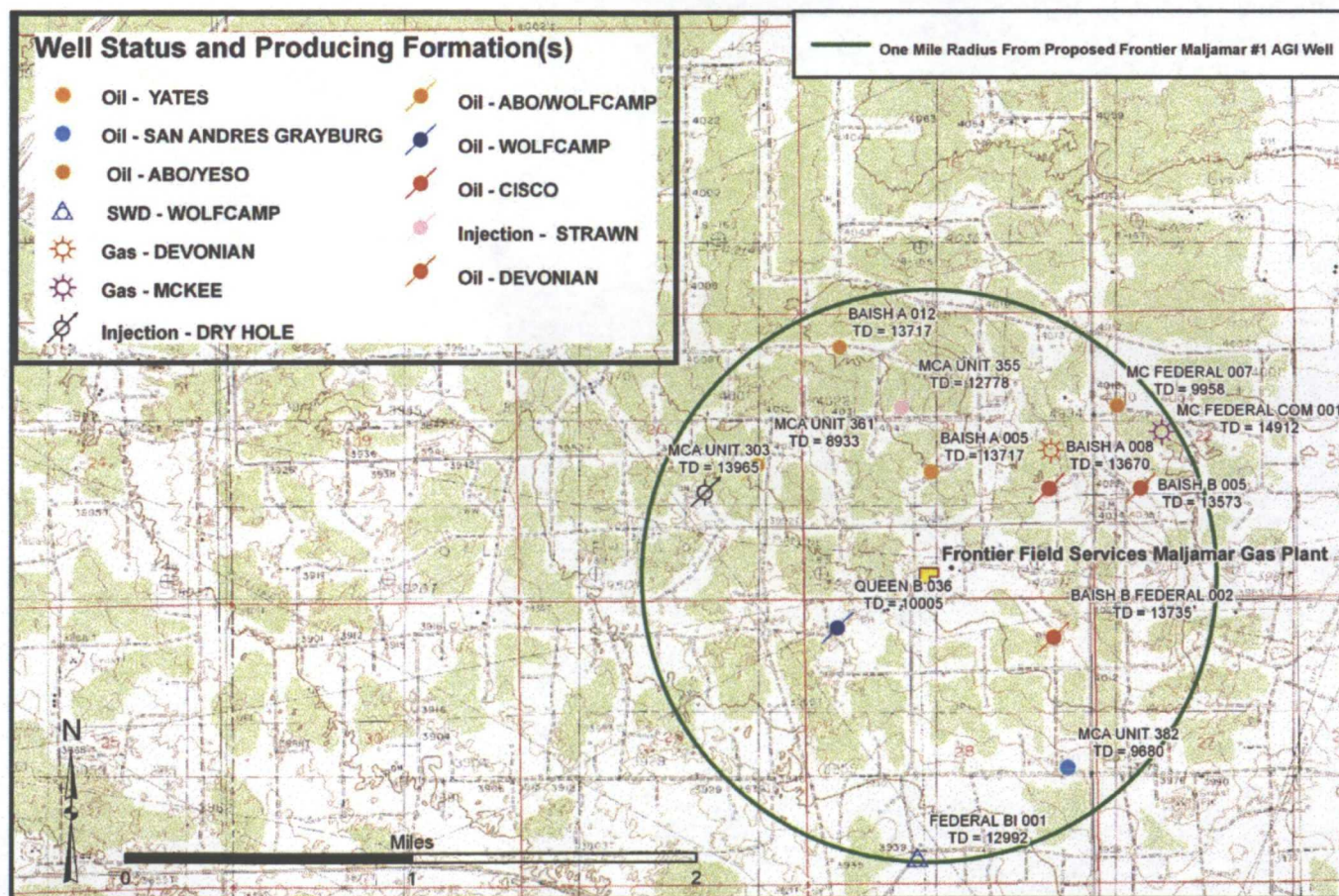
✓ **Frontier's Proposed Maljamar AGI #1 Meets all of these Criteria**

Identification & Characterization of Wells, Stratigraphy & Geologic Structure in the Project Area

- ▶ Most producing wells and plugged wells within one-mile area of review are in shallower units
- ▶ Twelve wells only (six plugged and six active) penetrate proposed injection zone
- ▶ Based on stratigraphic and 3-D seismic analysis and evaluation of nearby SWD experience, the injection zone is excellent acid gas reservoir
- ▶ 3-D seismic analysis and detailed information on well completions penetrating injection zone conclusively demonstrate that proposed injection will not negatively affect current or potential production and protect fresh water resources

Wells Within Area of Review

Penetrating Proposed Injection Zone



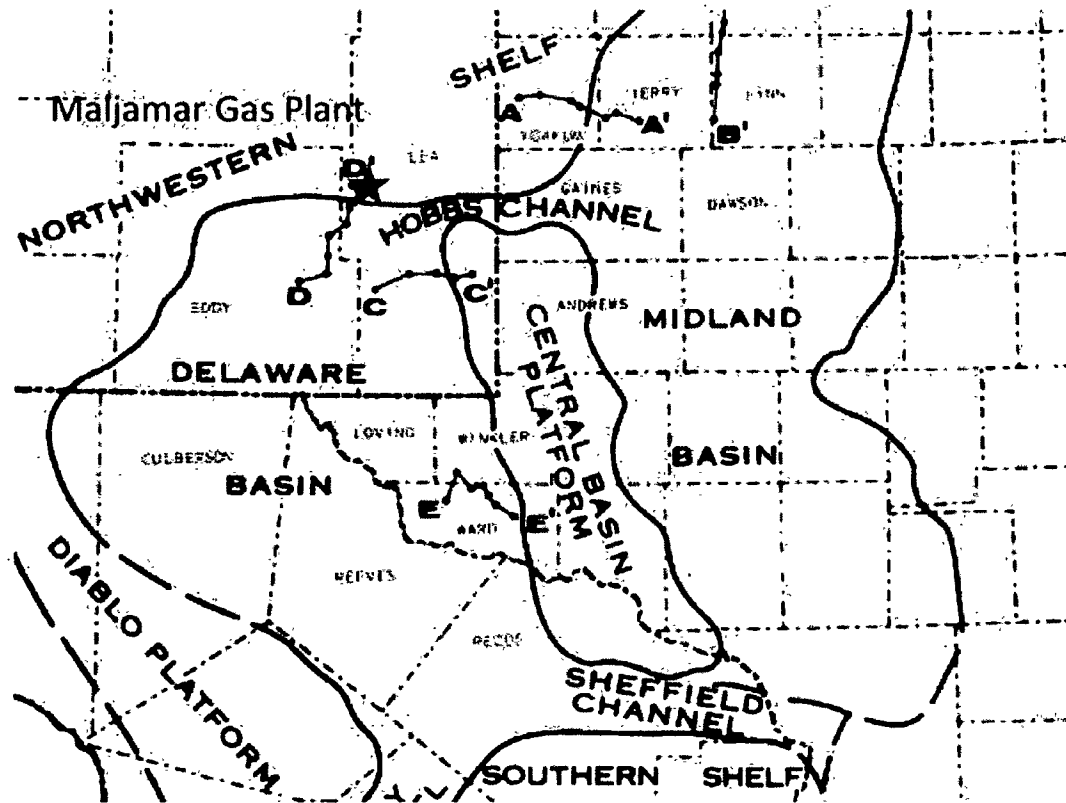
Six
Plugged
Wells

Six
Active
Wells

Geologic Evaluation Summary

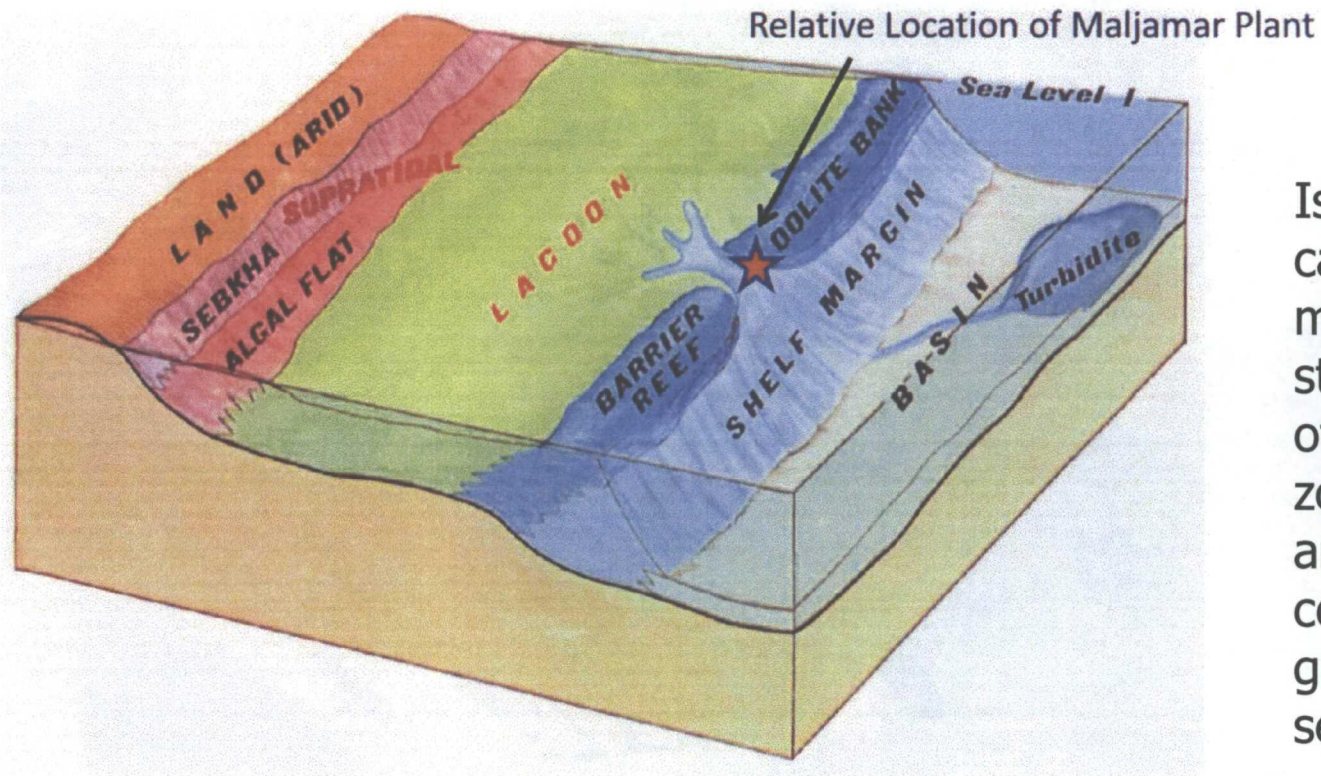
- ▶ Identified background regional geologic data (C-108, Section 4)
- ▶ Identified, located and evaluated all wells in local area (C-108, Section 5 and Appendix C)
- ▶ Evaluated stratigraphic information and 3-D seismic data to confirm that reservoir meets basic geologic criteria (C-108, Section 4 and Figures 5-15)
- ▶ Constructed cross-sections with available logs and seismic data (C-108, Section 4)
- ▶ Prepared C-108 and submitted to NMOCD for approval

