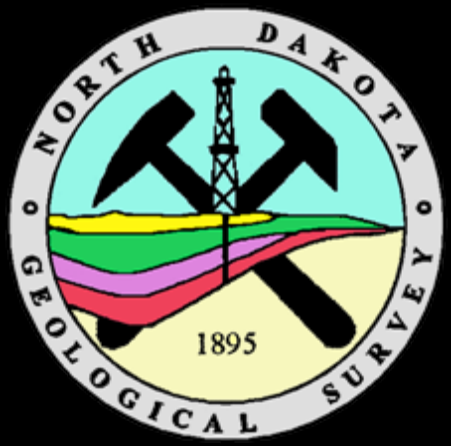
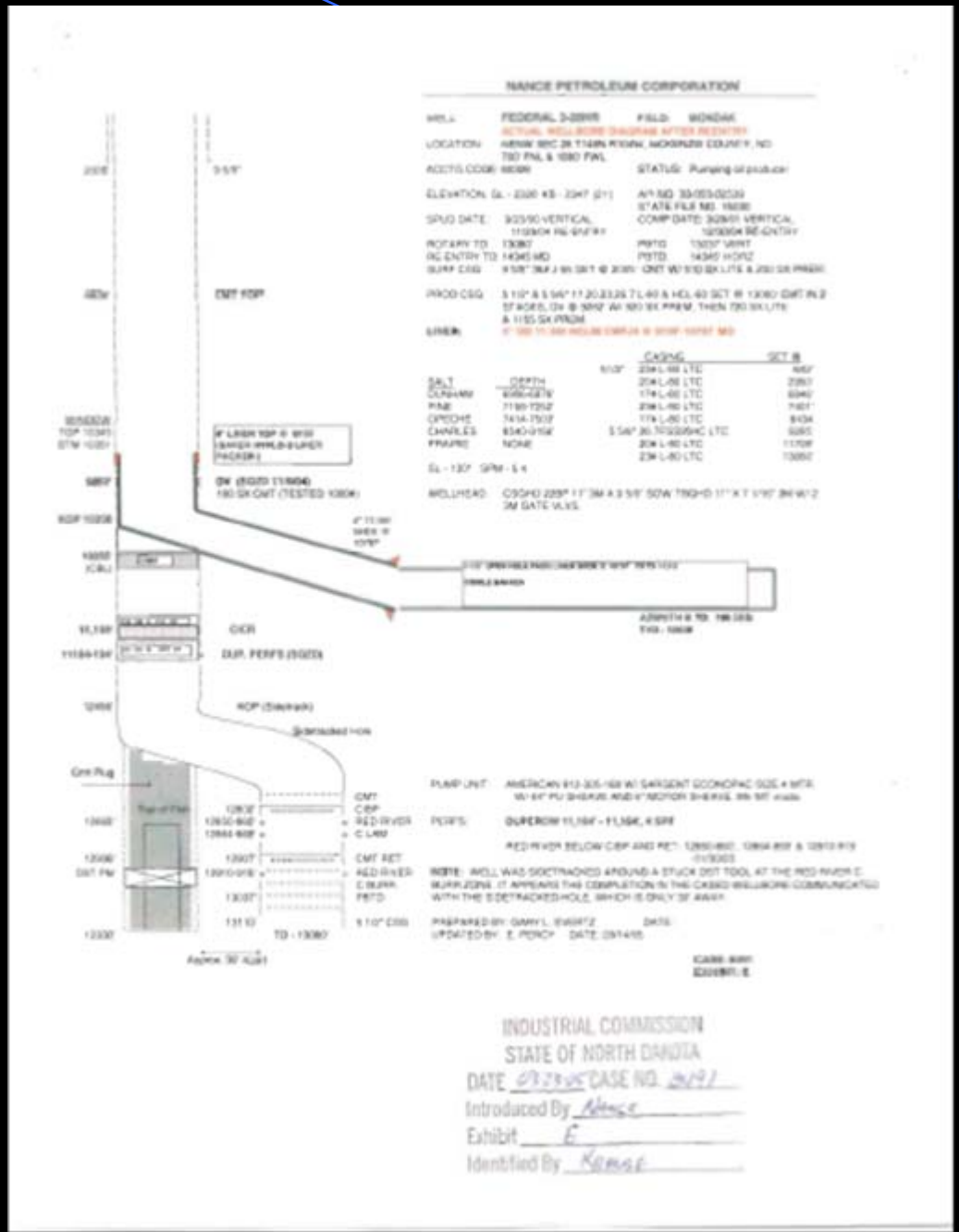
Middle Bakken Play
The Ongoing Evolution of Bakken E&P

Lynn D. Helms
NDIC Dept. of Mineral Resources



Re-Entry – Open hole – Lodgepole liner un-cemented



NANCE PETROLEUM CORPORATION

INDUSTRIAL COMMISSION
STATE OF NORTH DAKOTA
DATE 07/29/05 CASE NO. 14197
Introduced By Nance
Exhibit E
Identified By Nance

- Re-Entry
  - Open hole
  - Lodgepole liner uncemented
  - Proppant Fractured after 4 months
  - Problems and Questions
    - This worked!
    - Liner maintained hole stability?
    - Liner hanger packer kept proppant fracture in zone?
    - Pressure drawdown kept proppant fracture in zone?
    - Good rock?

