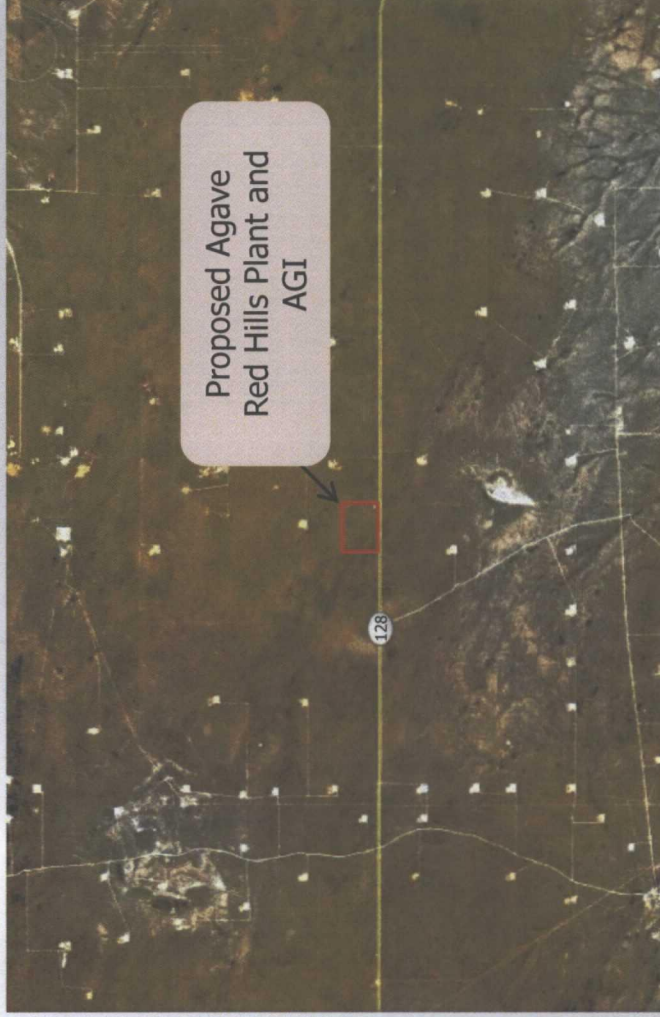


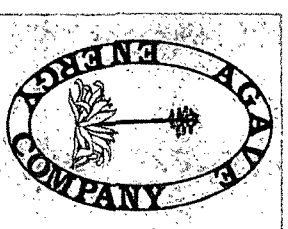


December 8, 2011 NMOCC Hearing in Case 14720



Agave's Witnesses at Today's Hearing

- ▶ Ivan Villa - Engineering Manager
- ▶ Jennifer Knowlton, PE - Environmental Manager
- ▶ Alberto A. Gutiérrez, RG - Geolex, Inc.



Presentation Goals and Outline of Testimony

- ▶ Describe gas plant operations, anticipated production/processing features and ramp up of processing capacity and injection volumes –

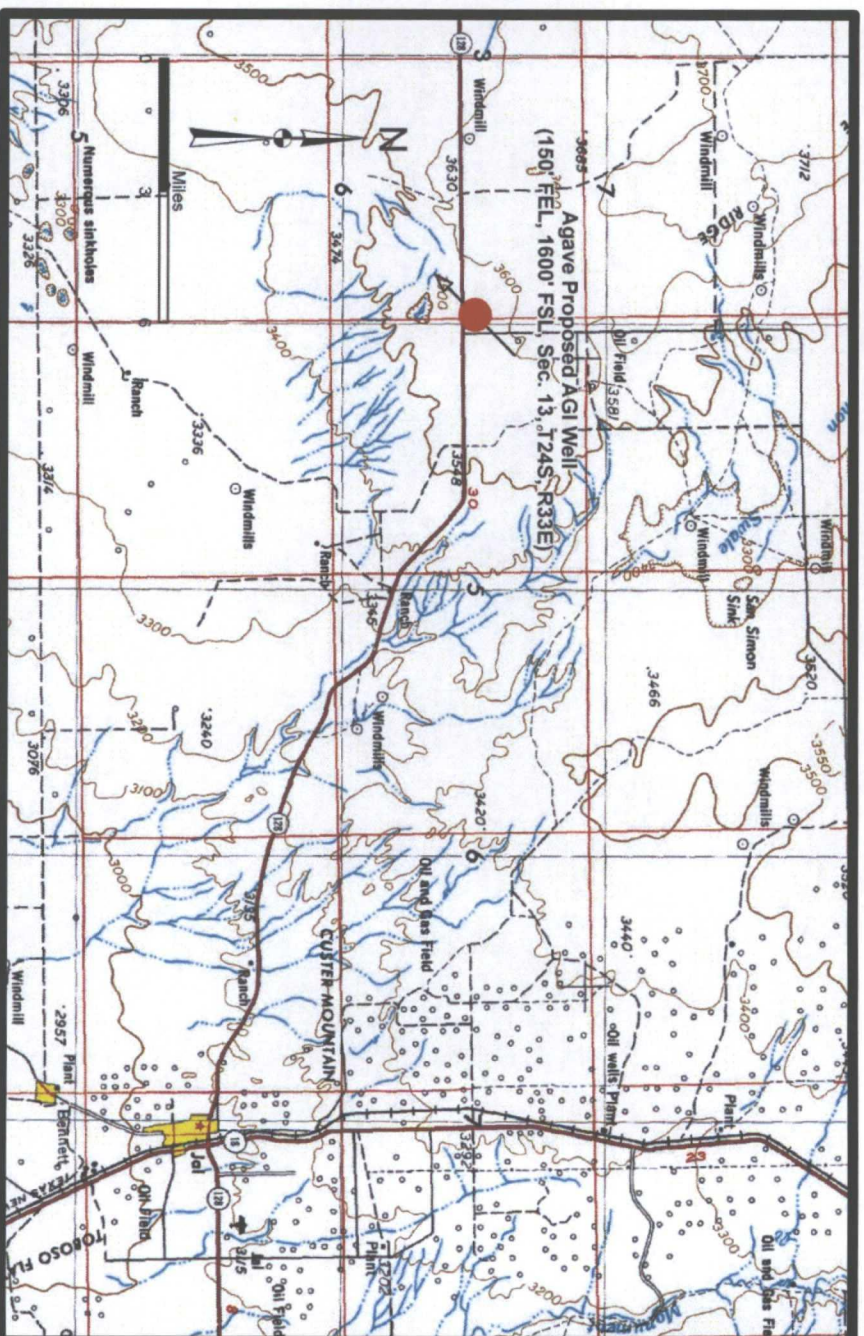
Ivan Villa

- ▶ Describe environmental benefits of Agave's Red Hills AGI project; describe future H₂S Contingency Plan -
Jennifer Knowlton, PE

- ▶ Describe relevant site geology and hydrogeology, system design, operation, analyses of anticipated effect on injection zone. Review all components of C-108 –

Alberto A. Gutiérrez, RG

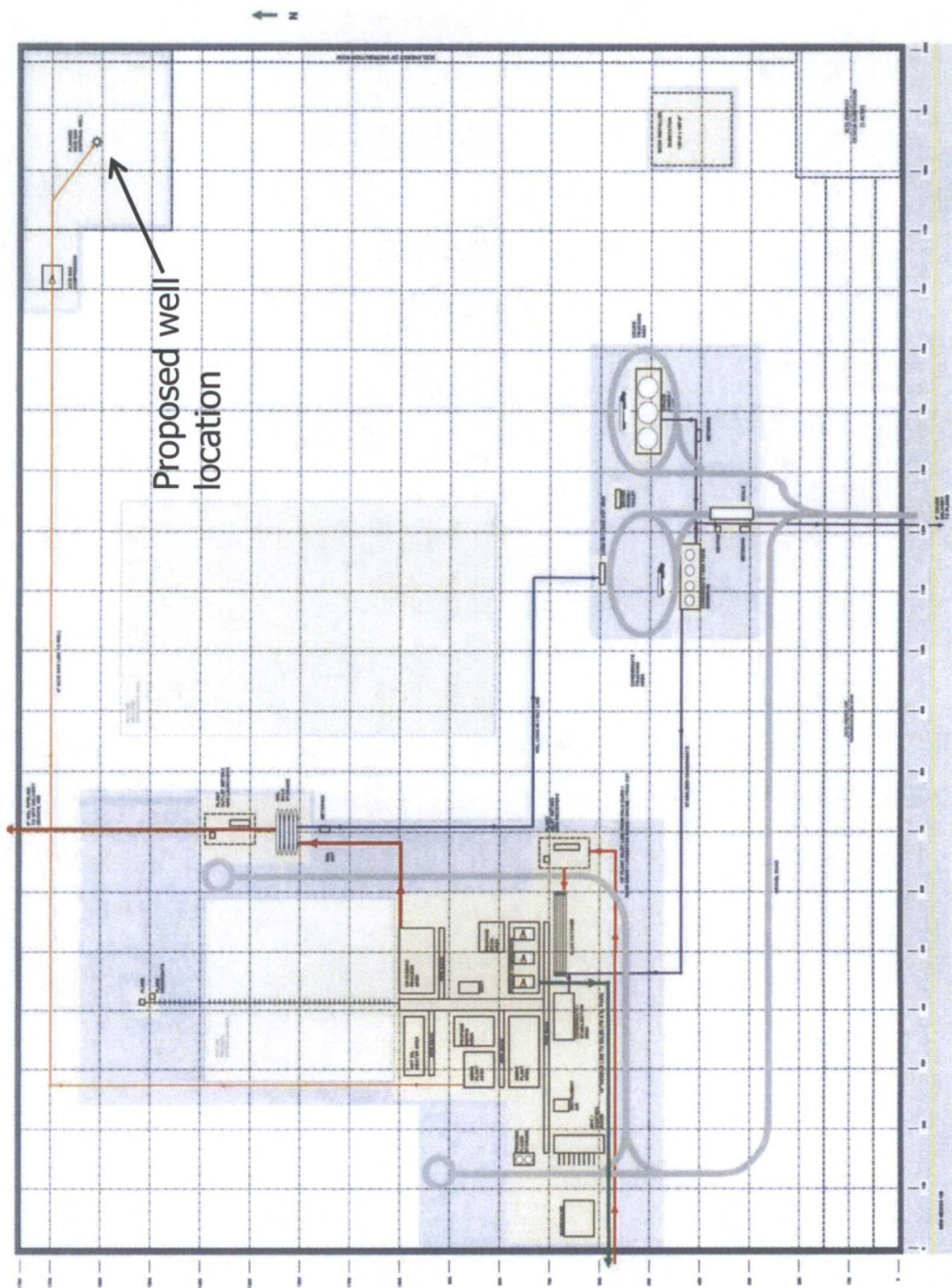
Location of Agave's Red Hills Plant and Proposed AGI #1