Structural Features of Permian Basin



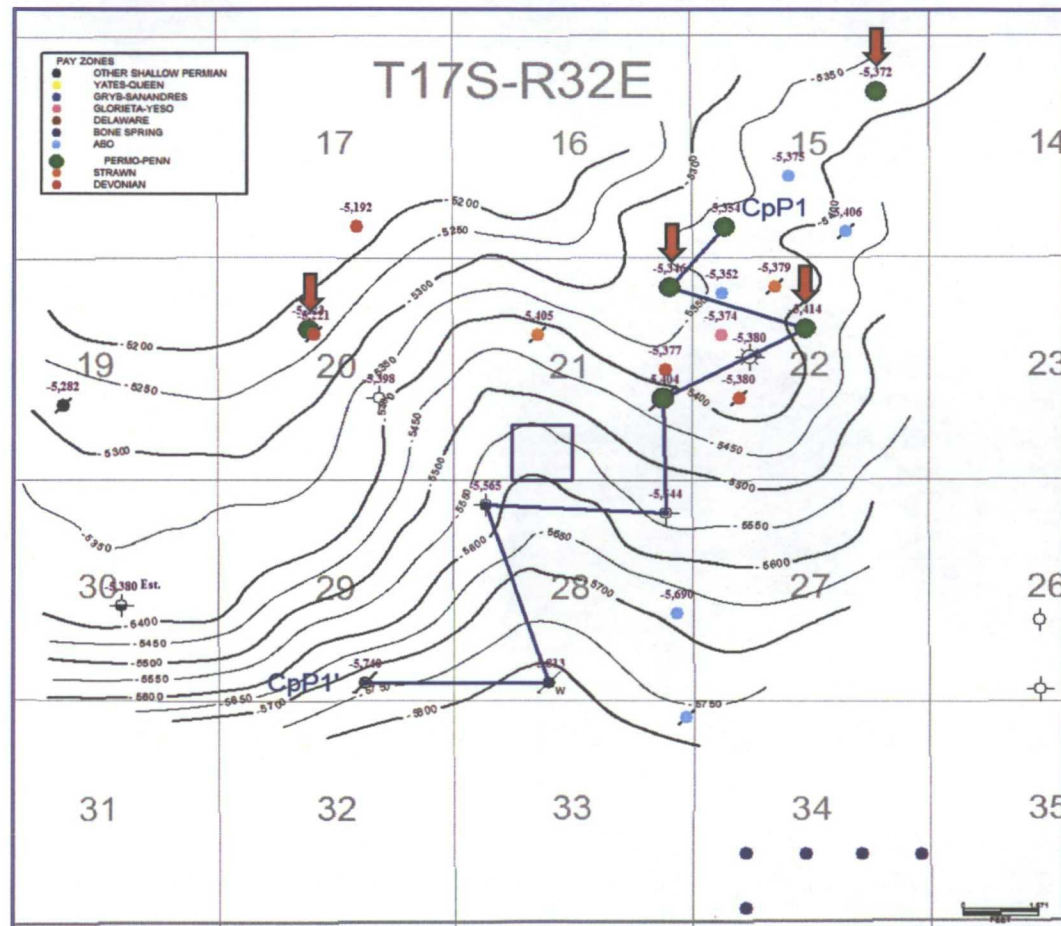
Plant is located on the edge of the Northwestern Shelf with depositional units generally dipping to the southeast

Schematic Regional Depositional Environment

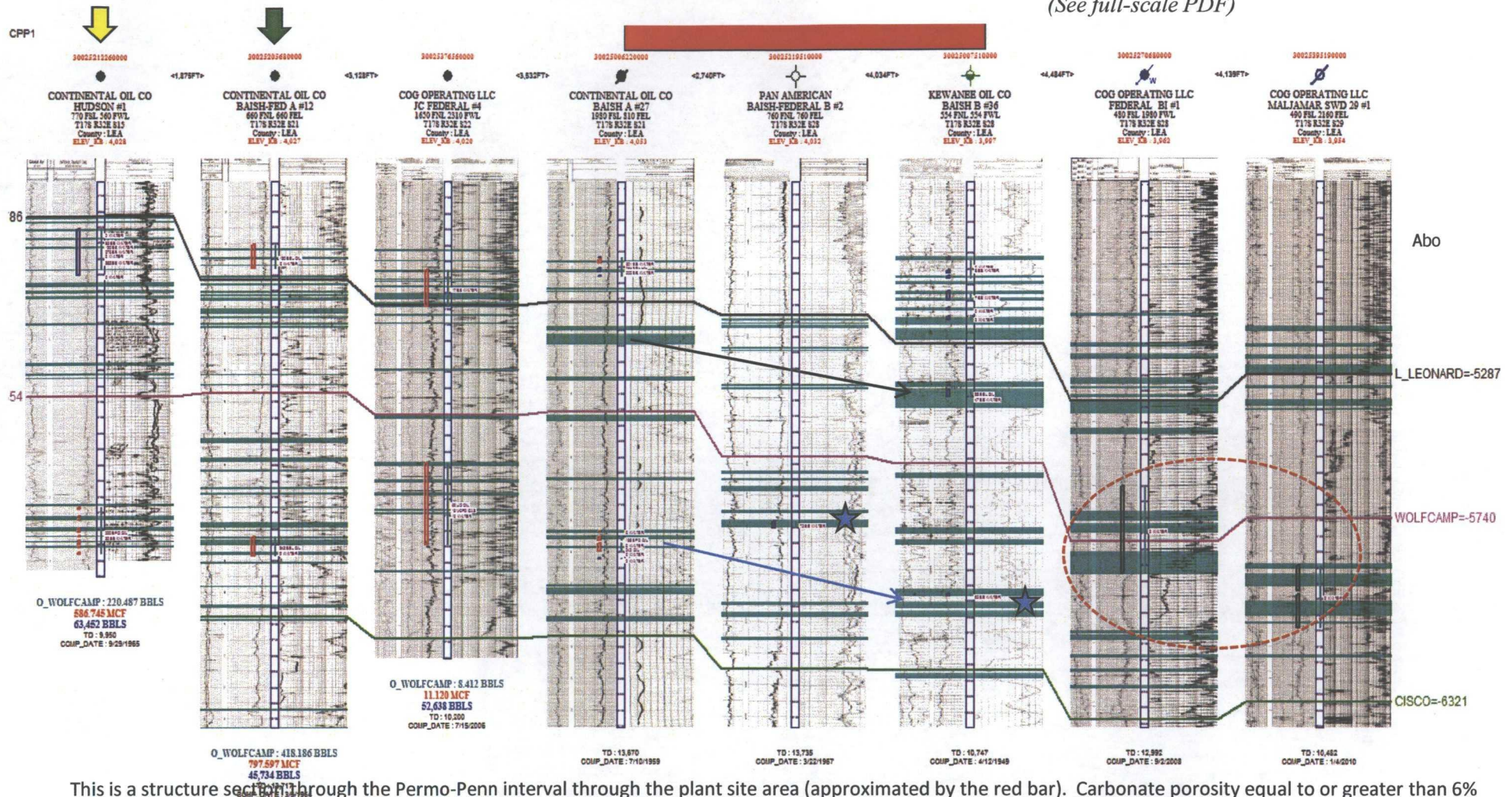


Isolated detrital carbonate and reef mounds in general stratigraphic interval of proposed injection zone are limited in areal extent and confined by fine-grained deeper basin sediments

Structure on Top of Wolfcamp (CI=50 ft.)



(See full-scale PDF)

