

OPEN FILE 84-15

ESTIMATED OIL AND GAS RESERVES FOR ROUTT COUNTY, COLORADO

Compiled by
A. H. Scanlon

Funded by the Department of Local Affairs--
Division of Commerce and Development



Colorado Geological Survey
Department of Natural Resources
State of Colorado
Denver, Colorado
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DOI: <https://doi.org/10.58783/cgs.of8415.gmey5014>

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Acknowledgments

I would like to thank the staff of the Colorado Oil & Gas Conservation Commission (C.O.G.C.C.) who provided considerable assistance during the course of this compilation, and the staff of the Colorado Geological Survey, who assisted in the manuscript preparation.

However, I assume full responsibility for any errors or omissions in these tabulations. Users of this OPEN FILE REPORT could provide a significant service if they would inform the Colorado Geological Survey of any misinformation or omissions.

This project was completed by the staff of the Colorado Geological Survey as part of a grant from the Department of Local Affairs - Division of Commerce and Development.

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ESTIMATED OIL AND GAS RESERVES FOR ROUTT COUNTY, COLORADO

Introduction

This report is the thirteenth* in a series of oil and gas reserve investigations undertaken for those counties in which oil and/or gas is currently being produced.

This study involves Routt County, located in northwest Colorado, partially within the eastern edge of the Sand Wash Basin. Routt County covers 2,331 square miles. In this county, oil and/or gas are produced from, in descending order of age, the Intrusive Alpha Sill, Niobrara Limestone and the Shinarump Conglomerate.

There are 16 fields considered active producers as of December 31, 1983. Of these, 14 are classified as oil fields (based on cumulative gas-oil ratio (GOR) of <15:1), and 2 are classified as gas fields (based on cumulative GOR >15:1).

* Refer to:

- OPEN-FILE REPORT 84-3: Estimated Oil and Gas Reserves for Washington County, Colorado;
- OPEN-FILE REPORT 84-4: Estimated Oil and Gas Reserves for Rio Blanco County, Colorado.
- OPEN-FILE REPORT 84-5: Estimated Oil and Gas Reserves for Adams County, Colorado;
- OPEN-FILE REPORT 84-6: Estimated Oil and Gas Reserves for Weld County, Colorado;
- OPEN-FILE REPORT 84-7: Estimated Oil and Gas Reserves for Arapahoe County, Colorado;
- OPEN-FILE REPORT 84-8: Estimated Oil and Gas Reserves for Baca County, Colorado.
- OPEN-FILE REPORT 84-9: Estimated Oil and Gas Reserves for Cheyenne County, Colorado.
- OPEN-FILE REPORT 84-10: Estimated Oil and Gas Reserves for Garfield County, Colorado;
- OPEN-FILE REPORT 84-11: Estimated Oil and Gas Reserves for La Plata County, Colorado;
- OPEN-FILE REPORT 84-12: Estimated Oil and Gas Reserves for Moffat County, Colorado;
- OPEN-FILE REPORT 84-13: Estimated Oil and Gas Reserves for Elbert County, Colorado; and
- OPEN-FILE REPORT 84-14: Estimated Oil and Gas Reserves for Mesa County, Colorado.

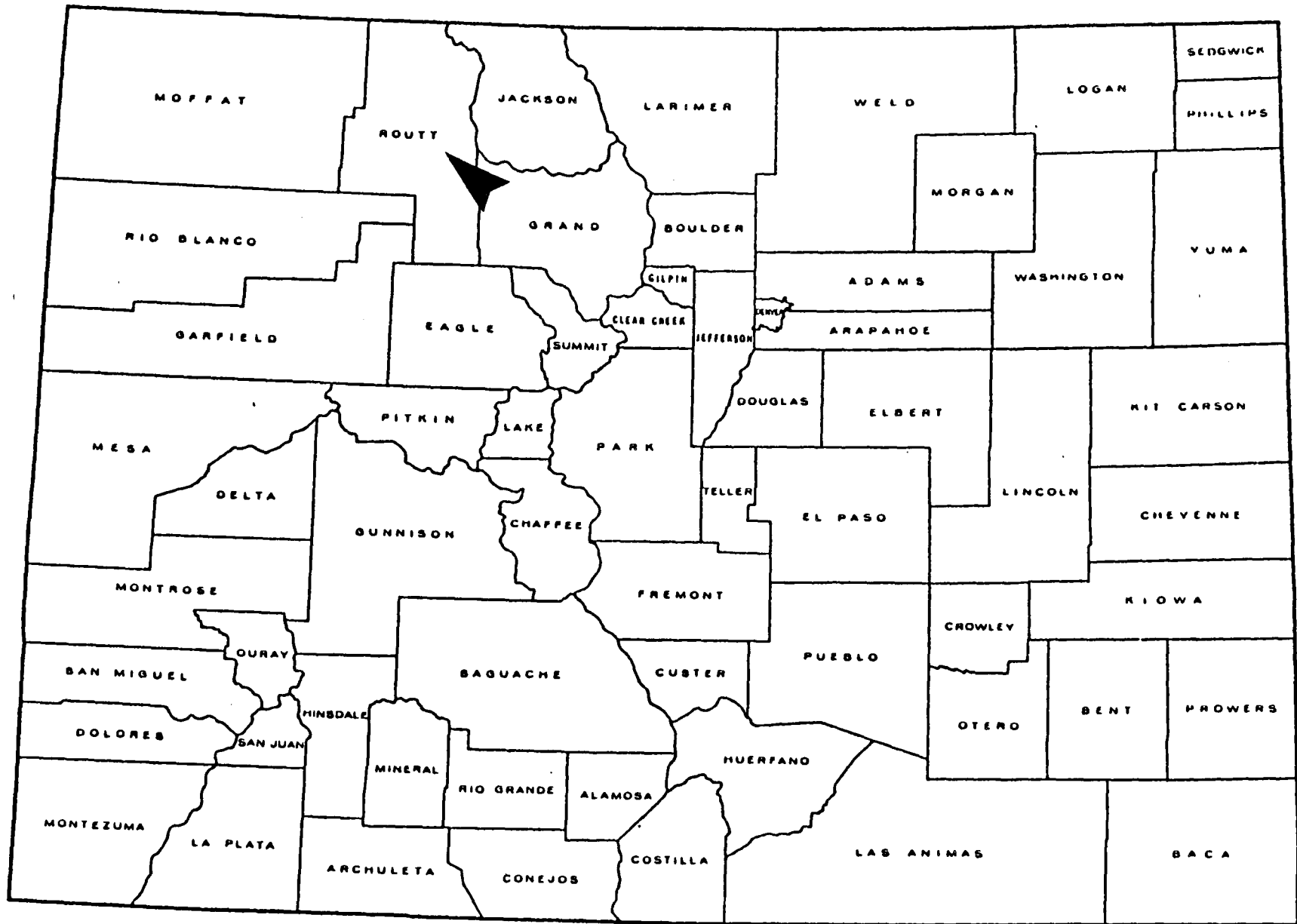


Figure 1. County Location Map

Method of Approach

Production decline curves are plotted for each currently producing horizon within each field, hereafter referred to as a field-horizon. There are 16 production decline curves plotted, one for each field-horizon. Production data were obtained from the C.O.G.C.C. annual production books. These books contain records of yearly production data, dating back to 1952. All production decline curves are plotted as rate (annual production in barrels of oil or MCF of gas) versus time (in years). The rate scale was adjusted to accommodate each field-horizon.