History of Agave's Red Hills Plant and Proposed AGI Well

- ▶ Driver for new plant is the need to process gas from the new Avalon gas play in Southeast NM which contains significant CO₂ concentrations
- ▶ Inlet gas is anticipated to initially be sweet gas with relatively high CO₂ concentrations and some lesser concentrations of H₂S are anticipated as the development of the field matures
- ▶ Geolex was retained in late 2010 to evaluate potential AGI well feasibility in the area and subsequently to prepare and submit a C-108 application for construction of an AGI well at the plant site – this application was submitted in July 2011
- ▶ Agave purchased approximately 80 acres in the SE corner of Sec. 13, T24S, R33E in Lea County just north of Highway 128 to construct the plant in July 2011
- ▶ NMOCC sets application for hearing on September 22, 2011
- ▶ Plant construction was initiated in August 2011 and is anticipated to begin operation processing sweet gas only in March 2013
- ▶ Initial operation of the cryogenic plant will begin with processing sweet gas and venting the CO₂ to the atmosphere
- ▶ As plant operations ramp up, overall CO₂ emissions will increase and some H₂S is expected triggering need for an AGI well
- ▶ The proposed AGI well is anticipated to be drilled in late 2012 and begin operation in 2013 depending on ramp up in volumes and H₂S concentrations in inlet gas
- ▶ The TAG stream to the proposed AGI well may contain only CO₂ and trace hydrocarbons and nitrogen initially
- ▶ A H₂S contingency plan pursuant to Rule 11 and modeled after the approved plan for the Dagger Draw Plant and Metropolis AGI well will be submitted for review and approval prior to injecting TAG containing H₂S

Design for Proposed Agave Red Hills Gas Plant



Summary of Plant Operations

- ▶ Operation anticipated to begin in March 2012
- ▶ Initial inlet gas will be sweet gas with no H_2S ; CO_2 will be vented prior to proposed AGI well completion
- ▶ Anticipated ramp up will result in average daily injection rate over 30 years of 7.8 MMSCFD with maximum daily rate anticipated at 13 MMSCFD
- ▶ Sour gas anticipated to begin affecting the inlet gas stream in approximately 1-4 years
- ▶ Proposed AGI well has added environmental benefit of sequestering CO_2 and safely dealing with potential H_2S

Operational & Environmental Benefits of Proposed AGI Well

- ▶ Agave's Red Hills Plant will provide additional needed capacity to process Avalon gas and increase royalties to NM and employment in SE NM
- ▶ AGI will result in air quality improvements over initial venting of CO₂ by permanently disposing of TAG safely and geologically sequestering CO₂
- ▶ Plant will be able to rapidly adjust to changing and unpredictable inlet gas concentrations of CO₂ and H₂S from new gas resources being developed in SE NM

Relationship of Air Permitting to AGI Timing

- ▶ *This is a placeholder bullet point for Jennifer if we feel we need to discuss this issue—ie current status of air permit reviews and conditions that affect timing of AGI, if any*
- ▶ Agave will develop a complete Rule 11 H2S contingency plan for NMOCD review and approval prior to bringing the Red Hills AGI #1 on line

Executive Summary

- ▶ Agave is requesting authority to inject acid gas:
 - With a composition of 95% CO₂, 5% H₂S, trace C₁-C₆ and N
 - Into the Cherry Canyon Formation at a depth of approximately 6200 feet – 6530 feet
 - At a maximum rate of 13MMCFD and maximum operating pressure of 2085 psig
- ▶ Five plugged and one active wells penetrate the injection zone within the one-mile radius area of review
- ▶ The maximum possible area of the reservoir expected to be affected over 30 years of injection is approximately 523 acres and a radius of approximately 2700 feet from the well
- ▶ Actual area anticipated to be affected is significantly smaller due to ramp up in injection volumes (313 acres and a radius of approximately 2084 ft)

Adjacent Operators and Surface Owner Notification and Notice

- ▶ Agave's C-108 application details the full information needed to approve the proposed Red Hills AGI #1 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 NMOCC hearing was published in the *Hobbs News Sun*
- ▶ No objections to Agave's application by surface owners have been submitted
- ▶ The AGI project will allow increased production and increase royalties to State of New Mexico
- ▶ BLM APD and bond were filed in September, the application has been deemed complete and is currently awaiting approval

Injection Fluid Volume, Composition and Pressure Considerations

- ▶ Design involves initial injection of 2-5 MMCFD of CO₂ only with the eventual introduction of H₂S in the TAG stream as required based on inlet gas concentrations building up to the maximum rate of 13MMCFD
- ▶ Injected fluid composition will range from 0-5% H₂S, 95-100% CO₂ and <1% Trace hydrocarbons (C₁-C₆)
- ▶ Injected fluid compatibility determined by evaluating formation fluid and previous SWD in general area
- ▶ Maximum allowable operating pressure per NMOCD calculation guideline is 2085 psi surface

Summary of Key Findings in Evaluating AGI Feasibility

- ▶ **Best Target – Upper Cherry Canyon Formation**
 - *177 feet of coarse sands between 6,200-6,530' depth*
 - *Excellent average porosity of 18.9% (8.7% considering S_{wir})*
 - *Overlain by 900 feet of sands & interbedded tight limestones, shales, and siltstones that protect overlying Delaware production and shallower fresh water resources*
- ▶ **Deeper zones –** Some production in area, some deeper reservoirs in addition to Avalon are actively being developed
- ▶ **Only six wells in area of review –** one active and four plugged deep wells, one plugged shallow well (Delaware Sand)
- ▶ **Anticipated footprint –** radius only 0.51 miles at maximum rate of 13 MMSCFD for 30 years-actual footprint anticipated to be 0.39 mile radius at average 7.8 MMSCFD for 30 years

Factors in AGI Evaluation

1. Land and Mineral Ownership and Nearby Development
2. Existing and Potential Production
3. Reservoir Geology and Caprock Integrity
4. Preliminary Well Design and Specifications
5. Permitting and the C-108 Process

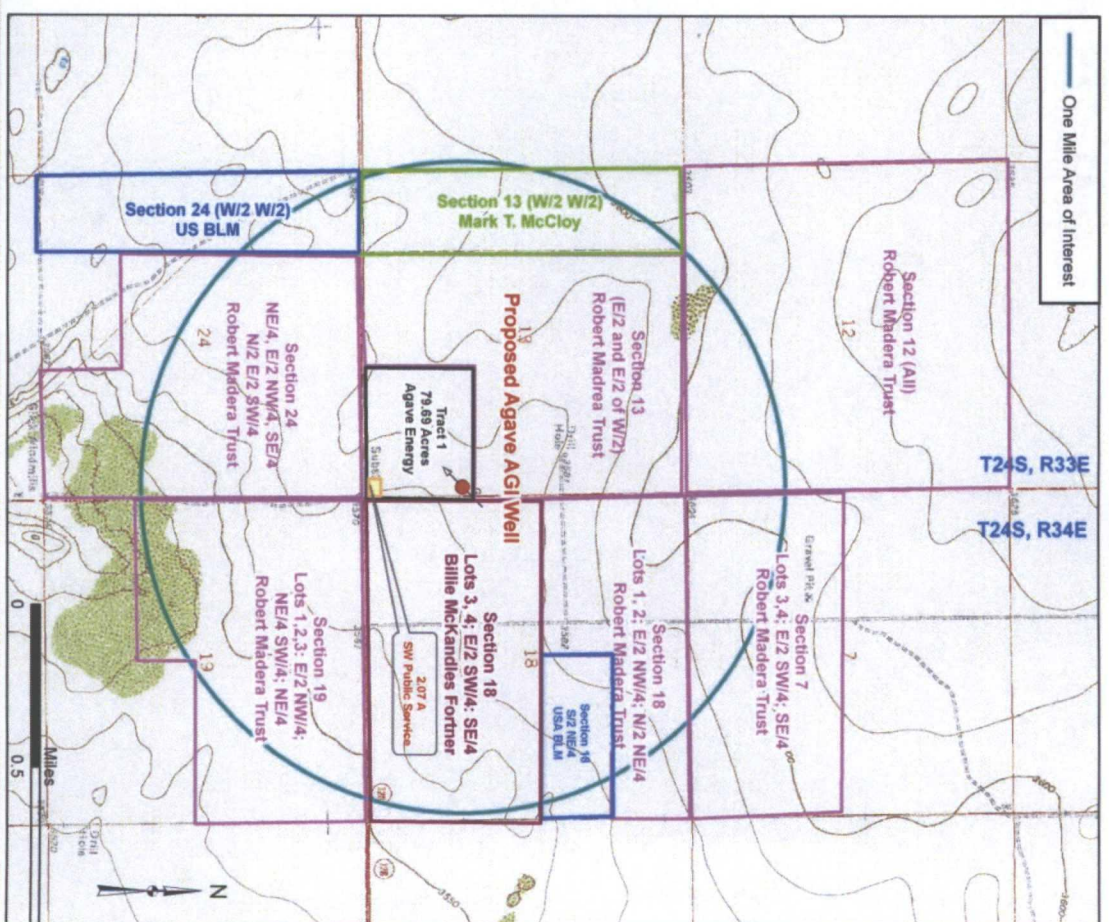


1. Land and Mineral Ownership and Nearby Development

- ▶ Agave Energy owns plant site and location for proposed well
- ▶ Surface within one mile is largely privately-owned
 - 5 private owners including Agave Energy (primarily Madera trust)
 - Two small tracts are owned by BLM
- ▶ Entire Area within one mile is leased, unitized and held by shallow production
 - South Bell Lake Unit operated by Kaiser & Francis Oil Company
- ▶ Plant will be adjacent to Highway 128 and is in an uninhabited and undeveloped area

