United States Department of the Interior
BUREAU OF RECLAMATION
UPPER COLORADO REGIONAL OFFICE
P.O. BOX 11568
SALT LAKE CITY, UTAH 84147

FEB 21 1991

OIL CONSERVATION DIVISION RECEIVED
'91 FEB 25 AM 10 24

IN REPLY REFER TO:
UC-459

Mr. William J. Lemay
Director
New Mexico Oil Conservation Division
PO Box 2088
Santa Fe NM 87501

Subject: Fruitland Coal Gas Well Spacing, Navajo Unit, Colorado River Storage Project, New Mexico (Oil and Gas)

Dear Mr. Lemay:

Our staff in Durango, Colorado, has informed us that the well spacing for Fruitland Coal Gas development could soon be changing from one well every 320 acres to one well every 160 acres. We are requesting the following sections be designated as areas of critical concern and the spacing remain at one Fruitland Coal Gas well per 320 acres:

Township 30 North, Range 7 West, N.M.P.M.

1. Section 7, NE¼ of Section 8 and NW¼ of 18: Developed recreation area.

2. S½ of Section 18 and Section 19: Safety of Navajo Dam.

Township 30 North, Range 8 West, N.M.P.M.

1. Section 13: Safety of Navajo Dam, Reclamation facilities, wetlands, and developed and undeveloped public recreation.

For us to assure the public of the continued safety of Navajo Dam, provide protection to essential wetland areas, and to provide the public with recreation, it is imperative that the above areas remain at one Fruitland Coal Gas well per 320 acres until all environmental concerns are addressed in a new Environmental Impact Statement (EIS) completed by the appropriate Federal agency.

We appreciate the opportunity to comment on this important issue. If you have any questions, please contact Steve Sacks at our Durango Projects Office at FTS 323-6574.

Sincerely,

FOR Roland Robison
Regional Director

cc: Area Manager, Bureau of Land Management, Farmington Resource Area, 1235 LaPlata Highway, Farmington NM 87401

Memo

From

ERNIE BUSCH
Geologist - Field Rep.
3-27-89

To DAVE CATANACH

THE LETTER I WAS TELLING
YOU ABOUT

Oil Conservation Aztec, New Mexico

A. R. KENDRICK
BOX 516 • AZTEC, NEW MEXICO 87410 • (505) 334-2555

March 6, 1989

Mr. Ernest L. Busch
Oil Conservation Division
1000 Rio Brazos Road
Aztec, New Mexico 87410

Re: Order R-8769, Fruitland Nomenclature Order

Dear Ernie:

The move to expedite time seems to have caused some slight problems in pool definitions in the referenced order.

The wording ". . . are hereby contracted to include only the sandstone interval of the Fruitland formation . . ." in paragraphs (j), (l), (r),(t), (y), and (z) seems to be too restrictive to have the pool names continue to include the words "Pictured Cliffs".

It appears to me that the word "only" eliminates any Pictured Cliffs formation participation in these pools.

Yours very truly,

A. R. Kendrick

MALLON OIL COMPANY
1099 18th Street, Suite 2750, Denver, Colorado 80202
(303) 293-2333

8 37

February 8, 1991

State of New Mexico
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Attn: Florene Davidson

RE: Case 9420, Order R-8768
Special Pool Rules

Gentlemen:

I, Kevin Fitzgerald , am hereby making an appearance on behalf of Mallon Oil Company on the above referenced case on the following dates of February 21 and 22nd . I am requesting to receive copies of all documents filed in the Case 9420.

Sincerely yours,

MALLON OIL COMPANY

Kevin Fitzgerald
President

KF:gb

Memo

From

ERNIE BUSCH
Geologist - Field Rep.

To DAVE CATANACH

Oil Conservation Aztec, New Mexico

COAL WELLS

MERIDIAN
20 comp + Prod
40 completed
4 ~~being~~ completed
11 waiting for completion rigs
6 plugbacks
203 locations staked not yet drilled

Amoco
Cedar Hill -
10 comp ~~[illegible]~~ 2 not hooked up to a pipe line
3 redrills proposed
1 new drill proposed
2 recomp in Fit. ~~not~~ proposed

Blanco
6 recomp
3 new drills
~~2 recomp~~
Colo. 104 proposed

Tenneco
23 completed + producing
10 new drills proposed

Union Texas
4

Dugan
~~20 28 27~~
9 coal wells ~~only [illegible]~~
4 proposed

ICF RESOURCES[SM]
INCORPORATED

165 South Union Boulevard, Suite 816, Lakewood, Colorado 80228 Phone: 303 986-2121 Fax: 303 986-8017

January 24, 1991

NMOCD Examiner
New Mexico Oil Conservation Division
P. O. Box 2088
Santa Fe, NM 87501

RE: San Juan Coalbed Methane Committee Spacing Report
Case 9420, Order R-8768 Basin Fruitland Coal Pool

Dear Sir:

Enclosed is an outline of testimony and list of exhibits which will be presented on behalf of the San Juan Coalbed Spacing Committee and the Gas Research Institute before your Commission on February 21, 1991. The list of exhibits is not entirely complete at this time and some slight variation may be expected by February 21st.

We expect the direct testimony to require approximately 2-1/2 hours on February 21st. Should you desire a shorter presentation, perhaps we can decide between us what features of the intended testimony are not required.

Sincerely,

ICF RESOURCES INCORPORATED

John E. McElhiney, Ph.D.
Vice President

JEM/kmh
Enclosure

cc: Rich McBane, GRI

06K00530.

PROPOSED OUTLINE OF TESTIMONY
FOR THE SAN JUAN BASIN COALBED METHANE SPACING STUDY
TO BE PRESENTED AT THE
NEW MEXICO OIL CONSERVATION DIVISION EXAMINER HEARING
CASE NO. 9420, ORDER NO. R-8768

I. INTRODUCTION

A. Study Objective - develop an appropriate methodology for evaluating well spacing in the development of the coalbed methane resources of the San Juan Basin.

B. Definition of Areas 1, 2 and 3 of the San Juan Basin - adopted from Bureau of Economic Geology.

II. TECHNICAL APPROACH

A. Basis: Reservoir simulation-based approach to study.

B. Model Validation

1. Validated simulator utilized in the investigation by comparison to results from Arco Oil and Gas simulator.

2. Further validation of simulator achieved by history matching actual field and laboratory data from an area with established commercial levels of production; i.e., the Cedar Hill field in Area 1 of the basin.

C. Reservoir Characterization

1. Purpose: provide realistic range in reservoir parameters that can be anticipated for a particular area of the basin; i.e., Areas 1, 2 and 3.

2. Review literature as well as available field and laboratory data.

3. History match available field and laboratory data, where feasible; e.g., Cedar Hill and Tiffany fields in Area 1 of the northern San Juan Basin.

D. Sensitivity Analyses

1. Purpose: define reservoir performance (production volumes and timing) on the basis of the anticipated range in reservoir parameters from the characterization phase of the study.

2. Define a "matrix" of simulations to be run for Areas 1, 2 and 3 on the basis of the most important reservoir parameters influencing performance; i.e., cleat permeability, well spacing, fracture half-length, initial reservoir pressure and free gas saturation.

3. Define a set of "variations" where reservoir parameters not analyzed in the primary matrix are evaluated at least to a limited degree; i.e., cleat porosity, Langmuir volume, desorption pressure, and relative permeability behavior.

III. DISCUSSION OF STUDY RESULTS

A. Cedar Hill Field Area History Match (Area 1)

1. Description of sources of data; i.e. density logs, adsorption isotherm from Mesa Hamilton well, gas and water production and completion data from Dwight's, Petroleum Information, and New Mexico State records, etc.

2. Description of model building process; i.e. map building, contouring, and digitizing. Development of grid, assignment of wells to grid and layer, input of production data into model, etc.

3. Description of well control in model; i. e. water rate-driven wells with gas rate being match parameter. Calculation of flowing bottomhole pressures as a natural ancillary result of the process. Describe simultaneous adjustment of absolute permeability, relative permeability, and porosity as integral part of history matching process.

4. Illustrate results; i. e. show the gas and water rate match for each production well and for the monitor wells. Show pressure and gas saturation maps in time sequence for different sequences of production wells coming on line; e. g. show Cahn #1, Schneider #1, and State BW #1 interaction, both in pressure and in resulting gas saturation.

5. Conclusions of Cedar Hill History Matching.

   a. The history matching process generated geometric average permeabilities in the range of 1-10 md. These geometric average permeabilities have anisotropic components in the face/butt cleat directions of the order of 3-4/1 respectively. For instance, in the Cahn #1 well the face cleat permeability is 12 md, the butt cleat permeability is 3 md, which results in a geometric average permeability of 6.93 md (square root of 4*12). The face cleat is oriented approximately 45 degrees east of north. This direction is the direction found by the oriented core taken in the Mesa Hamilton well.

   b. Cleat porosities resulting from the history match ranged from 0.0025 to 0.0075. These values are lower than the generally expected values for Fruitland coal in the 0.02-0.04 range.

   c. Structural relief (up to 70 ft across the model grid area) is an important factor influencing the production behavior of wells in the Cedar Hill Field. The proximity, timing of drilling and operational mechanics of the Cahn #1, Schneider #1, and State BW #1 wells contributed to pressure interference between these three wells. The gas saturation behavior which developed in the proximity of these three wells is the result of coupling pressure interference effects with structural relief of the Fruitland coal. The development of gas saturation may be observed from a time- sequence of gas saturation maps and ultimately is demonstrated by a 20% increase in aggregate gas production from these three wells.

B. Tiffany Field Area History Match (Area 1)

C. Areas 1, 2 and 3 Sensitivity Analyses

1. Gas recovery, expressed as a percentage of initial gas-in-place, increases with decreasing well spacing. Magnitudes of variability for different values of permeability and fracture half-length are presented.

2. Gas recovery increases with both increasing permeability and increasing fracture half-length.

3. Cumulative gas production and recovery increase with decreasing cleat porosity due to lower water production rates and the shorter time required to dewater the reservoir.

4. Cumulative gas production and recovery increase with increasing initial reservoir pressure.

5. Cumulative gas production and recovery increase with increasing initial free gas saturation. This increase is in part due to a relative permeability effect.

IV. CONCLUSIONS

A. The permeability-thickness product has the strongest effect on gas recovery of all the reservoir parameters evaluated.

B. Unlike conventional wells, well interference effects are beneficial to the exploitation of the coalbed methane resource.

C. The selection of an optimum spacing is a function of both reservoir performance and economic considerations. This study only dealt with an evaluation of reservoir performance and did not address the economic analysis which must necessarily follow. It is important, however, to remember that the spacing issue is best resolved on a site-specific basis to achieve the best utilization and conservation of the coalbed methane resource.

D. The current 320 acre temporary spacing rules provide an appropriate basis for initial development and evaluation of the Fruitland Coal pool of the San Juan Basin. However, this study indicates that there are many combinations of reservoir properties where spacing other than the existing temporary rules of 320 acres may be appropriate. There are likely to be areas of the basin where these combination of properties exist; however, there are not sufficient data at this time to properly define the location and extent of these areas. In order to prevent waste and protect correlative rights, individual operators should be afforded every opportunity to present testimony and technical data to support their application for spàcing in their respective areas. This study has identified key parameters which should be considered in spacing applications which may include the following: Well Performance Data, Permeability, Porosity, Coal Thickness, Pressure, Gas Content, Sorption Isotherm and, Initial Water/Gas Saturation.

LIST OF EXHIBITS FOR THE
SAN JUAN BASIN COALBED METHANE SPACING STUDY
TO BE PRESENTED AT THE
NEW MEXICO OIL CONSERVATION DIVISION EXAMINER HEARING
CASE NO. 9420, ORDER NO. R-8768

FEBRUARY 21, 1991

NO. OF EXHIBITS	TASK DESCRIPTION
12	Introduction and Technical Approach
35	Cedar Hill Field Area History Match
22	Tiffany Field Area History Match
24	Area 1 Sensitivity Analyses
34	Area 2 Sensitivity Analyses
34	Area 3 Sensitivity Analyses

DESCRIPTION OF EXHIBITS
FOR THE
INTRODUCTION AND TECHNICAL APPROACH

DESCRIPTION OF EXHIBITS FOR
CEDAR HILL FIELD AREA HISTORY MATCH

List of Plates

DESCRIPTION OF EXHIBITS
FOR
TIFFANY FIELD AREA HISTORY MATCH

List of Plates

DESCRIPTION OF EXHIBITS FOR AREA 1 SENSITIVITY ANALYSES ASSUMING A CLEAT POROSITY OF 0.25% AND A FRACTURE HALF-LENGTH OF 300 FEET

DESCRIPTION OF EXHIBITS FOR AREA 2 SENSITIVITY ANALYSES ASSUMING NO INITIAL FREE GAS SATURATION AND AN INITIAL RESERVOIR PRESSURE OF 200 PSIA

DESCRIPTION OF EXHIBITS FOR AREA 2 SENSITIVITY ANALYSES ASSUMING NO INITIAL FREE GAS SATURATION AND AN INITIAL RESERVOIR PRESSURE OF 300 PSIA

Exhibit No.	List of Tables
1.	Summary of Reservoir Parameters for Area 2 Sensitivity Analyses
2.	Inventory of Initial Fluids in Place for Area 2 Sensitivity Analyses
3.	Simulation Results for Area 2 Sensitivity Analyses Assuming No Initial Free Gas Saturation
4.	Simulation Results for Area 2 Sensitivity Analyses Assuming 10% Initial Free Gas Saturation
5.	Simulation Results for Variations in Cleat Porosity for Area 2 Sensitivity Analyses

	List of Figures
6.	Gas Production for a 160 Acre Well Spacing (Parametric Cleat Permeability)
7.	Water Production for a 160 Acre Well Spacing (Parametric Cleat Permeability)
8.	Gas Production for a 320 Acre Well Spacing (Parametric Cleat Permeability)
9.	Water Production for a 320 Acre Well Spacing (Parametric Cleat Permeability)
10.	Gas Production for a Cleat Permeability of 5 md (Parametric Well Spacing)
11.	Water Production for a Cleat Permeability of 5 md (Parametric Well Spacing)
12.	Difference in Cumulative Gas Production Resulting from Infill Drilling 320 Acre Well Patterns to 160 Acres (Parametric Cleat Permeability and Time)
13.	Difference in Cumulative Water Production Resulting from Infill Drilling 320 Acre Well Patterns to 160 Acres (Parametric Cleat Permeability and Time)
14.	Gas Production for Variations in Cleat Porosity
15.	Water Production for Variations in Cleat Porosity
16.	Gas Production for Variations in Initial Free Gas Saturation
17.	Water Gas Production for Variations in Initial Free Gas Saturation

DESCRIPTION OF EXHIBITS FOR AREA 3 SENSITIVITY ANALYSES
ASSUMING 23% INITIAL FREE GAS SATURATION
AND AN INITIAL RESERVOIR PRESSURE OF 400 PSIA

DESCRIPTION OF EXHIBITS FOR AREA 3 SENSITIVITY ANALYSES
ASSUMING 23% INITIAL FREE GAS SATURATION
AND AN INITIAL RESERVOIR PRESSURE OF 650 PSIA