Oil Reserve Calculations

There are 14 oil field-horizons. Production histories have allowed for decline rates to be calculated for 11 of these. The remaining 3 oil field-horizons have not produced for a long enough time (less than 3 years) to determine a reliable decline rate. For the previously mentioned 11 fields, decline rates were determined based on actual past production and recorded, see Table I. These decline rates were then applied to the equation:

$$R_r = \frac{q_1 - q_f}{-\ln(1-dy)}$$

where: R_r = remaining reserves
 q_1 = current annual production
 q_f = final economic production rate
(see note below.)
 $-\ln$ = negative natural log
 dy = yearly decline rate (in percent)

The ultimate recoverable was then determined by adding the estimated reserves to the cumulative production. These values are listed in Table I.

Note: the final economic production rate used was one barrel of oil per day per well, for one year; therefore 365 barrels, multiplied by the number of wells needed to keep field production economic. In most cases this was one well. The number of wells used was determined at the discretion of the author.

For associated gas production, estimated reserves were calculated in the same manner as that described in the Gas Reserve Calculations section.

Gas Reserve Calculations

There are 2 gas field-horizons. One field-horizon, Pagoda-Shinarump, has only produced for 3 years. This has not produced for a long enough time to determine a reliable decline rate. The other field-horizon, Pelt-Niobrara has been producing since 1973, but production is extremely erratic, therefore no reliable decline rate could be established. Decline rates for associated gas production were determined from actual past production for the oil field-horizons and applied to the equation:

$$S = \frac{a(1-r^n)}{1-r}$$

Where: S = gas reserves
 a = current annual gas production
 r = $(1-dy)$ where dy = annual decline rate
 n = number of years -- 20 years was used in all cases except where noted in the remarks column of Table II.

Results can be found in Table I.

For the associated oil production, where this production was significant, the same method to determine estimated oil reserves was used, as discussed in the previous section. Whether oil production was considered significant or not was determined by the author. In all cases, if oil production indicated any kind of trend, reserves were calculated. A few cases arose where oil production, though a trend was indicated, did not exceed the economic limit (as discussed previously) of one barrel of oil per day per year, and therefore no reserve estimate was calculated, or an economic limit of zero was used.

Results

The following figures are for those field-horizons for which reserves could be calculated. Estimated oil reserves for Routt County totaled 2,943,210 barrels. Estimated gas reserves for Routt County totaled 410,089 MCF. Note that the gas reserve calculations are based on a 20-year projection, therefore they do not account for gas production after the year 2003.

These figures also do not account for production increases due to secondary and/or tertiary recovery not already in progress, or account for undiscovered reserves, nor do they reflect changes in economics or demand.

In nine to ten years, roughly half of the estimated oil reserves in Routt County will have been produced. Roughly one half of the estimated gas reserves for the next 20-year period are expected to be produced in seven to eight years.

In this county there are two classes of field-horizons: I) those with a long enough production history to calculate reserves with confidence, and II) those new field-horizons with essentially no production history, or for other reasons, reserves cannot be calculated.

To be able to calculate total county oil and gas reserves, it was necessary to apply the overall decline rates (7.38 percent per year for oil and 6.5 percent per year for gas) obtained from class I field-horizons to the current production from Class II field-horizons.

Using this approach on current production from Class II field-horizons (10,262 Bbls. of oil and 959,031 MCF of gas) additional reserves of 133,855 Bbls. of oil and 10,907,063 MCF of gas were obtained. This gives total county reserves (Class I and II) of 3,077,065 Bbls. of oil and 11,317,152 MCF of gas.

To insure that the reserve figures calculated for Class II are reasonable using this method, a comparison was made between the sources (producing horizons) of the Class I and Class II field-horizons. It was determined that there were some significant differences in the sources of the gas production for the two groups. Most of the Class I gas production is from the Shinarump Conglomerate, while most of the Class II gas production is from the Niobrara. As the Class I decline rates are not considered unusual, it is concluded that the Class II reserve figures are somewhat optimistic, but acceptable using this method.

LIST OF ABBREVIATIONS USED IN TABLE OF RESERVE DATA

'a'	annual gas production
ABD.	abandoned
Approx.	approximate, approximately
Avg.	average, averaged
Bbls.	barrels
B.W.E.	Bottom Water Encroachment
calc.	calculate, calculated
Co.(s)	county (counties)
cond.	condensate
ck.	Creek
Cum.	cumulative
Dak.	Dakota Sandstone
Deplet.	Depletion
dy	annual decline rate
Econ.	Economic
Est.	Estimated
Exp.	Expansion
g	gas
Gas Exp.	Gas Expansion
G.C.E.	Gas Cap Expansion
G.E.	Gas Expansion
GOR	Gas-Oil Ratio
Inc.	Increase, increasing, increased
Inj.	Injection, injected
Lmtd.	Limited
MCF	Thousand cubic feet
Miss.	Mississippian
Mos.	Months
Mtn.	Mountain
N	North
N.P.	New Production or less than five years production, therefore, no reliable annual decline rate could be calculated to apply to the equations to calculate reserves.
No.	number, numbers, North
o	oil
P and A	Plug (ged) and Abandon (ed)
Poss.	Possible
Prod.	Production, produced
Proj.	Projection, projected
q	current annual production of oil
qf	final economic production of oil
react.	reactivated
Rr	Remaining reserves-oil
S	Remaining reserves-gas
S.G.D.	Solution Gas Drive
S.I.(SI)	Shut-in
So	South
W	West
W.D.	Water Drive
Yr or Yrs	Year or years