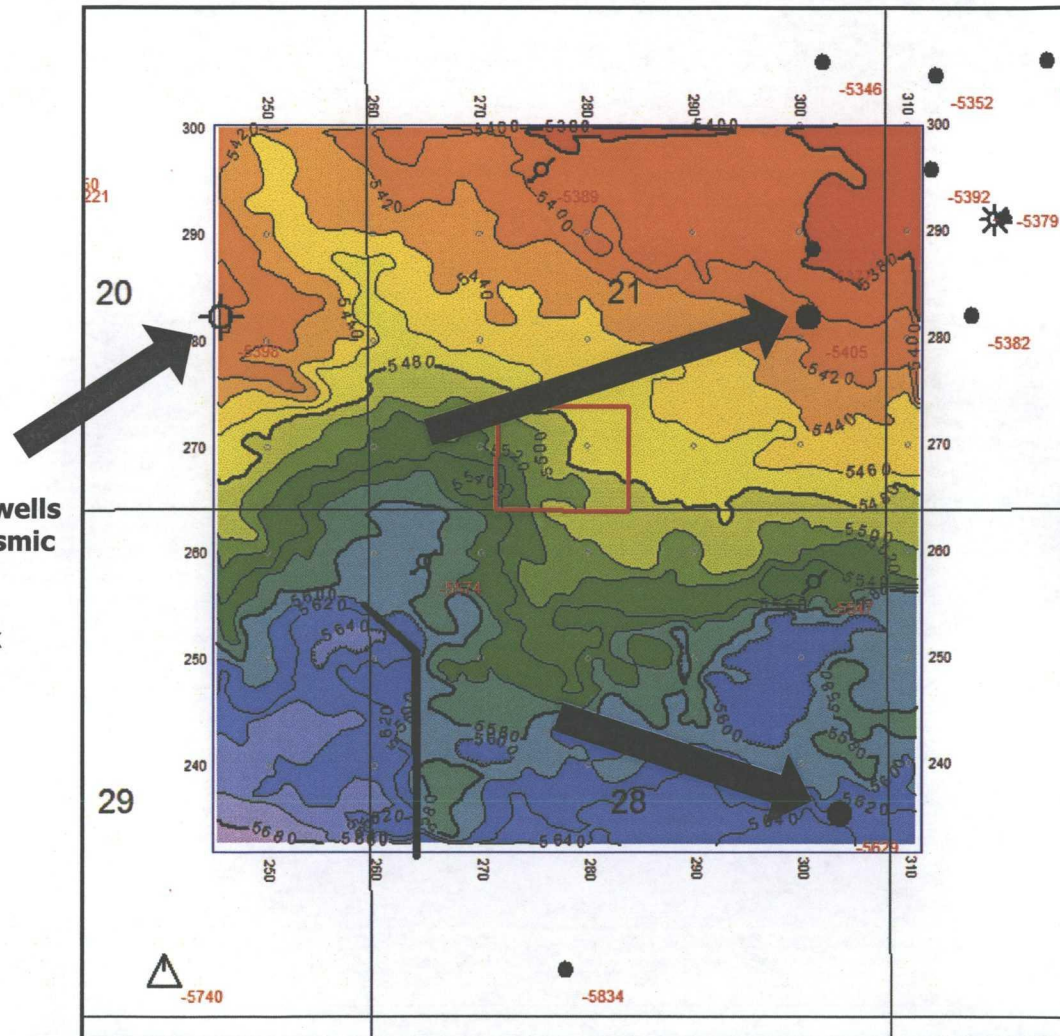


This is a structure section through the Permo-Penn interval through the plant site area (approximated by the red bar). Carbonate porosity equal to or greater than 6% is highlighted green. The best Permo-Penn producer in the area, which has made over 418,000 BO since 1964, is indicated by the green arrow, and was actually perforated in both the Wolfcamp and the basal Abo. The next best well, which has made 221,000 BO since 1965, is indicated by the yellow arrow, and was perforated solely in the Wolfcamp. Only the well at the green arrow still produces from the Wolfcamp, making 8 BOPD as of the end of 2010. This section illustrates how the stratigraphic position of porous carbonates change from well to well. The best correspondence seen is in the Lower Leonard Formation (black arrow), where thick porosity may project under the plant site. The same may be said for the middle Wolfcamp (blue arrow). The two wells that are currently being used for water injection are shown, their perforated intervals within the dashed red outline. Two production tests in the Wolfcamp that yielded water are indicated by the blue stars.

3-D Seismic Data Acquisition and Analysis

Outline of the 3D seismic data set which we analyzed showing a seismic depth map, top of Wolfcamp (C. I. = 20 ft). The location of the Maljamar Plant is indicated by the red outline.

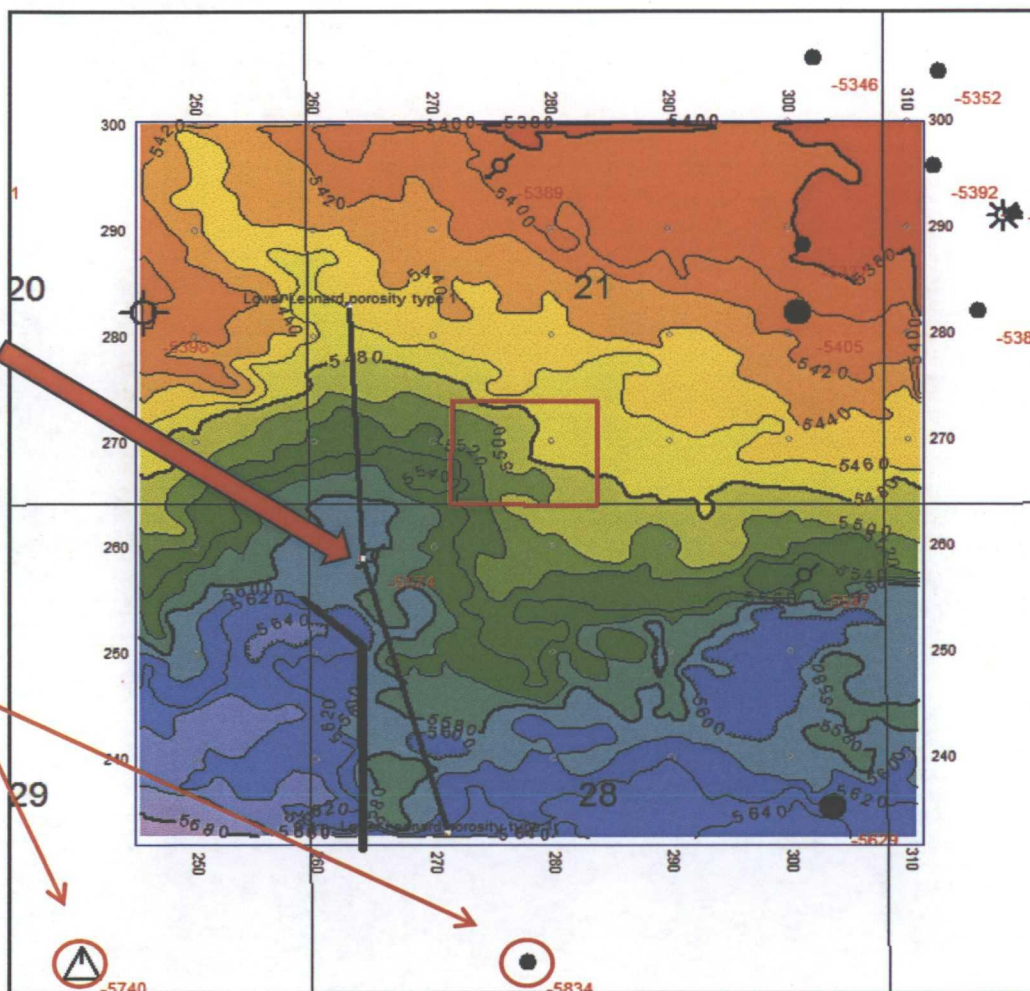
Location of control wells where synthetic seismic profiles were constructed are indicated with black arrows.



Development of Seismic Sections to Evaluate Reservoir Porosity and Geometry

The Baish B #36 well is shown by the red arrow.

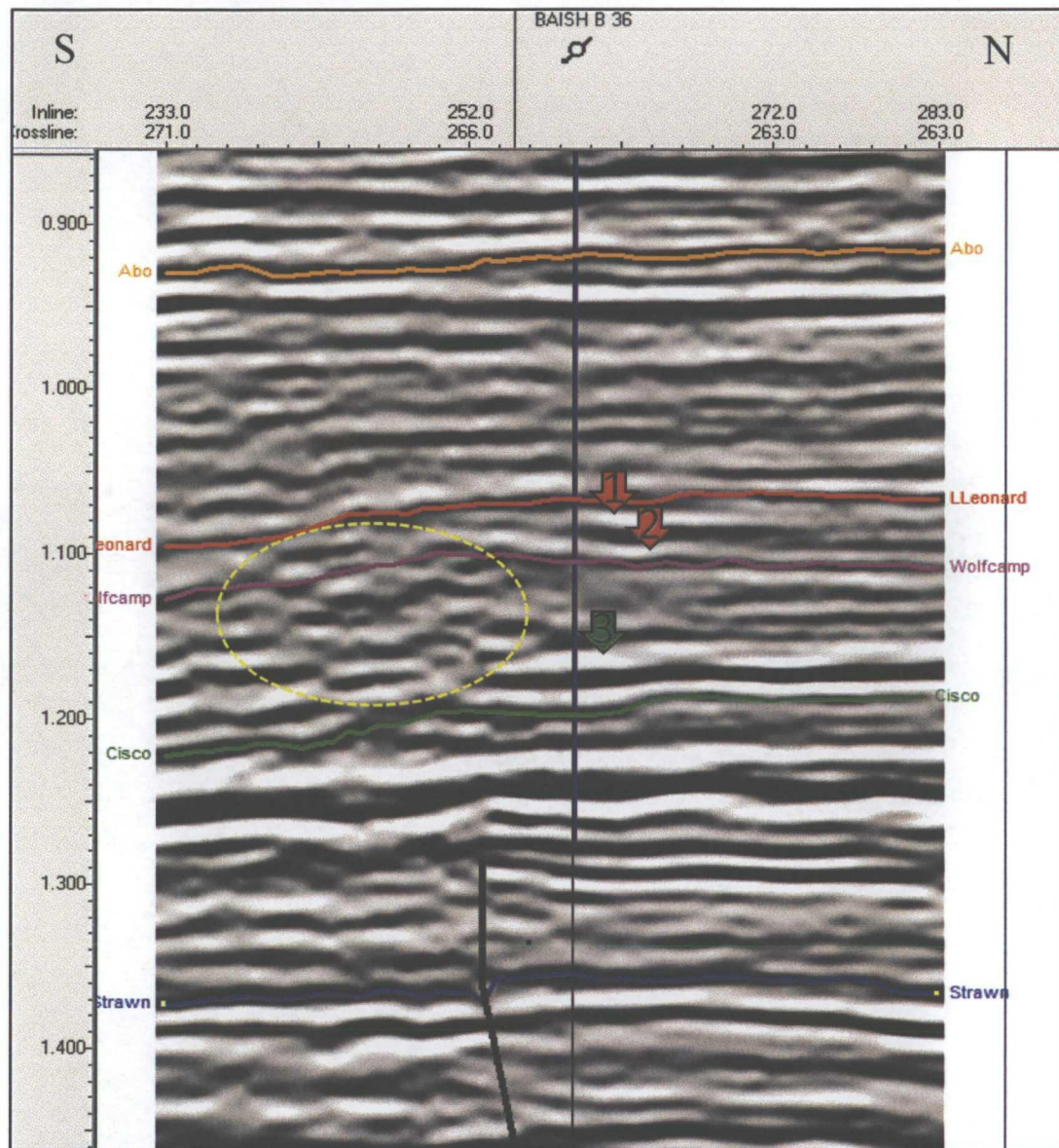
The red circles highlight the two wells to the south that have disposal zones in the lower Leonard-Wolfcamp interval. Those wells are outside the boundaries of the seismic survey and well outside the one-mile area of review but a type vertical seismic section (thinner black line) runs from south to north from the area of those wells through the Baish B #36.



Vertical Seismic Section

Simple color raster rendition of the type vertical seismic section through the Baish B #36 well, showing the horizon tops around the Wolfcamp-Lower Leonard. The Lower Leonard porosity zones (red arrows) and lower Wolfcamp porosity zone (green arrow) correspond to the same zones shown on the preceding log cross-section, and will be detailed in the coming slides. The loss of coherency in the interval circled in dashed yellow probably represents fracturing attendant to a nearby fault that cuts through the Wolfcamp and Lower Leonard just off the view of this section (to the immediate west).