FIGURES FOR

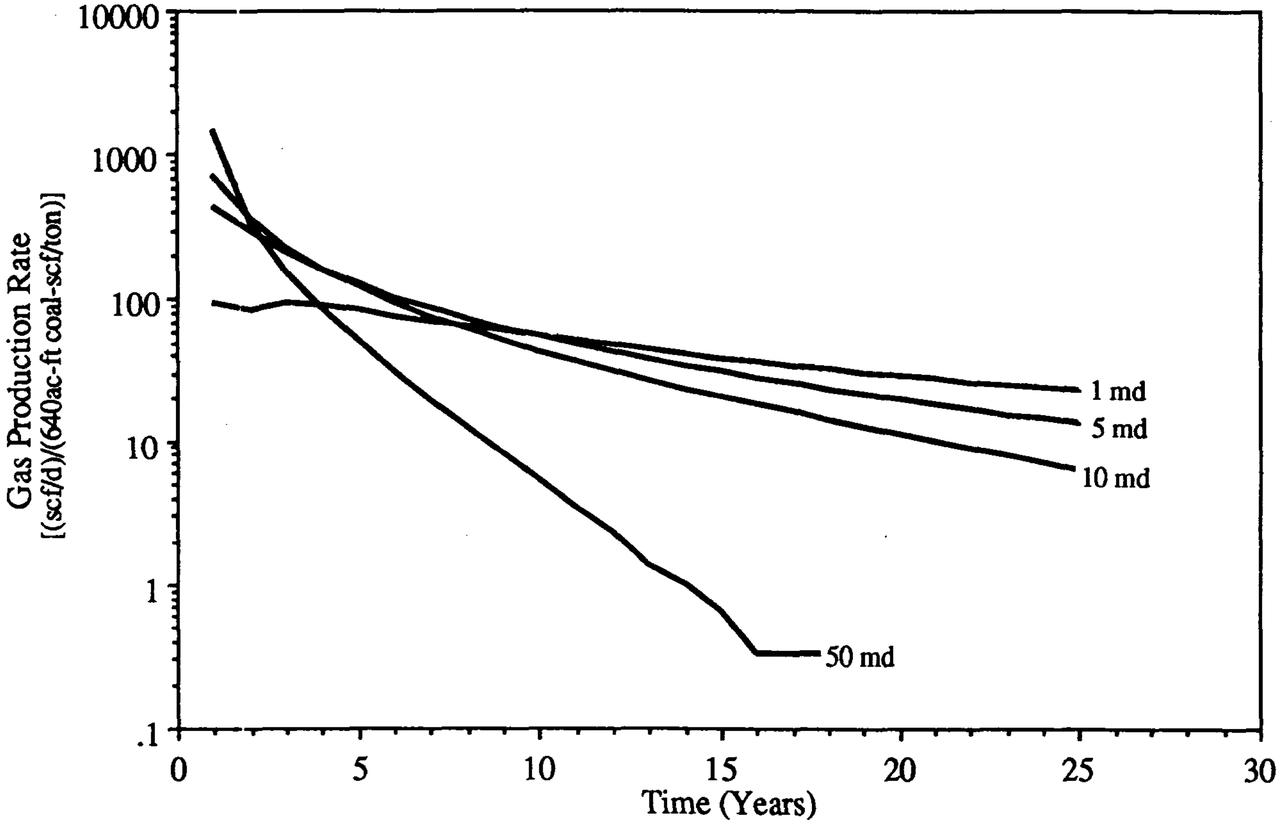
AREA 1 SENSITIVITY ANALYSES

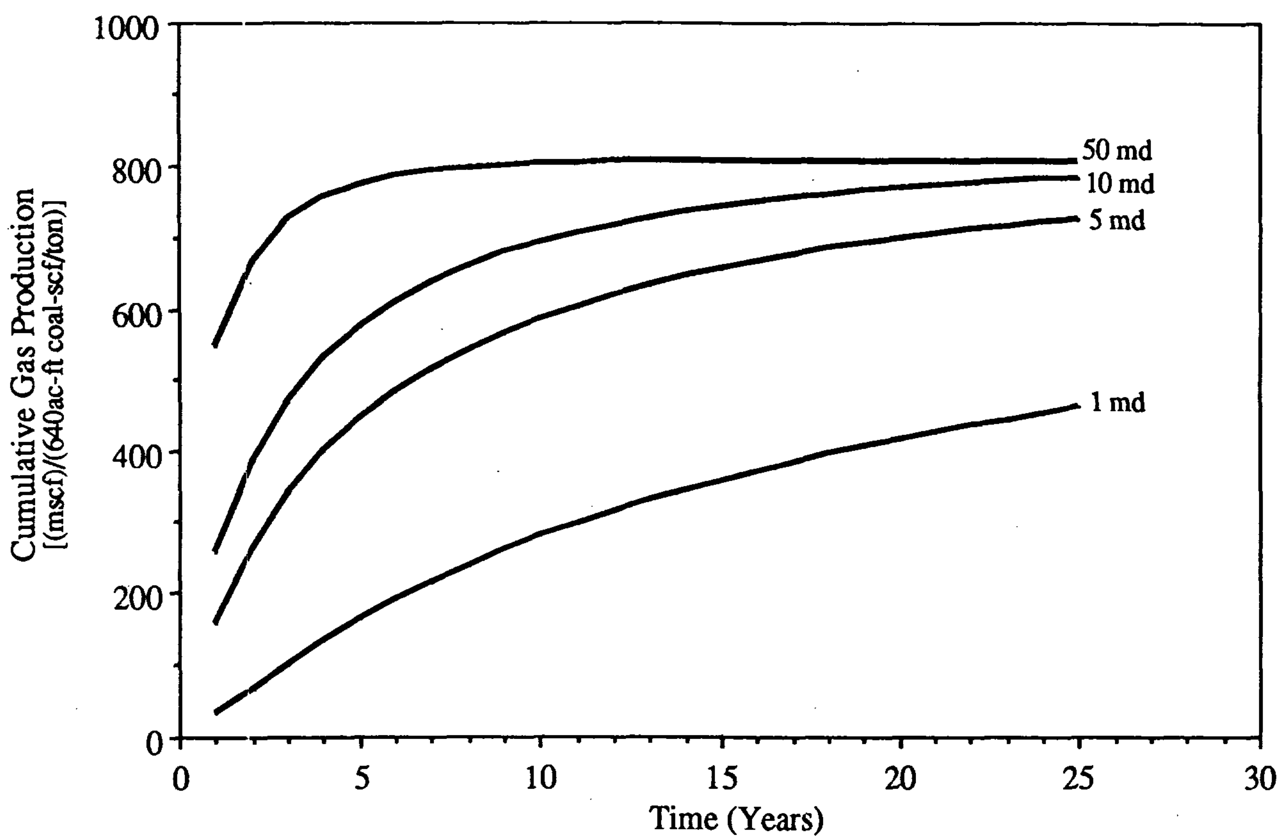
San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Gas Production for a 160 Acre Well Spacing

Preliminary

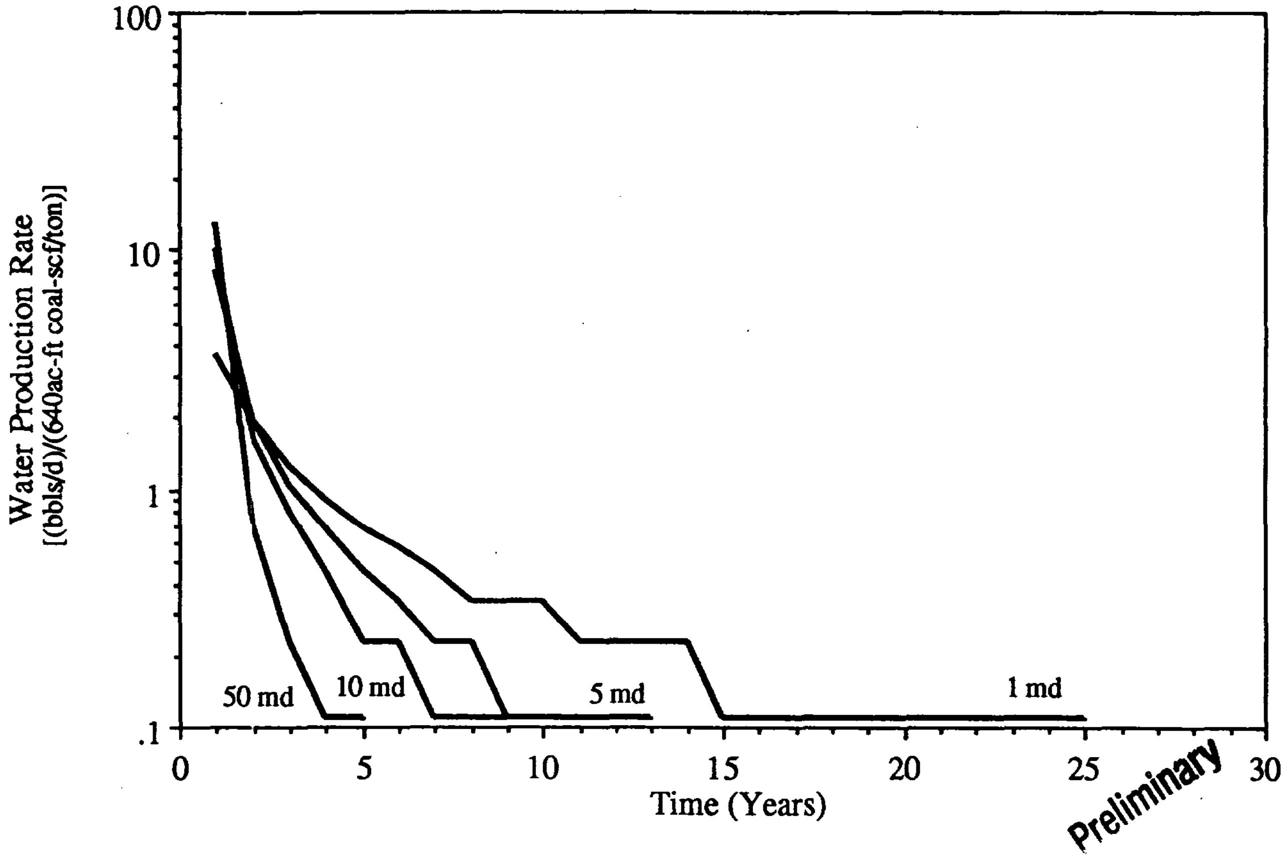


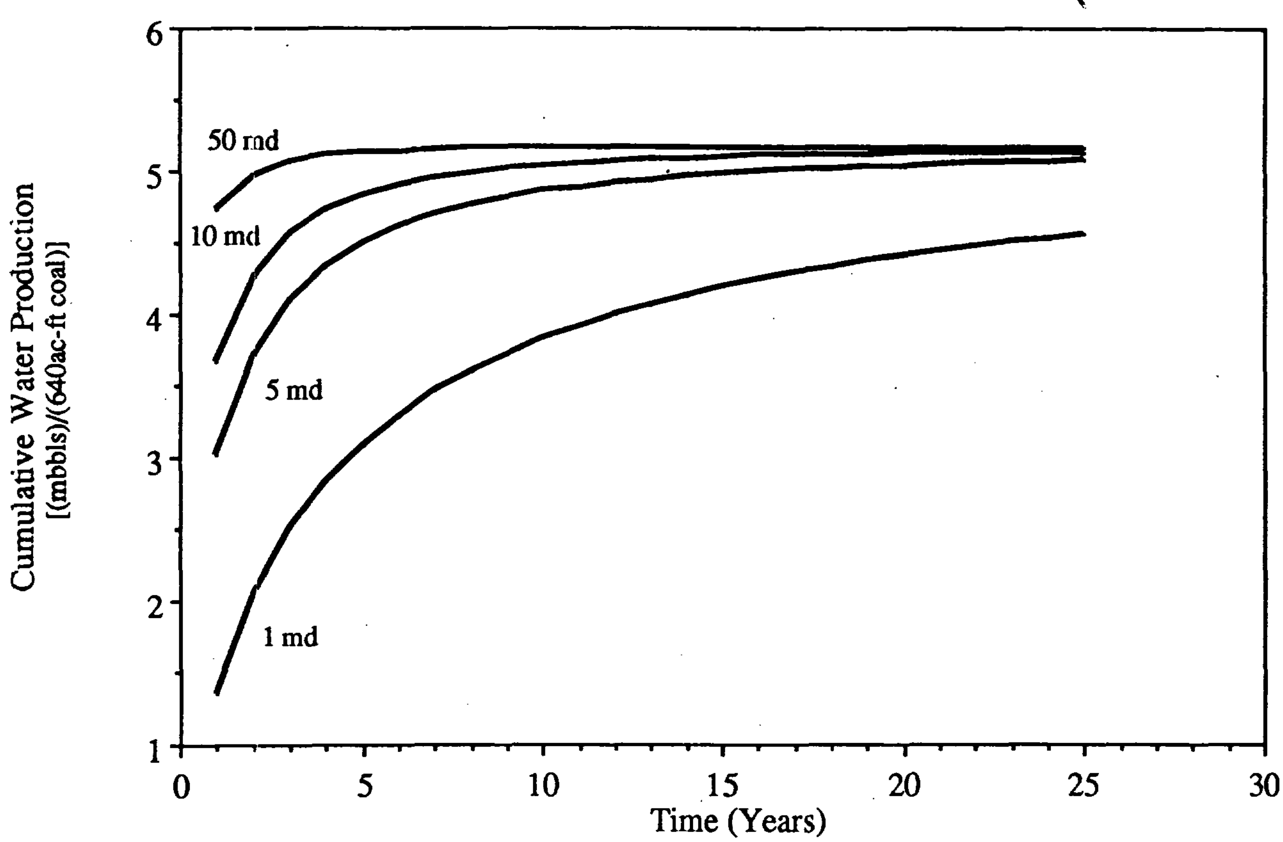


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Water Production for a 160 Acre Well Spacing