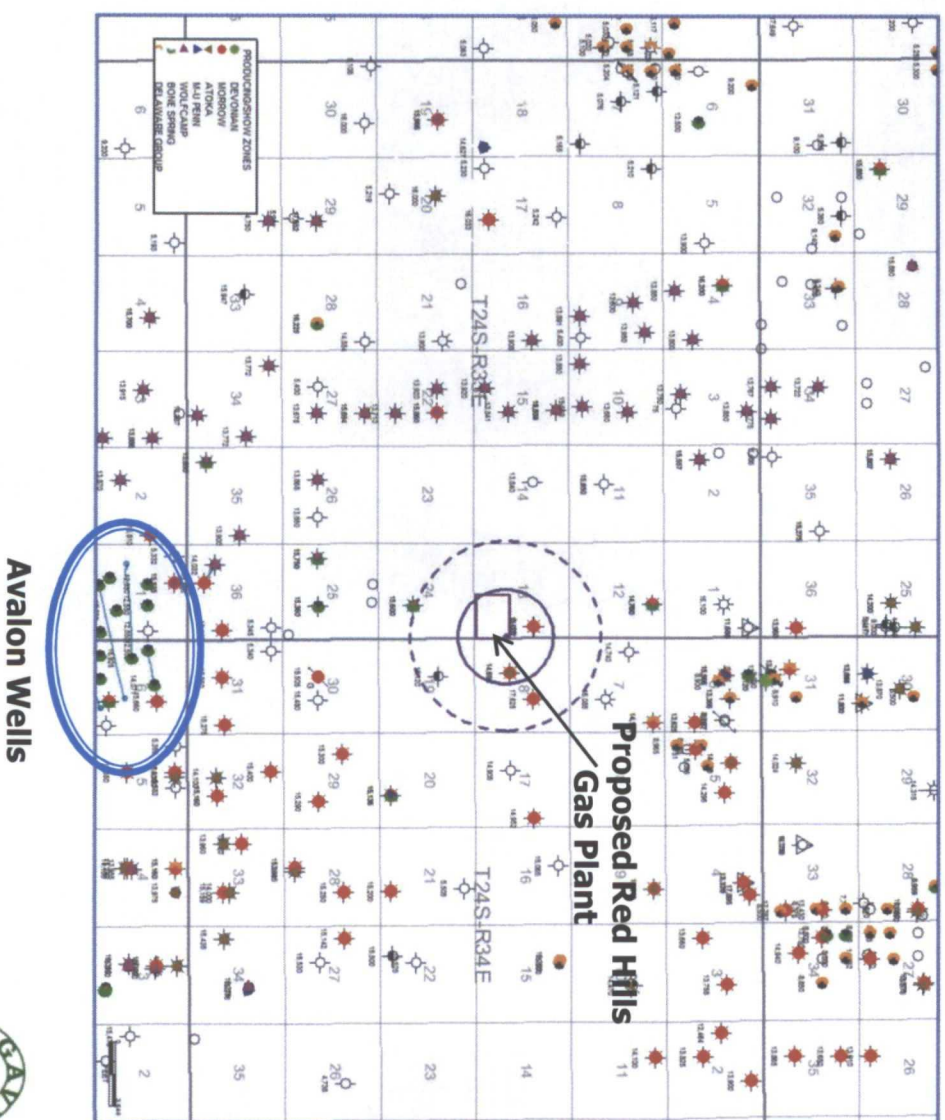


Surface Ownership Within One Mile of Proposed Red Hills AGI #1



2. Existing and Potential Production

- ▶ Deep reservoirs are currently producing in area
 - Bone Springs
 - Wolfcamp
 - Atoka-Morrow
- ▶ Large number of planned wells in Bone Springs “Avalon”
- ▶ Dashed circle is one mile area of review and solid circle is anticipated extent of TAG at maximum rate over 30 years



- ▶ Six wells within one mile of proposed well
- ▶ Three plugged Morrow wells
- ▶ One plugged and one active Bone Springs well
- ▶ One plugged shallow Delaware Sand well



Local Stratigraphy and Hydrocarbon Production

SYSTEM	DELAWARE BASIN	RESERVOIRS	DEPTH
PERMIAN	Rustler	★	
	Salado		
	Castile		
	Bell Canyon	★	"Delaware Sands" ~5150-5200
	Cherry Canyon	▲	~6050-6415
PERMIAN	Brushy Canyon		
	Bone Spring	★	"Avalon" ~9150-9600
	Wolfcamp	★	~13,650-13,800
PENNSYLVANIAN	Cisco		
	Canyon		
	Strawn	★	~14,225-14,380
	Atoka	★	~14,420-14,450
	Morrow	★	~15,650-15,750
MISSISSIPPIAN	"Barnett" Shale		
	Mississippian Ls		
	Woodford		
	Devonian	★	

★ Local Producing Zones
(within 4-5 miles of plant site)

- Delaware Sands (~5150-5200 ft)
- Avalon (~9150-9600 ft)
- Wolfcamp (~13,650-13,800 ft)

▲ Reservoir Selected

- Cherry Canyon (6050-6530 ft)

Note: Depths of formations estimated from nearby Yates Atoka Bank State #1

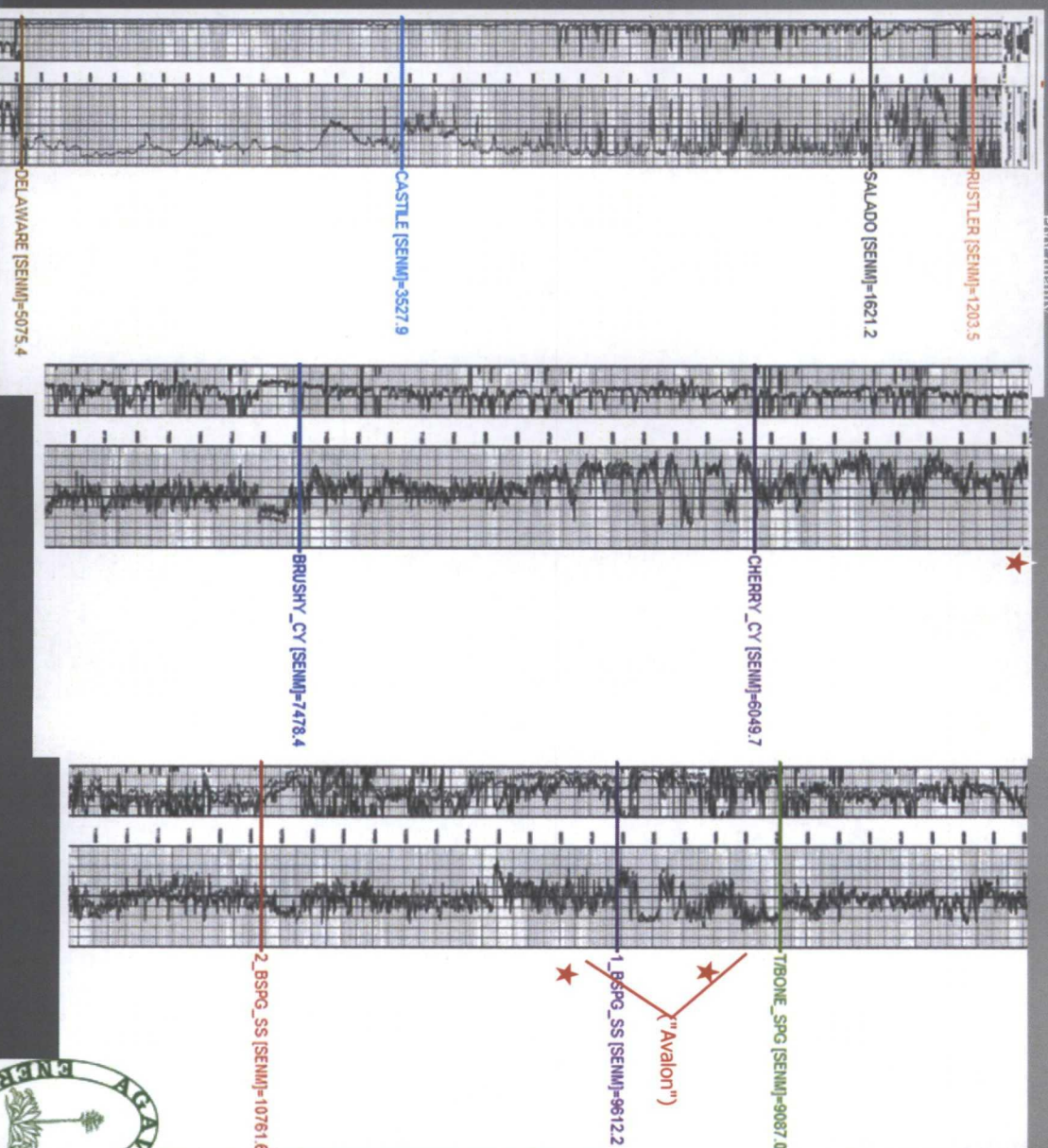
3. Reservoir Geology and Caprock Integrity

- ▶ Characterization of proposed injection reservoir
 - Depth, thickness, porosity, permeability
 - Geology and structure of reservoir
 - Ability to safely take injected fluids
- ▶ Demonstration of protection of producing zones & groundwater
 - Geology, structure and integrity of caprock
- ▶ Estimated “footprint” of injection based on anticipated injection of 13 MMSCFD of TAG vs. actual anticipated average rate of 7.8 MMSCFD for 30 years

Stratigraphy and Oil/Gas Production

Rusler – local
Postmortem

- Cherry Canyon is composed of sandstones interbedded with siltstones and limestones (6050-6415 ft)
- Well above production in “Avalon” (9150-9600 ft)
- Well below production in Bell Canyon (5150-5200 ft)