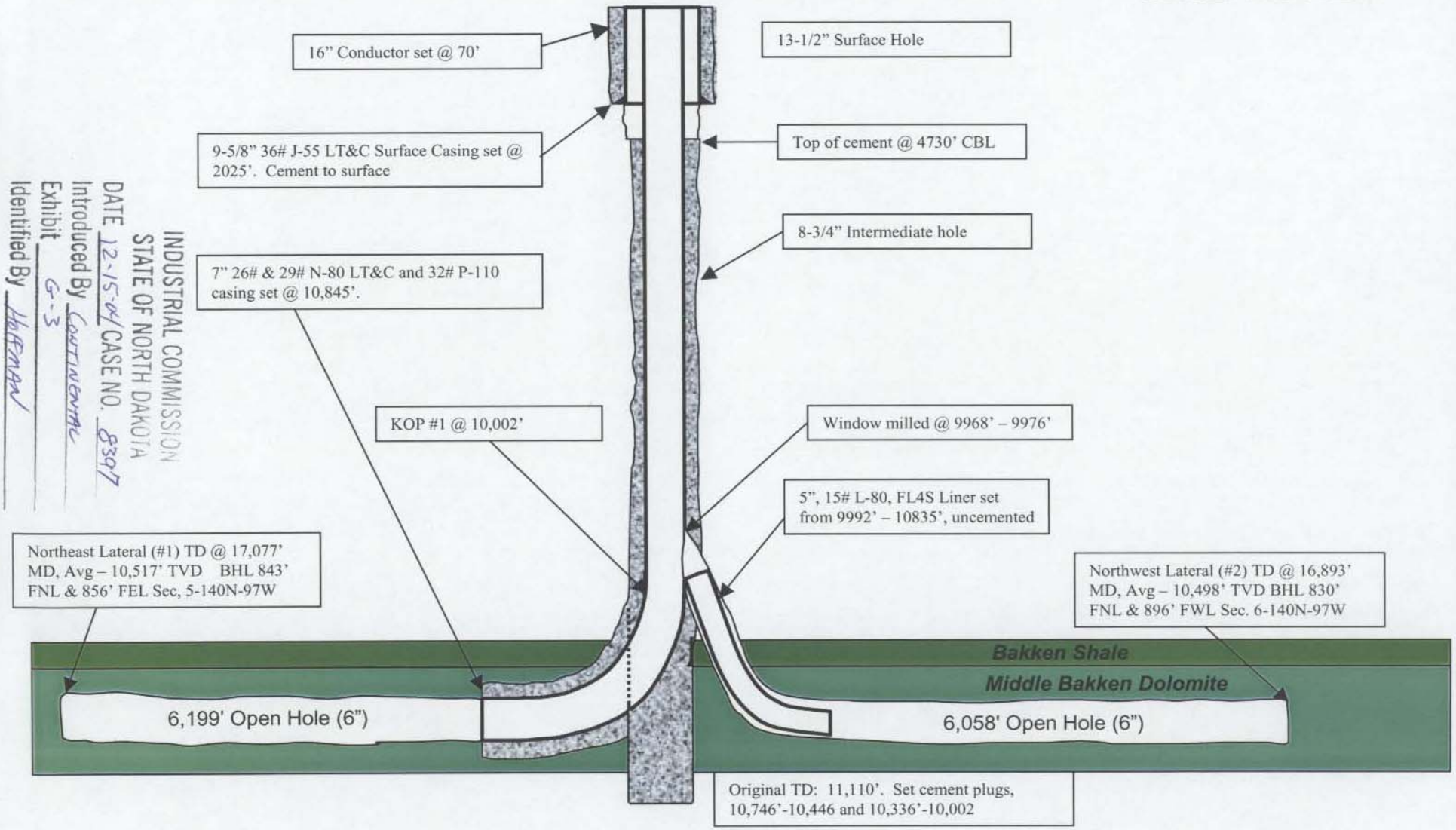
Dual Lateral
Well Construction Diagram

Eleanore 1-5H

Section 5-140N-97W 415' FSL & 160' FWL
Elevation 2,651' GL & 2,669' KB
Stark County, ND

EXHIBIT G-3

CASE NO. 8397



INDUSTRIAL COMMISSION
STATE OF NORTH DAKOTA
DATE 12-15-04 CASE NO. 8397
Introduced By Courtney
Exhibit G-3
Identified By Hoffman

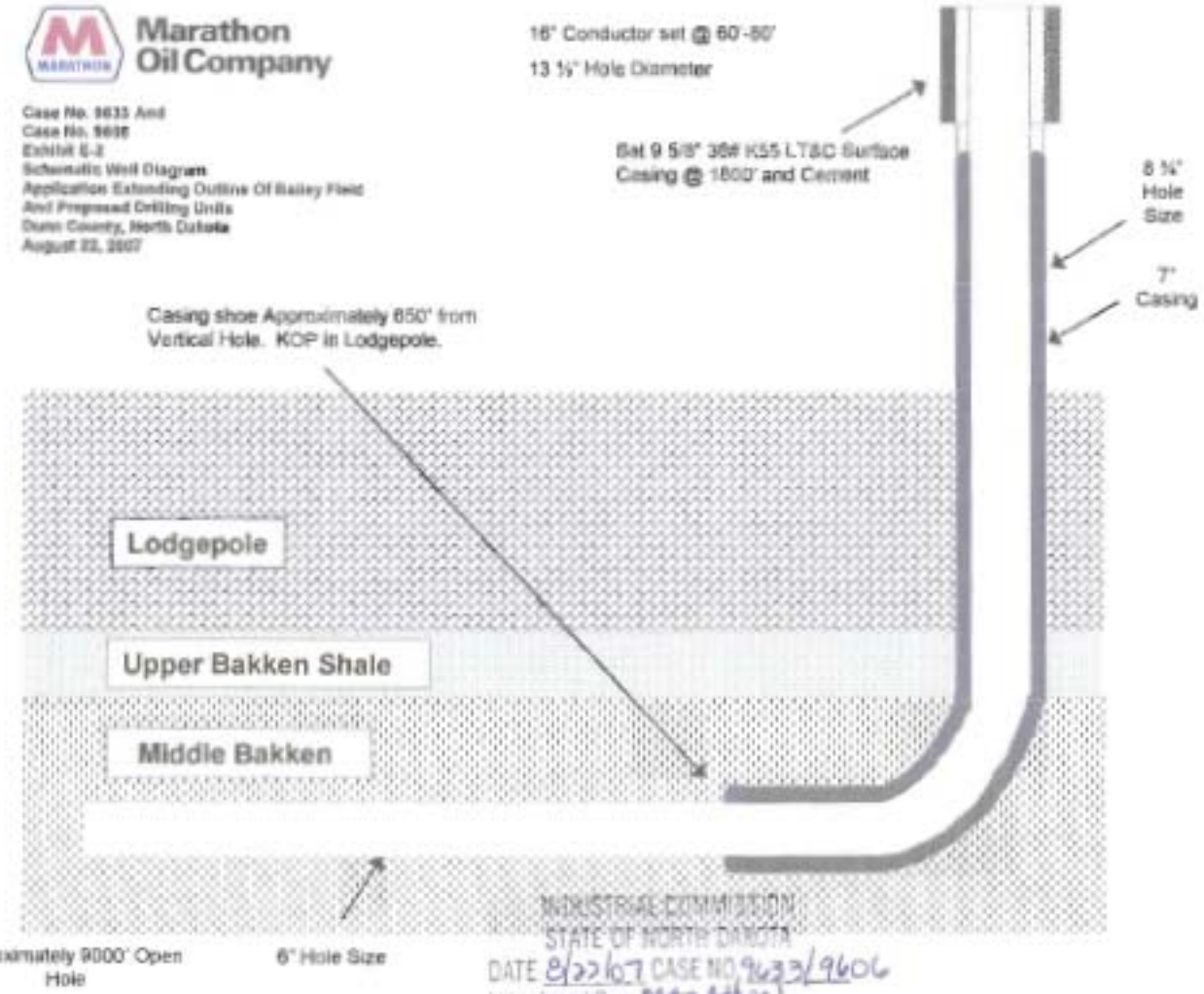
- Dual lateral
  - Open hole or perforated liners
  - Lodgepole lined but un-cemented
  - Proppant Fractured
  - Problems and Questions
    - This has not worked!
    - Liner maintains hole stability?
    - Proppant fracture grows into Lodgepole & Mission Canyon?
      - water salinity and H_2S indicative of Mission Canyon
      - isolated the lateral with the Lodgepole un-cemented (spacing?)
    - Only for the best rock?
    - Will more pressure drawdown keep prop fracture in zone?