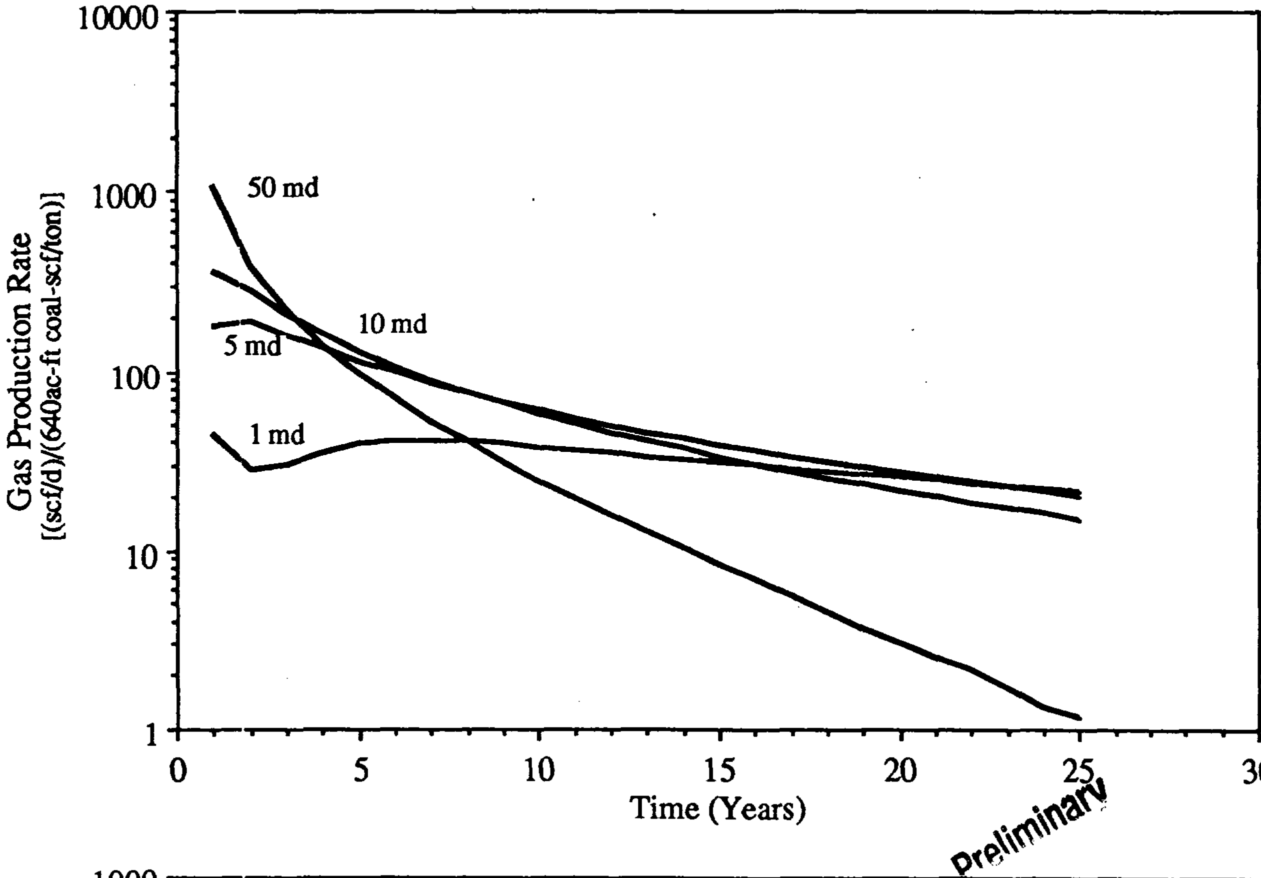


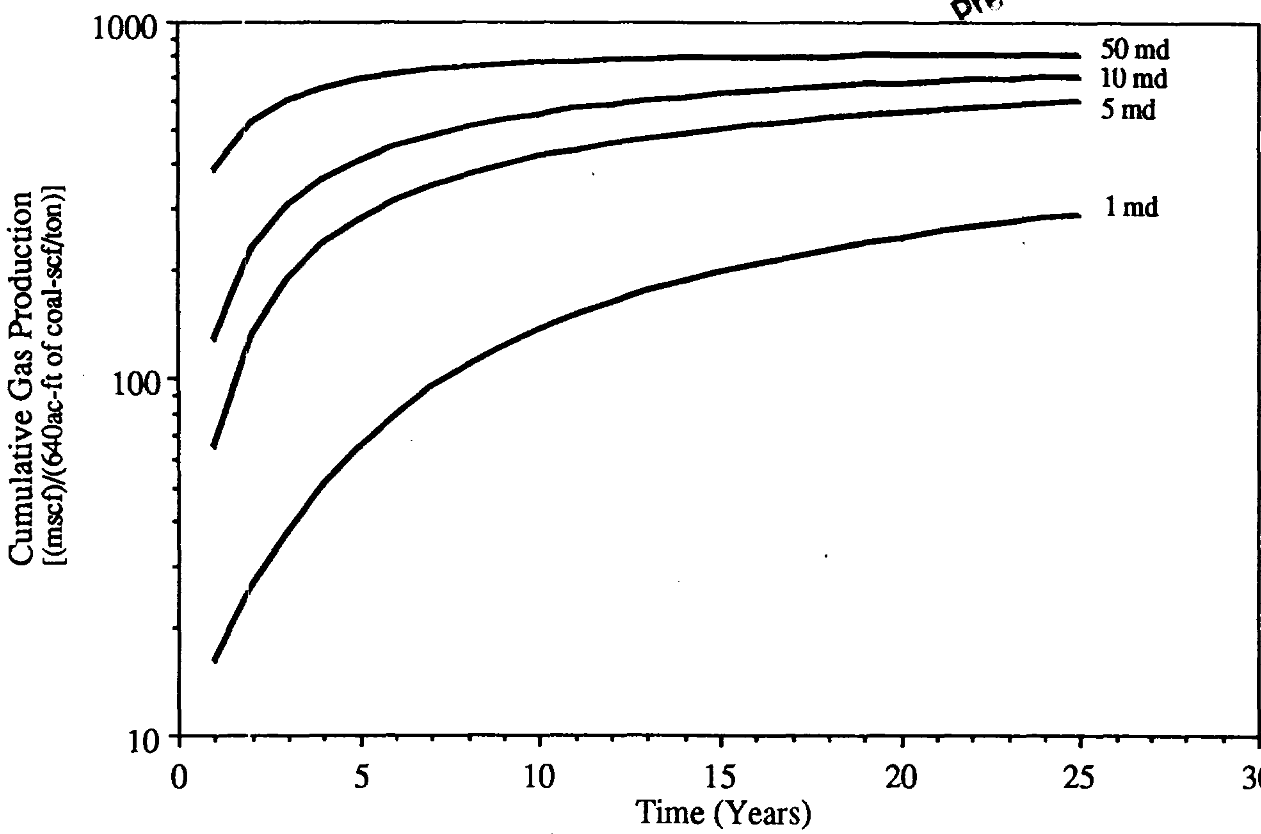


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Gas Production for a 320 Acre Well Spacing

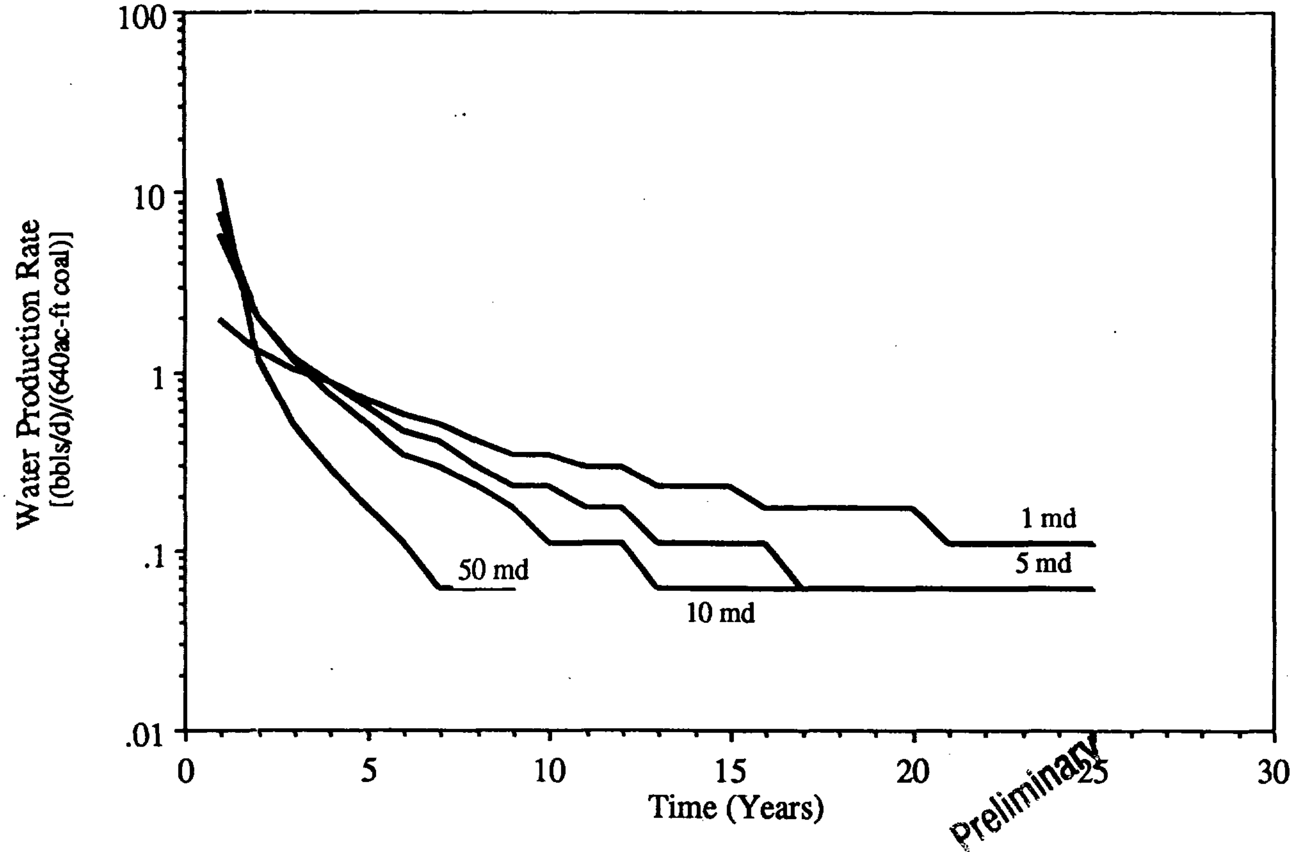


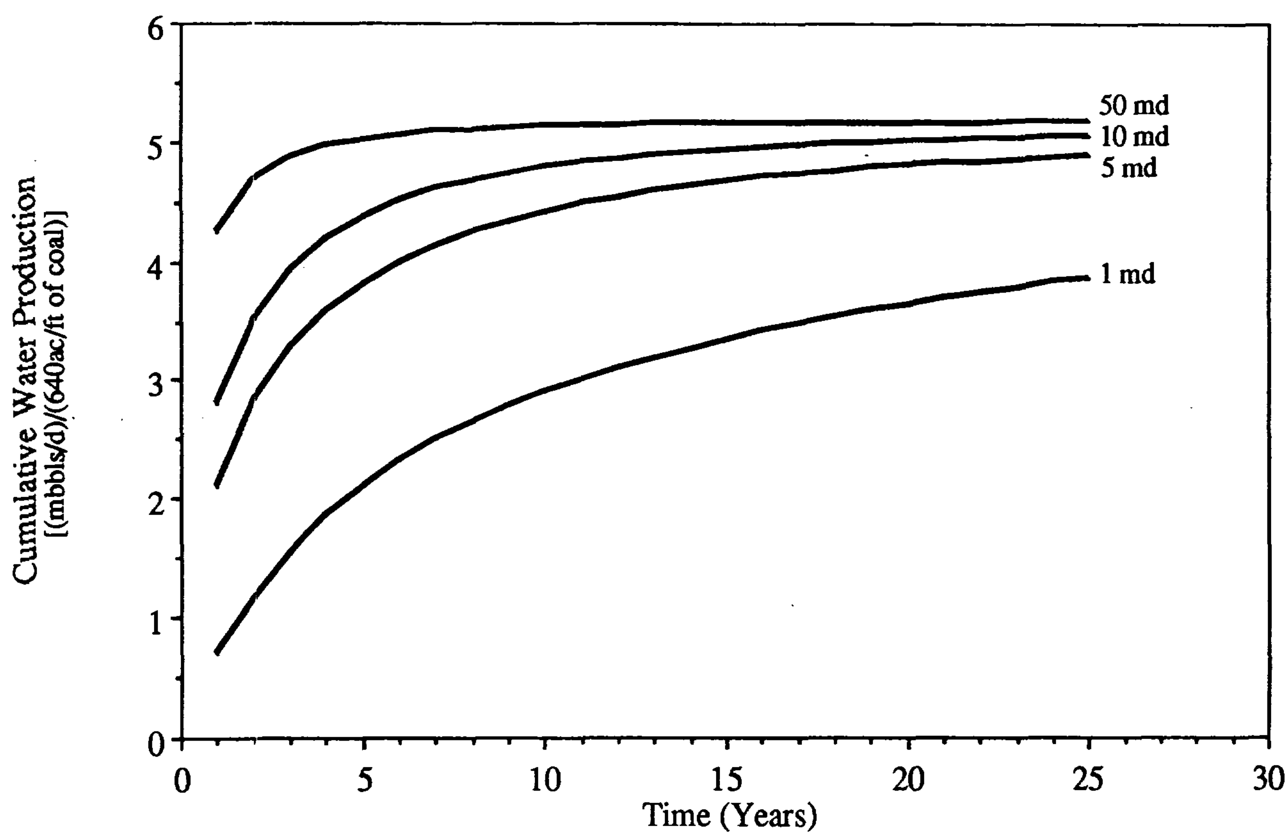


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Water Production for a 320 Acre Well Spacing