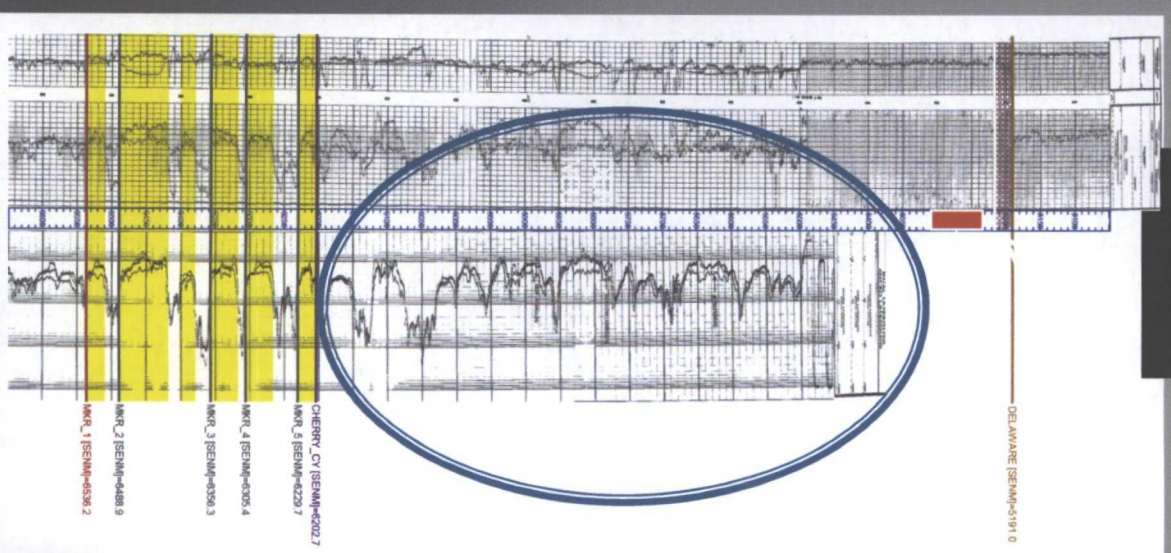
Limestone



GEOLEX
INCORPORATED

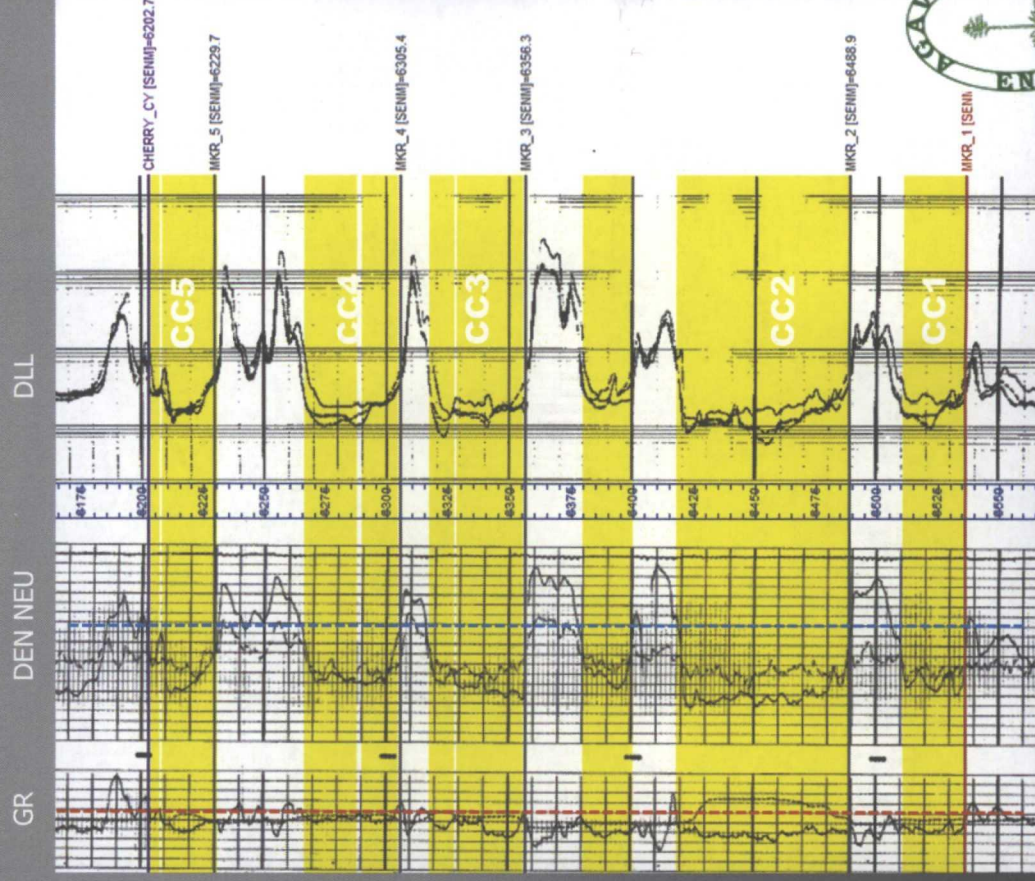
Protection of Shallow Production

- ▶ Proposed Cherry Canyon injection zone separated from Delaware Sands by 900 ft of sands and interbedded tight limestones, shales, and siltstones
- ▶ **Note: No Delaware Sands production within one mile – all wells have been dry**



AGI Evaluation of Cherry Canyon

- Upper Cherry Canyon (above M1 marker)
 - Composed of 5 clean sand units (yellow)
 - 18.9% average porosity
 - Good data across site
 - Laterally continuous sand units over site



AGI Evaluation of Cherry Canyon Reservoir

- ▶ Accounting for irreducible water (S_{wir}) - fraction of porosity that retains water using following equation:

$$Por_{avail} = Por_{ave} * (1 - S_{wir})$$

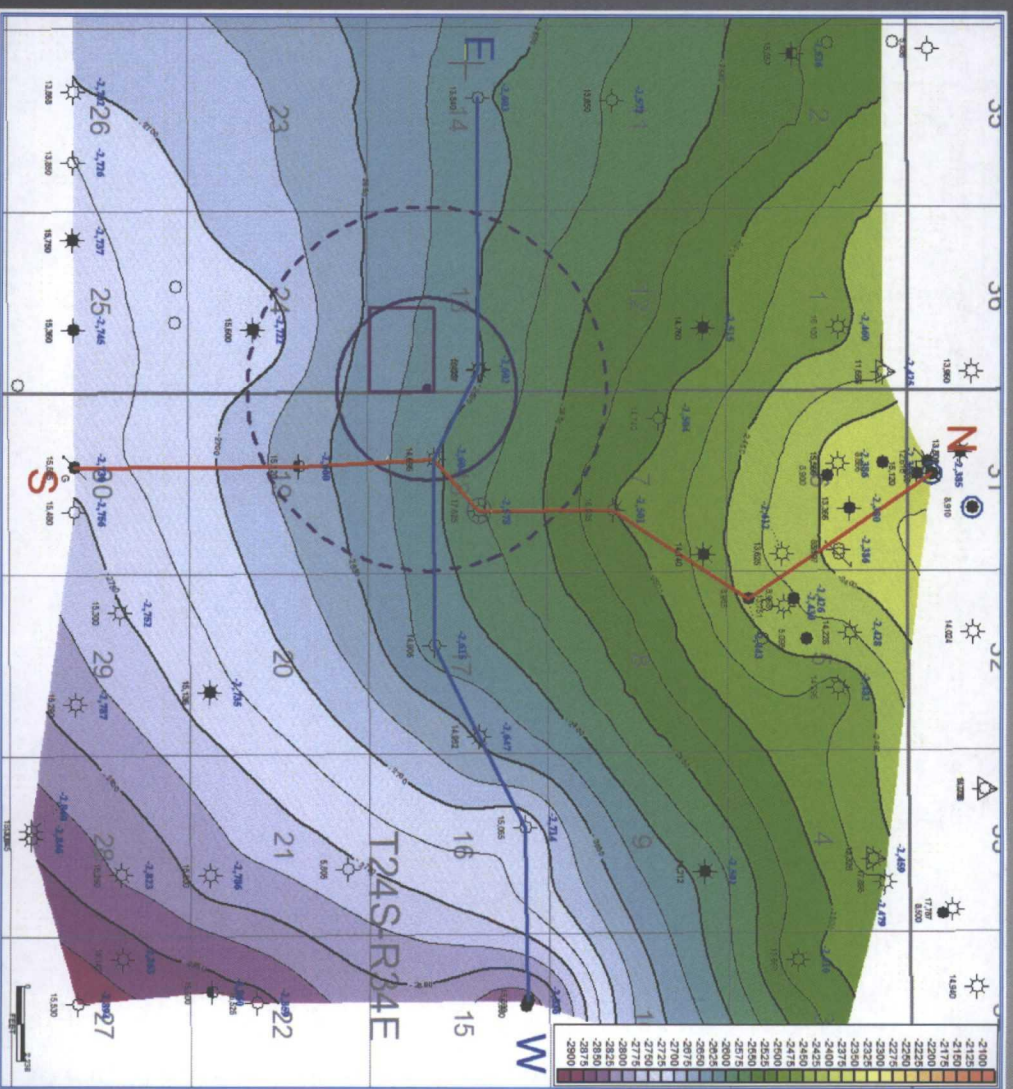
- ▶ Determine S_{wir} using geophysical well data and Archie's Equation

$$S_{wir} = (F * R_w / R_t)^{1/2}, \text{ where:}$$

- Formation Factor $F = a / Por_{ave}^n$ $F = 1.45 / (0.189^{(1.54)}) = 18.86$
- Water resistivity $R_w = 0.031$
- Bulk resistivity $R_t = 2$
- $S_{wir} = (18.86 * 0.031 / 2)^{1/2} = 0.54$
- ▶ $Por_{avail} = 0.189 * (1 - 0.54) = 0.087$ or 8.7% (vs 18.9 available)