TABLE I
OPEN FILE 84-15
RESERVE DATA FOR ROUTT COUNTY

FIELD NAME/ PRODUCING HORIZON	LOCATION	DATE OF DISCOVERY	TYPE OF DRIVE	Dy	CUMULATIVE PRODUCTION 9/30/83		ESTIMATED RESERVES		ULTIMATE RECOVERABLE		REMARKS	
					OIL (Bb1s.) ()Condensate (Bb1s.)	GAS (MCF)	OIL (Bb1s.)	GAS (MCF)	OIL (Bb1s.) ()Condensate (Bb1s.)	GAS (MCF)		
1. Bear River/ Niobrara	6N-87W	1975		7.2 -o 6.4 -g	738,399	160,481	1,725,279	198,911	2,463,678	359,392		
2. Bull Mountain/ Niobrara	8N-87W	1981		39.0 -o 43.2 -g	27,423	51,907	6,615	9,259	34,038	61,166		
3. California Park/ Niobrara	9N-87W	1983			1,748	471					N.P.	
4. Curtis/Niobrara	6N-86W	1958	S. G. D.	5.8 -o 5.4 -g 9.3 -o	235,132	96,293	134,962	993	370,094	97,286		
5. Dill Gulch/ Niobrara	5N-89W	1974			9,823		2,407		12,230		Econ.Limit=0	
6. Dry Creek/ Niobrara	5N-88W	1980			17,970	55,708					N.P.	
7. Fish Creek/ Niobrara	5N-87W	1971		5.7 -o 5.7 -g	25,339	7,595	18,470	5,260	43,809	12,855	"	
8. Focus Ranch/ Intrusive Alpha Sill	12N-87W	1971		13.0 -o	9,117		4,186		13,303		Econ.Limit=0	
9. Grassy Creek/ Niobrara	6N-87W	1959	S. G. D. & Gravity Drainage	6.0 -o 4.2 -g	750,749	115,343	552,223	195,666	1,302,972	311,009	Econ.Limit-2 wells	
10. Meander/ Shinarump	4N-89W	1981			5,578	6,139					N.P.	
11. Pagoda/ Shinarump	4N-89W	1948	Gas Exp. & W. D.		(278)	1,719,542					Prod. 1953, 1981-83. N.P. Erratic Prod.	
12. Pelt/Niobrara	6N-89W	1973			85 (2,054)	138,627						
13. Sage Creek/ Niobrara	5N-88W	1959	Gravity, Low Press- ure G.C.E.	6.8 -o	102,027	3,480	31,425		133,452			
14. Sage Creek N./ Niobrara	5N-88W	1960	Gravity, Low Press- ure G.C.E.	3.5 -o	529,936		286,270		816,206			
15. Tow Creek/ Niobrara	6N-86W	1924	S. G. D. & Gravity Drainage	5.0 -o	2,949,519	338,899	33,669		2,983,188	+338,899		
16. Wolf Mountain/ Niobrara	7N-87W	1976		21.4 -o	211,486		147,704		359,190			
COUNTY TOTAL OF ESTIMATED RESERVES								2,943,210 Bb1s 410,089 MCF				

Reference List

Colorado Oil and Gas Conservation Commission Production Records and Injected Fluids - Water and/or Gas-File.

Crouch, M.C., III, editor, 1982 Oil and Gas Fields of Colorado, Nebraska and Adjacent Areas: Rocky Mountain Association of Geologists, vols. I and II, 791 pp.

Haun, J.D., Cardwell, A.L., Herrod, W.H. and Cronoble, J.M., 1976. Oil and Gas Reserves of Colorado in Colorado School of Mines Research Institute, Mineral Industries Bulletin, v. 19, #5.

Parker, J.M., editor, 1961 Oil and Gas Field volume: Colorado-Nebraska: Rocky Mountain Association of Geologists, 389 pp.

Appendix I

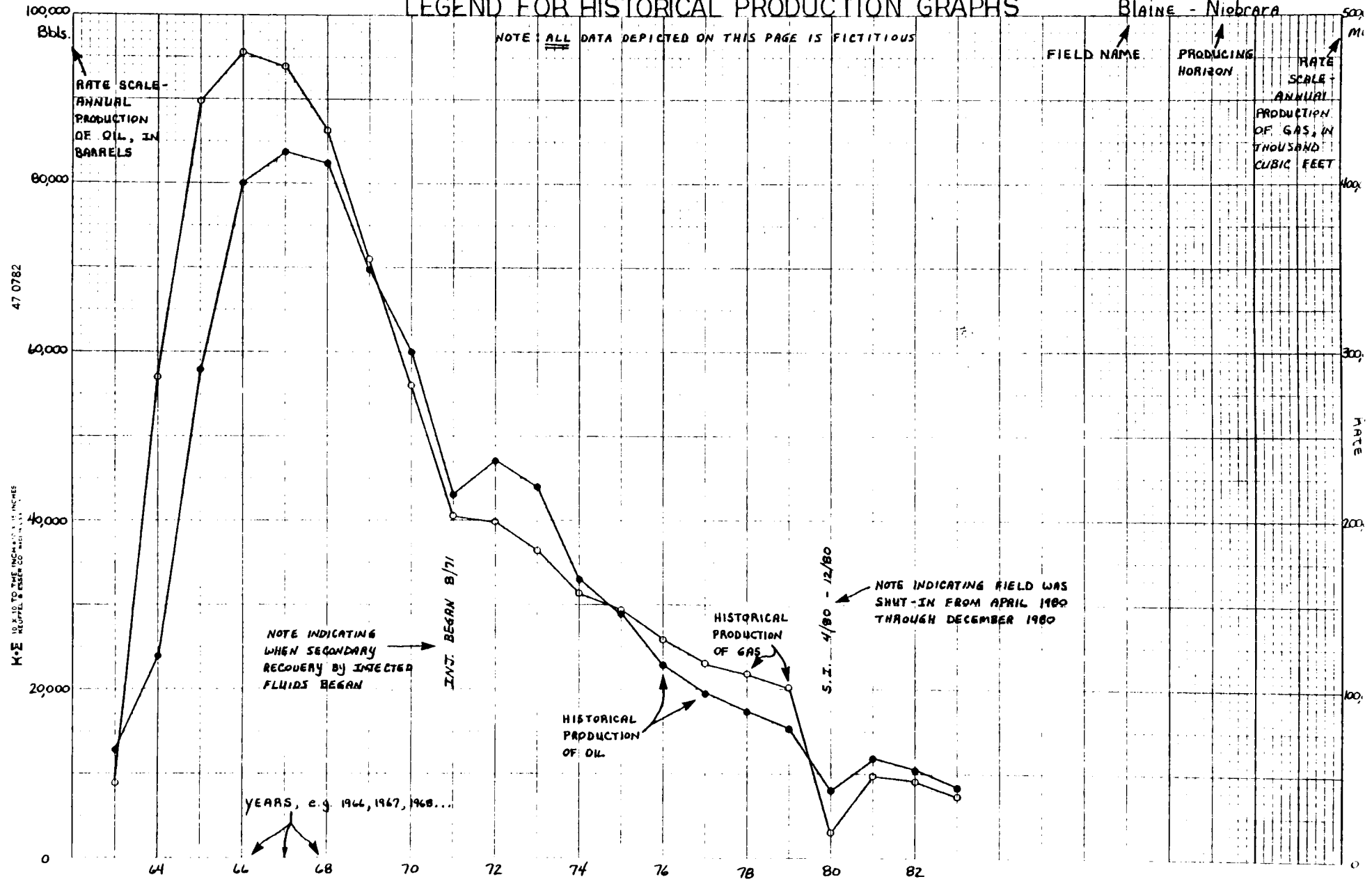
Historical production decline curve graphs for Routt County. These graphs are presented in alphabetical order by Field name and then by producing horizons within each field.