Conclusions

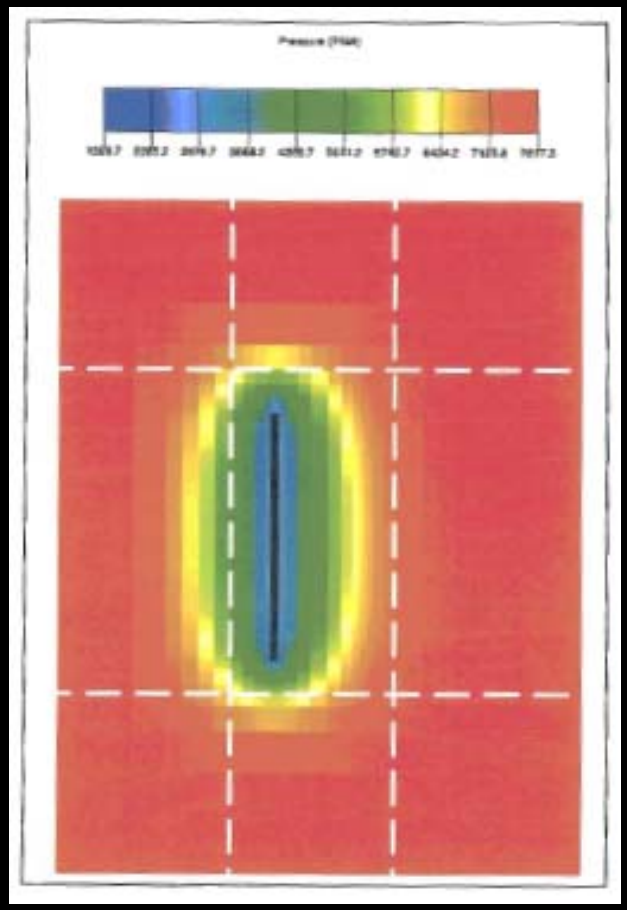
- ND bottom hole temperature is high
- ND is clastic versus carbonate
- ND bottom hole pressure is high (>0.55 psi/ft)
- Bakken shale in open hole is not stable
- Rock properties
  - Naturally fractured
  - Oil wet
  - Swelling and migrating clays