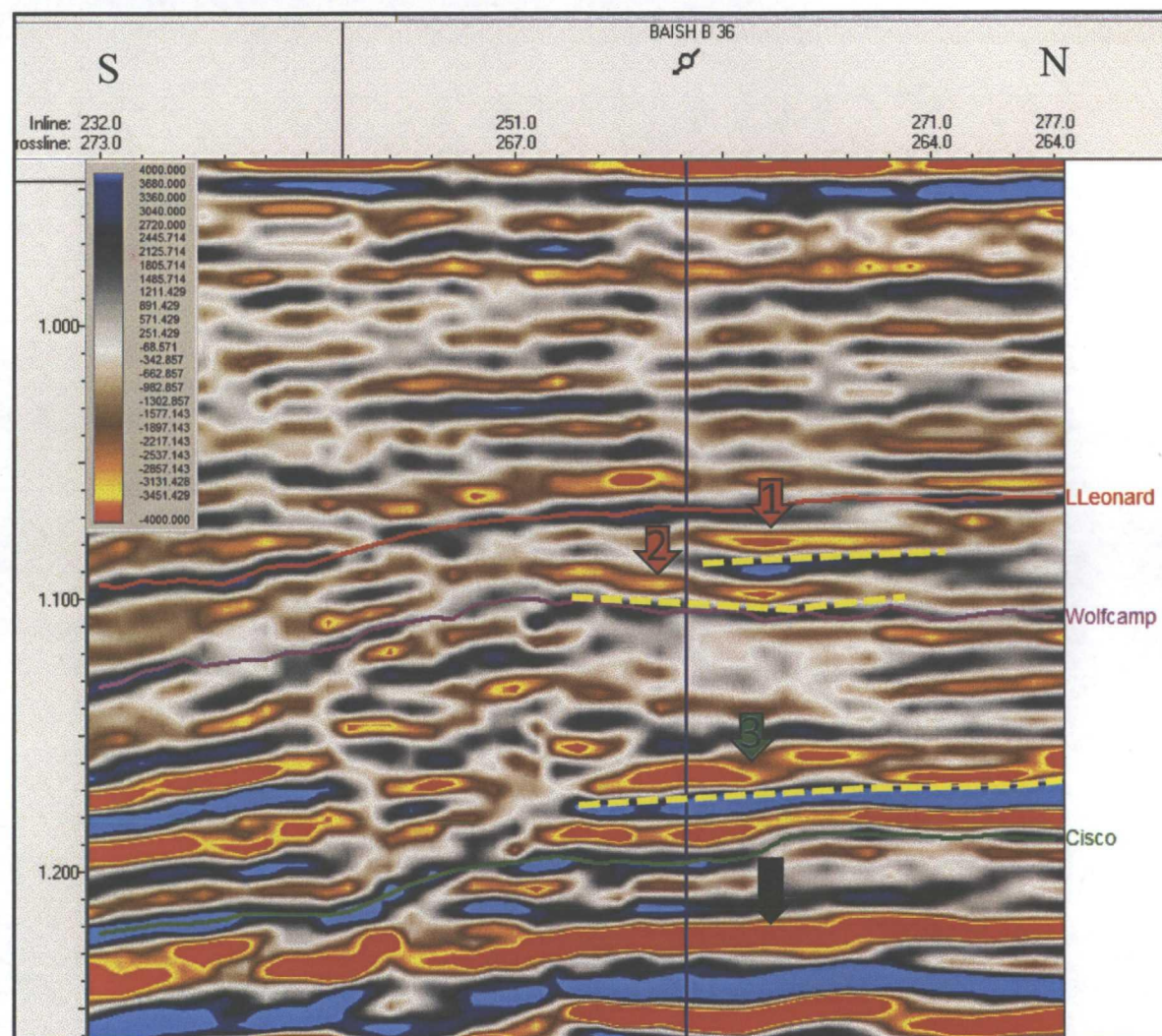
Zones 1 and 2 do not correspond to any local pay zones. Zone 3, although stratigraphically equivalent to some pay zones in the area, is not in lateral communication with those pay zones, as conclusively demonstrated by analysis of 3-D seismic data.



Enhanced Vertical Seismic Section

Expanded scale, color-enhanced vertical section showing the locations of the three zones of interest (red and green arrows). Yellow and red correspond to lower-amplitude events that, if sporadically developed along a given horizon, more likely indicate porosity development, as opposed to low-amplitude, persistent events (e.g., black arrow) that could simply indicate shale beds. Additionally, the presence of a strong, localized peak event directly beneath the low amplitude (porosity) events, as we particularly see under #1 and #3 (yellow dashed lines) shows strong density contrast between beds, which may also indicate development of significant porosity above.

The next series of slides will show the amplitude maps for each of the three horizons.

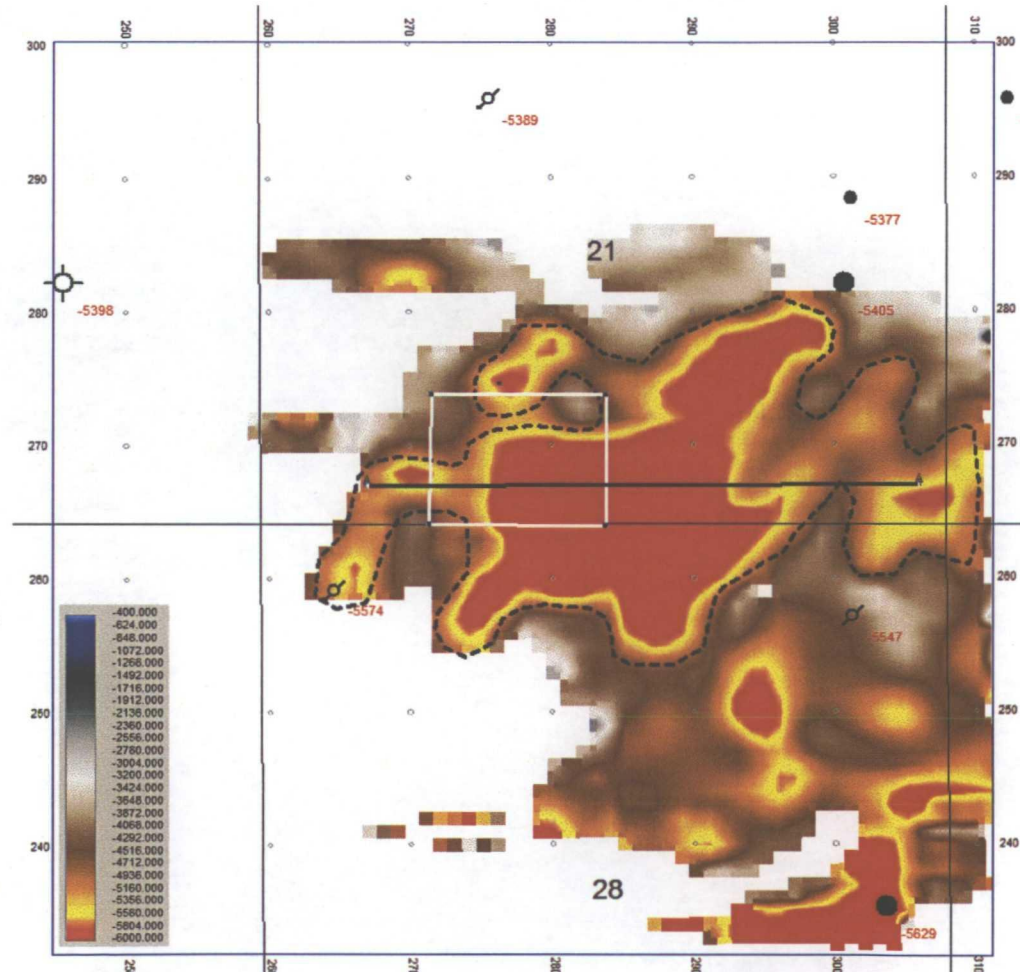


Primary AGI Target – Lower Wolfcamp Formation – Amplitude (time slice) Map

Amplitude (time slice) map along the lower Wolfcamp porosity zone horizon, approximately 410 feet below the top of the Wolfcamp. The black dashed outline shows a coherent porosity trend that is underlain by a sharply contrasted, high amplitude event, and it covers 189 acres. The limits of this map represent the limits of the Wolfcamp target reservoir except for that portion that goes off-survey to the east. The geometry of this zone suggests a possible debris apron fed by a narrow channel on its northeast boundary.

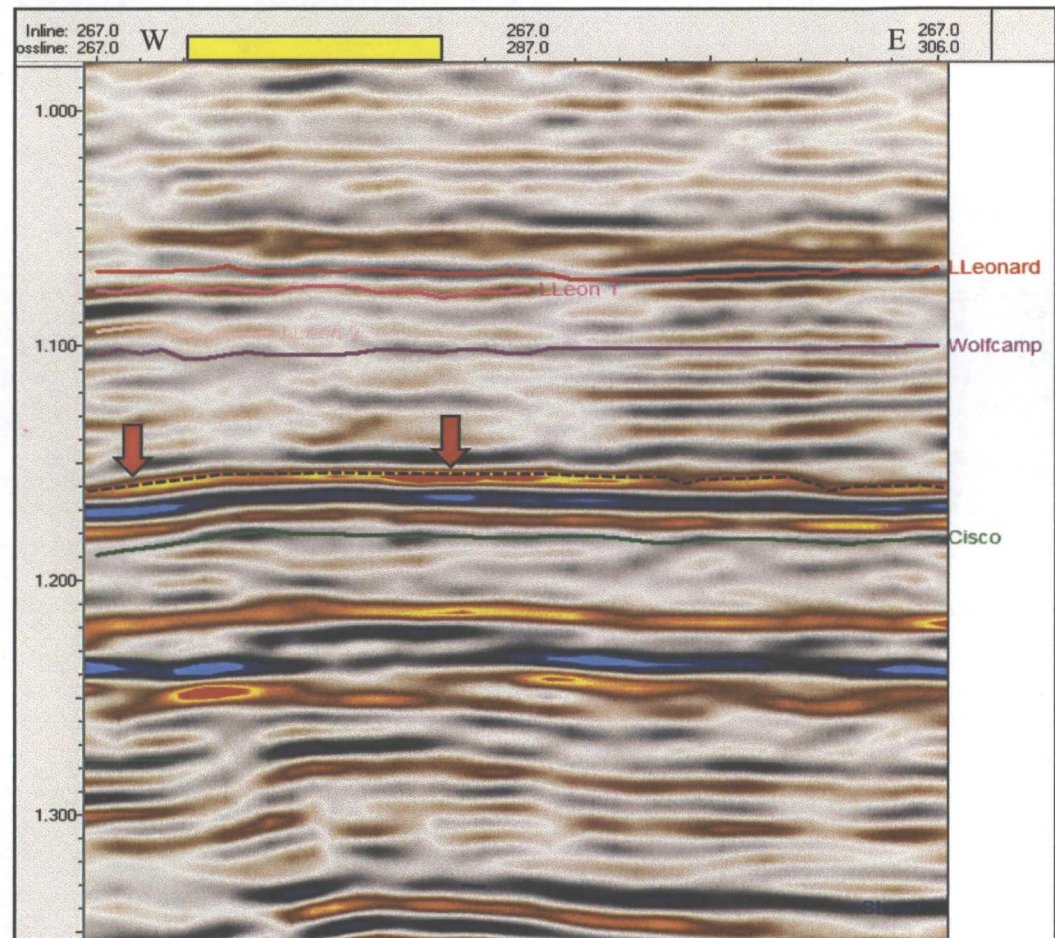
A vertical seismic section, whose trace is shown in black, is presented in the next slide.