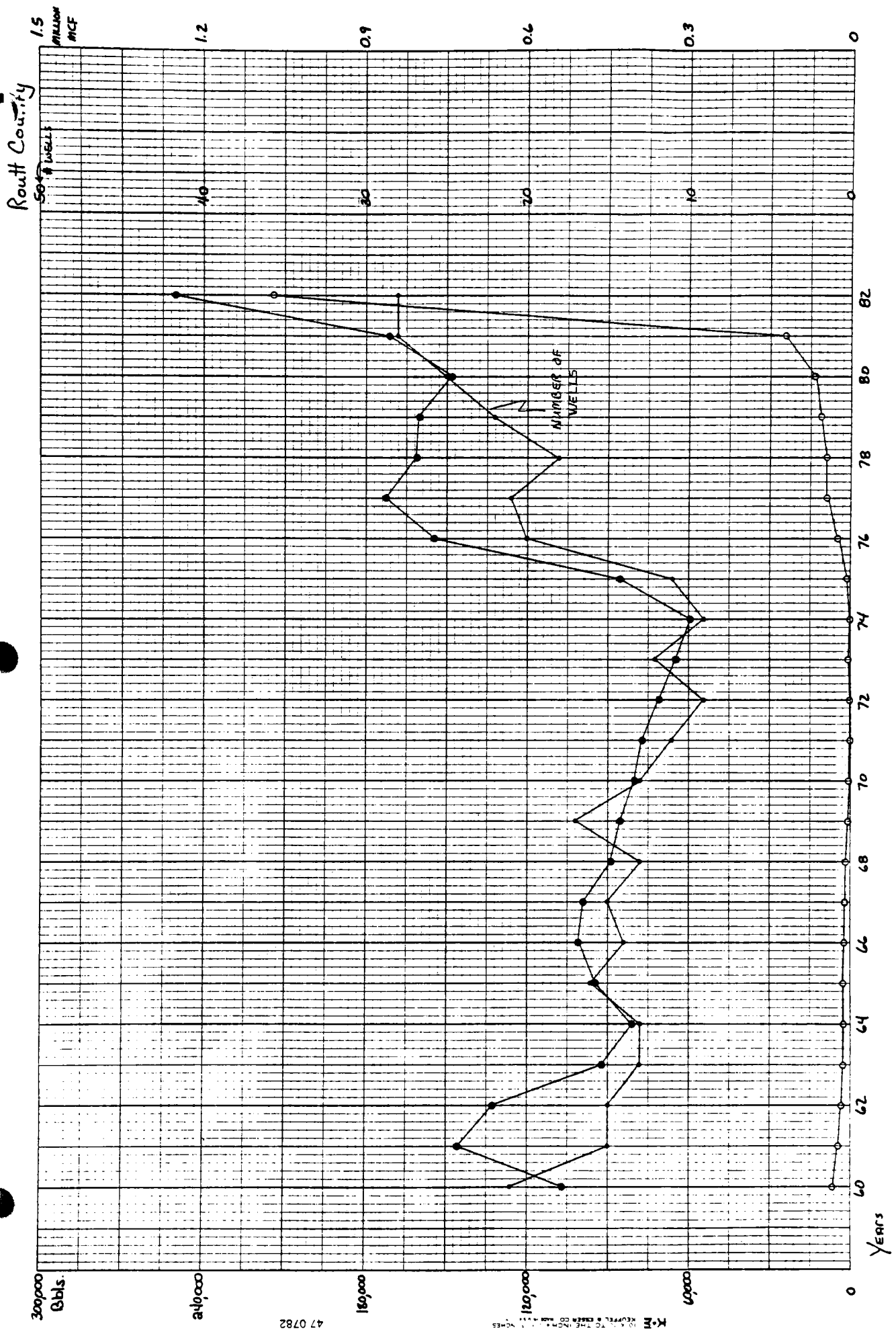
Note that only those fields actively producing as of 12-31-83 are included. Abandoned fields or field-horizons are not included.