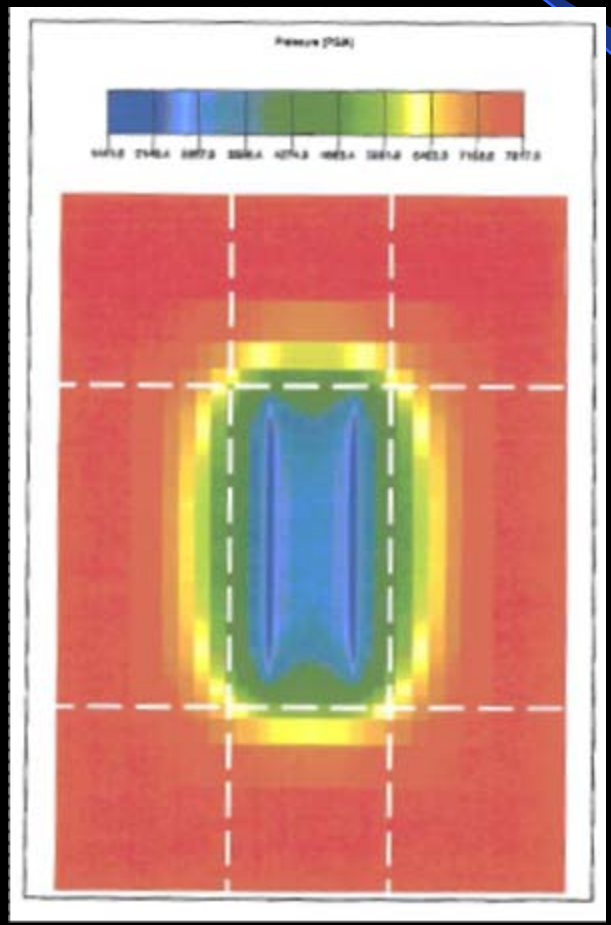
Marathon Oil Company

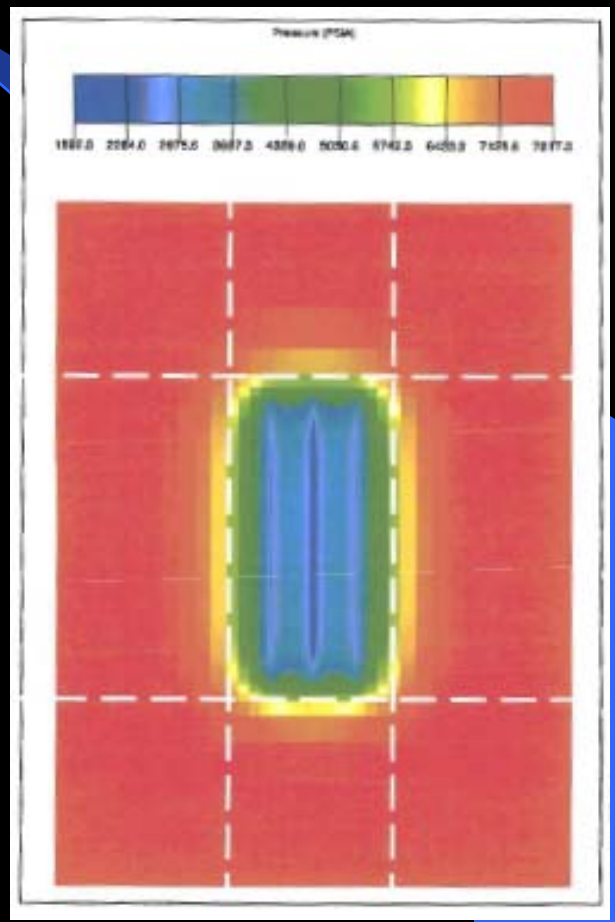
Case No. 9633 And
Case No. 9606
Exhibit E-2
Schematic Well Diagram
Application Extending Outline Of Bailey Field
And Proposed Drilling Units
Dunn County, North Dakota
August 22, 2007



INDUSTRIAL COMMISSION
STATE OF NORTH DAKOTA
DATE 8/22/07 CASE NO 9633/9606
Introduced By MARATHON
Exhibit E-2
Identified By Cook







Economic Summary

	High kh			Medium kh			Low kh		
Scenario	Investment M$	NPV10 M$	Recovery MBO	Investment M$	NPV10 M$	Recovery MBO	Investment M$	NPV10 M$	Recovery MBO
One well	5,500	7,958	790	5,500	950	333	5,500	-1,065	202
Two wells	11,000	11,885	1,251	11,000	1,317	617	11,000	-4,318	279
Three wells	16,500	14,625	1,353	16,500	-301	721	16,500	-6,459	379

