

Stateline Increased Density Hearing

Reservoir Engineering Exhibits



Sample Gas in Place Calculation

Average Isotherm Properties for the Stateline

P_L (psia)	473
$V_{L,DAF}$ (scf/ton)	705
ash (fraction)	0.345149
moisture (fraction)	0.030524
bulk density (g/cc)	1.530988

***Taken from five wells (eight samples total)

Reese Mesa 8

Average Bulk Density (g/cc)	1.68
Thickness, h (feet)	42
Initial Pressure (psia)	1655
Average Drillblock Acreage in N.M. Along Stateline, acres	188

DEFINITIONS FOR VARIABLES

OGIP = Original Gas in Place, MMcf

A = Area, acres

h = Net Coal Thickness, feet

$G_{S, initial \text{ in situ}}$ = Gas Storage Capacity at Initial Conditions, in situ, scf/ton

$V_{L, DAF}$ = Dry, ash-free Langmuir Storage Capacity, scf/ton

a = Ash Content, weight fraction

w_c = Moisture Content, weight fraction

b = $1/P_L$ = Langmuir constant, $psia^{-1}$

P_L = Langmuir Pressure, psia

P = Pressure, psia

ρ = Bulk Density, g/cc

ρ_c = Density of Pure Coal, g/cc

= 1.21 g/cc, from GRI "A Guide to Coalbed Methane Reservoir Engineering"

ρ_a = Density of Pure Ash, g/cc

= 2.14 g/cc, published value for San Juan Basin, from "GRI Guide to Coalbed Methane Reservoir Engineering"

Ash Content

$$a = \frac{\rho - \rho_c}{\rho_a - \rho_c}$$

$$a = \frac{1.68 - 1.21}{2.14 - 1.21} = 0.505$$

Initial Gas Storage Capacity at Initial Conditions, In-situ

$$G_{S, initial \text{ in-situ}} = V_{L, DAF} \frac{P}{P + P_L} (1 - (a + w_c)) = V_{L, DAF} \frac{bP}{1 + bP} (1 - (a + w_c))$$

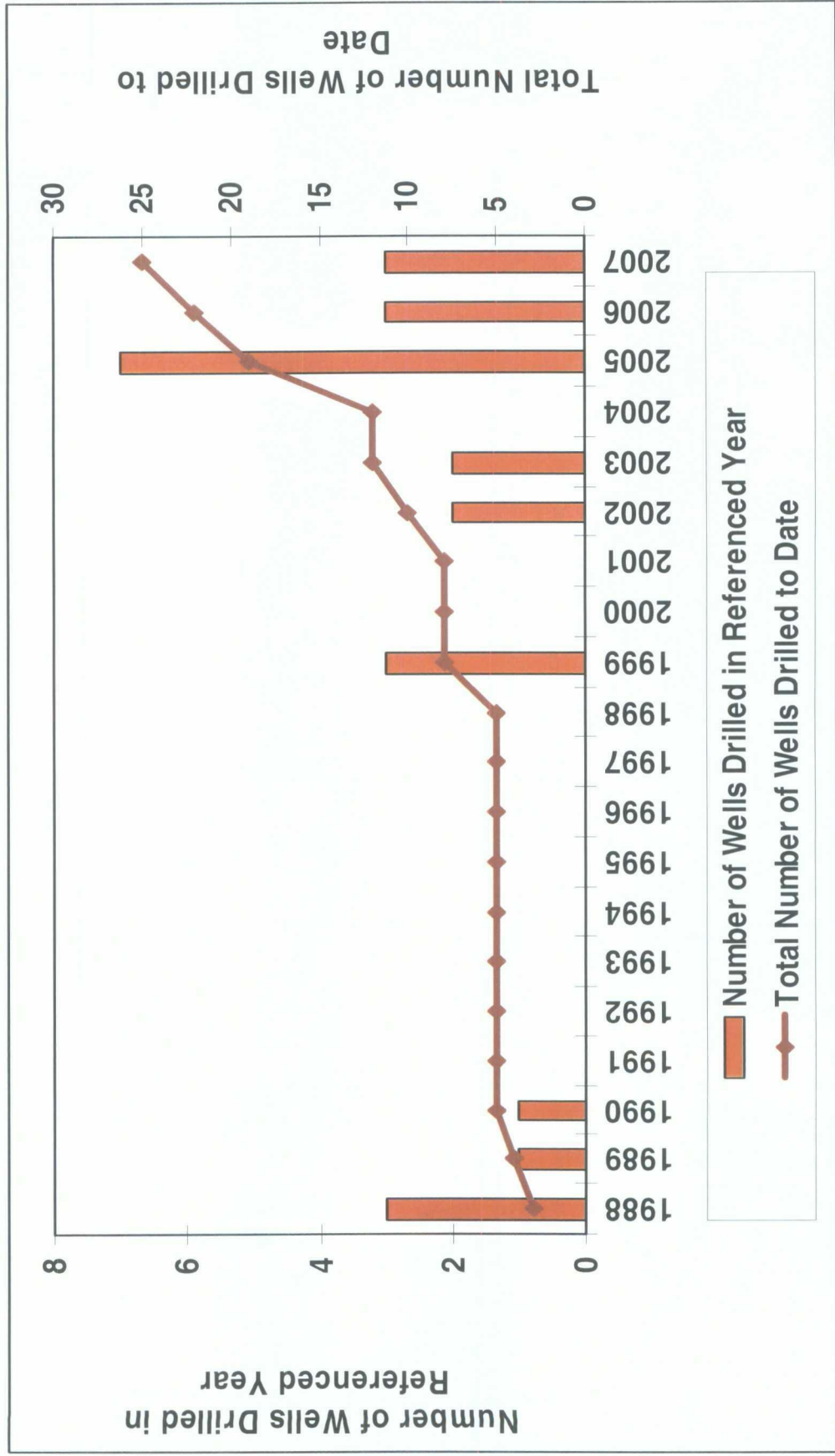
$$G_{S, initial \text{ in-situ}} = 705 \frac{1655}{1655 + 473} (1 - (0.505 + 0.0305)) = 255 \frac{scf}{ton}$$