LEGEND FOR HISTORICAL PRODUCTION GRAPHS

Blaine - Niobrara

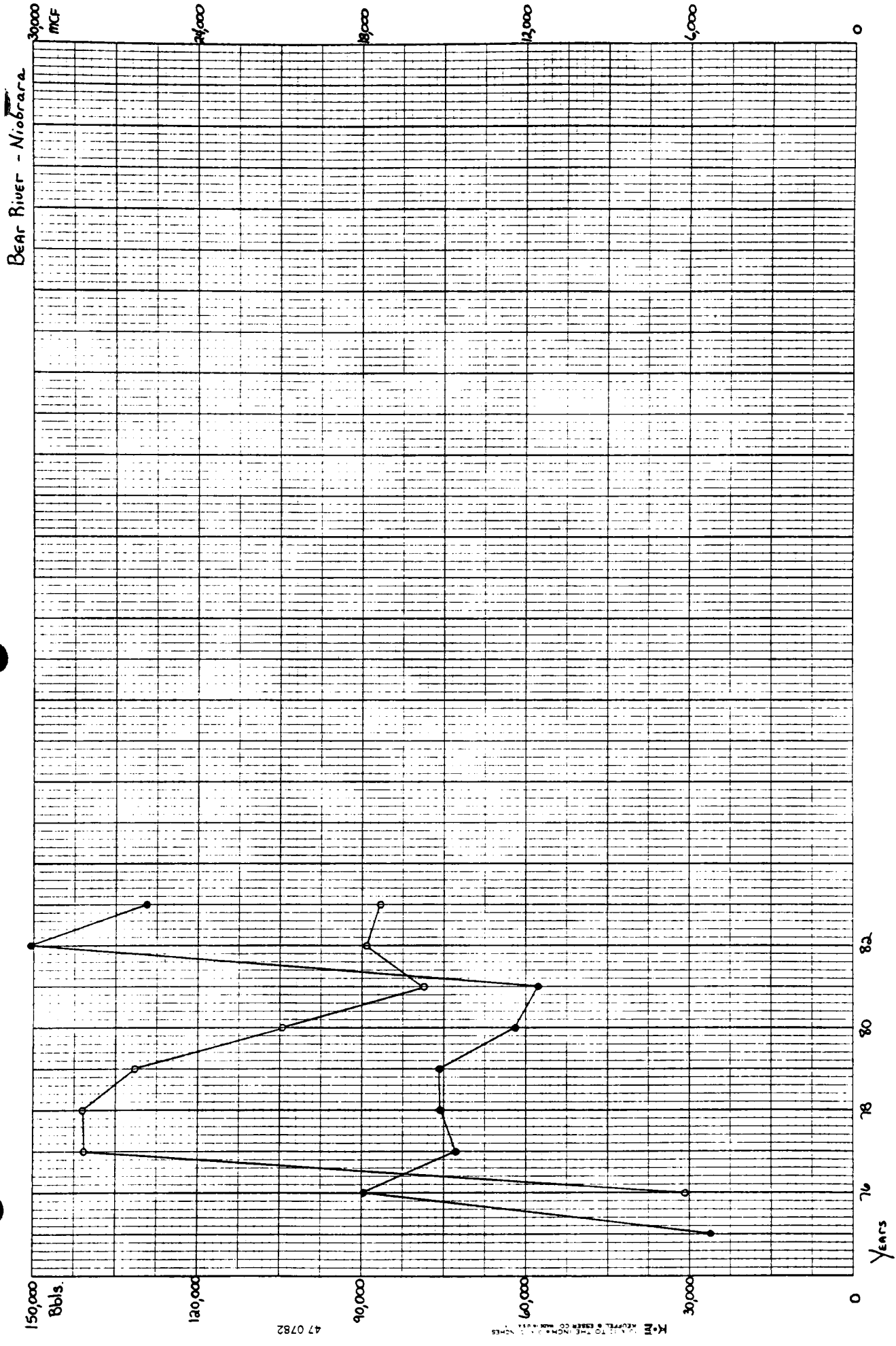
NOTE: ALL DATA DEPICTED ON THIS PAGE IS FICTITIOUS





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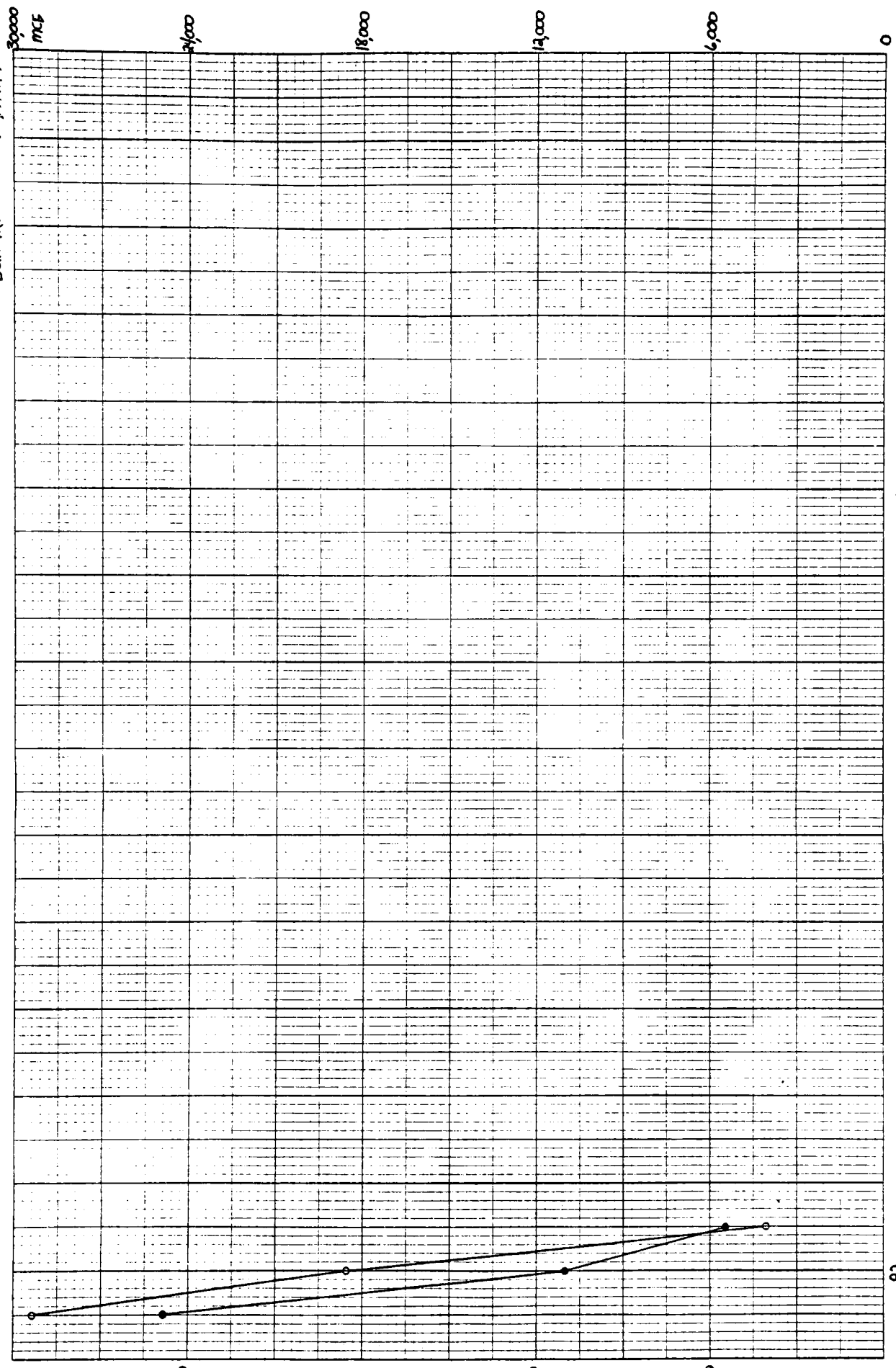
K. M. KEPPLE & SONS, INC. ENGINEERS



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K-M
 REPERF. TO THE NORTH
 OF THE NIobrara