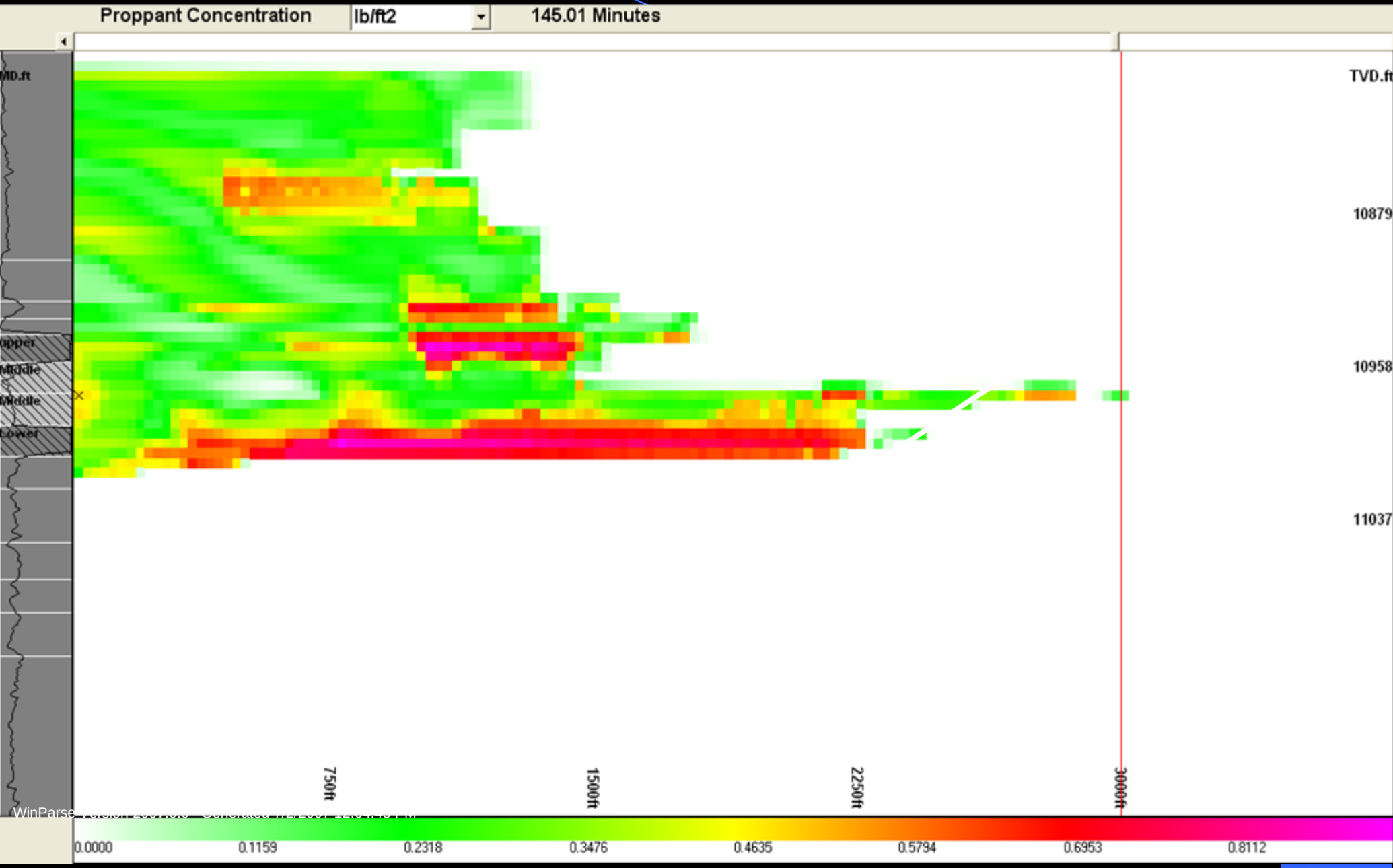
Marathon Oil Company

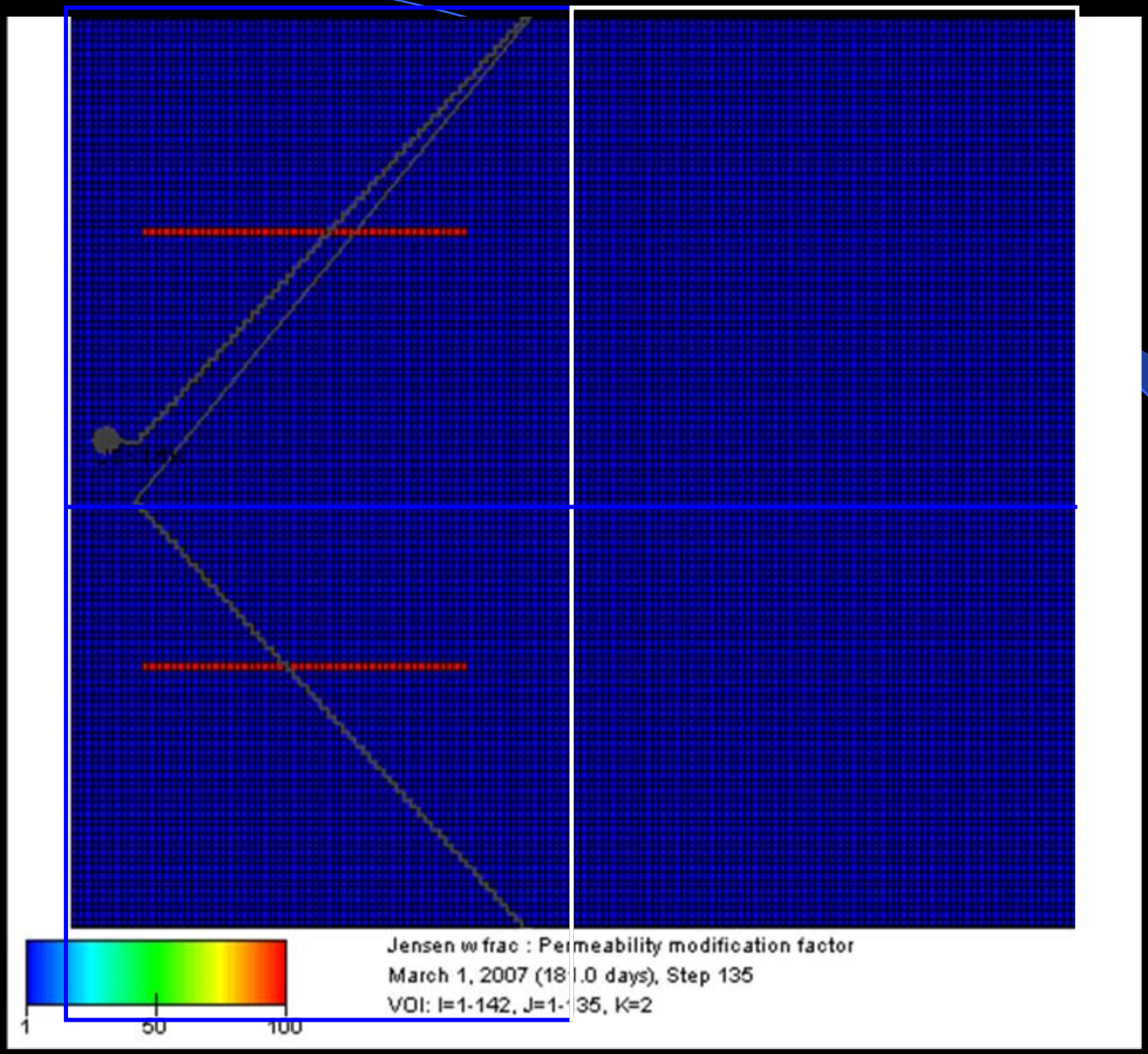
Case No. 9833 and
Case No. 9836
Exhibit 6-5
Economics Summary
Application Extending Outline Of Bailey Field
And Proposed Drilling Units
Dunn County, North Dakota
August 22, 2007

Margaret #3-15 Frac

- Margaret #3-15 Frac
  - Date - 4/6/2007
  - Time - 9:42 AM to 12:46 PM
- East and West offsets pressure buildups
- Most response seen in the East offset
  - East offset delta 300 psi in 45 minutes
  - West offset delta 20 psi in 3 hours

Jensen 1-5H Frac Model Using Middlestatd 1-17 Logs
WinGOHFER Proppant Concentration