Original Gas in Place

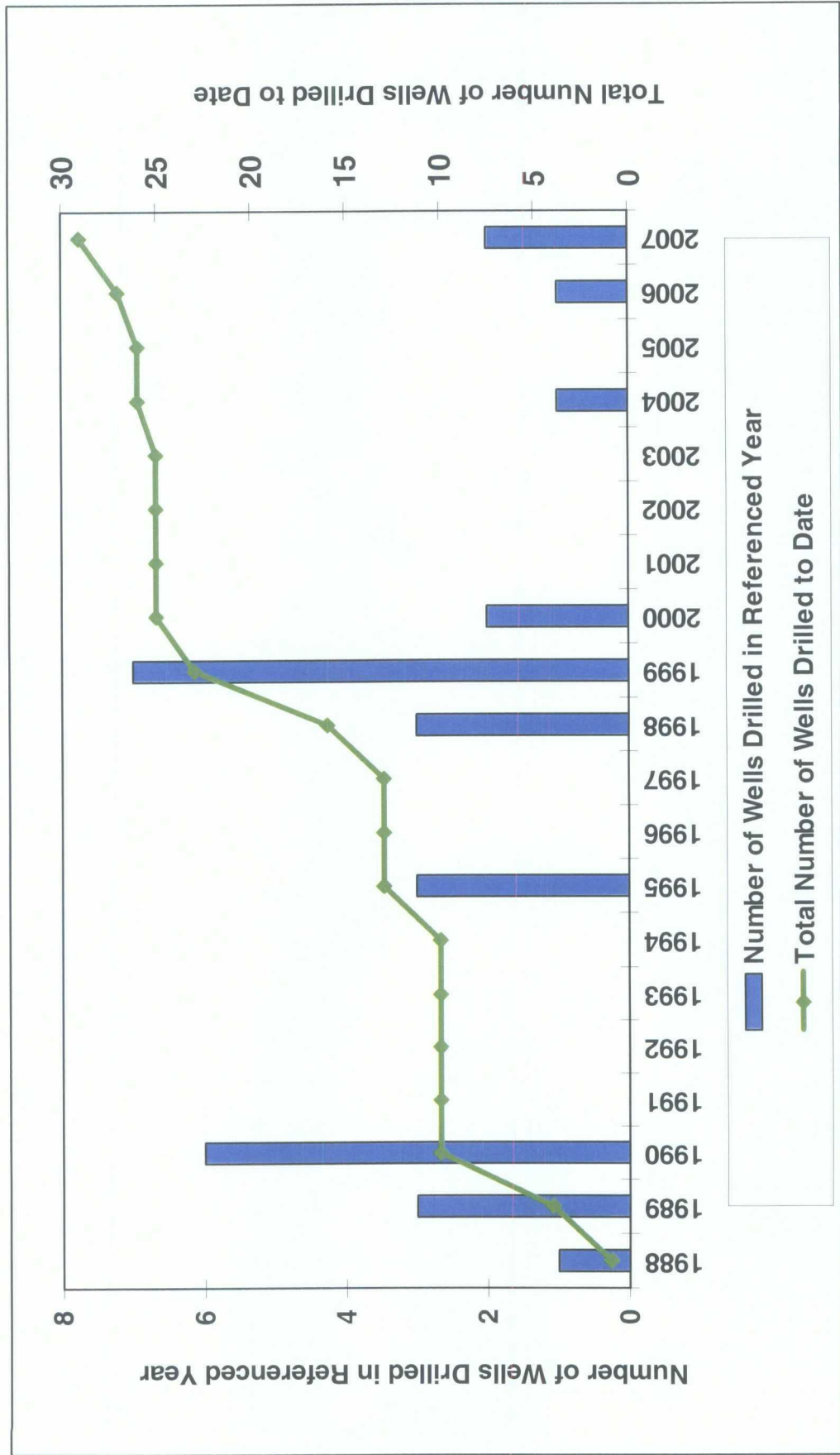
$$OGIP = \frac{1.3597}{1000} A \cdot \rho \cdot h \cdot G_{S, initial \text{ in-situ}}$$