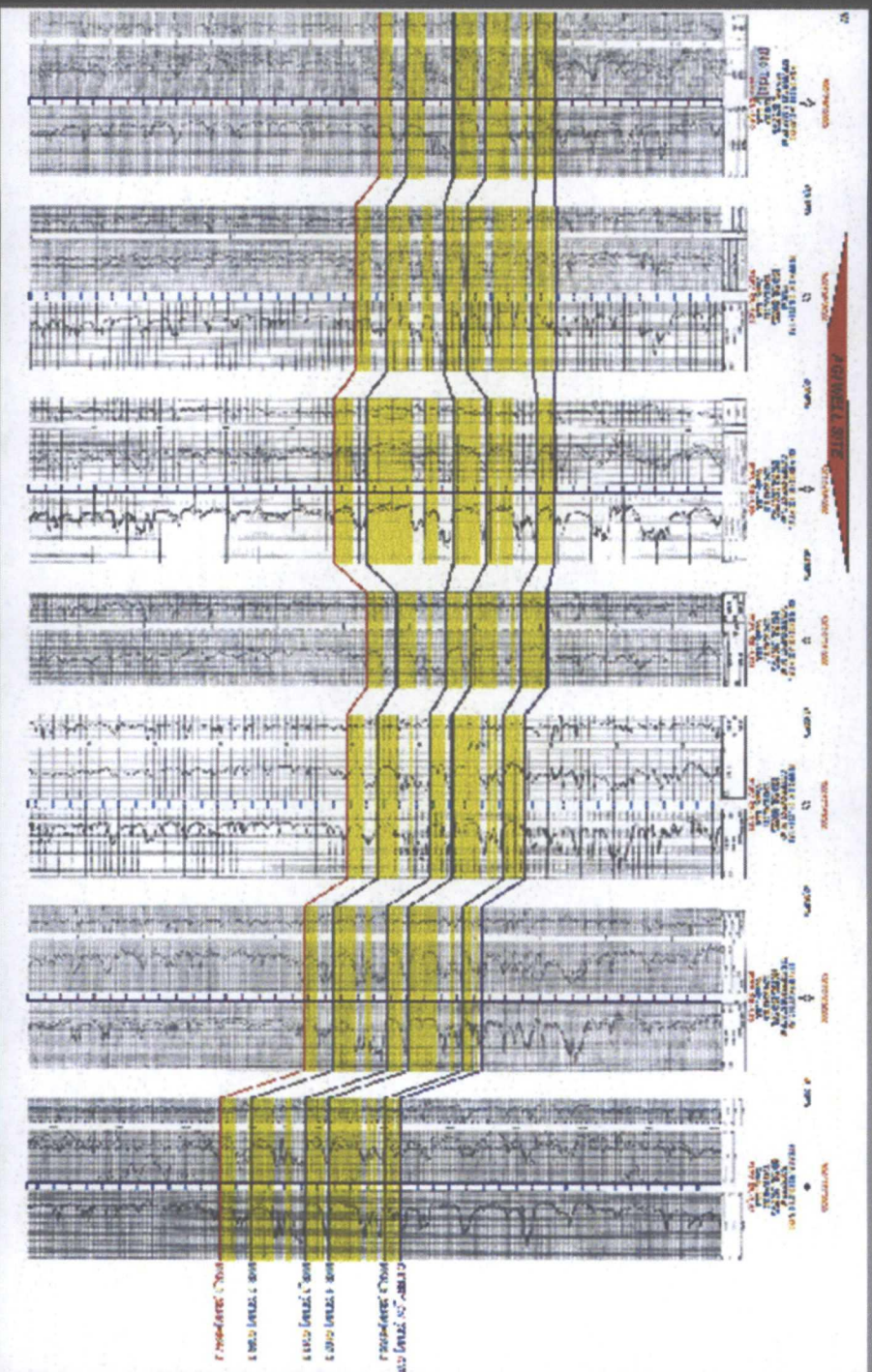
Structure on top of Cherry Canyon

Location of
E-W and N-S
Cross
Sections on
following
slides shown
here



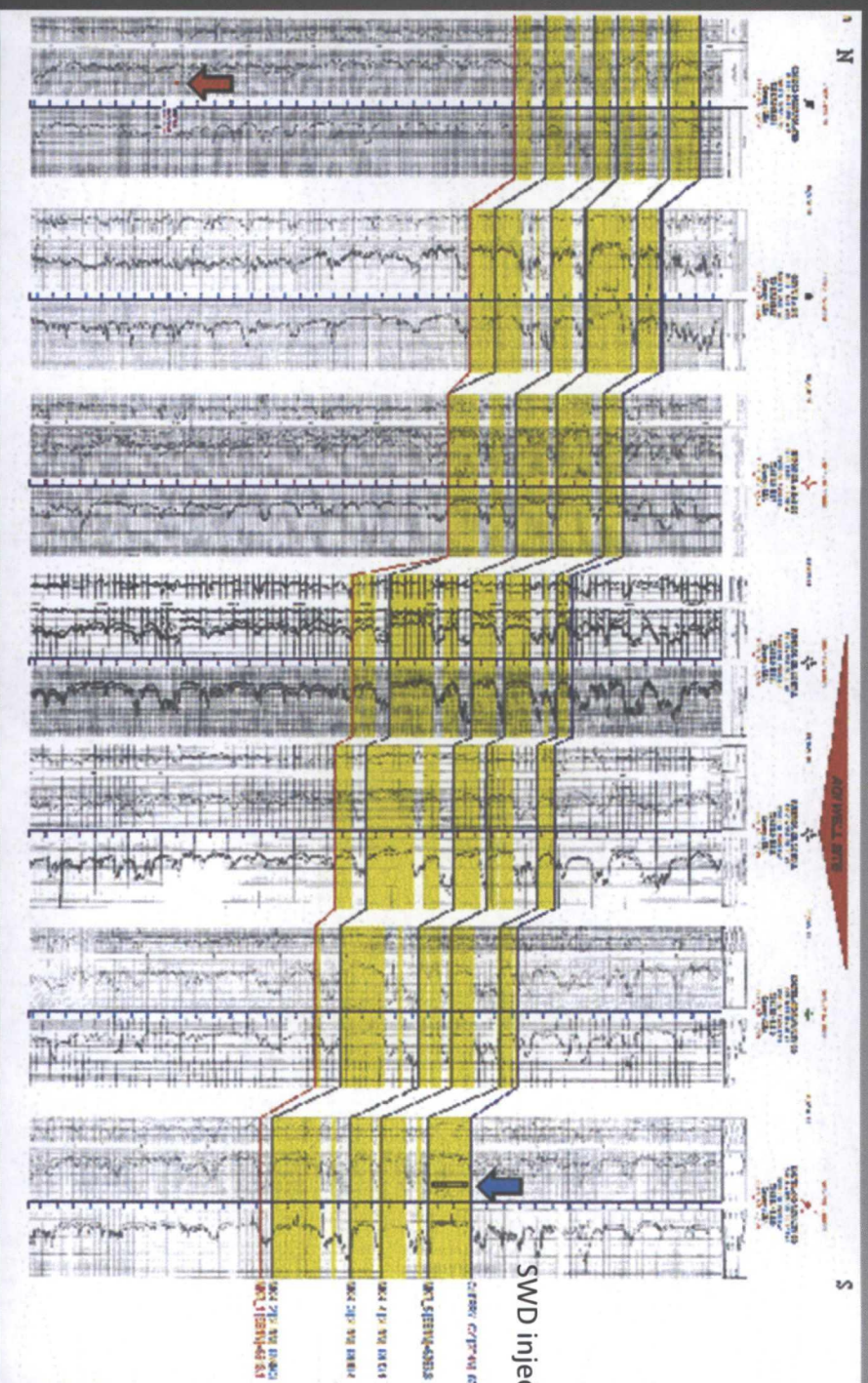
Gentle 1° slope to South – No evidence of faulting