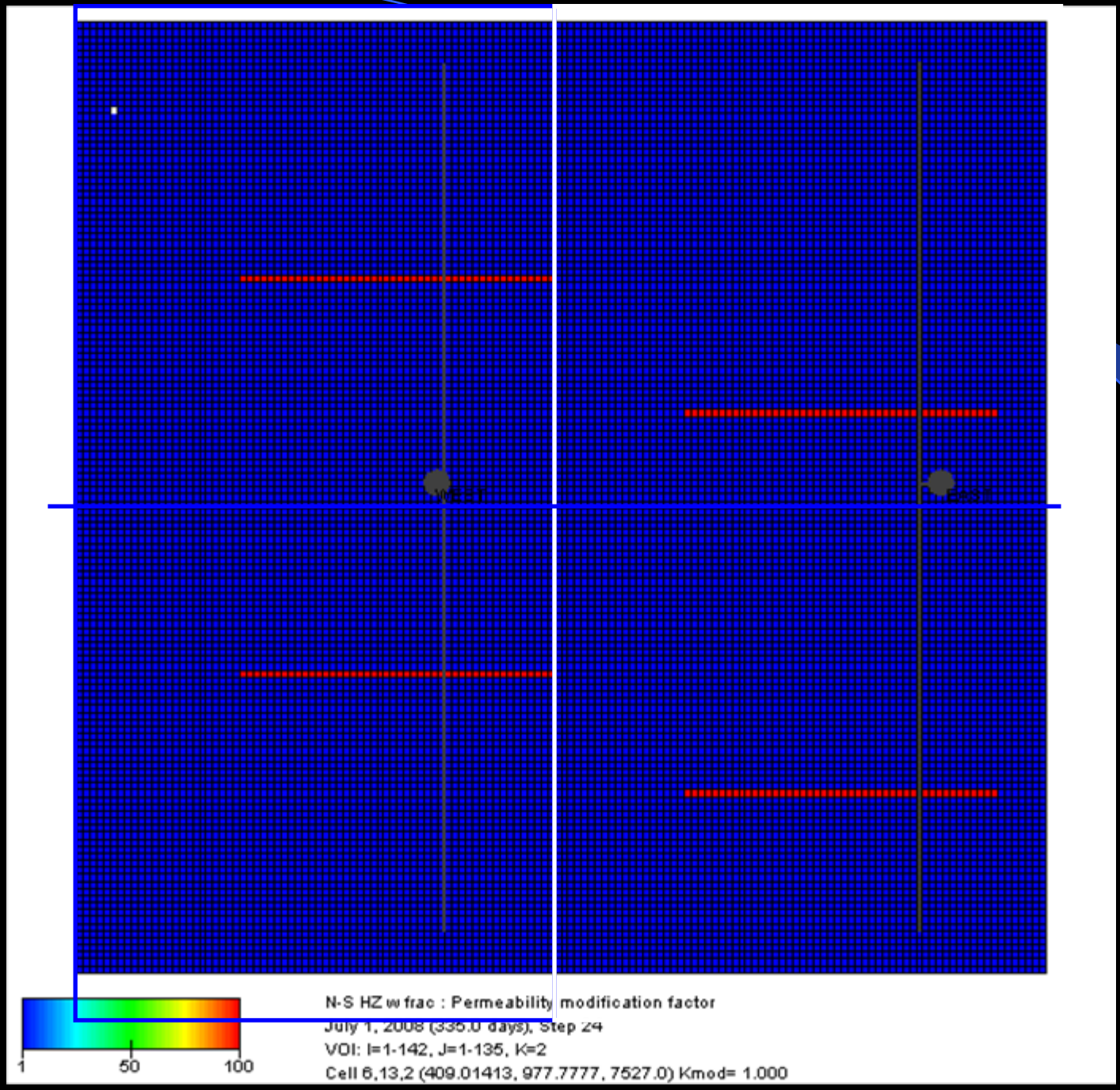




Areal view of Model grid for Jensen 1-5H

Dark line represents wellbore path

Red line represents the high perm of the Hydraulic Fractures



Model grid for 4 section area with N-S Hz Wells

Dark line represents wellbore paths

Red line represents the modeled Fractures

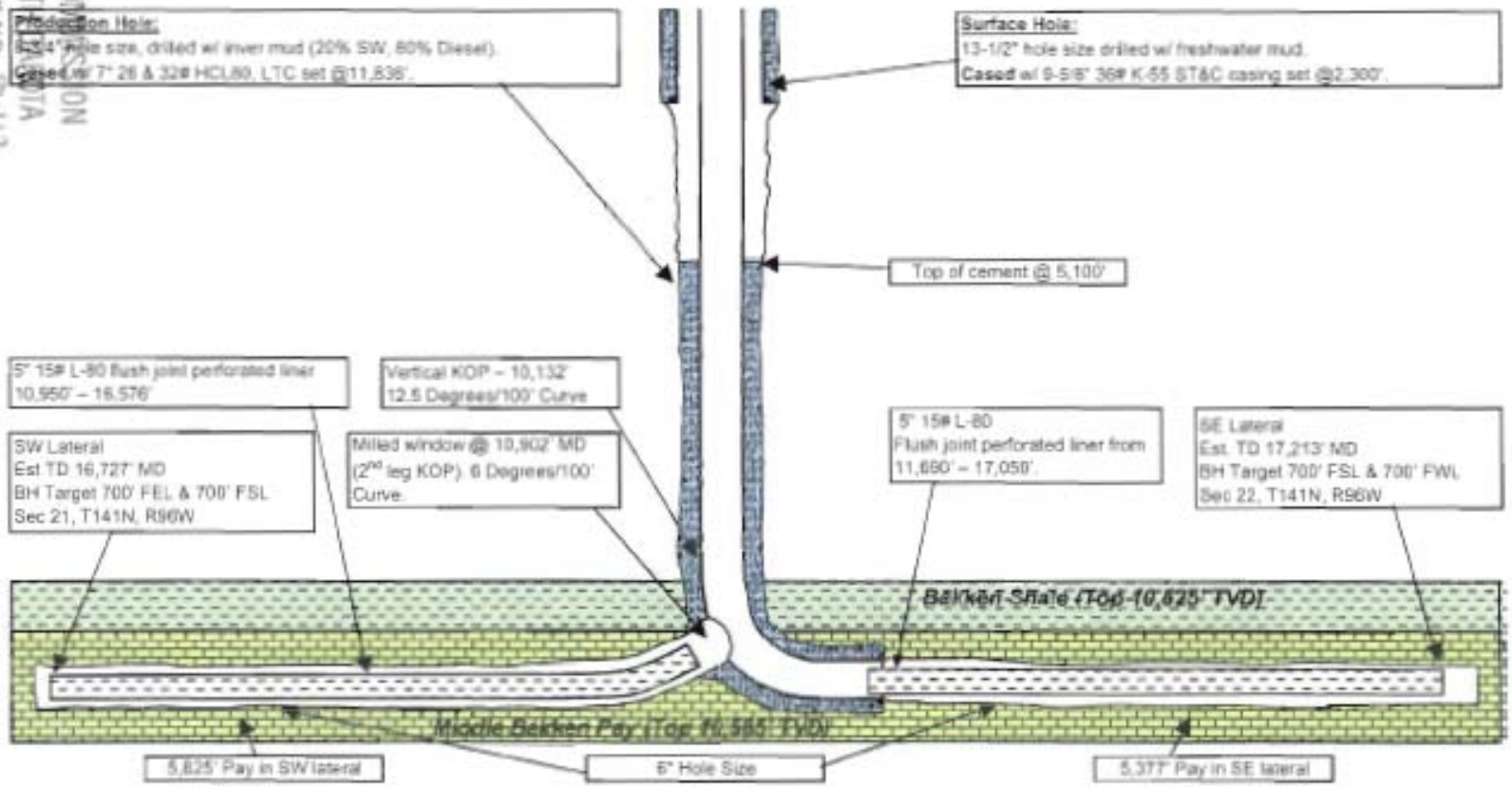
Summary

- Fracture and production modeling of the Jensen 1-5H indicates fracture half lengths of 2500’ or more.
- Lower permeability and long fracture(s) help the model match production and pressure behavior better than higher permeability.
- Multiple shorter fracs per lateral provide too much production capacity to match observed pressure and production data.