This zone is not laterally connected to the wells located outside the one-mile area of review that produced from the Wolfcamp.



Primary AGI Target – Lower Wolfcamp Formation – Vertical Seismic Section

Vertical seismic section across the plant area (yellow bar), showing the lower Wolfcamp porosity zone (dashed black line). Within this zone are pockets of higher porosity, noted where there is a sharper amplitude contrast between the zone and the underlying peak reflector (e.g., at red arrows). The warmer colors are thought to denote higher porosity. The time thickness of this anomaly suggests an average porosity thickness of approximately 30 feet, with a maximum of 50 feet.

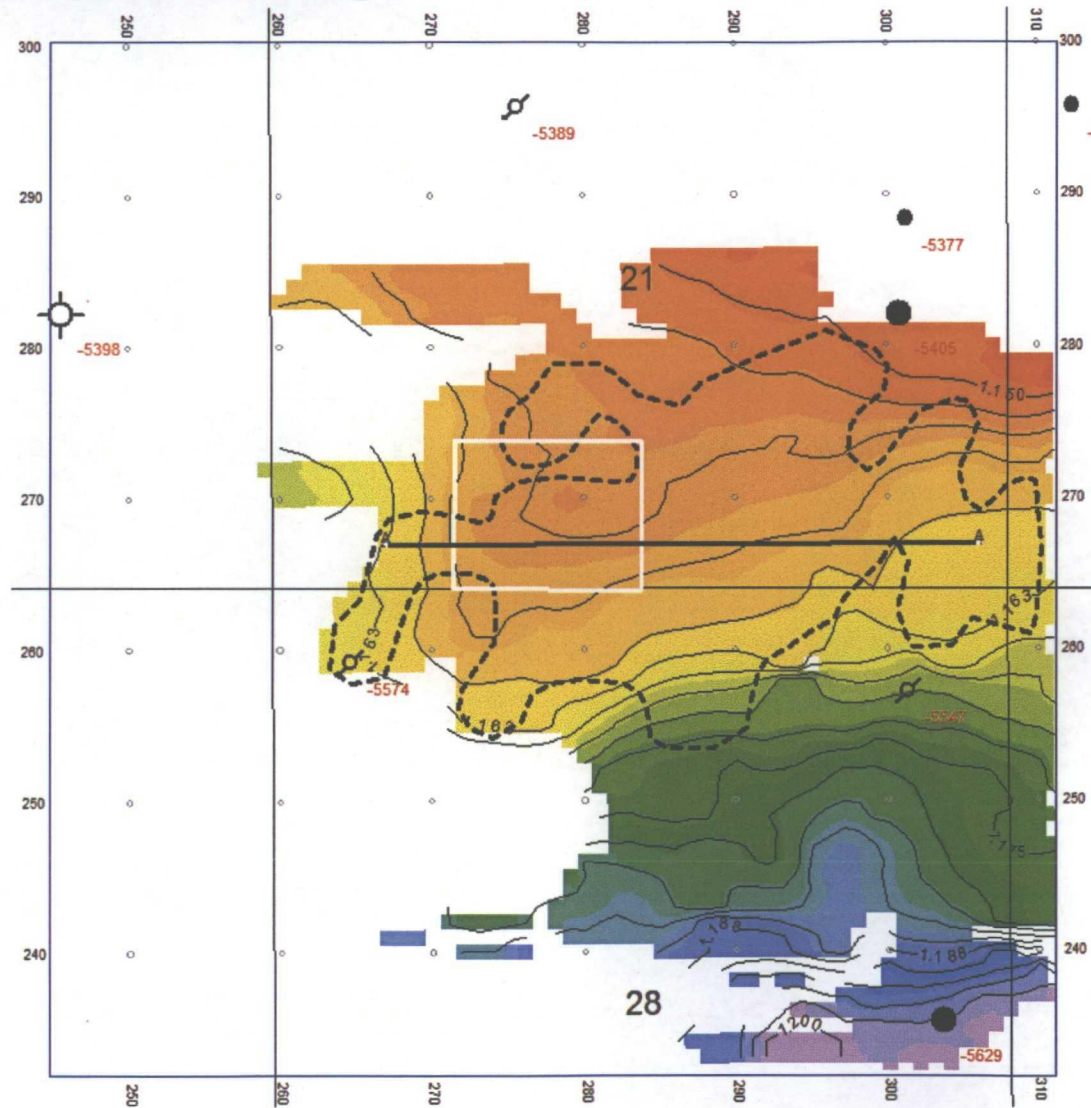


Primary AGI Target – Lower Wolfcamp Formation – Time Structure Map

Time structure map of the lower Wolfcamp injection zone, showing the outline of highest porosity within dashed black line. This is essentially the limits of the reservoir which could be affected by proposed injection

Dip is towards the south.

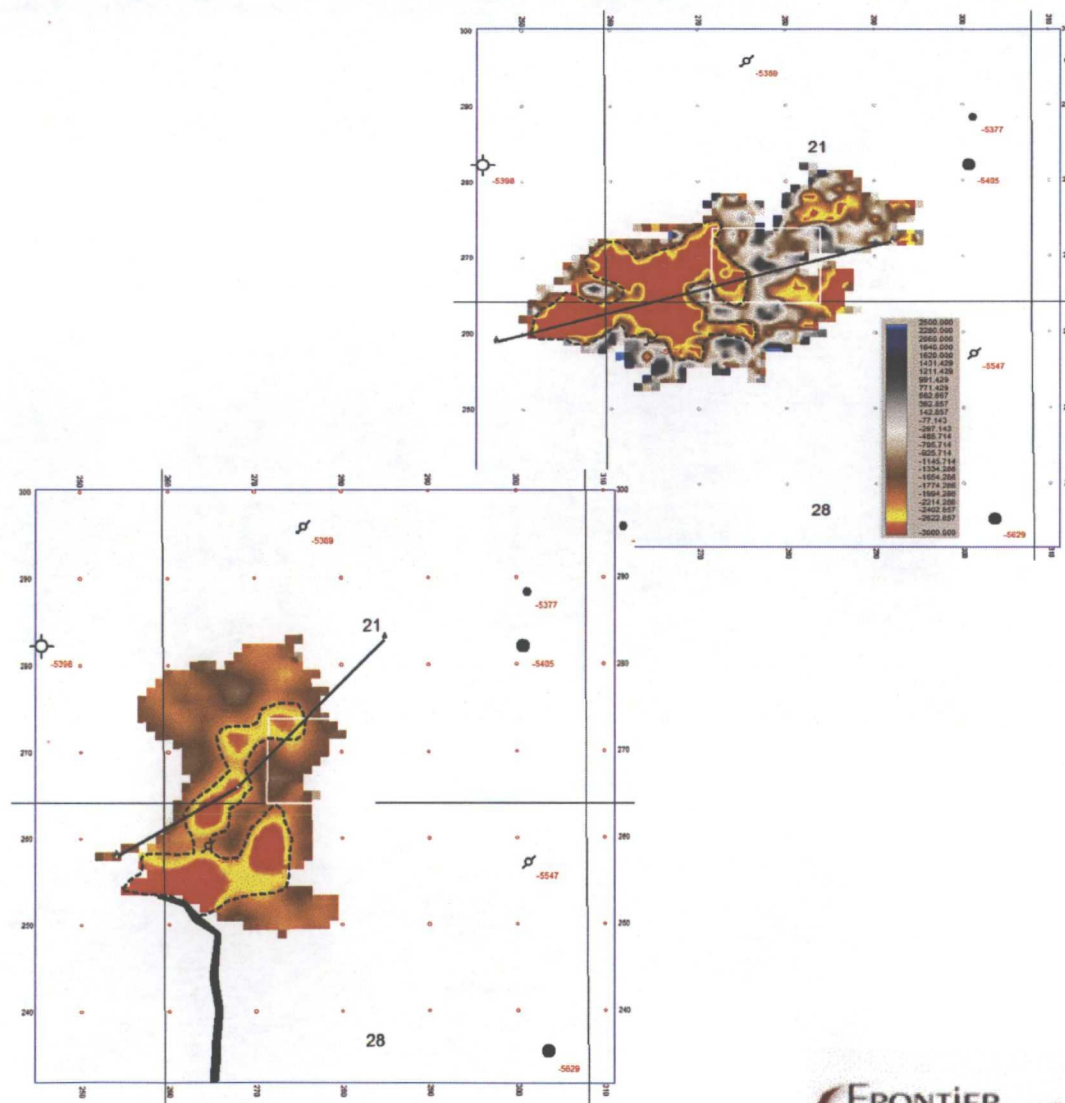
(C.I. = 2.5 msec, or approximately 20 feet)



Secondary AGI Target – Lower Leonard Formation – Amplitude (time slice) Maps

Amplitude (time slice) maps along the both Lower Leonard porosity zone horizons, approximately 225 feet and 85 feet, respectively above the top of the Wolfcamp. The white outline shows the plant site. The black dashed outline of the first zone shows a coherent porosity trend that is underlain by a sharply contrasted, high amplitude event, and covers 64 acres. The other zone covers approximately 53 acres. The limits of this map represent the limits of the Lower Leonard potential injection targets.