Bull Mountain - N. S. AAA



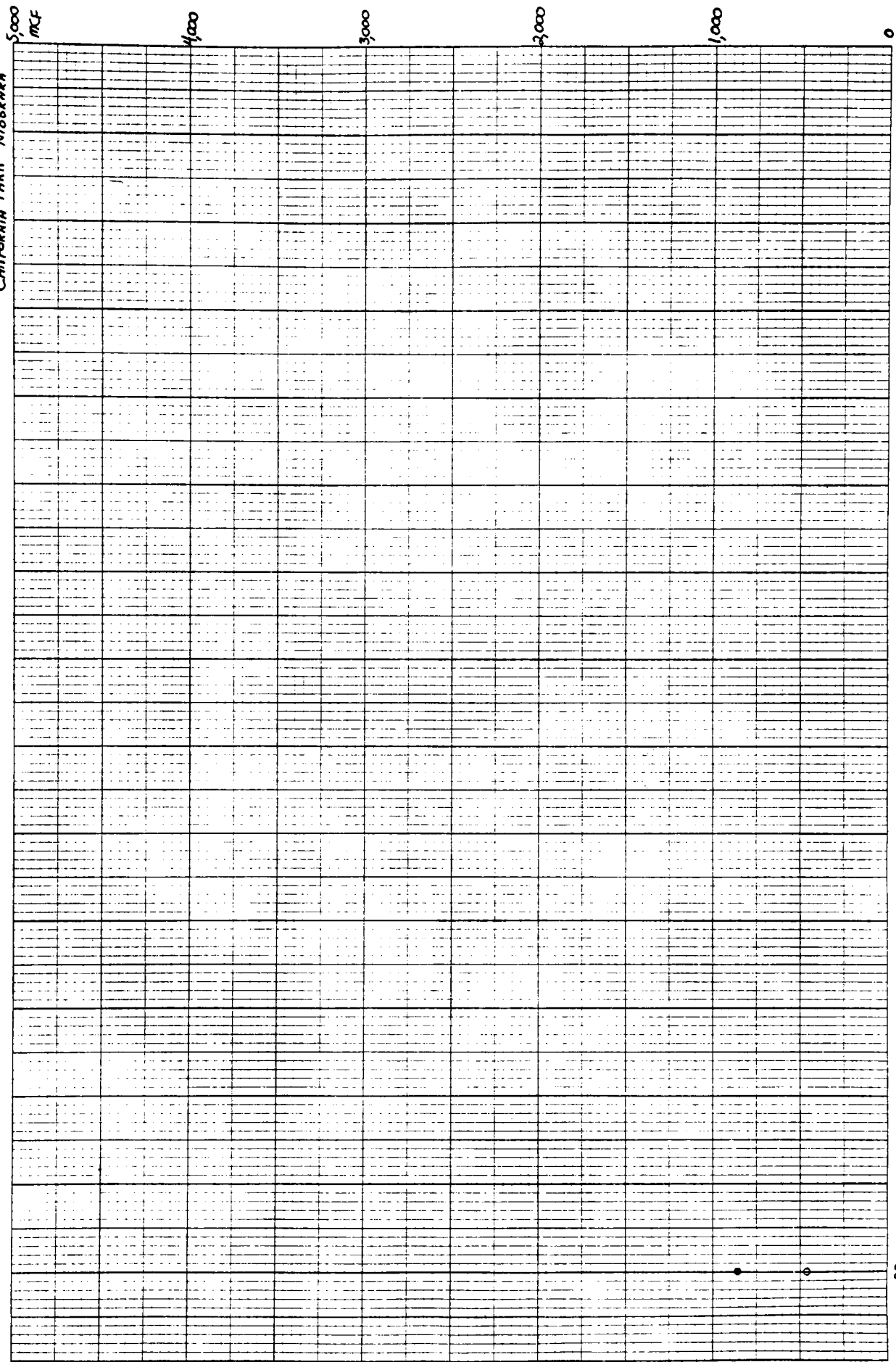
20,000 Bbls. 16,000 12,000 8,000 4,000 0