- Single lateral
  - Perforated liner or open hole
  - Lodgepole cased and cemented
  - Proppant Fractured
  - Problems and Questions
    - This has worked well
    - Casing maintains hole and minimizes upward fracture growth
    - Mechanically simple
      - Fractures un-controlled
      - Significant proppant in lateral on clean outs

Well Construction Diagram

Russian Creek Prospect - Ficek 41-21H
SHL: 275 ft FNL; 300 ft FEL Sec 21
NE NE Sec 21 T141N-R96W
Elevation: 2641 GL 2661 KB
Dunn County, ND



Case No. 8642
Exhibit 6
July 27, 2005

ANSBRO PETROLEUM COMPANY

Case #9590

PRELIMINARY CONSTRUCTION DIAGRAM

Headington Oil Co, LP
Well Construction Diagram

Fenton Federal 14x-33
Location: SW SW Sec 33 - T148N - R96
Footage: est. 300 FWL & 700 FSL
Elev: est. Graded Pad 2040, KB 2061
Dunn County, North Dakota

Directions to Well:
32.5 miles E of Williston, ND on Highway 1804, then 1 mile S, then 2 miles W on CR to well.

16" Conductor set at 60' - 80'. Drill out w/ 13.5" bit.
Set 9-5/8" 36# K-55 surface casing at **1,500**
Lead Cement: **302** Sacks SwiJel - Control Set C plus 0.25% CFL-3, 1% CGC-60 and 1/4 #/sk Cellofalke. Mixed at 18.95 gps wtr, 3.00 ct/sk yield and 11.2 ppg.
Tail Cement: **200** Sacks Class G plus 2% CaCl2 and 1/4 #/sk Cellofalke. Mixed at 5.0 gps wtr, 1.15 ct/sk yield and 15.8 ppg. Volume calculated using 55% excess.

6-3/4" hole size. Drilled with invert mud (80% diesel & 20% SW)
7" Casing set at: **11,550** FT MD
Lead Cement (top at **4,600** & **30.0°**) **196** Sacks LiteCRETE w/ 10% Salt, 0.7% Dispersant, 0.25% Fluid Loss, 0.3% Retarder, 0.2% Anti-foam and 1/4#/sk Cellophane Flakes. Yield: 1.85 ct/sk, Wt: 11.5 ppg.
Tail Cement (top at **6,200** & **30.0°**) **763** Sacks Class G w/ 35% Silica Flour, 3% KCL, 0.2% Fluid Loss, 0.6% Dispersant, 0.8% Retarder, 1/4#/sk Cellophane Flakes. Yield: 1.59 ct/sk, Wt: 15.6 ppg.
Assume 9" caliper hole.

Lat #1 TD: 15,045 FT MD
Liner: 5" 15# L80 FJ
11,440 to 14,945 Pre-Drilled 1 per 2 FT

KOP1
10,307
14deg/100

Bakken Target
Pay TVD:
10,716

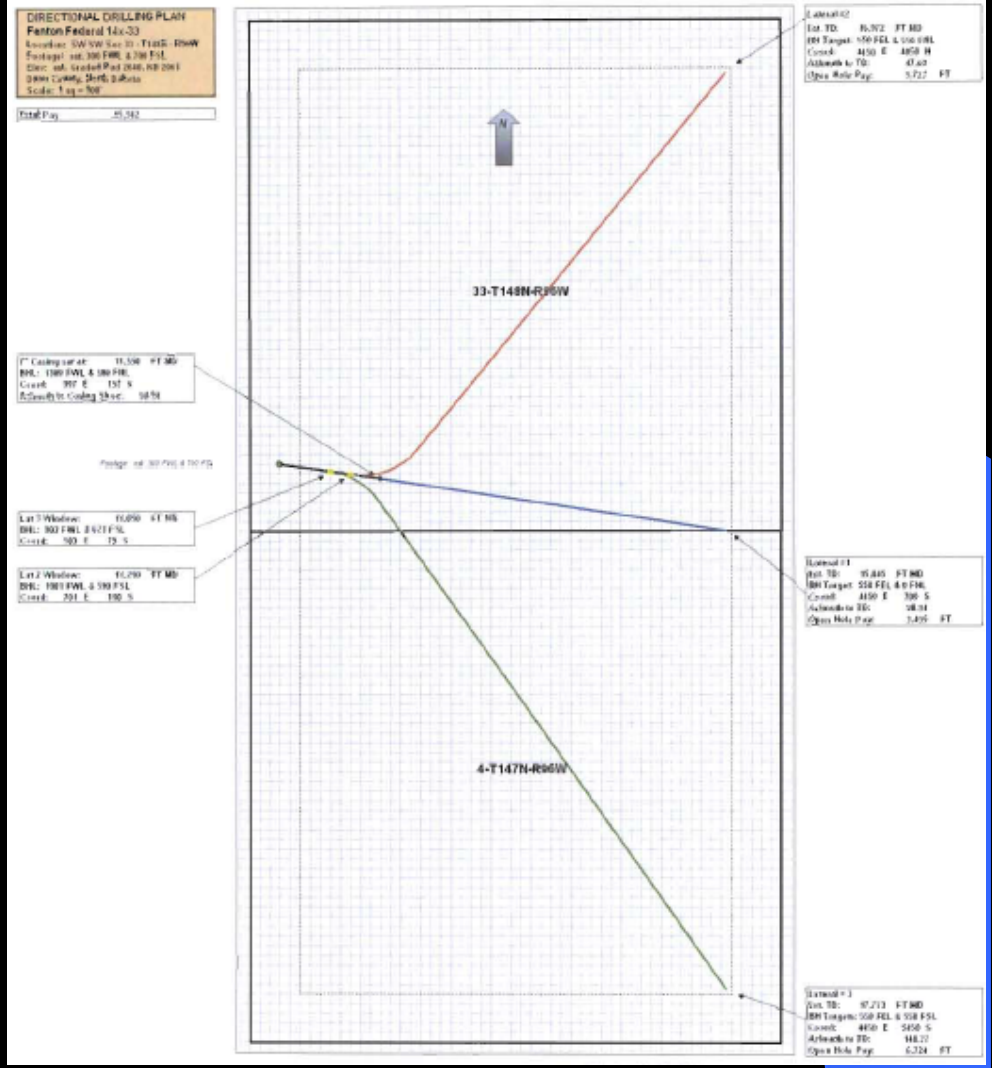
Bakken Shale
Bakken Dolomite Pay

Lat #2 TD: 16,972 FT MD
Window: 11,250
Liner: 5" 15# L80 FJ
11,250 to 16,872 Pre-Drilled 1 per 2 FT