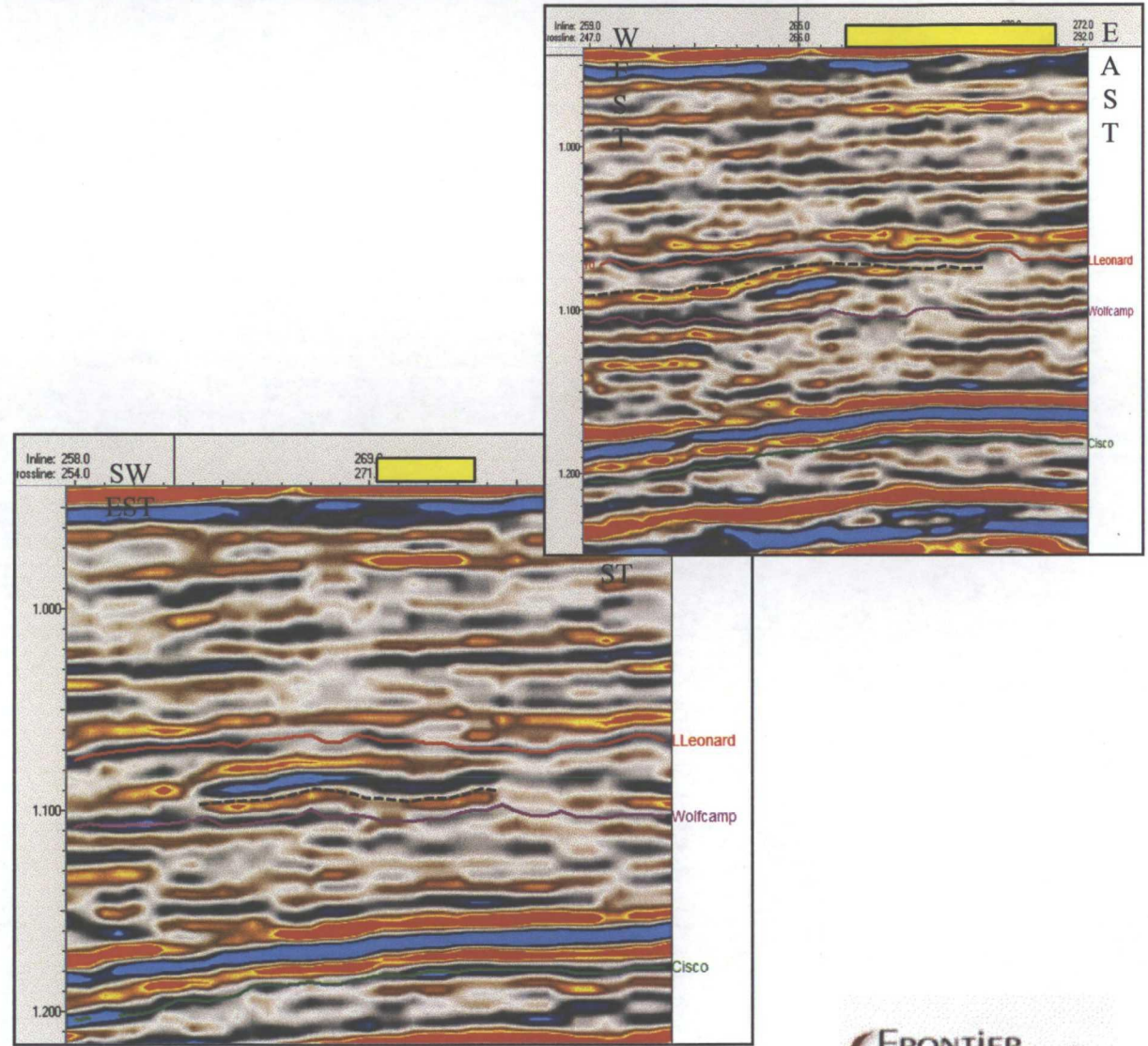
Vertical seismic sections, whose traces are shown in black, are presented on the next slide.



Secondary AGI Target – Lower Leonard Formation – Vertical Seismic Sections

Vertical seismic section across the plant area (yellow bar), showing the Lower Leonard porosity zones (dashed black lines). Within these zones are pockets of higher porosity, noted where there is a sharper amplitude contrast between the zone and the underlying peak. The warmer colors are thought to denote higher porosity. The time thickness of this anomaly suggests an average porosity thickness of approximately 33 feet, with a maximum thickness of up to 58 feet for one zone and approximately 17 feet, with a maximum thickness of up to 41 feet for the second zone.

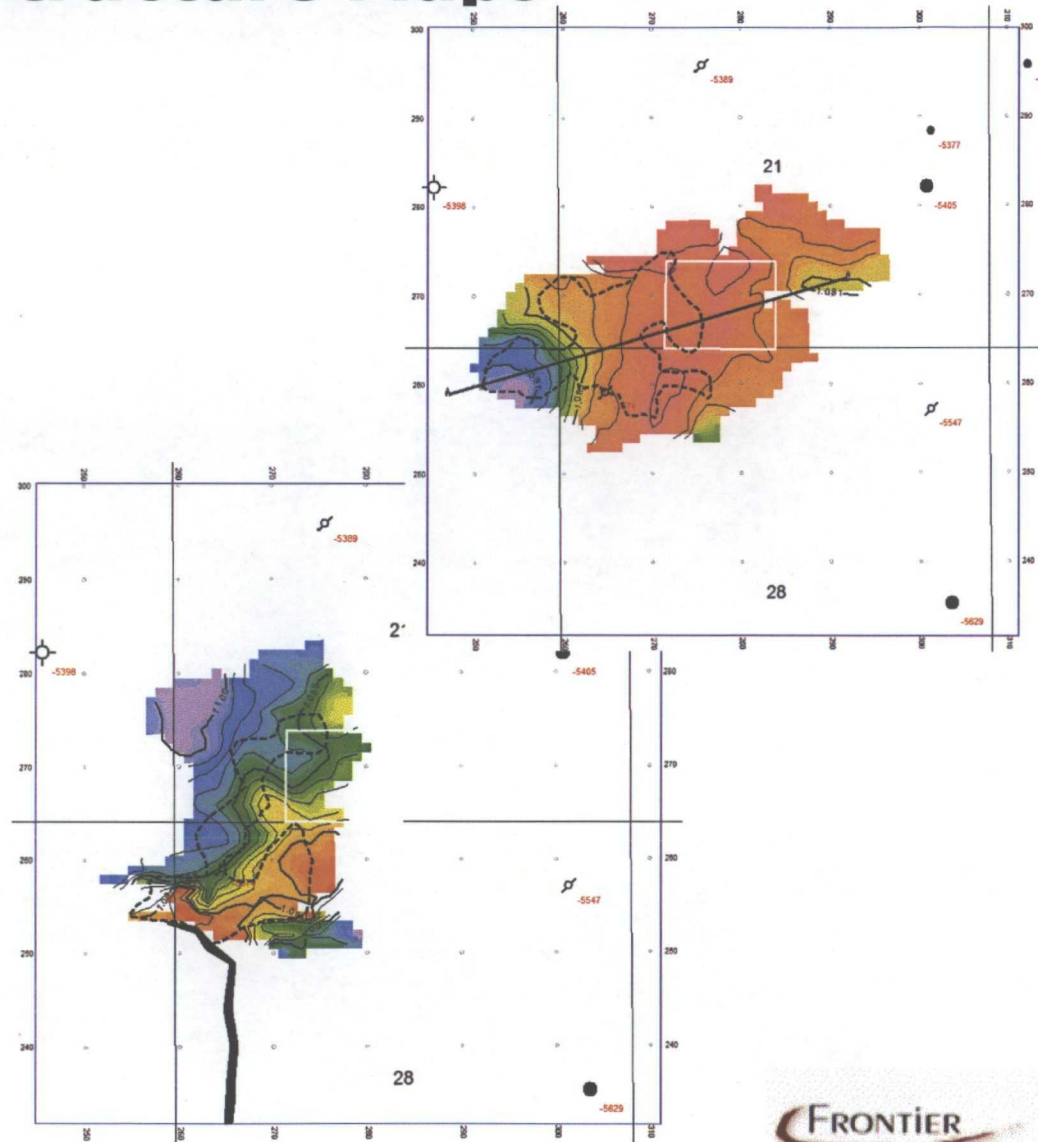
Here it is more apparent that the first unit is comprised of a shelf-margin algal mound that built westward off an underlying paleo-topographic high whereas the second zone is more channelized.



Secondary AGI Target – Lower Leonard Formation – Time Structure Maps

Time structure maps of the top of two zones in the Lower Leonard showing the outline of highest porosity in dashed black. This represents essentially the limits of these potential injection reservoirs

(C.I. = 2.0 msec, or approximately 16 feet)



Proposed Maljamar AGI #1 Location

Summary of various Lower Leonard-Wolfcamp porosity anomalies, showing index cross-section, and minimum acreage size for each.

The available reservoir volume of each of these zones to TAG are calculated using the following formula:

$$P_{\text{tot}} (\text{ft}^3) = \text{Area}(\text{ft}^2) * P_{\text{net}} (\text{ft}) * (1 - S_{\text{wr}})$$