East-West Cross-Section



- Sand units are laterally continuous

North-South Cross-Section



Cherry Canyon
production over
2.5 miles from
proposed well

- Sand units are laterally continuous

Multiple Confining Beds within and above Injection Zone

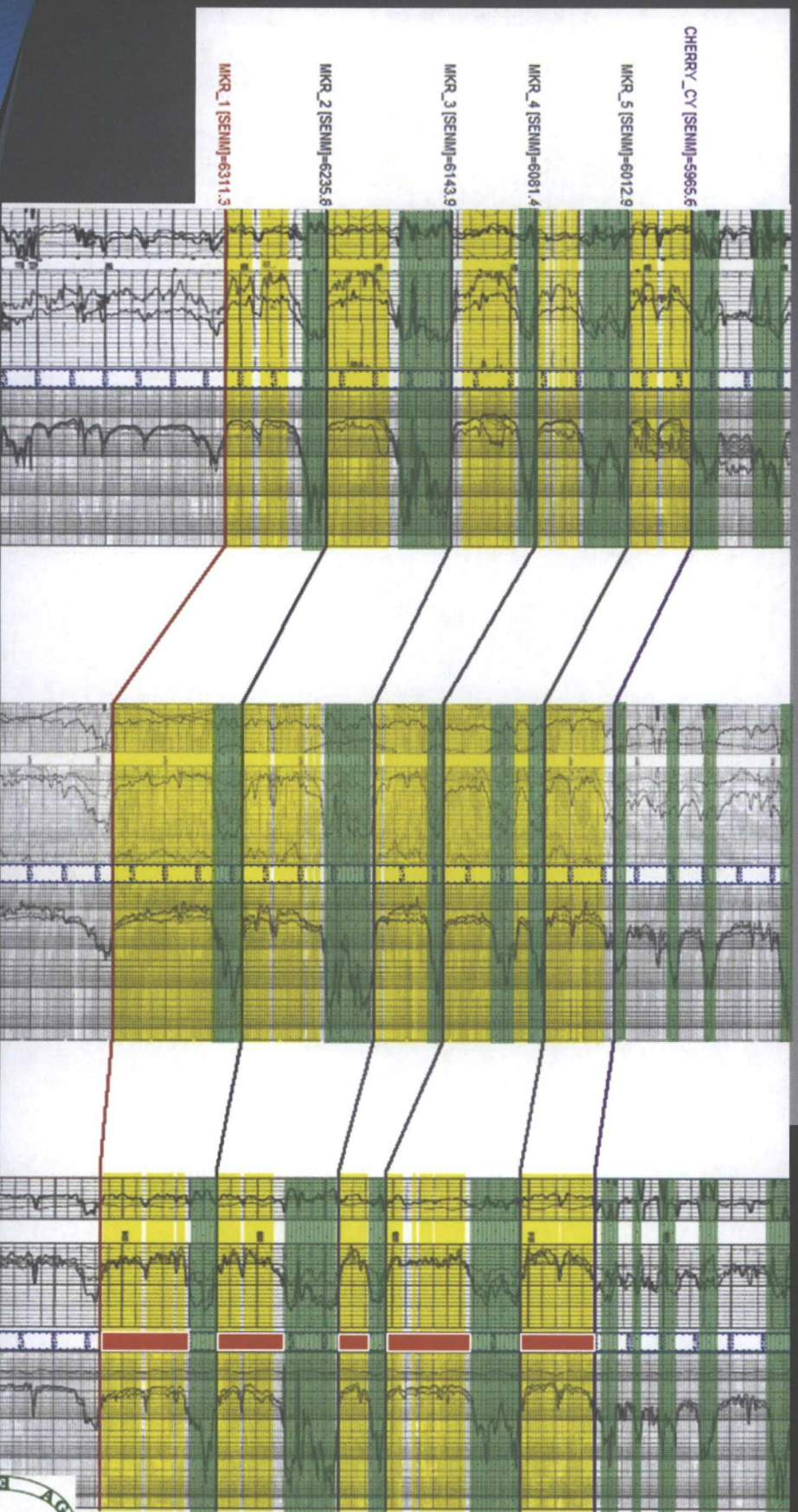
A

COPPERHEAD 18 STATE #1

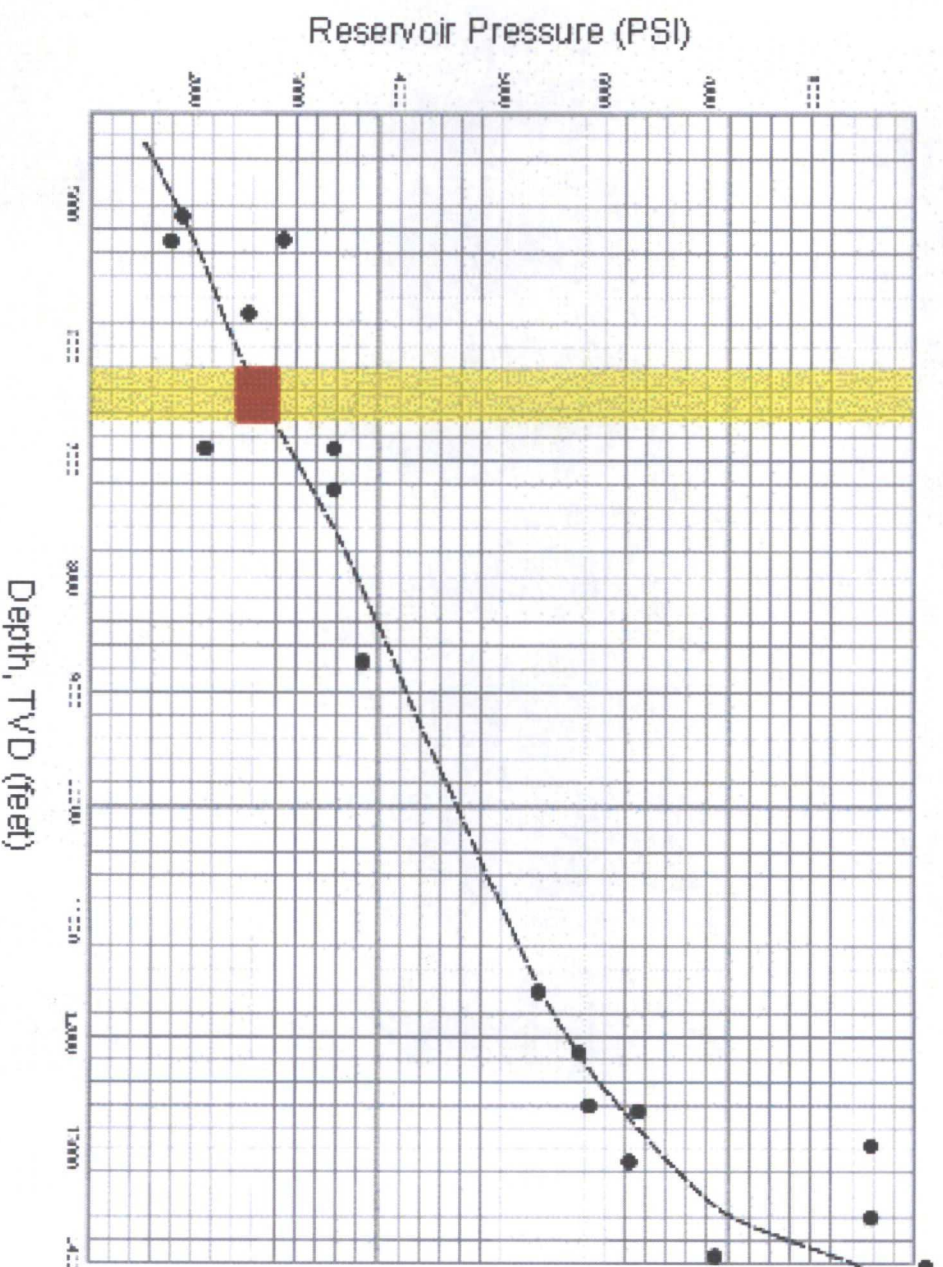
STATE "20" COM #1

ATOKA BANK STATE UNIT #1

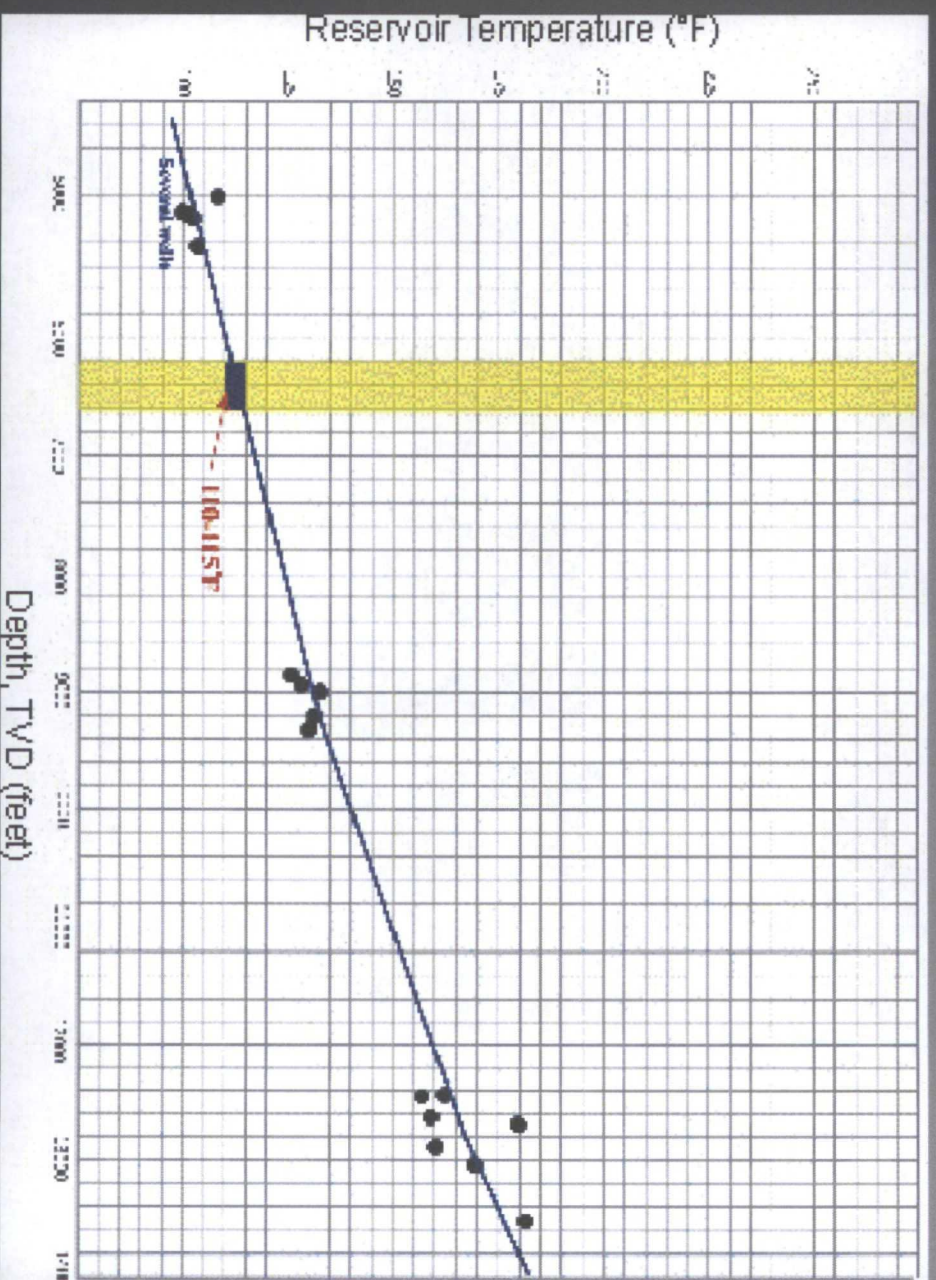
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Estimated Reservoir Pressure Conditions



Estimated Reservoir Temperature Conditions

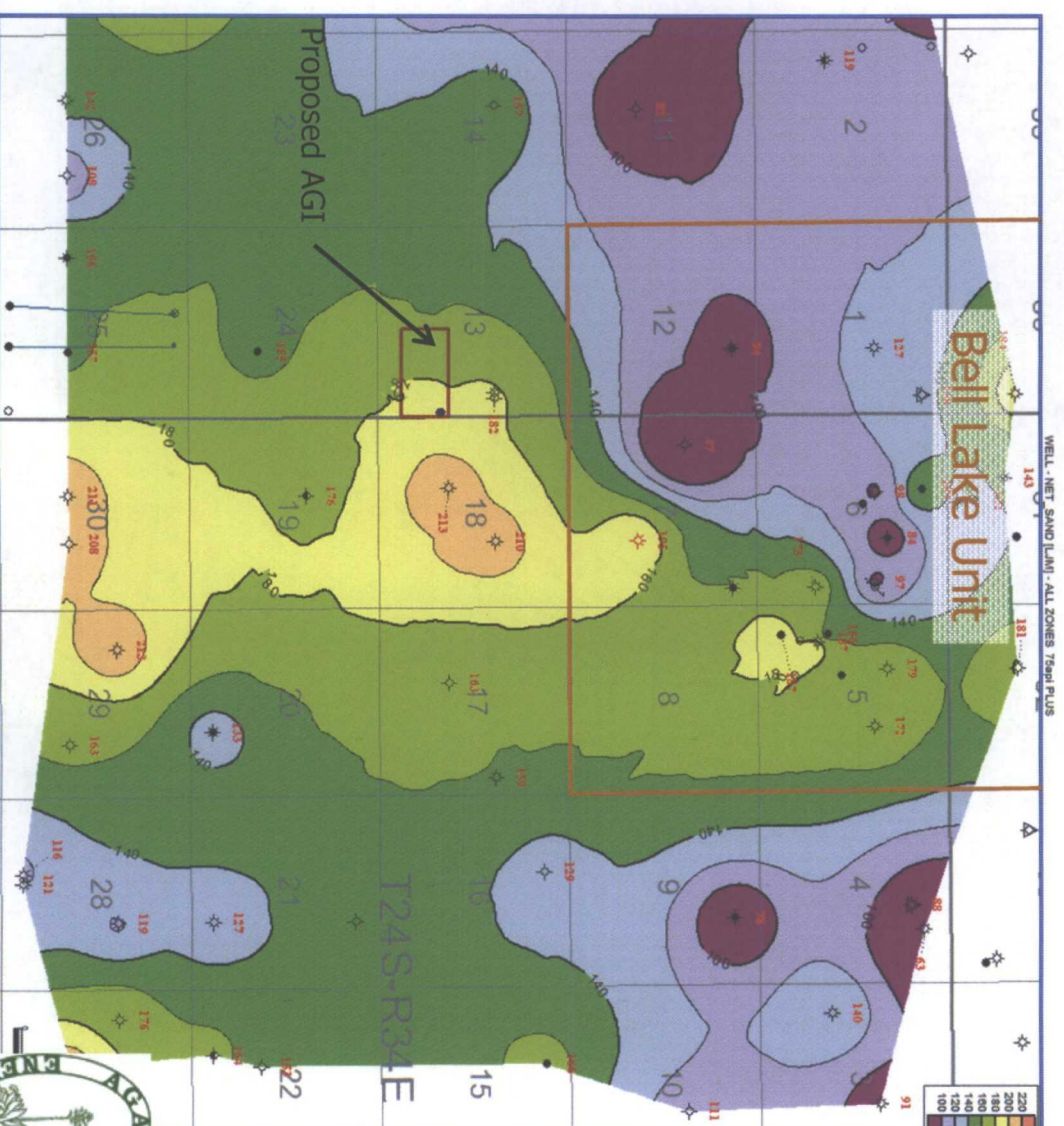


Factors that Influence Calculations of Area of Reservoir Affected

- ▶ Reservoir Conditions (based on tests at nearby wells)
 - Pressure and Temperature control TAG density
- ▶ Injection Ramp up Rate (assumed constant at maximum allowable vs. actual predicted ramp up)
 - 13 MMSCFD vs. 7.8 MMSCFD
- ▶ Available Reservoir Volume (based on nearby well logs)
 - Average thickness, 177 ft
 - Average porosity, 18.9%
- ▶ Irreducible Water (based on calculations from well logs)
 - Fraction of porosity that will retain water, 0.54
- ▶ Cylindrical Distribution (standard assumption)
 - Homogeneous reservoir properties
 - Very shallow dip results in little opportunity for updip migration of TAG plume
- ▶ Calculated Minimum Safety Factor of 200% for Kaiser Francis' Bell Lake Unit
 - Based on anticipated TAG volume injection and reservoir area affected – demonstrated that even if predicted area affected is somewhat uncertain due to cylindrical assumption the safety factor is 200% after 30 years of injection

Cherry Canyon Injection Zone Thickness

- ▶ Thickest portion of Cherry Canyon injection zone located to east, perpendicular to Bell Lake Unit Area
- ▶ Average thickness ~177 ft



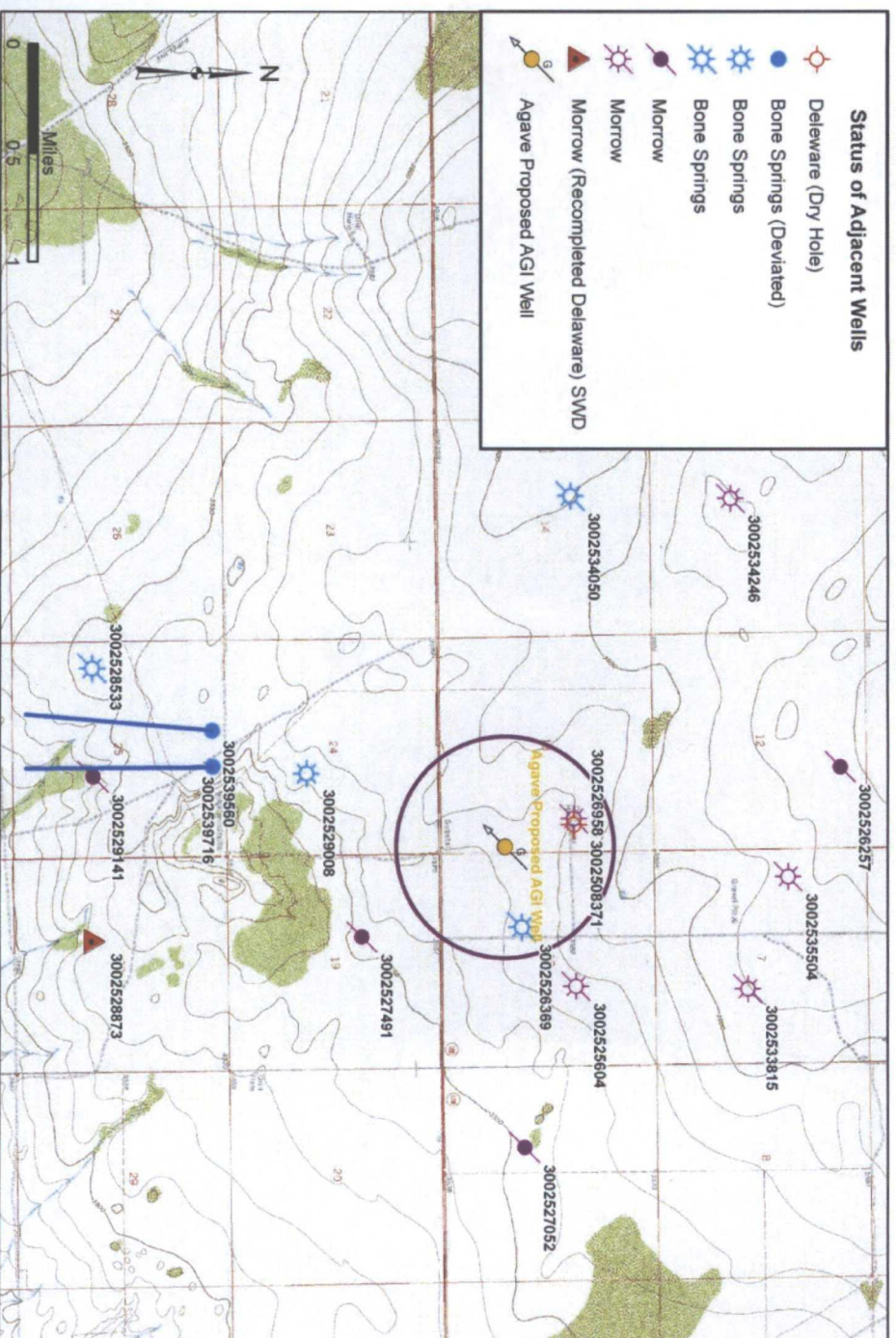
Calculating Area of Reservoir Affected over Lifetime of AGI Well using Maximum Injection Rate from Initiation