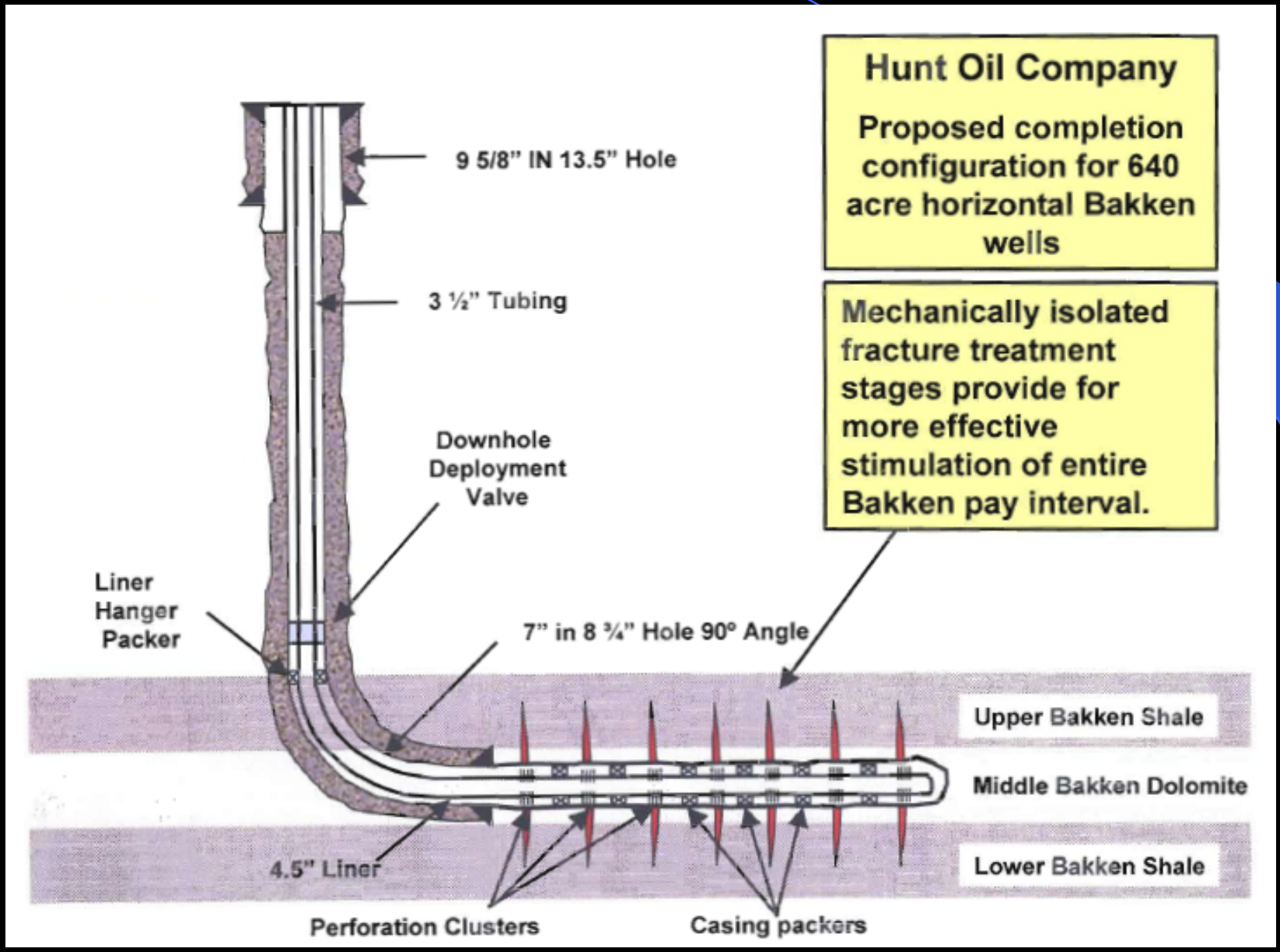
Lat #3 TD: 17,773 FT MD
Window: 11,050
Liner: 5" 15# L80 FJ
11,075 to 17,673 Pre-Drilled 1 per 2 FT

PRELIMINARY DIRECTIONAL DRILLING PLAN

Case #9590



- Dual or Tri lateral
  - Open hole or perforated liners
  - Coplanar - Lodgepole lined and cemented
  - Proppant Fractured
  - Problems and Questions
    - This has worked
    - Casing and liners maintain hole stability
    - Proppant fracture growth into Lodgepole
      - Frac fluid recovery much higher than in Montana
      - Sustained water production
    - Azimuth not optimized with respect to natural fractures


Hunt Oil Company
Proposed completion configuration for 640 acre horizontal Bakken wells
Mechanically isolated fracture treatment stages provide for more effective stimulation of entire Bakken pay interval.
9 5/8" IN 13.5" Hole
3 ½" Tubing
Downhole Deployment Valve
Liner Hanger Packer
7" in 8 ¾" Hole 90° Angle
Upper Bakken Shale
Middle Bakken Dolomite
Lower Bakken Shale
4.5" Liner
Perforation Clusters
Casing packers

- Single lateral
  - Perforated liner with swell packers
  - Lodgepole cased and cemented
  - Proppant Fractured
  - Problems and Questions
    - This has worked well
    - Casing maintains hole and minimizes upward fracture growth
    - Mechanically simple
      - Limited lateral and liner length
    - Fractures more controlled and distributed
    - Expensive

Successful Designs

- Long Single lateral 1280
- Single lateral 640
- Coplanar Dual and Tri lateral 1280
- Coplanar 640