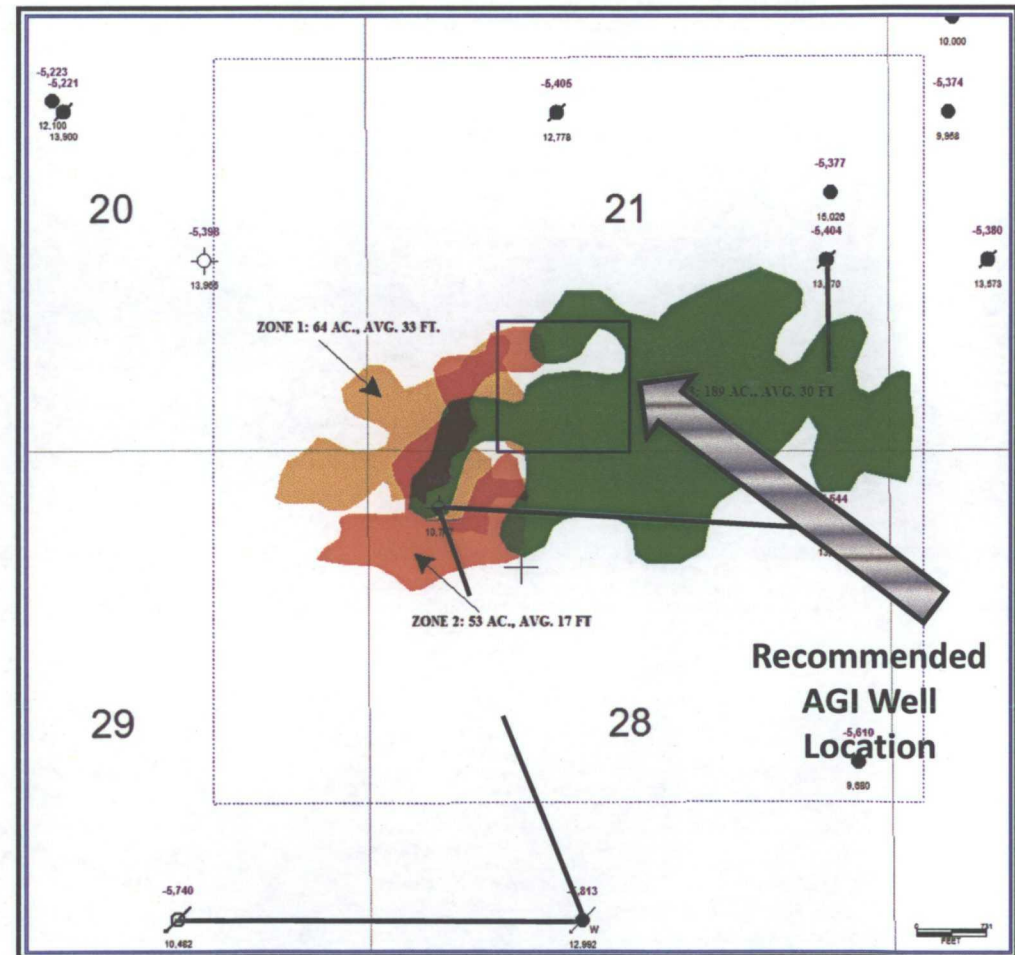
Where: P_{tot} = Total Available Pore Space for TAG in Reservoir

S_{wr} = Irreducible Water Saturation = 0.45

P_{net} = Average Net Porosity in Zone

The combined zones, if accessed at one well site, are estimated to have a total available reservoir volume for TAG of 37 Million Barrels if porosities and thicknesses are in the anticipated ranges.

P_{tot} for Zone 1 is 9 Million Barrels
 P_{tot} for Zone 2 is 3.8 Million Barrels
 P_{tot} for Zone 3 is 24 Million Barrels



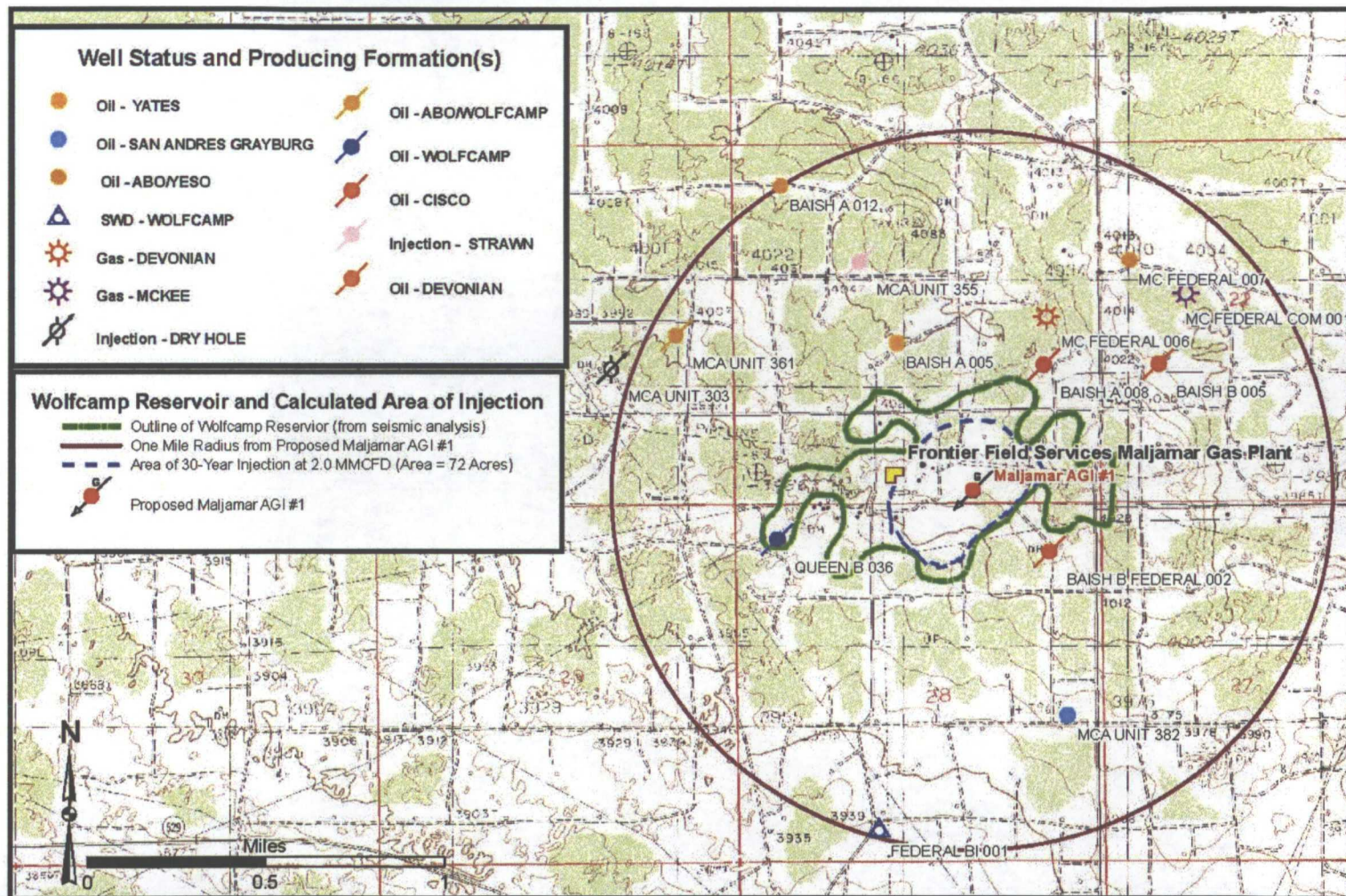
Total Life-Cycle Injection Volumes and Ranges of Reservoir Capacity

Daily TAG Injection Volume (MMSCF)	Daily Volume of TAG in Reservoir (BBL/D)*	Total TAG Volume in Reservoir after 30 Years (BBL)	Calculated Reservoir Volume in Wolfcamp (BBL)	Percentage of Maximum Reservoir Occupied	Calculated Radii of Affected Area of Reservoir (Miles)	Affected Area of Reservoir (Acres)
2.00	850	9.3 Million	24 Million	38.8%	0.19	72.8

Notes:

At reservoir conditions of 3400 psi and 130° F, each 1 MMSCF at the surface will be compressed to 425 BBL. The irreducible water saturation of the reservoir is 45% and the available reservoir volume has been calculated taking this value into consideration. For this reason, while the actual configuration of the injected fluid plume will vary depending on depositional variability, the modeled radius of the injected plume is an accurate simulation of the volume that will be occupied. The injected plume will be limited to the areal extent and configuration of the Wolfcamp reservoir identified with the 3-D seismic.

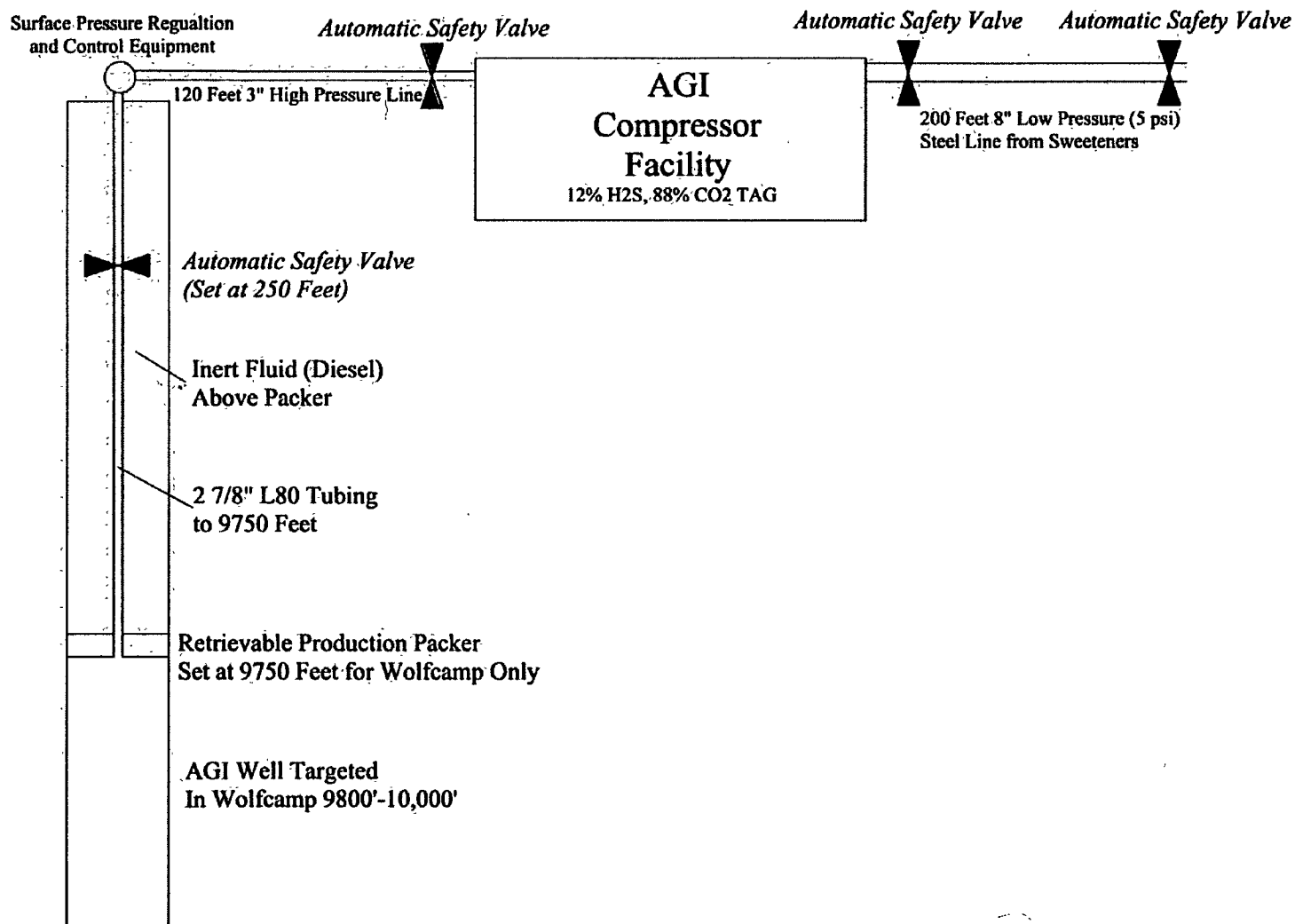
Calculations of Reservoir Area Affected after 30-Years of Injection