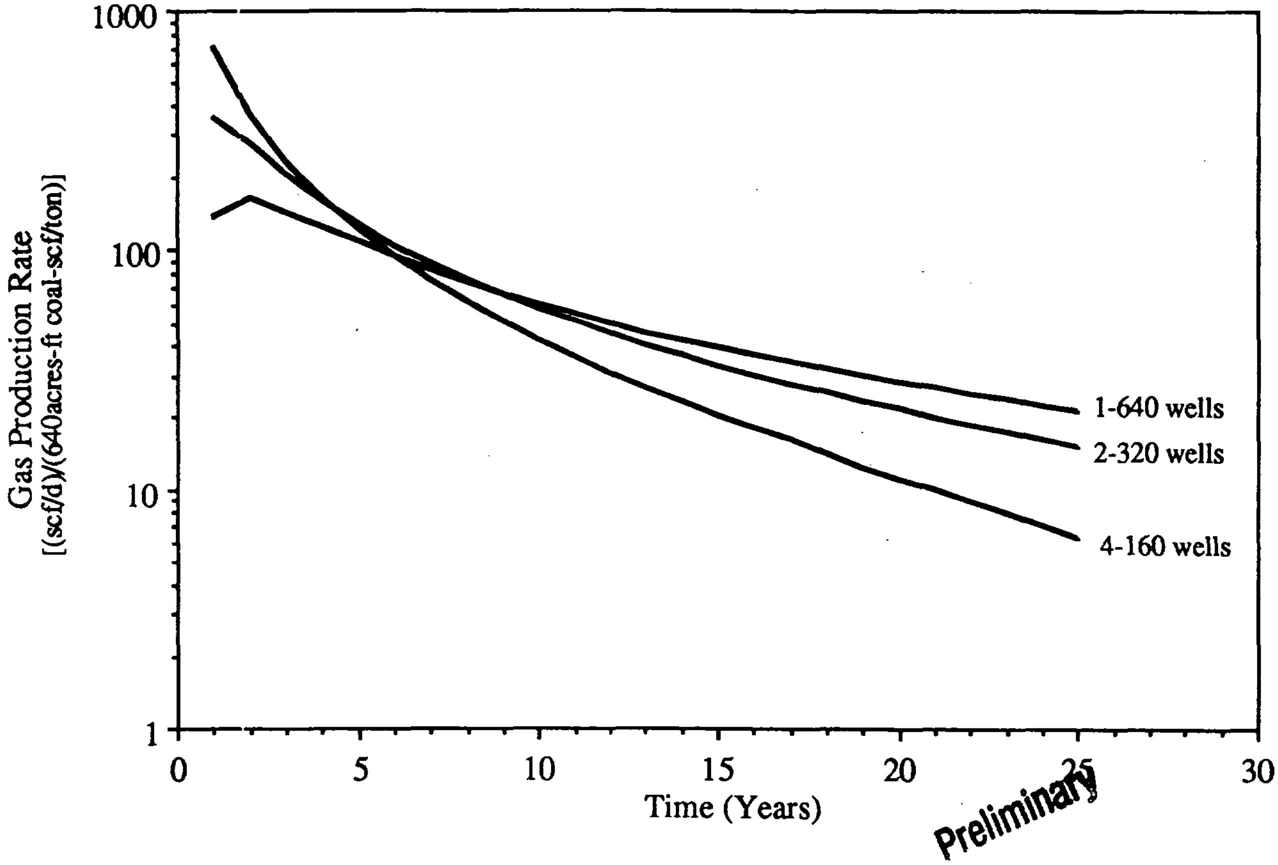


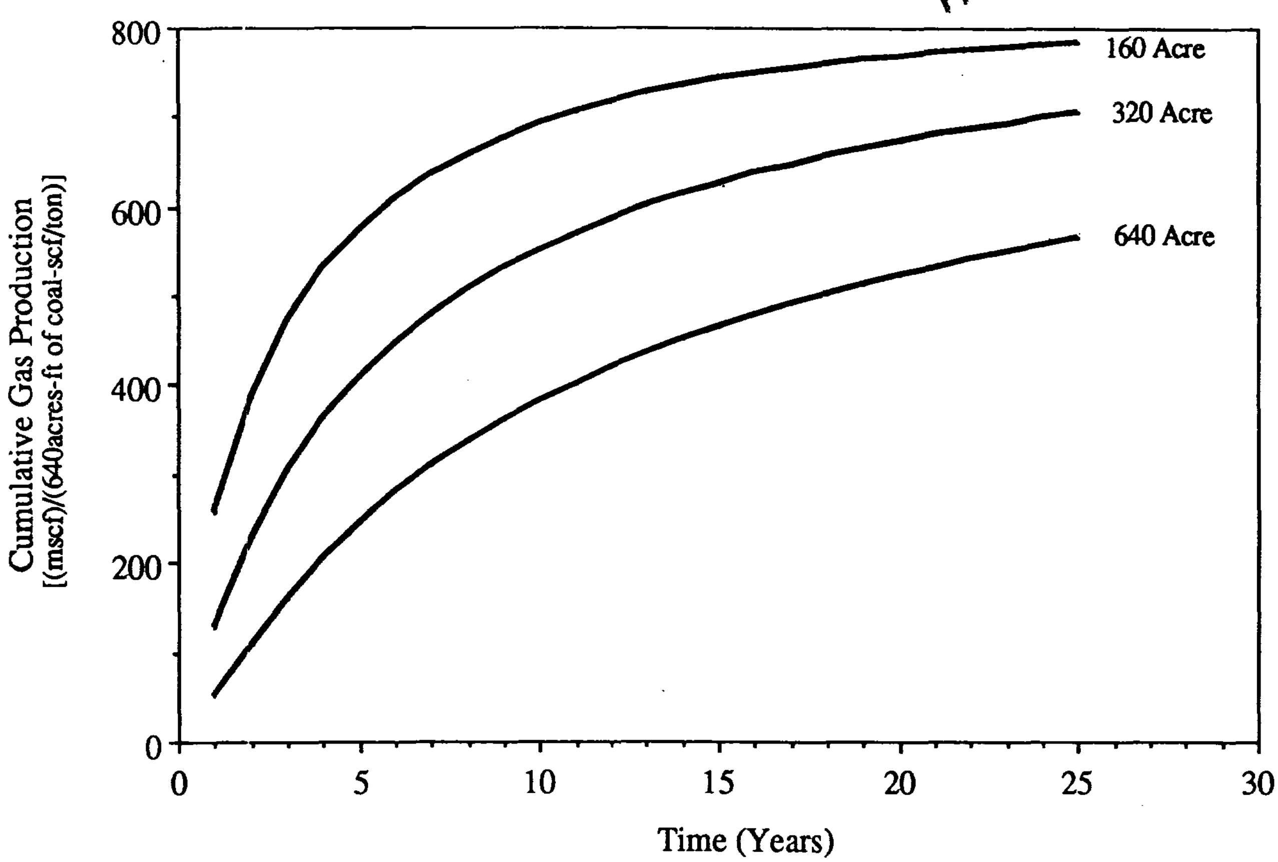


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Gas Production for a Cleat Permeability of 10 md

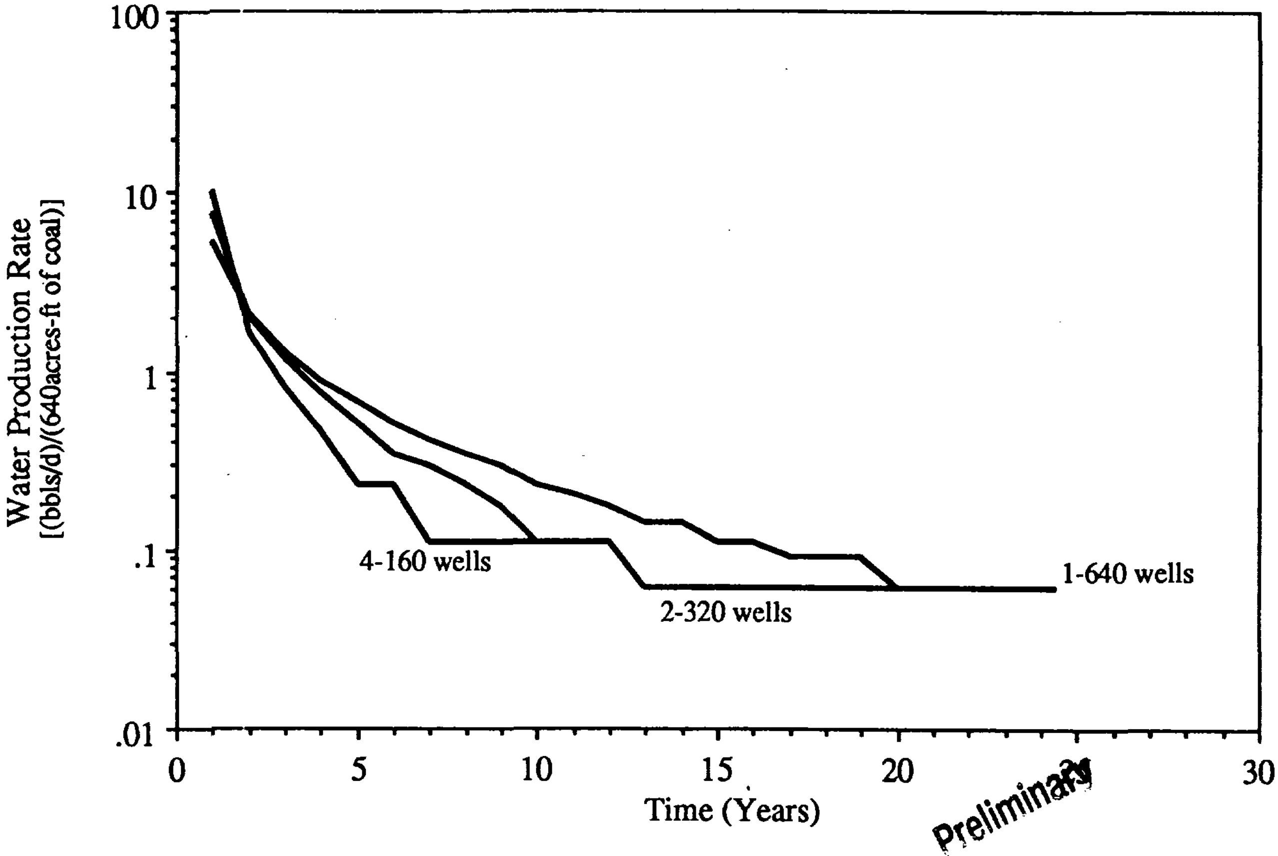


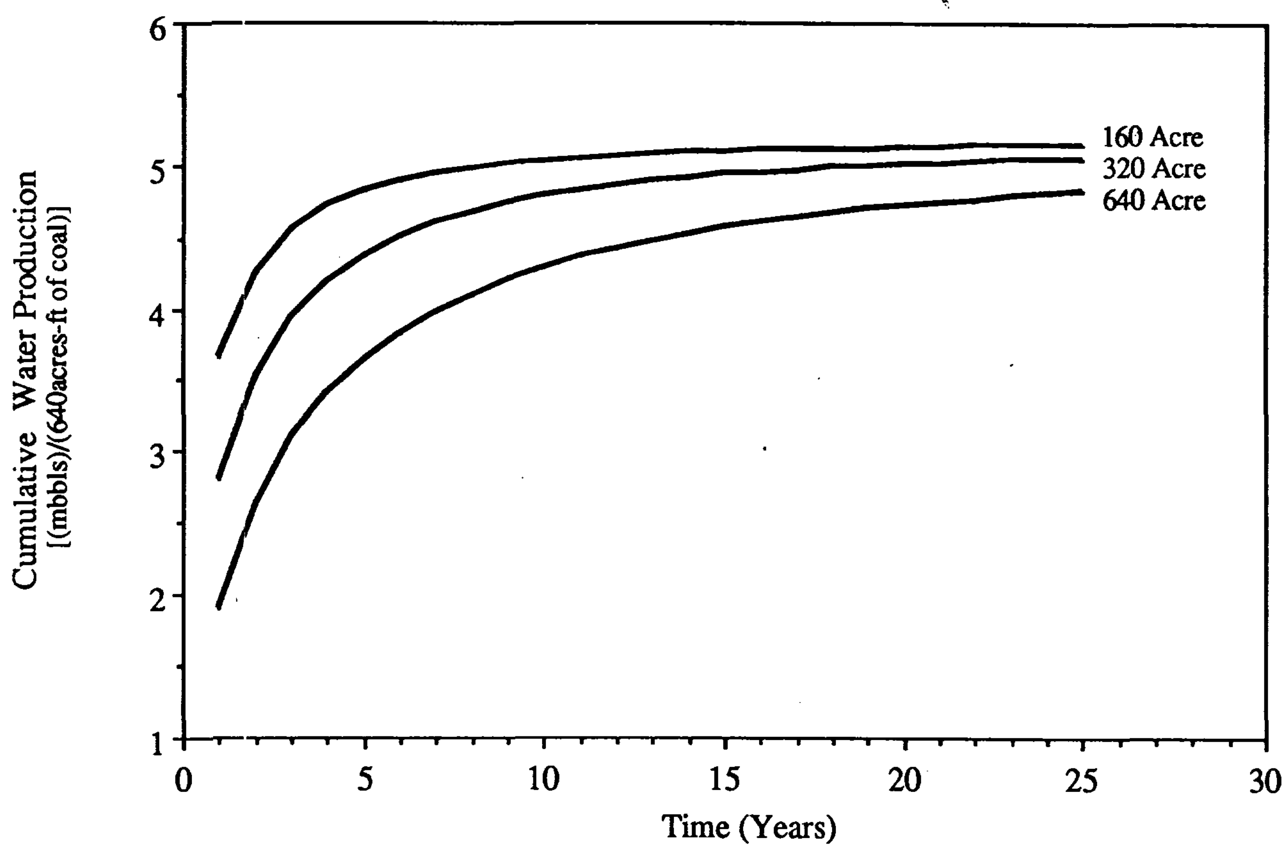


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Water Production for a Cleat Permeability of 10 md