$$OGIP = \frac{1.3597}{1000} 188 \cdot 1.68 \cdot 42 \cdot 255 = 4593 \text{ MMcf}$$

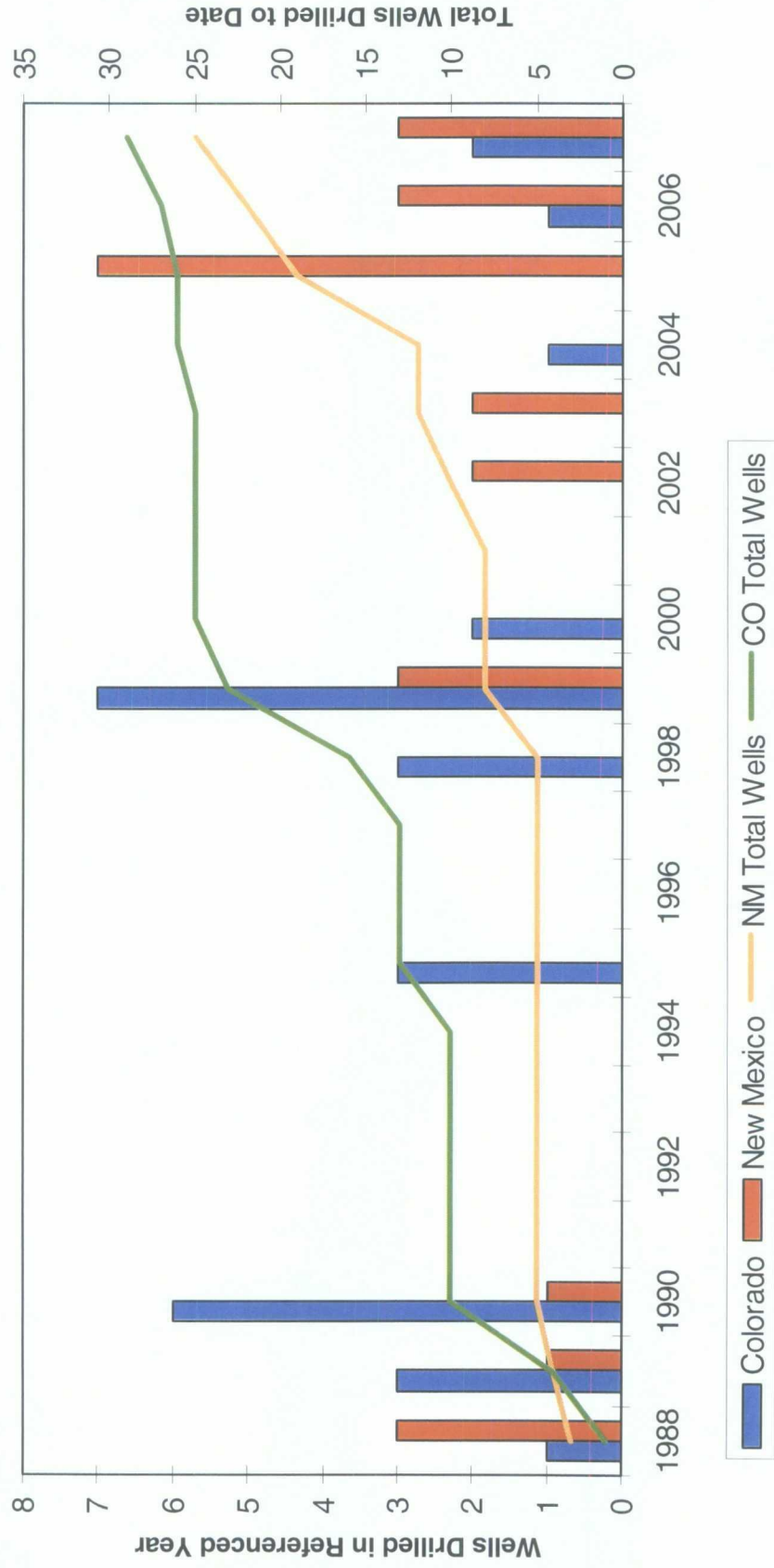
New Mexico Drilling Campaign Well Counts