Generalized Design of AGI System

- ▶ Conceptual design shown on Figures 4 and 6 of Frontier's C-108 application. The following safety features are included:
 - Corrosive resistant L-80 FJ FX threaded tubing
 - Automated subsurface safety valve
 - Choke and regulating pressure valves
 - Annulus between casing and tubing loaded with inert fluid (diesel) and pressure monitored
 - Corrosion resistant packer
- ▶ Meters are included to record volumes and pressures of injected acid gas

Schematic of Proposed AGI System



Maljamar AGI #1 Well Schematic

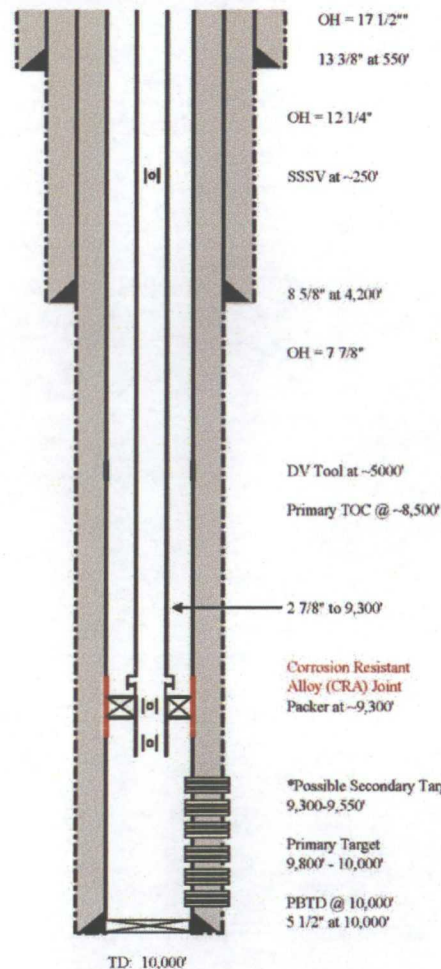
MIT will be performed prior to
commencing injection and every two
years

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Location: 130° FSL & 1831° FEL
STR: S22-T17S-R32E
County, St.: LEA COUNTY, NEW MEXICO

**FIGURE 4: MALJAMAR AGI #1
WELL DESIGN**

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Oil Services, Inc.
10000 E. 10th Ave., Suite 100
Denver, CO 80231



CONDUCTOR CASING

13 3/8", 48.00#/ft, H40, STC at ~550'

SURFACE CASING:

8 5/8", 24.0 #/ft, J55, STC at ~4,200'

PRODUCTION CASING:

5 1/2", 15.5 #/ft, L80, STC at ~10,000'

ANNULAR FLUID:

Diesel Fuel from top of packer to surface

TUBING:

Subsurface Safety Valve at ~250 ft

2 7/8", 6.5#/ft, L80, Premium thread at ~9,300'

PACKER:

Permanent Production Packer

Adj. Choke (if needed, placed in nipple below packer)

Check valve (if needed, placed in nipple below packer)

PERFORATIONS:

Primary Target	Secondary Target*
Lower Wolfcamp	Lower Leonard #1
9,800' - 10,000'	9,300' - 9,400'
	Lower Leonard #2
	9,450' - 9,550'

* Depending on logging and coring results

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Oil Services, Inc.
10000 E. 10th Ave., Suite 100
Denver, CO 80231

Only One Water Well in Area of Review

Only one water well is within area of review and total depth is 158 feet.

Groundwater will be protected by 550 feet of conductor casing cemented to the surface and 4200 feet of surface casing cemented to surface



Summary of Well Design Factors Assuring Integrity and Safety of Proposed AGI

- Conductor casing set over 390 ft below deepest fresh water and cemented to surface
- Intermediate surface casing set over 4000 ft below deepest fresh water and all shallow productive units and cemented to surface
- Tubing design and subsurface safety valve will assure the integrity of the well with annular space filled with inert fluid (diesel) and monitored for pressure to indicate potential tubing leak before it can affect production casing
- Similar designs have been implemented successfully for many years without any leakage problems at similar zones in NM, Texas and Alberta, Canada, including 7 similar installations designed, permitted and completed by Geolex

Summary of Geologic Factors Assuring Integrity and Safety of Proposed AGI

- No faults or structural pathways identified in the area of review
- Caprock is low porosity, impermeable rock which is effective barrier above injection zone
- Injection zone is significantly deeper than most adjacent production zones
- All fresh water zones isolated by conductor casing
- Proposed injection pressure is well below fracture pressure of reservoir and caprock
- 3-D seismic data demonstrates closed system

Key Elements of Frontier's C-108

- ▶ AGI project has substantial environmental benefits of greenhouse gas reduction due to sequestration of CO₂ which otherwise would be released to atmosphere
- ▶ AGI project reduces waste and air emissions by eliminating flaring of acid gas as sulfur control measure
- ▶ Nearby oil and gas wells, nearby water wells and surface water are protected by well design and geologic factors
- ▶ 3-D seismic has permitted the accurate delineation of the reservoir assuring that nearby SWD and producing wells will be protected

Key Elements of Frontier's C-108 (cont.)

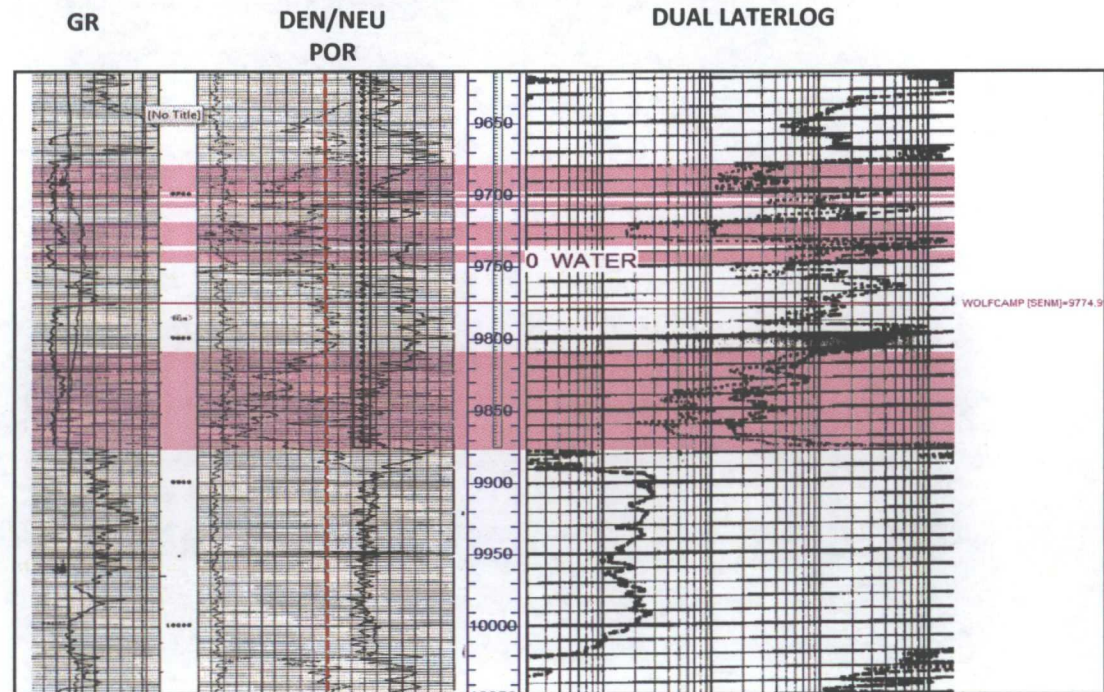
- ▶ Frontier's C-108 application details the full information needed to approve the installation of AGI well
- ▶ H₂S Contingency Plan for Maljamar plant was submitted to NMOCD for approval on May 10, 2011, and an updated plan will be submitted prior to NMOCD for review and approval prior to commencing injection
- ▶ Adjacent operators and the BLM support the project
- ▶ Operators and surface owners have received proper notice and there are no objections to the AGI project

Frontier's Request for NMOCD Order

- ▶ **Drill, test and complete well as specified in Frontier's C-108 application at 130 FSL, 1831 FEL Section 22 T17S R32E just east of Maljamar Gas Plant**
- ▶ **Frontier requests permission to inject acid gas at a maximum rate of 2 MMCFD and maximum operating pressure of 2970 psig**
- ▶ **Frontier would like to begin the well drilling and completion as soon as possible**

Composite Log Section - Wolfcamp SWD Wells Located Just Outside One Mile Area Of Review South Of Plant Site

Composite log section in the Concho #1 Federal BI well, 1 mile south of the plant site (drilled in 2008). This well is being used as a salt water injection well, and is perforated across the lower Leonard and upper Wolfcamp. Porosities here range up to 18% in both formations (the 10% porosity line is highlighted in dashed red). Since porosities of this magnitude are expected in the proposed Maljamar AGI #1 well, the capacity of any one zone will increase commensurately with any increase over 6%.



This zone is not laterally connected to the wells located just at the edge of the one-mile area of review that inject salt water into the Wolfcamp. -- these zones are similar in character to the primary proposed injection zone and provide evidence of injectability.

Log Composite Type Section For Primary And Secondary Injection Targets

Log composite section through the key interval in the Baish B #36 well, showing porosity development highlighted in violet. The three zones of interest are shown. This is the closest well to the plant site, but its log suite does not allow accurate measurement of porosity, only relative porosity can be gauged. This well was drilled and abandoned in 1948.

THE LOWER WOLFCAMP IS THE PRIMARY TARGET AND IS CAPABLE OF SAFELY CONTAINING THE ENTIRE PROPOSED ACID GAS INJECTION VOLUMES FOR THE ESTIMATED LIFE OF THE PROJECT