Years 0 82

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K-E REPORT TO THE NCA ON THE BULL MOUNTAIN MOUNTAINS

California Park - Niobrara

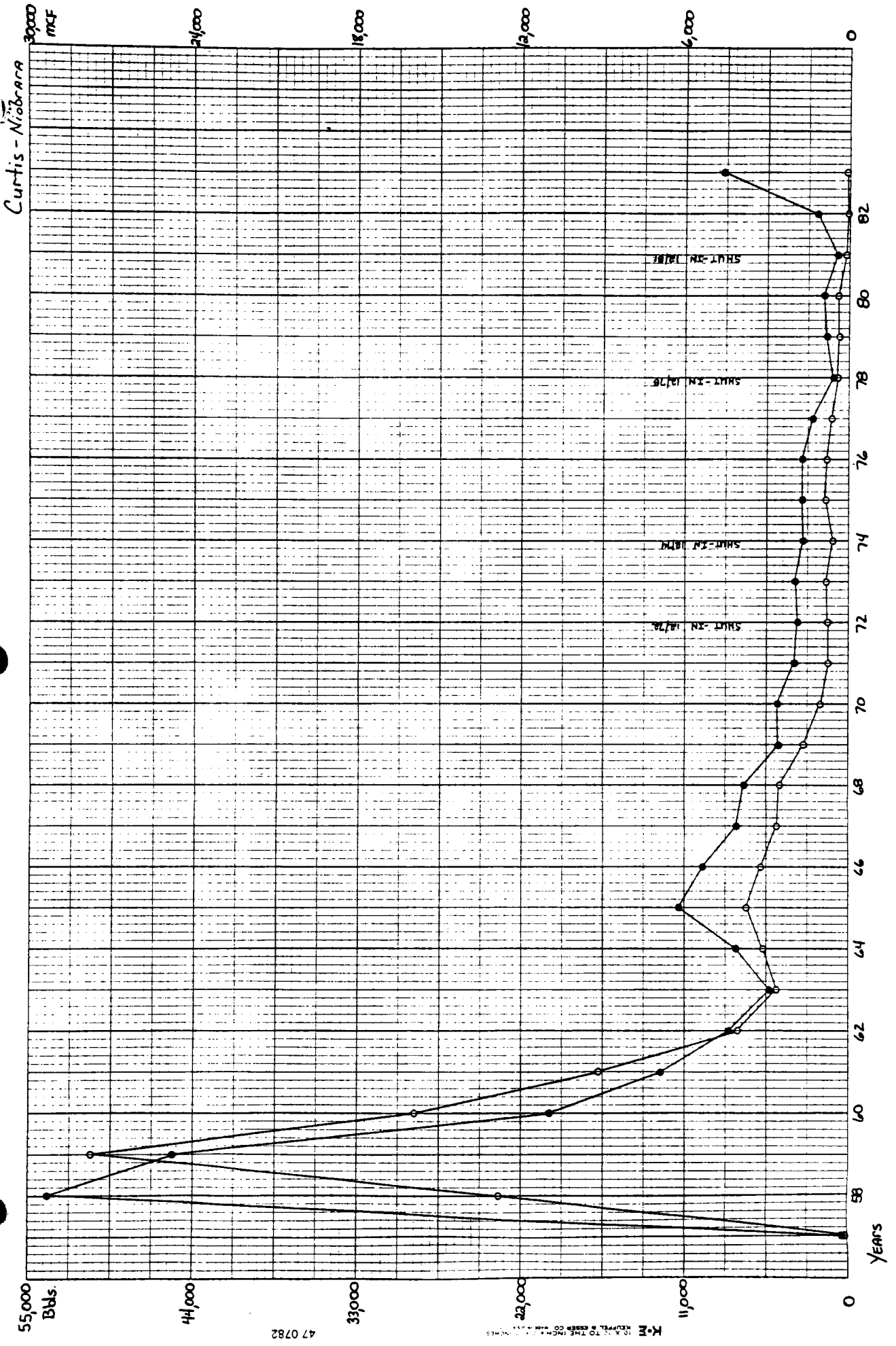


10,000 Bbls
8,000
6,000
4,000
2,000
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Years 83

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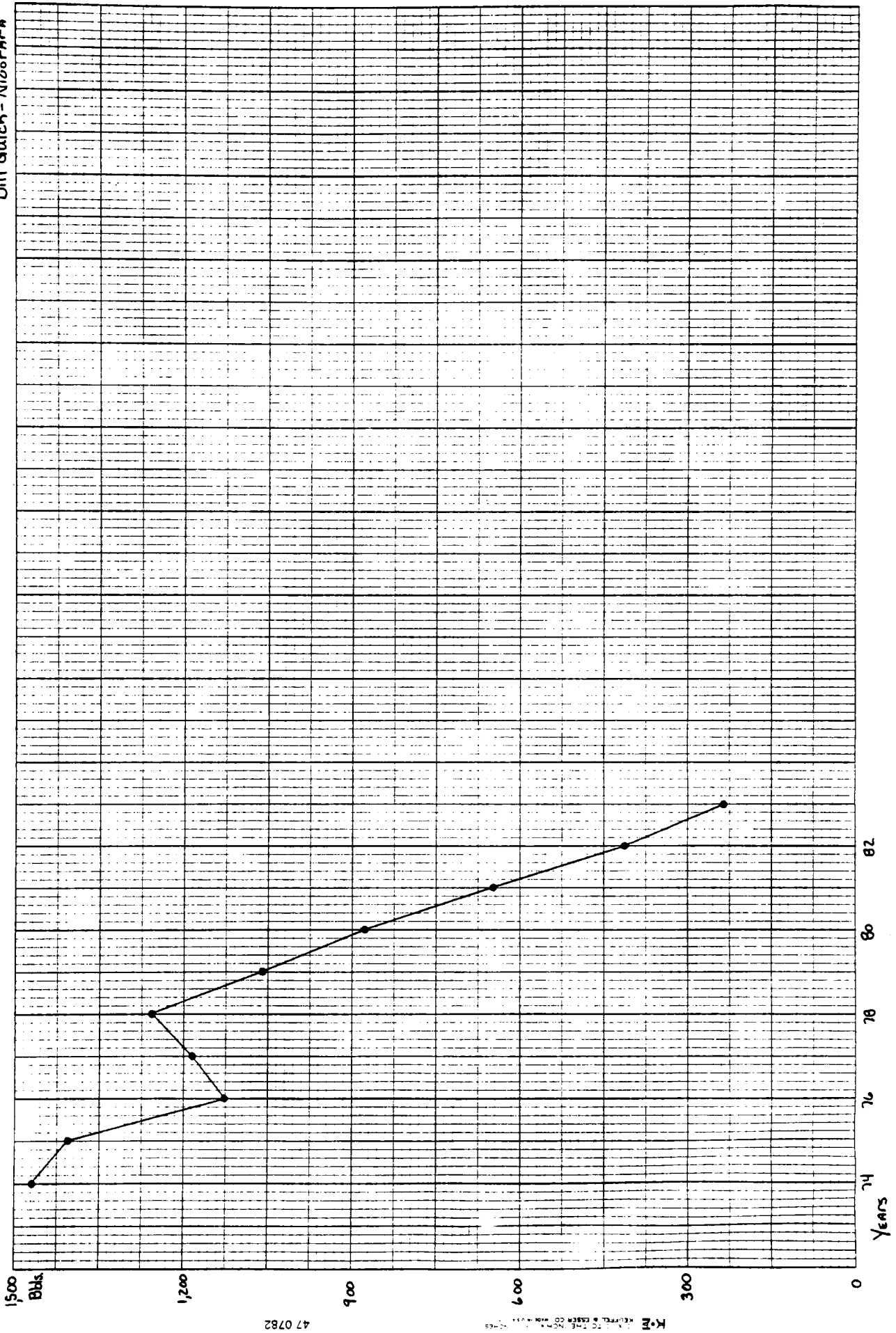
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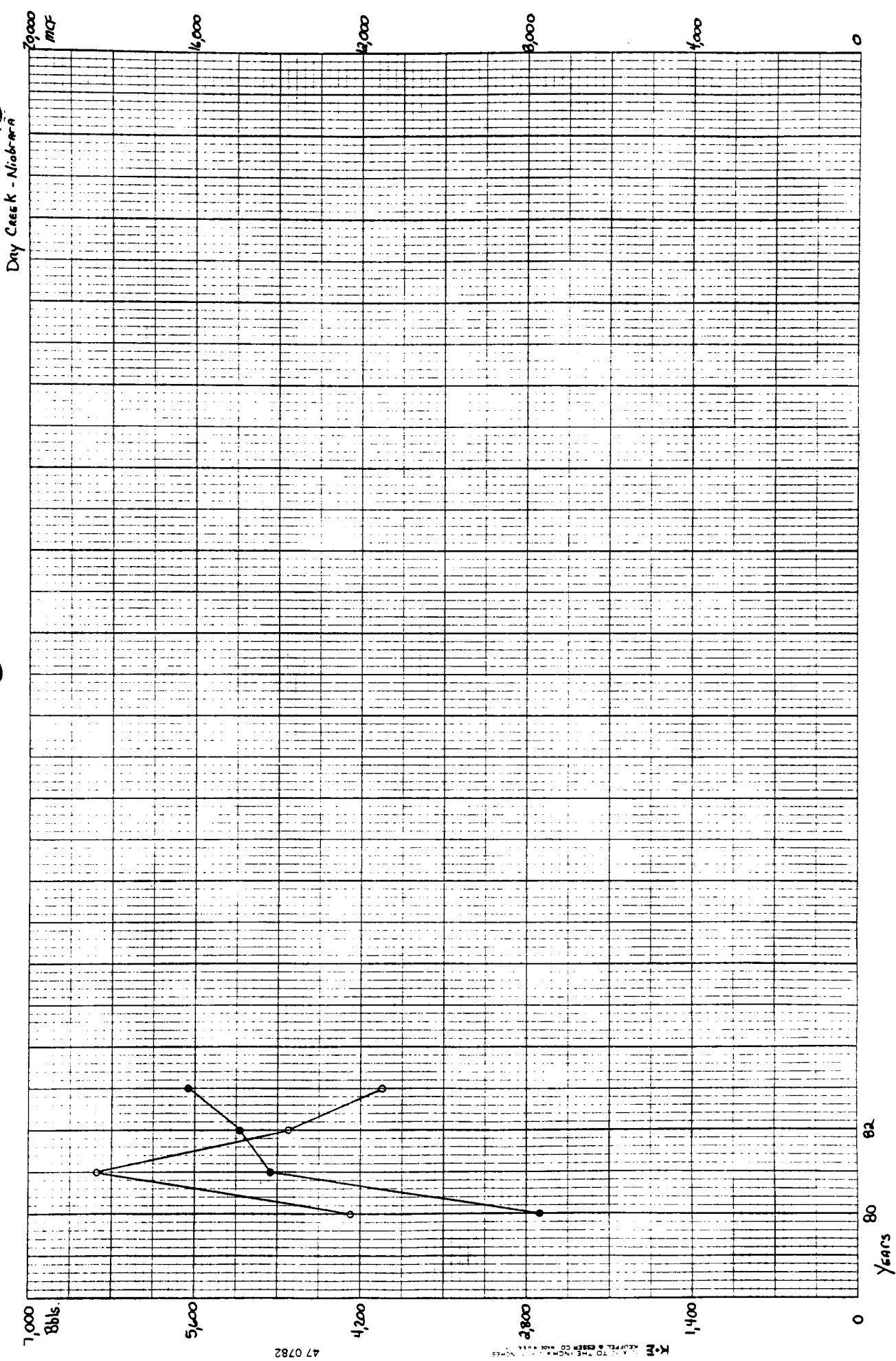