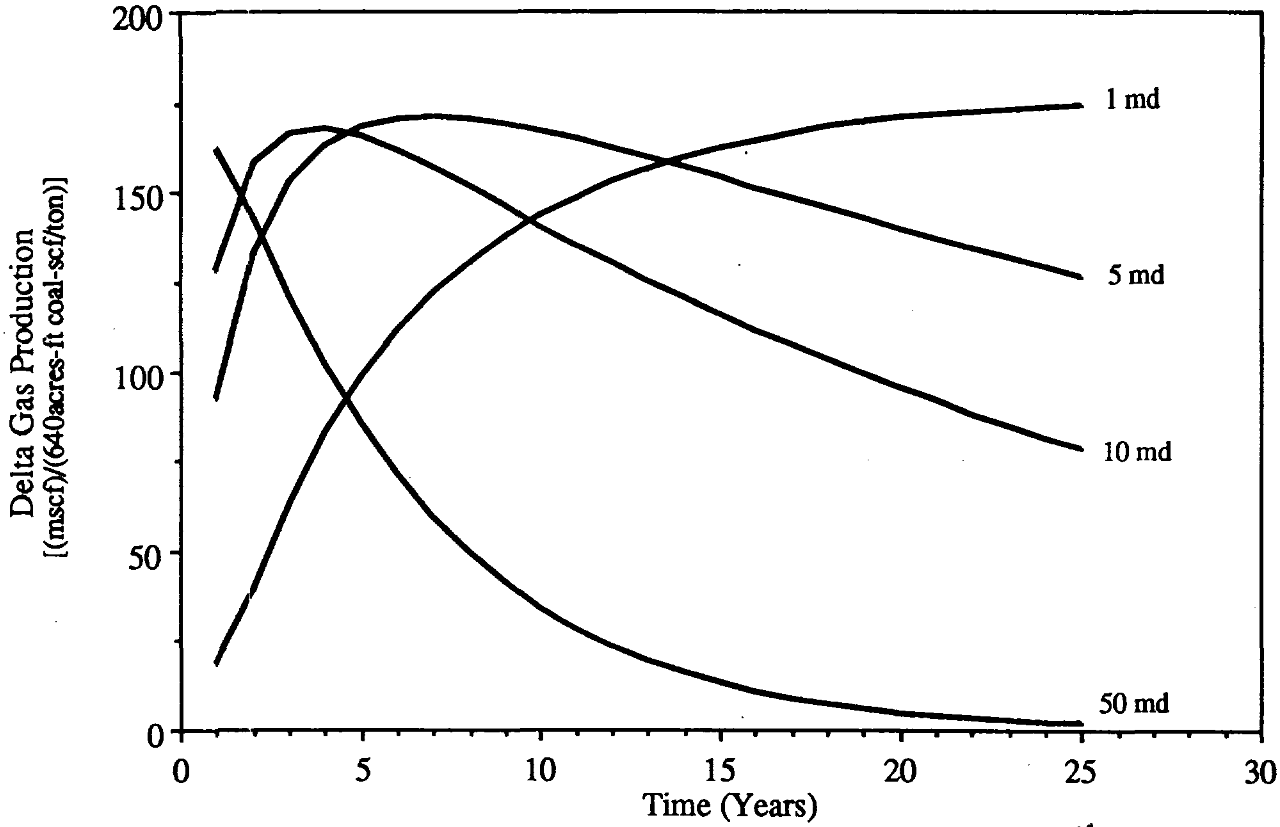


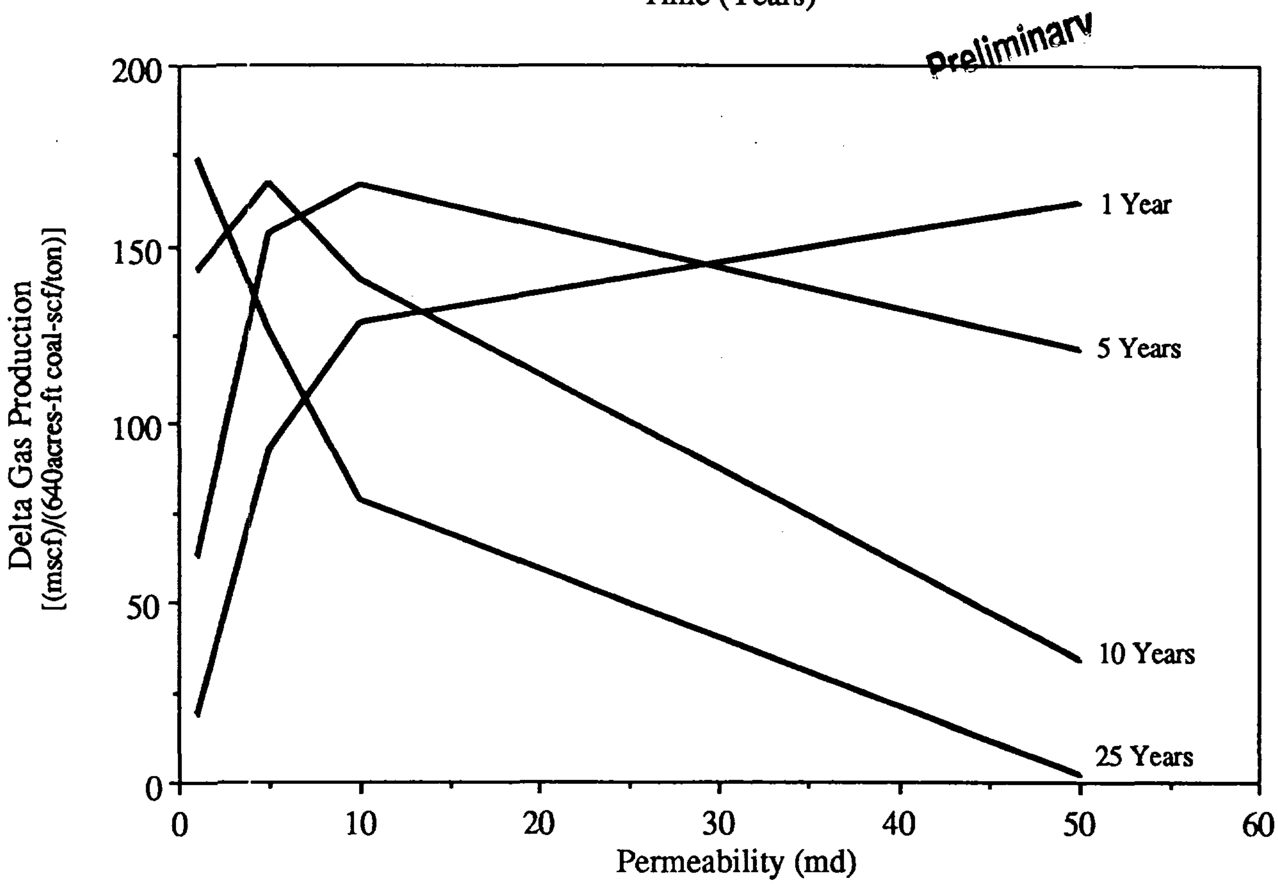


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Difference in Cumulative Gas Production Between 320 and 160 Acre Well Spacing

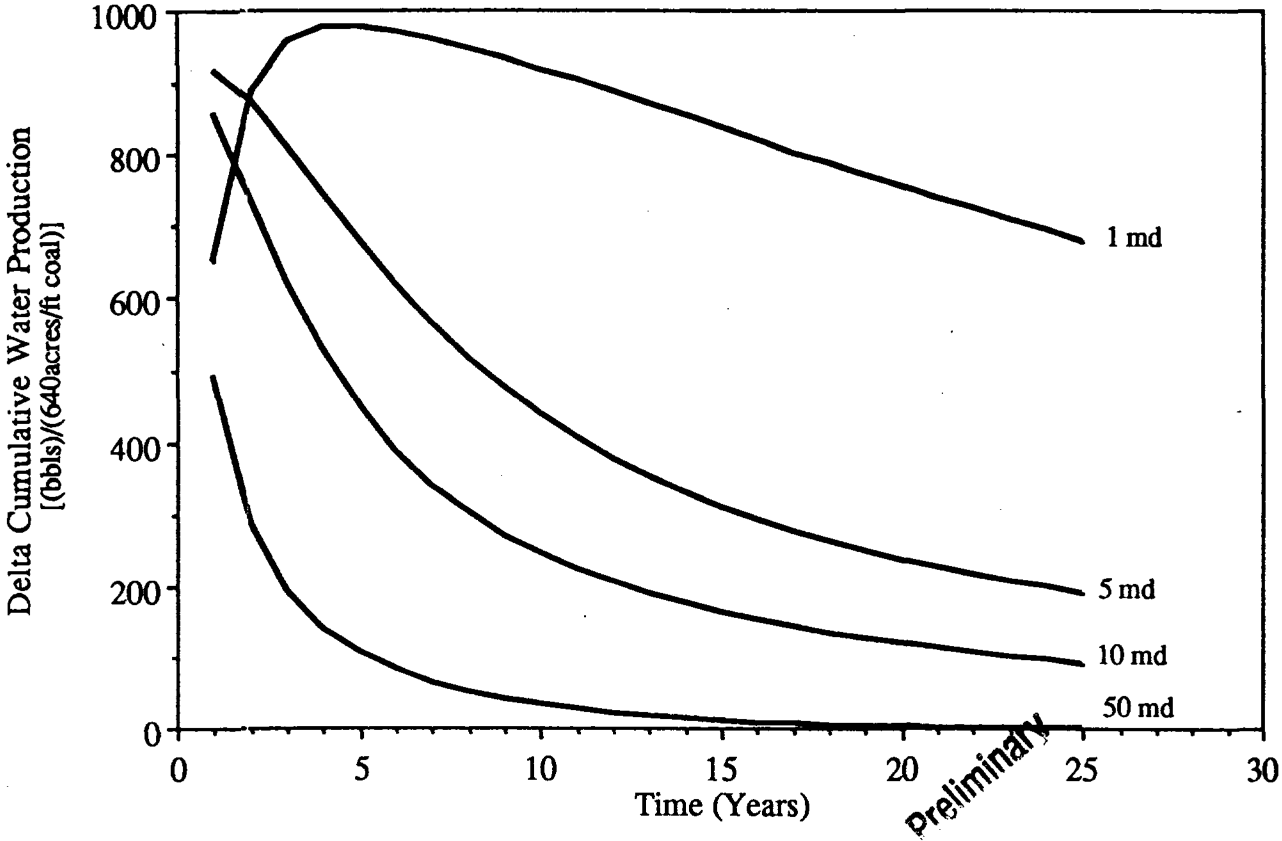


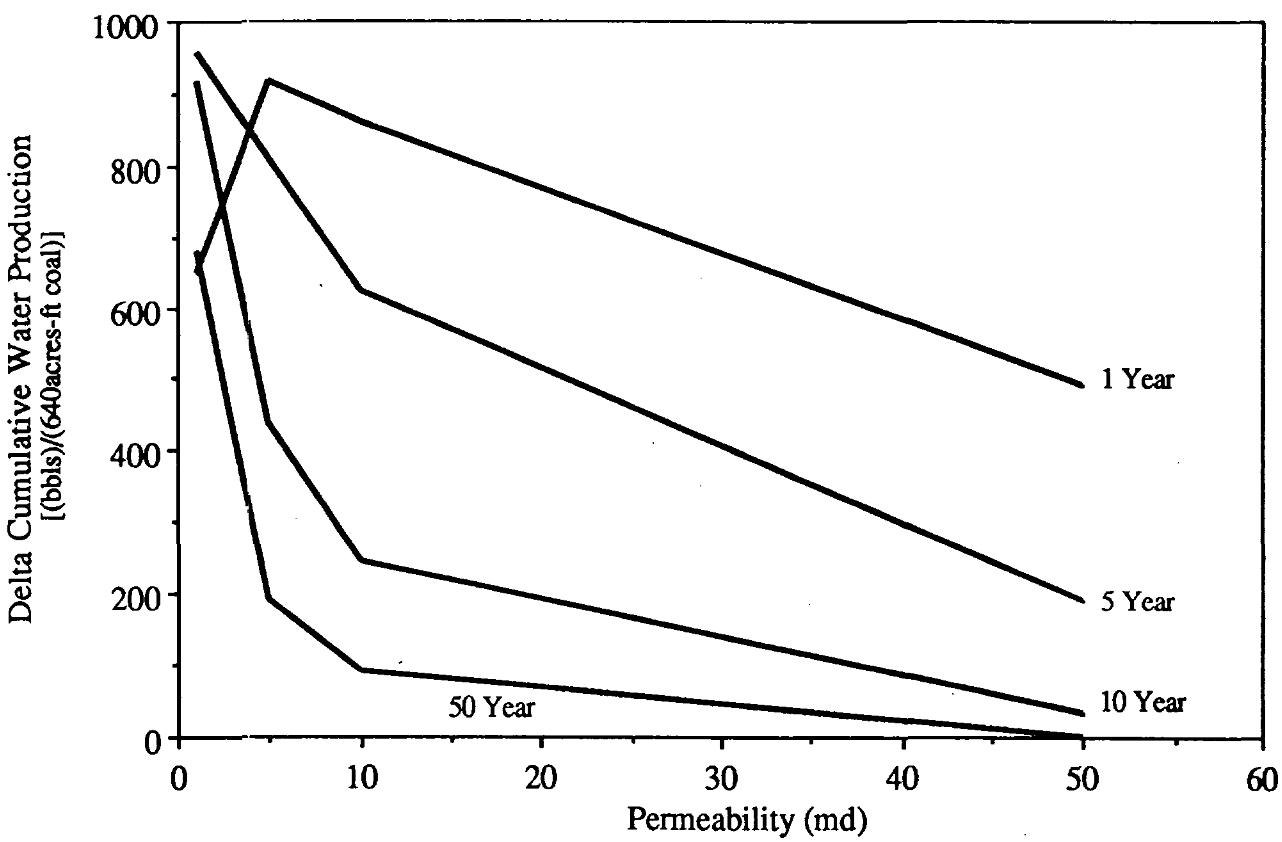


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Difference in Cumulative Water Production Between 320 and 160 Acre Well Spacing

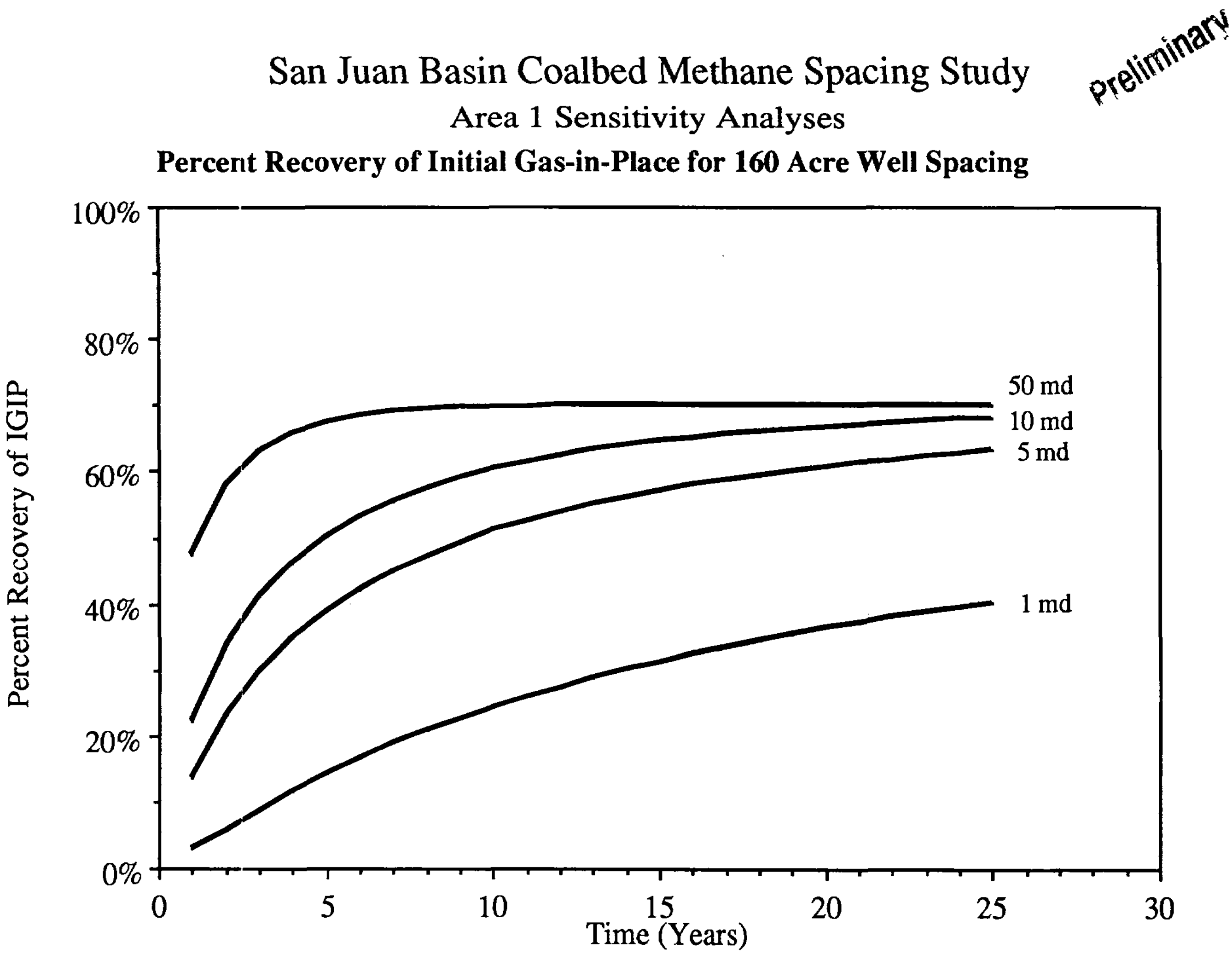




San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Percent Recovery of Initial Gas-in-Place for 160 Acre Well Spacing