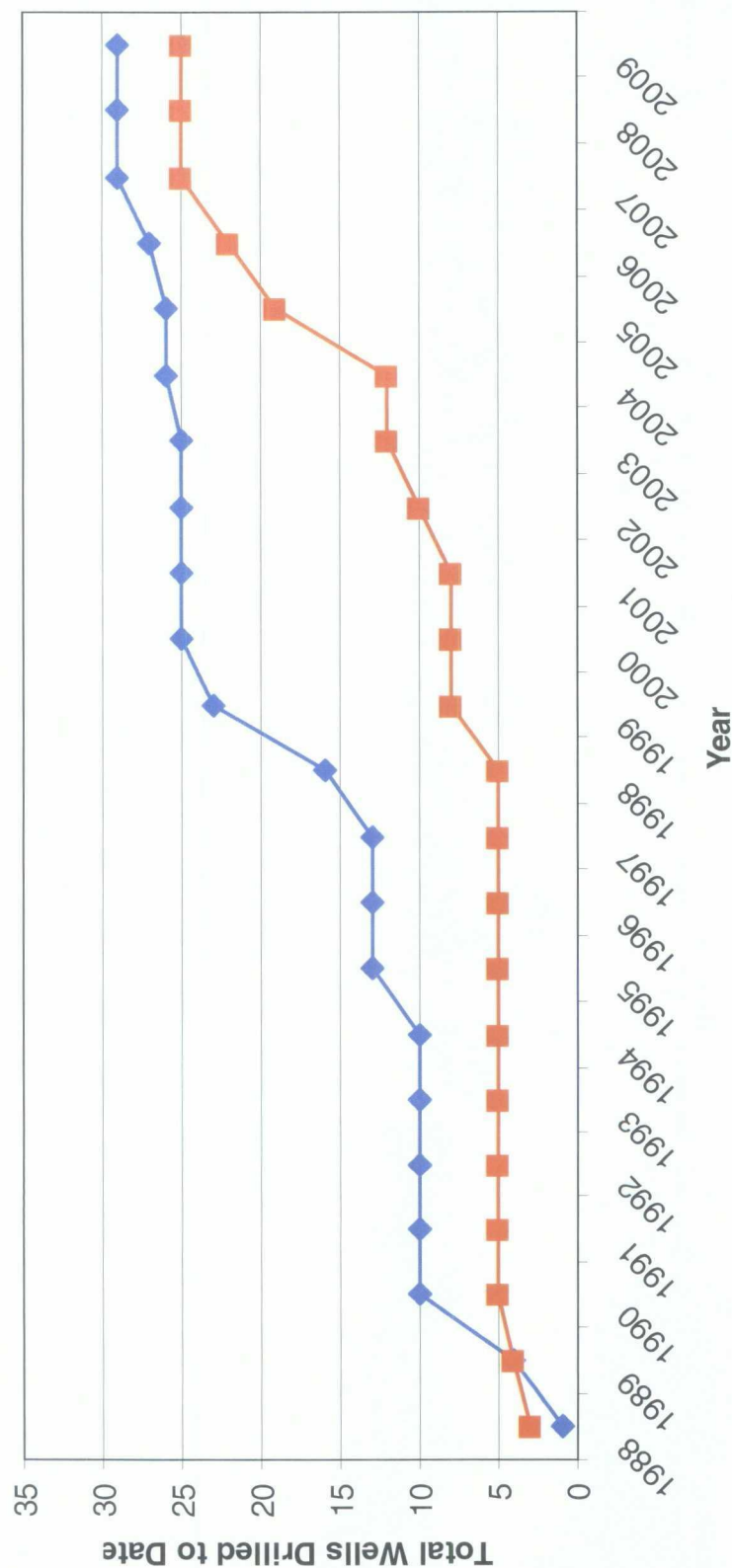
Colorado Drilling Campaign Well Counts



Drilling Campaigns



Total Wells Drilled to Date



NEW MEXICO

Total acres in New Mexico (acres)	4701
Current Density in New Mexico (acres/well)	188
Current Allowed Density in New Mexico (acres/well)	168
Current Proposed Density for New Mexico (acres/well)	112

COLORADO

Total acres in Colorado (acres)	5720
Current Density in Colorado (acres/well)	197
Current Allowed Density in Colorado (acres/well)	91