TAG Composition		
Proposed Injection Rate		
(MMSCFD)	CO ₂ (mol %)	H ₂ S (mol%)
13	95	5

Reservoir Temp	Reservoir Pressure	Ave. Thickness	Ave. Porosity	S _{wir}	Net Porosity
(°F)	(psi)	(ft)	(%)		(ft)
112	2600	177	18.9	0.54	15.4

TAG Specific Gravity	Volume Day		Volume Lifetime	Area	Radius	
	(bbl)	(ft ³ - CF)	(MMCF)	(acres)	(ft)	(miles)
0.79	5692	31957	350 MMCF	523	2693	0.51

Calculated Area After 30 Years of Injection at Maximum Rate of 13 MMSCFD



Calculating Actual Area of Reservoir to be Affected over Lifetime of AGI Well with Anticipated Injection Rates

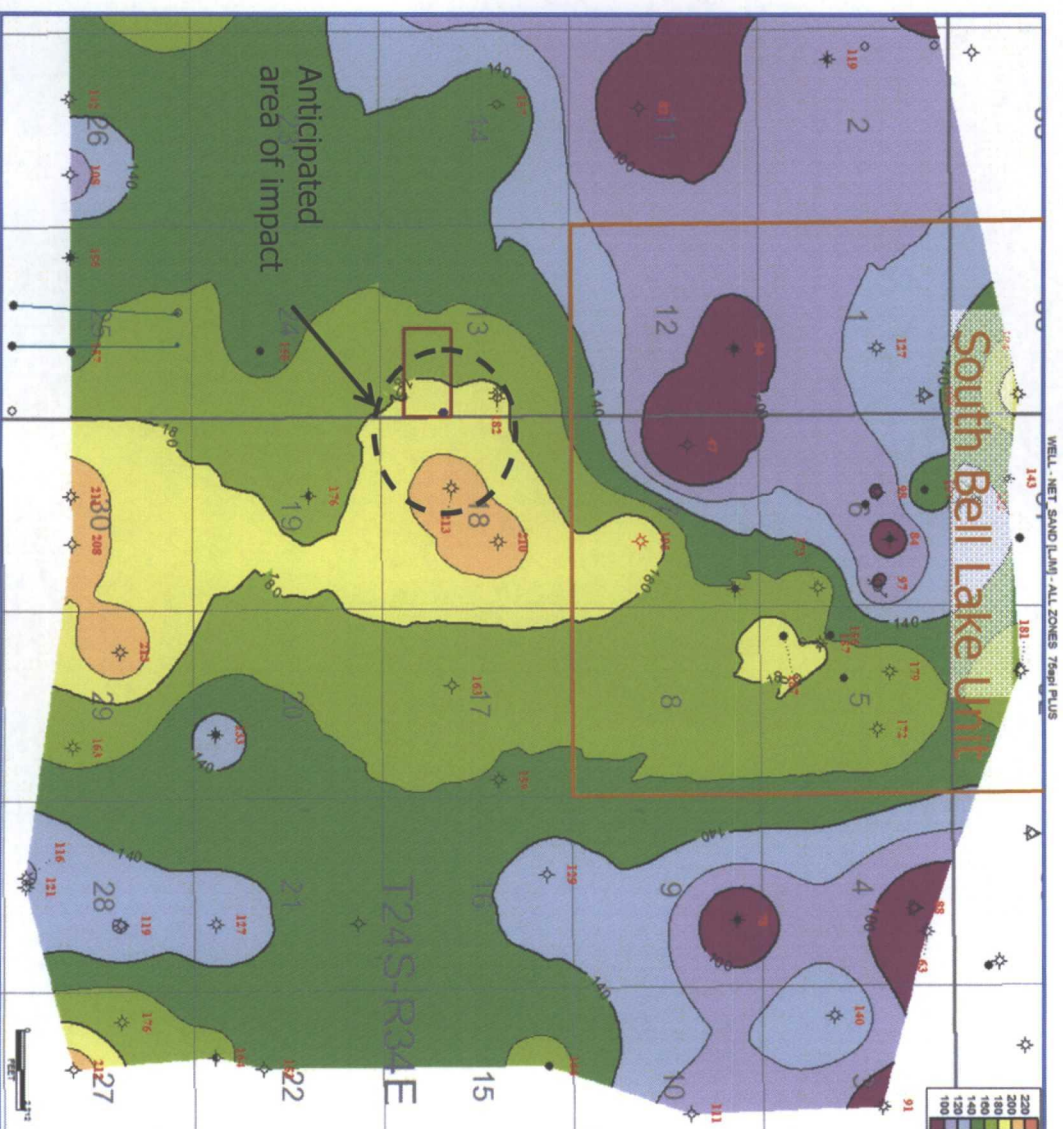
Projected Average Injection Rate	TAG Composition		
(MMSCFD)	CO ₂ (mol %)	H ₂ S (mol%)	
7.78	95	5	

Reservoir Temp	Reservoir Pressure	Ave. Thickness	Ave. Porosity	S _{wir}	Available Porosity	Net Porosity
(°F)	(psi)	(ft)	(%)		(%)	(ft)
112	2600	177	18.9	0.54	8.7	15.4

TAG Specific Gravity	Volume Day		Volume Lifetime	Area	Radius	
	(bbl)	(ft ³ - CF)	(MMCF)	(acres)	(ft)	(miles)
0.79	3406	19,125	210 MMCF	313	2084	0.39

Anticipated Area of Impact

- ▶ Dip of sediments will not influence fluid migration due to:
 - Injection into 5 separate zones
 - Gentle slope of beds
- ▶ Preferential migration, if any, will occur to east towards maximum porosity and permeability



Determination of Safety Factor for KFOC Bell Lake Unit Area

Summary of Calculations of Reservoir Area Affected by Injection

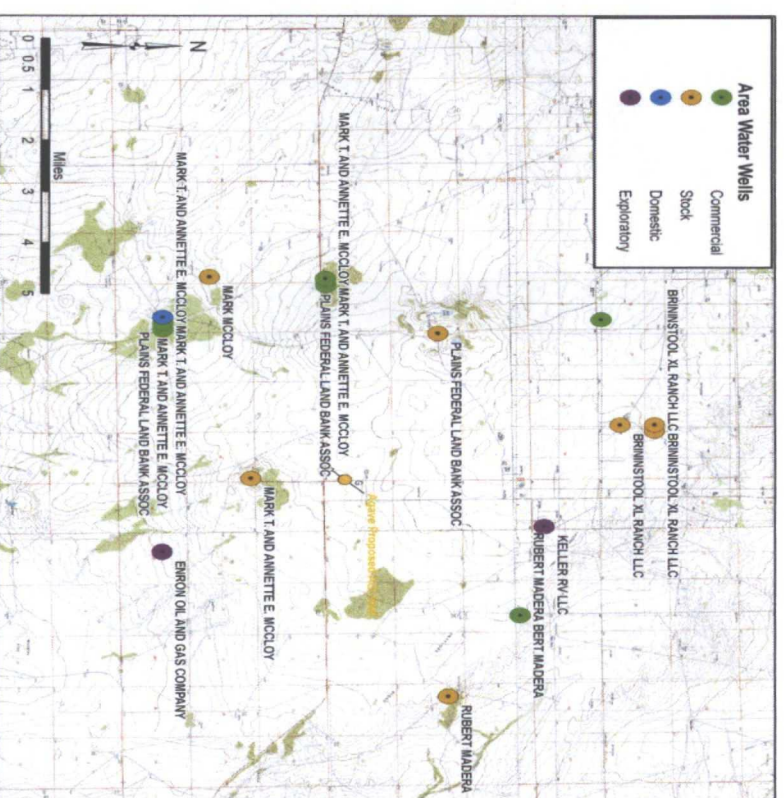
Net area in 0.67 mile radius (distance to Bell Lake Unit) in square feet	40,191,380 ft ²
Effective porosity of injection zone in feet	
Corrected for residual water = 0.54	15.4 ft
Available volume in 0.67 mile radius in cubic feet	617,509,115 ft ³
Volume injected in 30 years in cubic feet (projected)	
Projected average injection rate over 30 years = 8.0 MMSCFD	209,564,204 ft ³
Percentage of available volume in 0.67 mile radius	35%
This indicates a safety factor of ~200% after 30 years of injection	

Summary of Findings *Assuring Lack of Impact to* **KFOC Bell Lake Unit Area**

- ▶ Projected volume of injection over 30 year lifespan
~210 MMCF
- ▶ Anticipated area of impact ~ 313 acres or a circle with
a radius of ~0.4 miles
- ▶ KFOC Bell Lake Unit Area is 0.67 miles from the well
bore
- ▶ Calculated safety factor of ~200% after 30 years
- ▶ Area of impact will most likely be slightly elliptical with
an E-W orientation (perpendicular to Bell Lake Unit
Area)