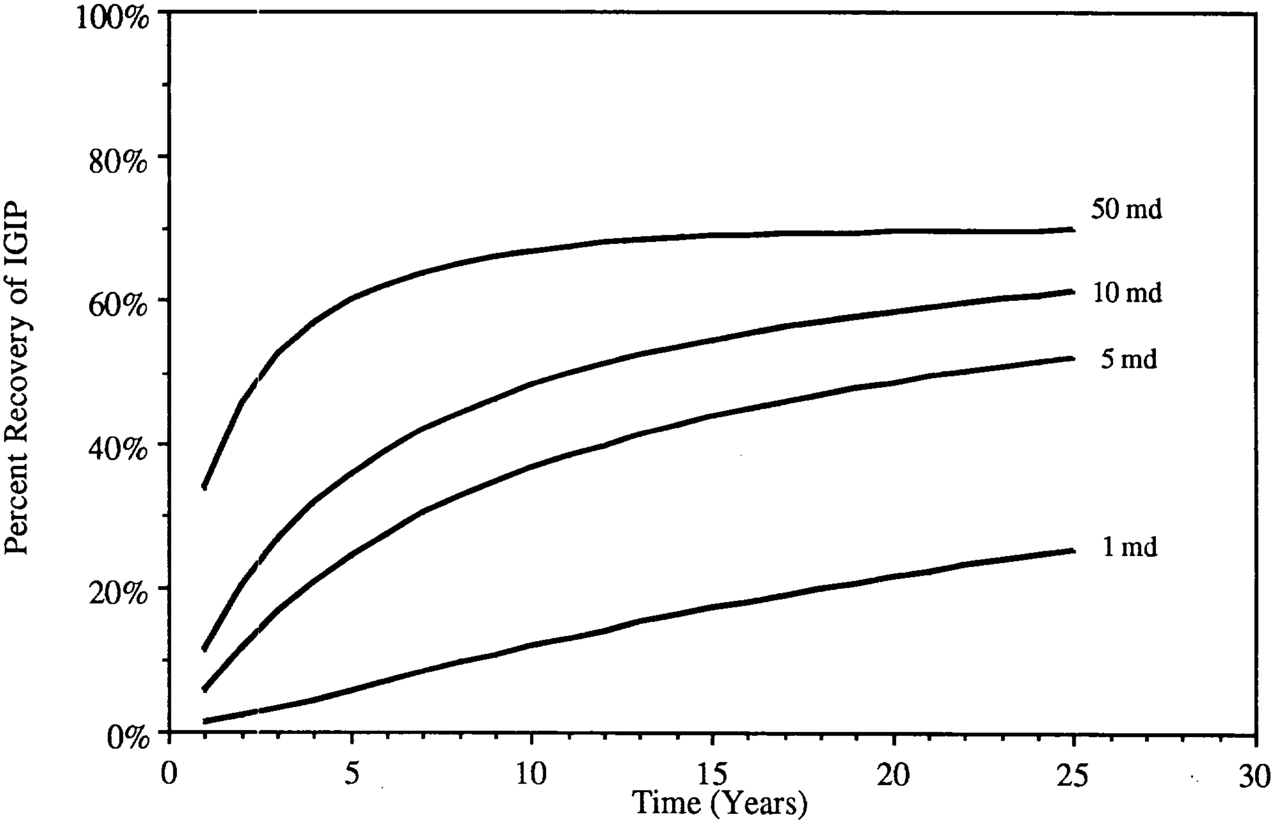


Preliminary

San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Percent Recovery of Initial Gas-in-Place for 320 Acre Well Spacing

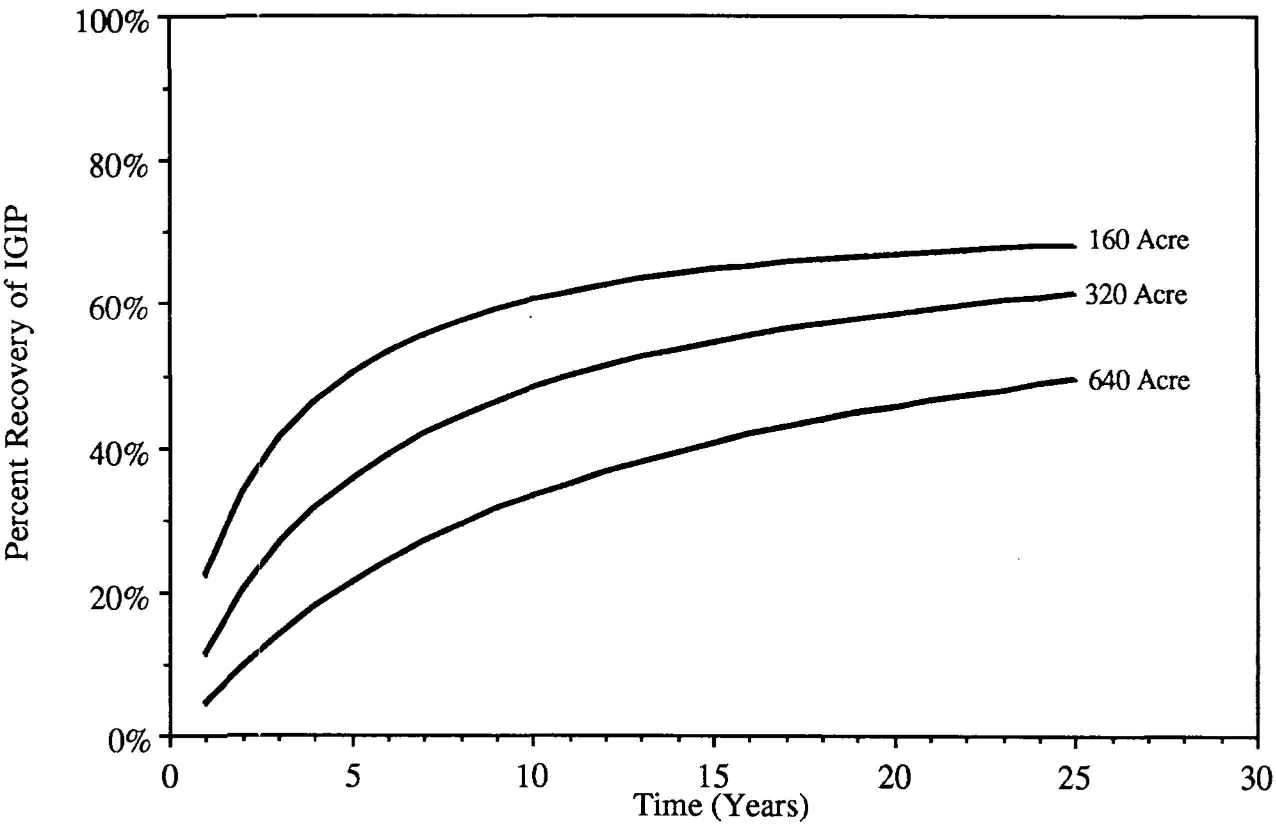


San Juan Basin Coalbed Methane Spacing Study

Area 1 Sensitivity Analyses

Percent Recovery of Initial Gas-in-Place for Cleat Permeability of 10 md

Preliminary



THE VARIATION CASES FOR THE AREA 1 SENSITIVITY ANALYSES ARE STILL IN THE PRELIMINARY GRAPHICAL FORM.

THE ATTACHED FIGURES ARE INTENDED ONLY TO BE DRAFT COPIES.

Figure 14

~~Figure 54~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Porosity

Gas Production vs Time

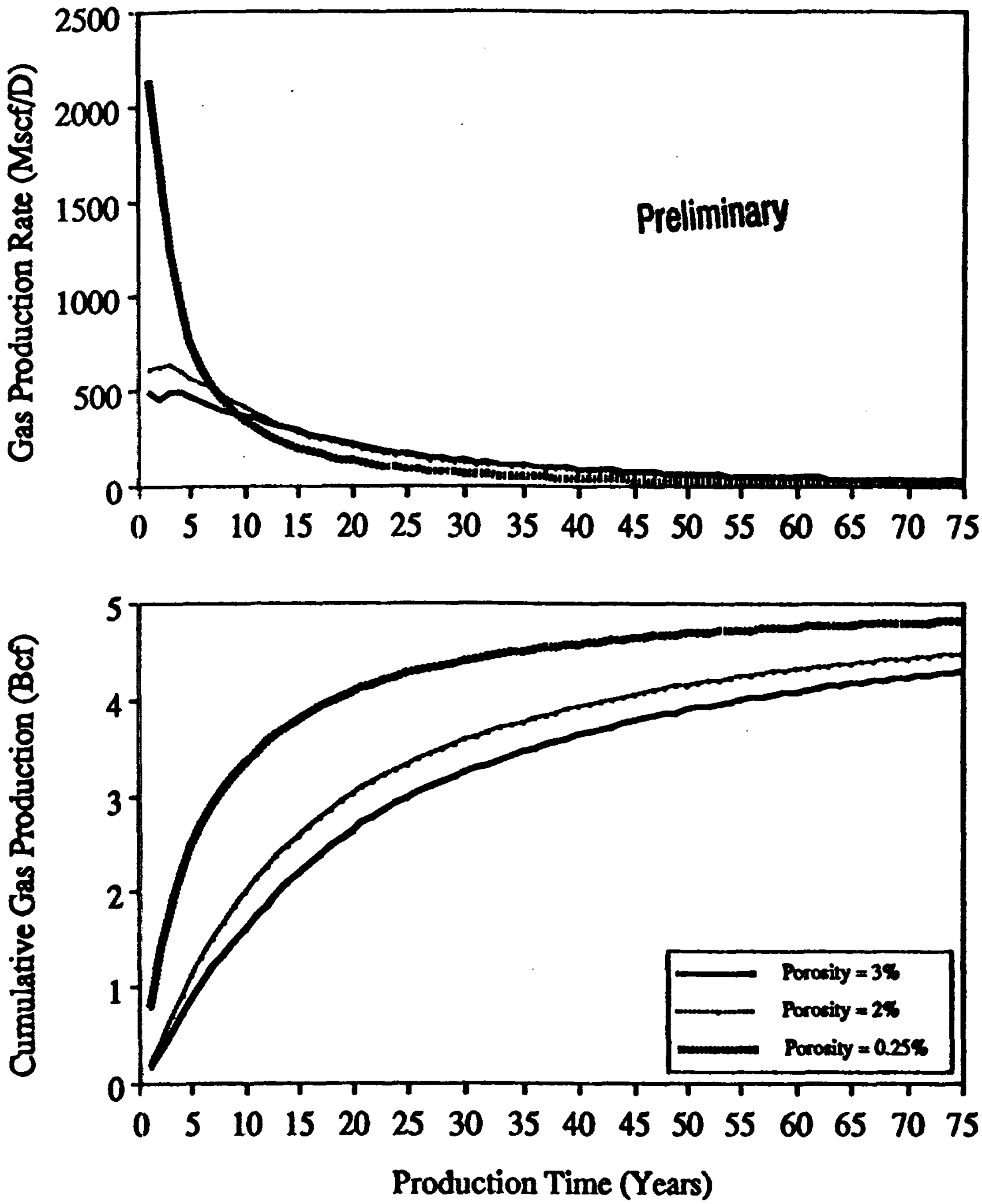


Figure 15

~~Figure 56~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Porosity

Water Production vs Time

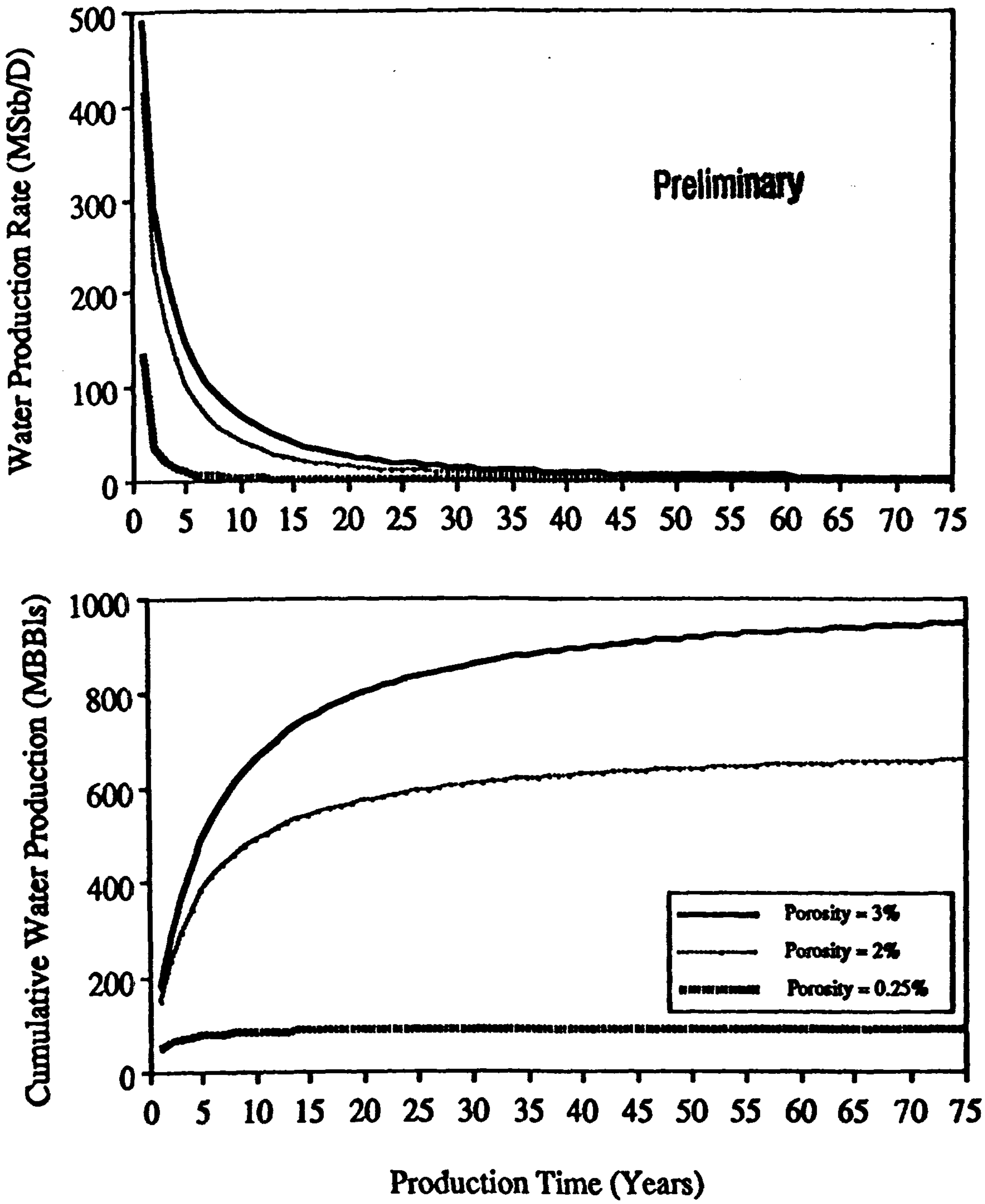


Figure 16

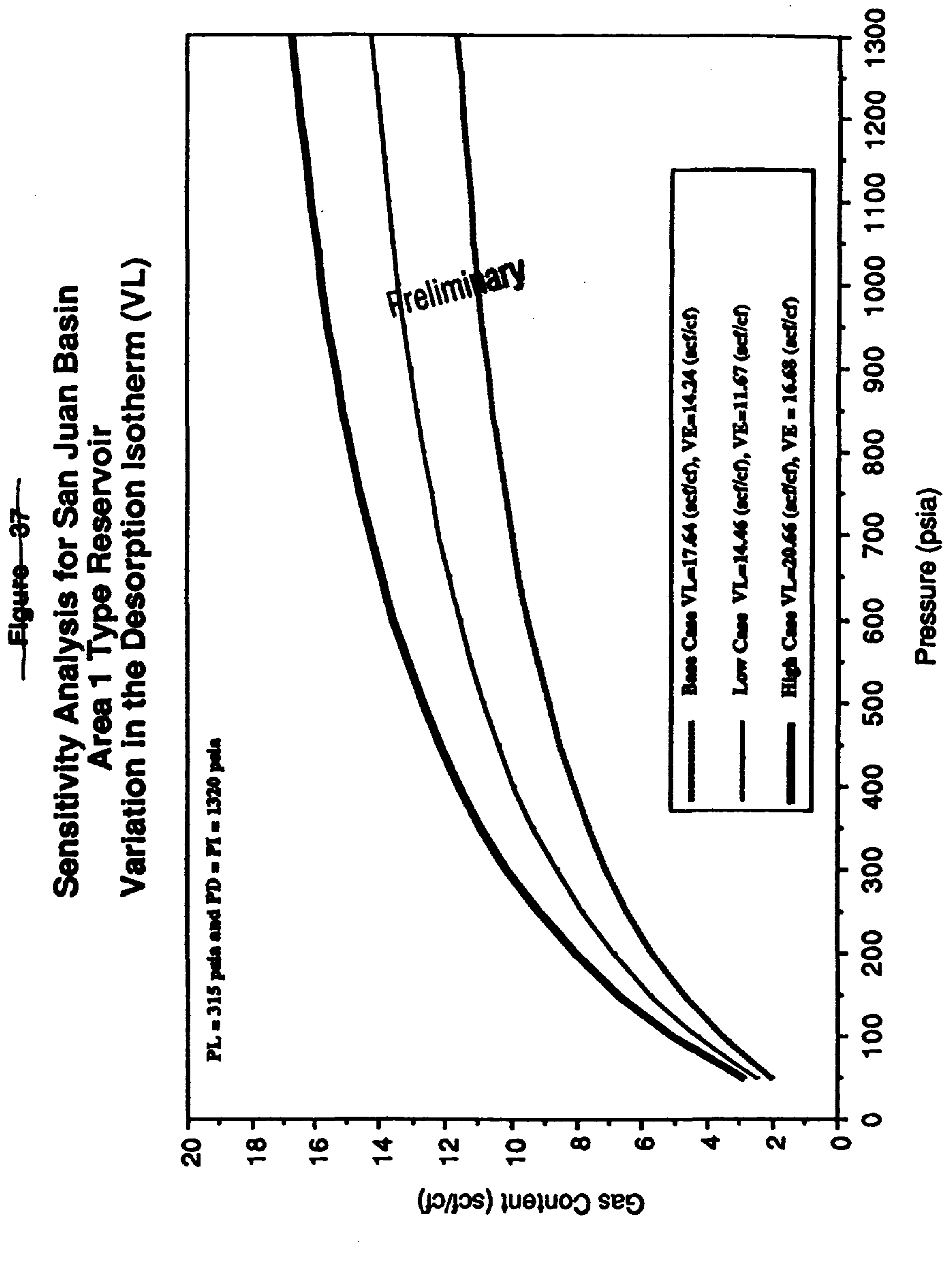

~~Figure 37~~
Sensitivity Analysis for San Juan Basin
Area 1 Type Reservoir
Variation in the Desorption Isotherm (VL)
PL = 315 psia and PD = PI = 1320 psia
Preliminary
Base Case VL=17.64 (scf/cf), VE=14.34 (scf/cf)
Low Case VL=14.46 (scf/cf), VE=11.67 (scf/cf)
High Case VL=20.66 (scf/cf), VE = 16.68 (scf/cf)
Gas Content (scf/cf)
0
2
4
6
8
10
12
14
16
18
20
Pressure (psia)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300

Figure 17

~~Figure 38~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Langmuir Volume

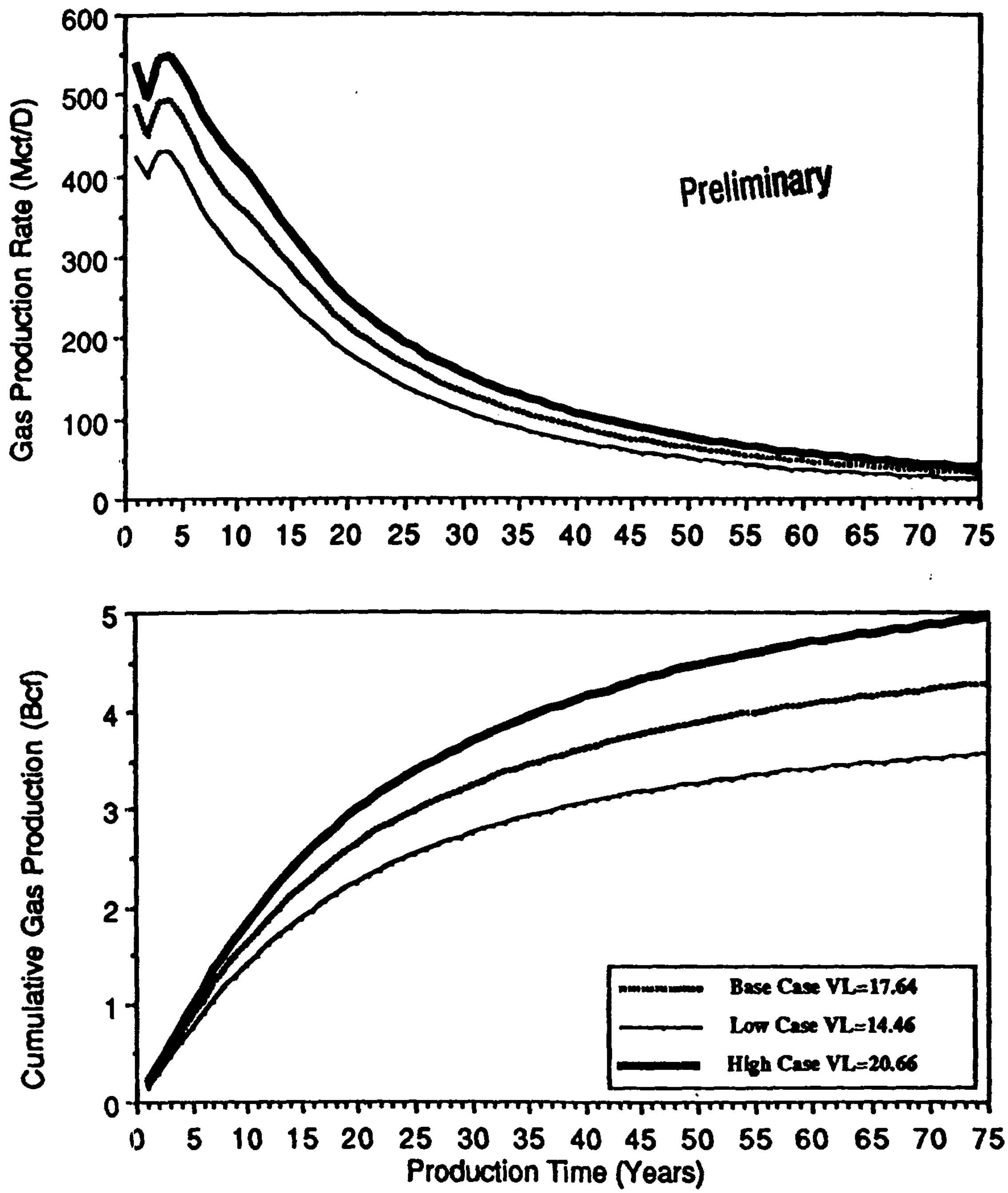


Figure 18

~~Figure 40~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Langmuir Volume

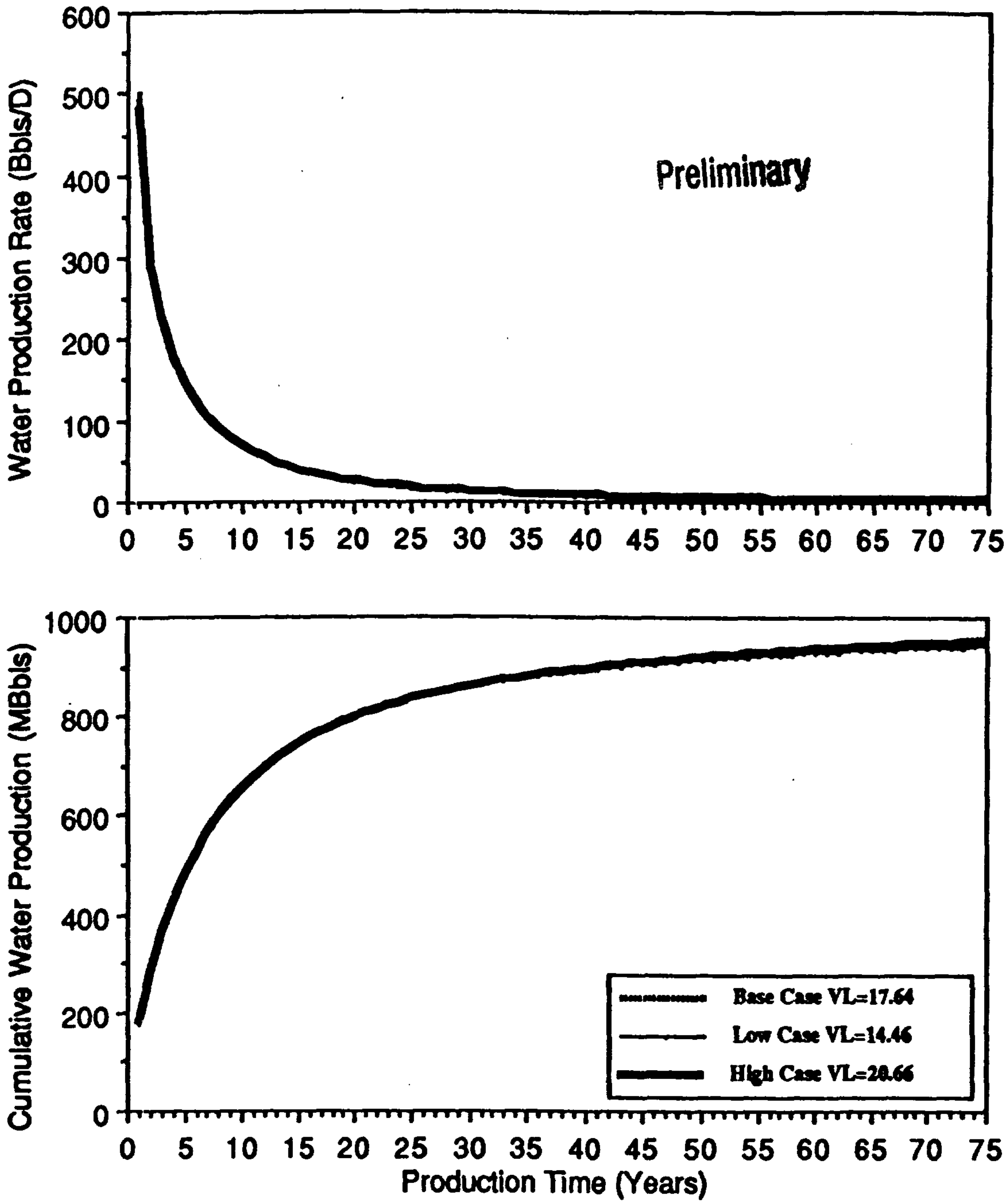


Figure 19

~~Figure 41~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Desorption Pressure

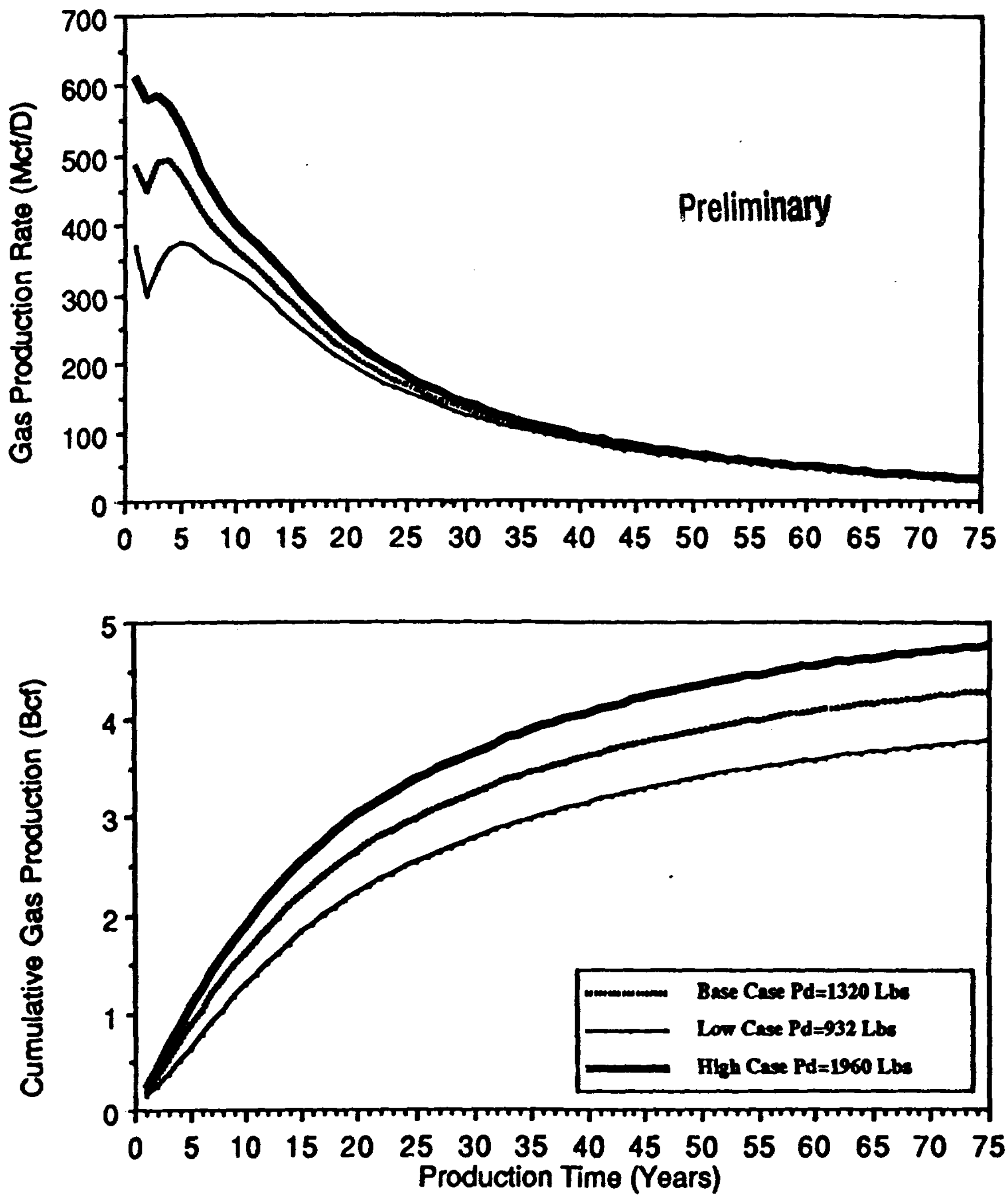


Figure 20

~~Figure 43~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Desorption Pressure