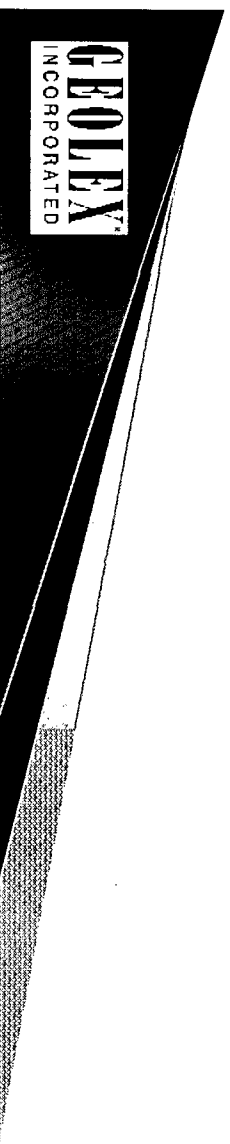
Protection of Groundwater

- ▶ Fresh water in Ogallalla and Dockum Group (to about 600 ft depth)
- ▶ Poor-Quality groundwater is present in Rustler Formation (>10,000 tds)
- ▶ No water wells within one mile of proposed well



Protection of Groundwater

- ▶ Aquifers are protected by thick Salado anhydrite and Castile salt deposits
 - Intermediate casing would extend to a depth of about 1900 ft
 - through Rustler and approximately 250 ft into Salado
- ▶ Plugged wells properly isolate injection zone
 - Delaware Group sediments are isolated
- ▶ No local production in Delaware Group



Summary of Geologic Analyses

▶ *Upper Cherry Canyon is an excellent target for acid gas injection at the Agave Red Hills Plant*

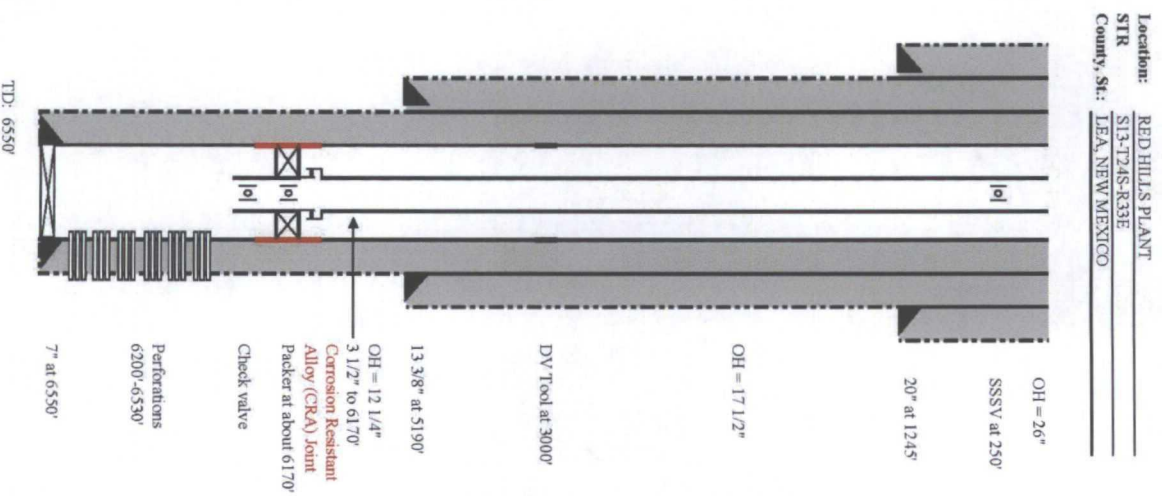
- Excellent porosity – around 15.4 ft net after S_{wir} considered
- Good permeability anticipated in injection zones
- Excellent cap rock integrity (900' of interbedded sands and tight shales and siltstones)
- No faulting observed in area
- Injection zone lacks hydrocarbon shows and doesn't produce in area
- Only 1 deep active, 4 deep plugged and 1 shallow plugged wells within Area of Review

4. Preliminary Well Design and Specifications

- ▶ Original design modified by August 30 submission to NMOCD to facilitate cementation and reduce risk of less adequate cement bond
- ▶ Production casing of 7" and 3 ½" tubing (FX FJ threads) to accommodate large volume of TAG injection
- ▶ Corrosion-resistant well tree and packer (Inconel)
- ▶ Corrosion-resistant subsurface safety valve (Inconel) set at 250'
- ▶ Check valve & adjustable choke at packer to control optimum injection pressures
- ▶ Corrosion-resistant casing joint to set packer
- ▶ Acid-resistant cement in first stage around packer annulus

Preliminary Design for Red Hills AGI #1

- Intermediate casing will extend to top of Delaware Group to ensure protection of groundwater resources and Salado Formation
- Larger hole diameters and casing strings will improve quality of cement bond



SURFACE CASING

20", 94#/ft, H40, STC at top of Rustler ~ 1245'

INTERMEDIATE CASING:

13 3/8", 54.5#/ft, J55, STC at base of salt ~ 5190'

PRODUCTION CASING:

7", 26 #/ft, L80, FJ at 6550'

TUBING:

Subsurface Safety Valve at 250 ft

3 1/2", 9.3#/ft, L80, Premium thread at 6170'

PACKER:

Permanent Production Packer

Check valve (optional)

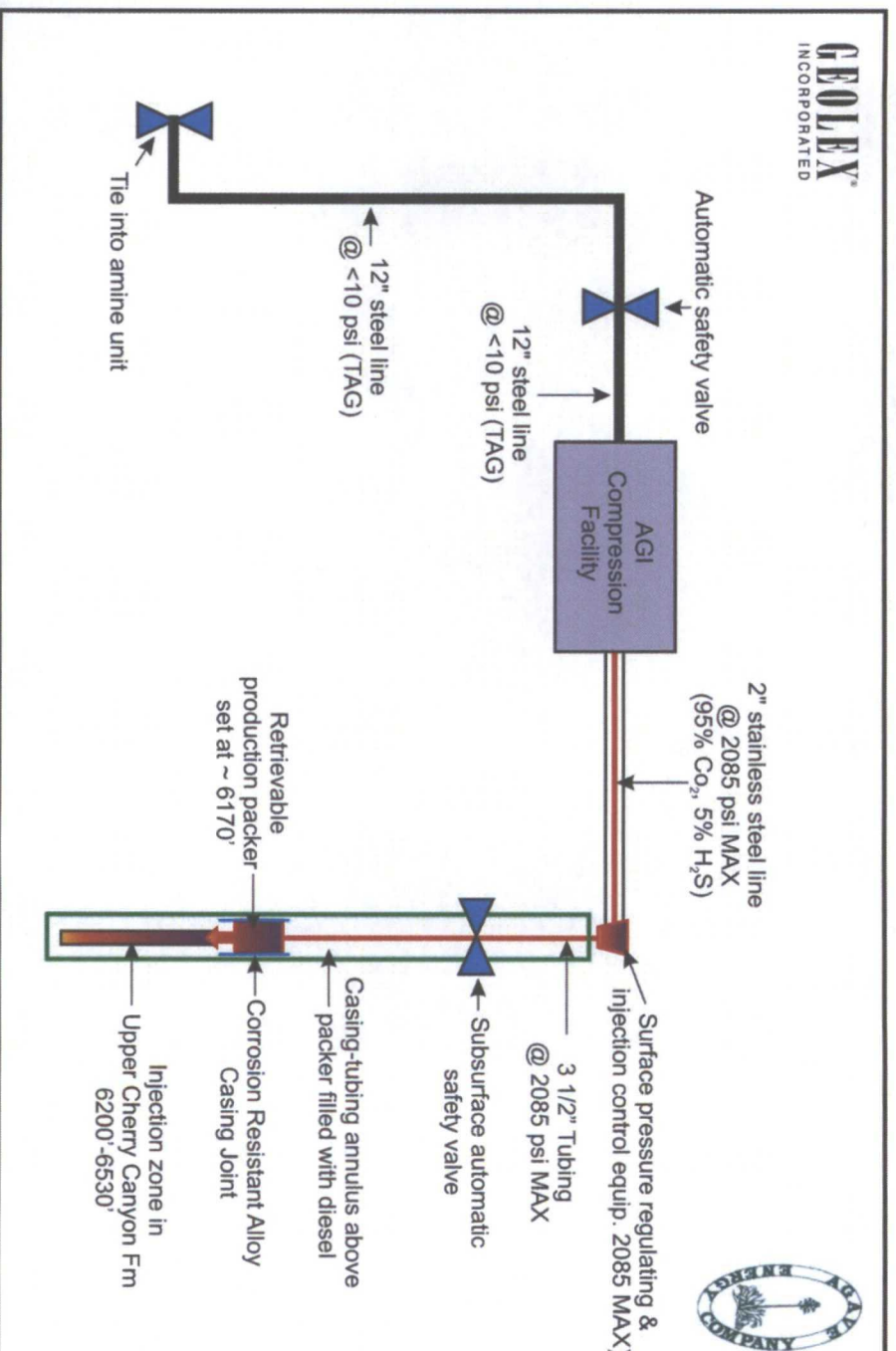
PERFORATIONS:

Primary Target	Secondary Target
Upper Cherry Canyon Fin	
at approx. 6200'-6530'	

Generalized Design of AGI System

- ▶ Conceptual design shown on Figures 2 and 3 of Agave'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 of acid gas injected

Schematic of Proposed AGI System



Summary of C-108: Geologic Factors Assuring Integrity and Safety of Proposed AGI

- ▶ No faults or structural pathways identified in the area of review
- ▶ Caprock is an interbedded sequence of low permeability rocks which form an effective barrier above injection zone
- ▶ Proposed injection pressure is well below fracture pressure of reservoir and caprock
 - MAOP of 2085 psig calculated per NMOCD requirements



Summary of C-108: Well Design Factors

Assuring Integrity and Safety of Proposed AGI

- ▶ Casing will be set to protect surface water and potential production in Delaware Group
- ▶ Safety features include:
 - Corrosion-resistant well tree and packer (Inconel)
 - Corrosion-resistant Subsurface safety valve (Inconel) set at 250'
 - Check valve & adjustable choke at packer to control optimum injection pressures
 - Corrosion-resistant casing joint to set packer
 - Acid-resistant cement in first stage around packer annulus
- ▶ Similar designs have been implemented successfully for many years without any leakage problems at similar zones in NM, Texas and Alberta, Canada, including 8 such installations designed, permitted and completed by Geolex

Key Elements of Agave'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 potential air emission upsets by eliminating flaring as control for sulfur in sour gas
- ▶ Nearby oil and gas wells, nearby water wells and surface water are protected by well design and geologic factors
- ▶ This project will result in significant economic benefits to NM through additional royalties from production, employment and taxes
- ▶ All operators and surface owners within area of review have received timely and proper notice and surface owners very supportive of project

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

- ▶ Adequacy of injection reservoir has been demonstrated by detailed review of available data
- ▶ Agave's C-108 application details the full information needed to approve the installation of AGI well
- ▶ H₂S Contingency Plan for proposed AGI will be submitted and approval obtained prior to initiation of injection
- ▶ BLM APD has been determined to be complete and is in review for approval by end of 2011
- ▶ Kaiser Francis' Bell Lake Unit is well protected due to geologic and well design factors and limits of area of reservoir to be affected by TAG injection

Agave's Request for NMOCC Order

- ▶ Approve Red Hills AGI #1 as requested pursuant to C-108 Application
- ▶ Agave requests permission to inject acid gas at a maximum rate of 13MMCFD and maximum operating pressure of 2085 psig
- ▶ Agave would drill well in late 2012 as required to accommodate anticipated increases in H₂S concentrations in inlet gas and as CO₂ volumes increase as the Red Hills Plant ramps up