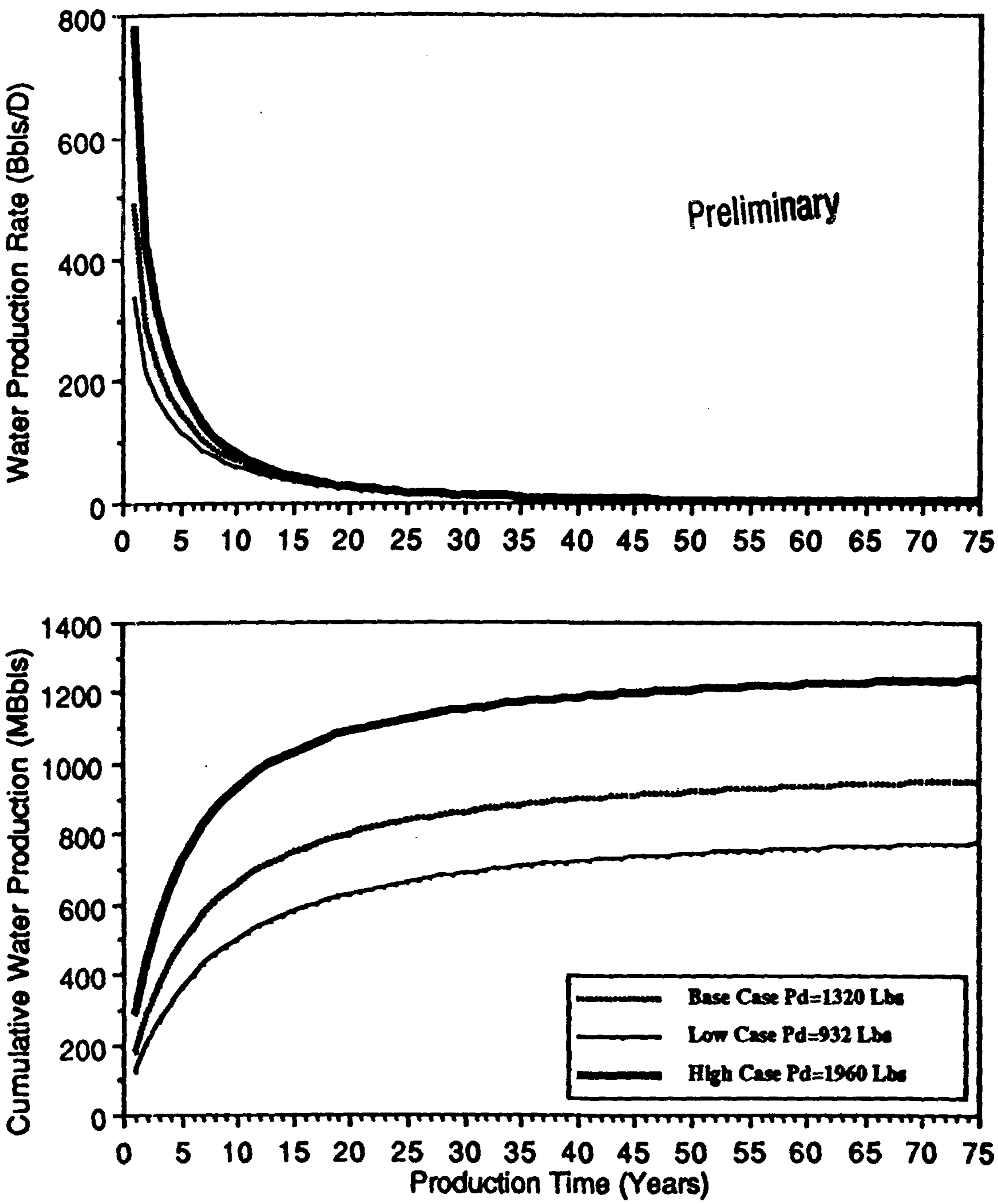
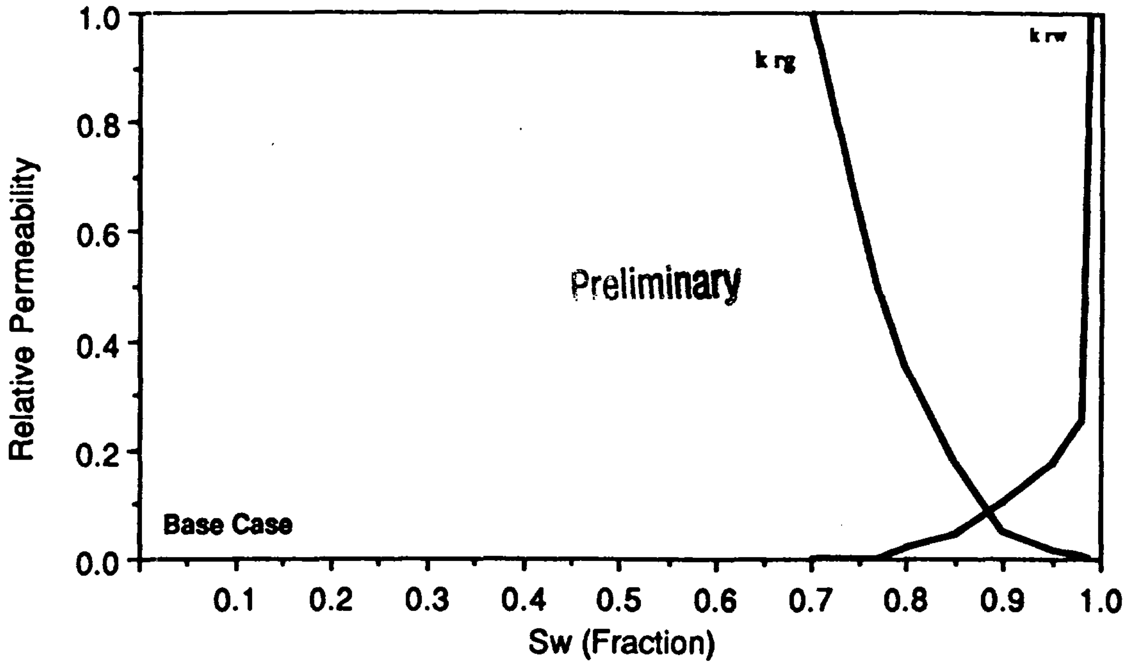
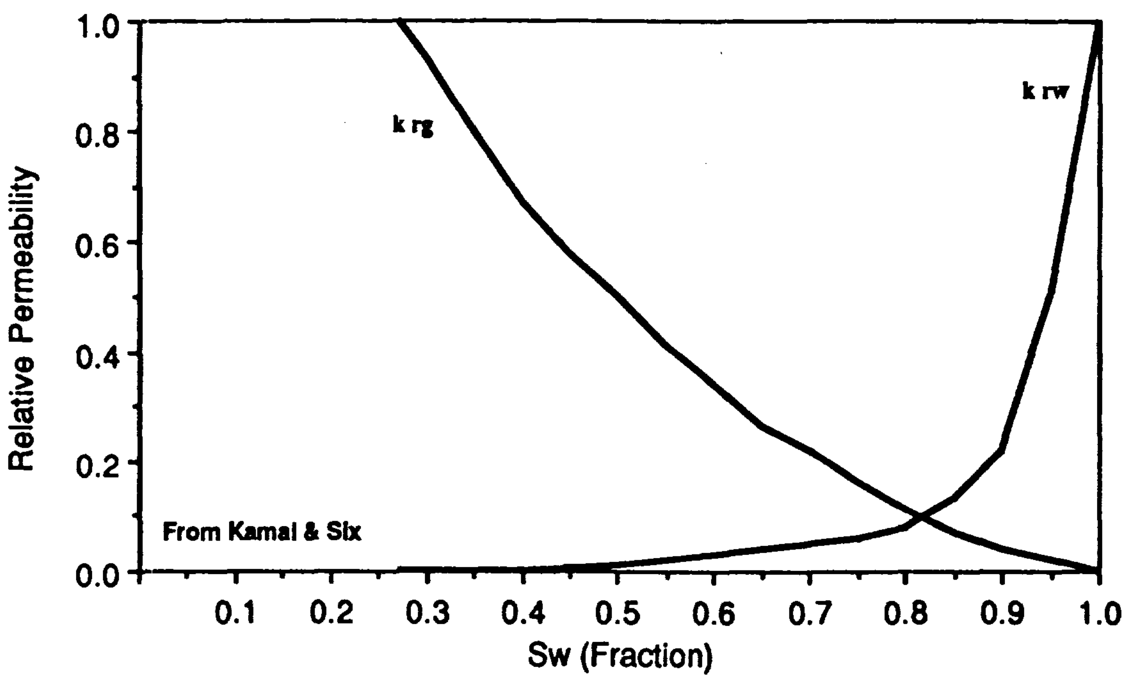


Figure 21

~~Figure 44~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Variation in Relative Permeability





~~Figure 45~~ Figure 22

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Variations in krg/krw Ratio

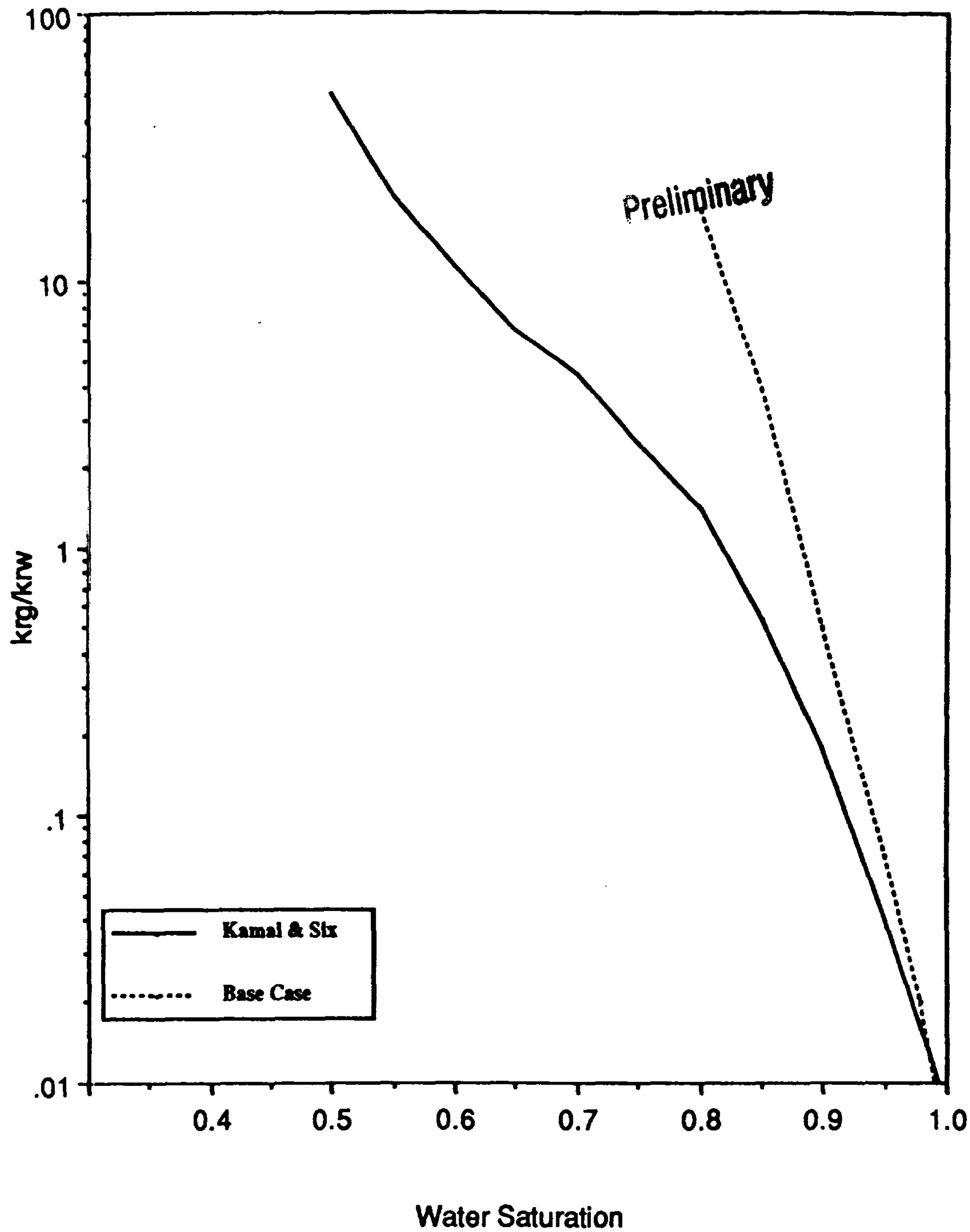


Figure 23

~~Figure 46~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Relative Permeability

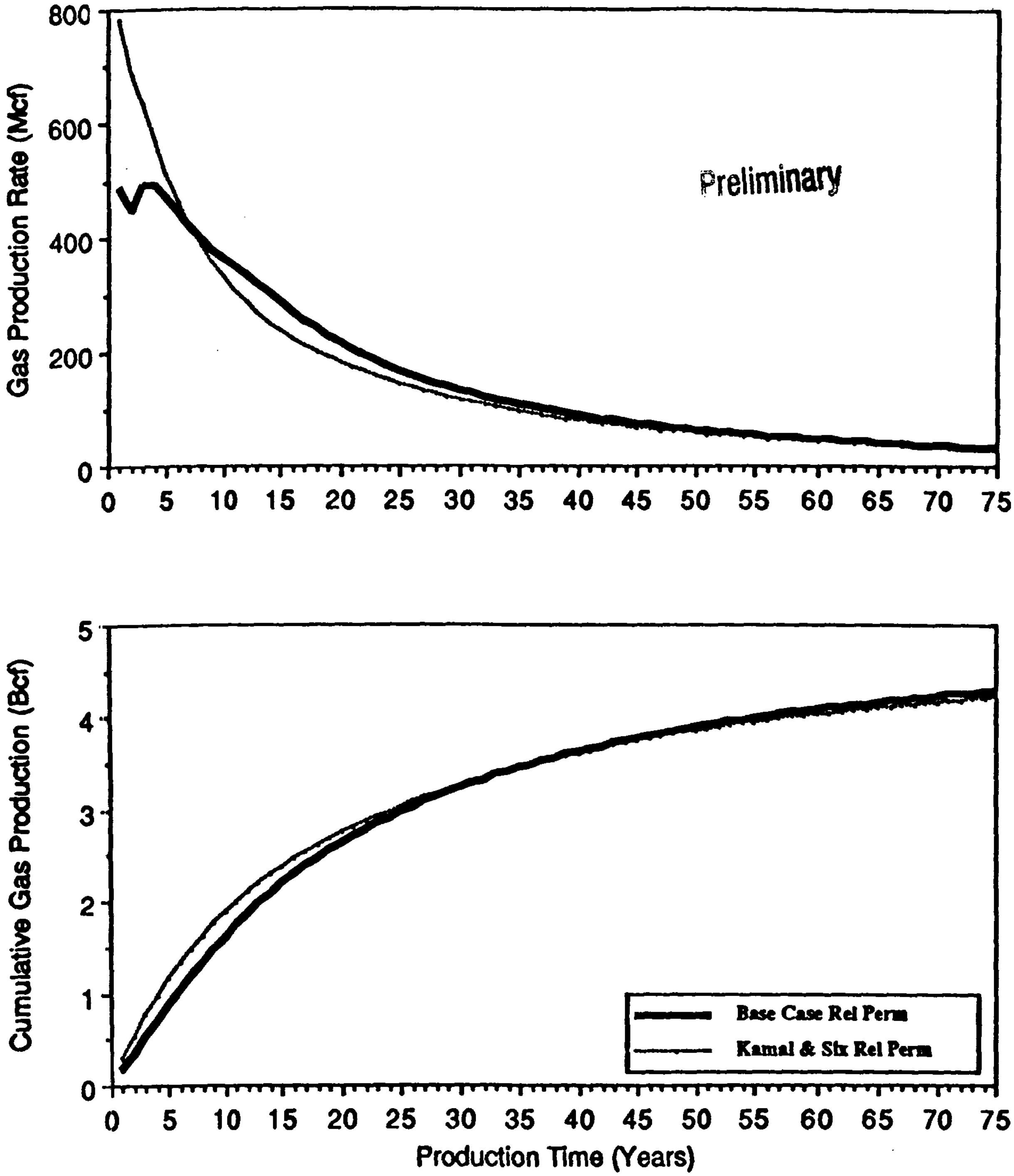


Figure 24

~~Figure 40~~

San Juan Basin Sensitivity Analysis
Area 1 Type Reservoir
Base Case Variation in Relative Permeability