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 KENNEDY & BAKER CO. ENGINEERS

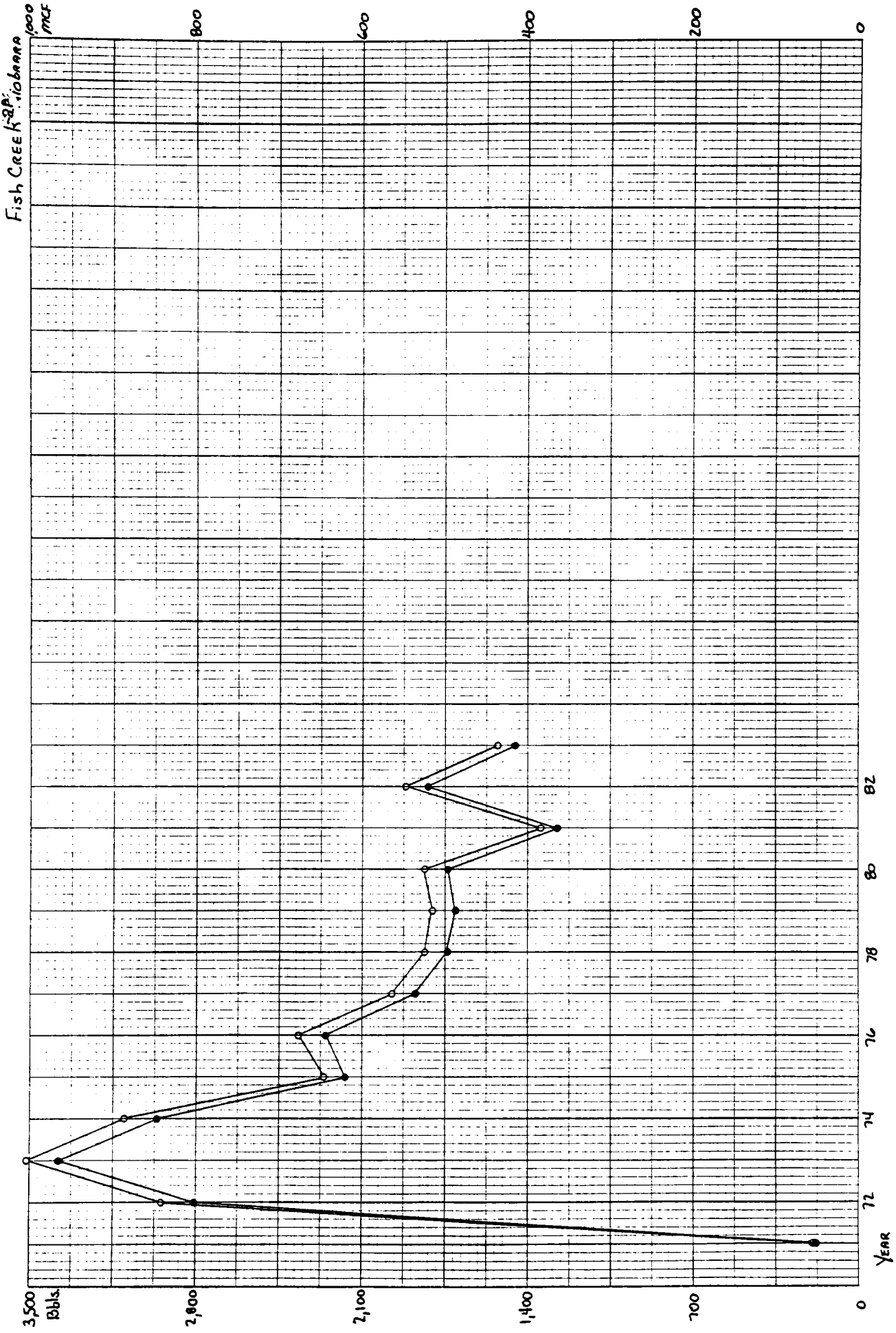
Dill Gulch - Nižorara



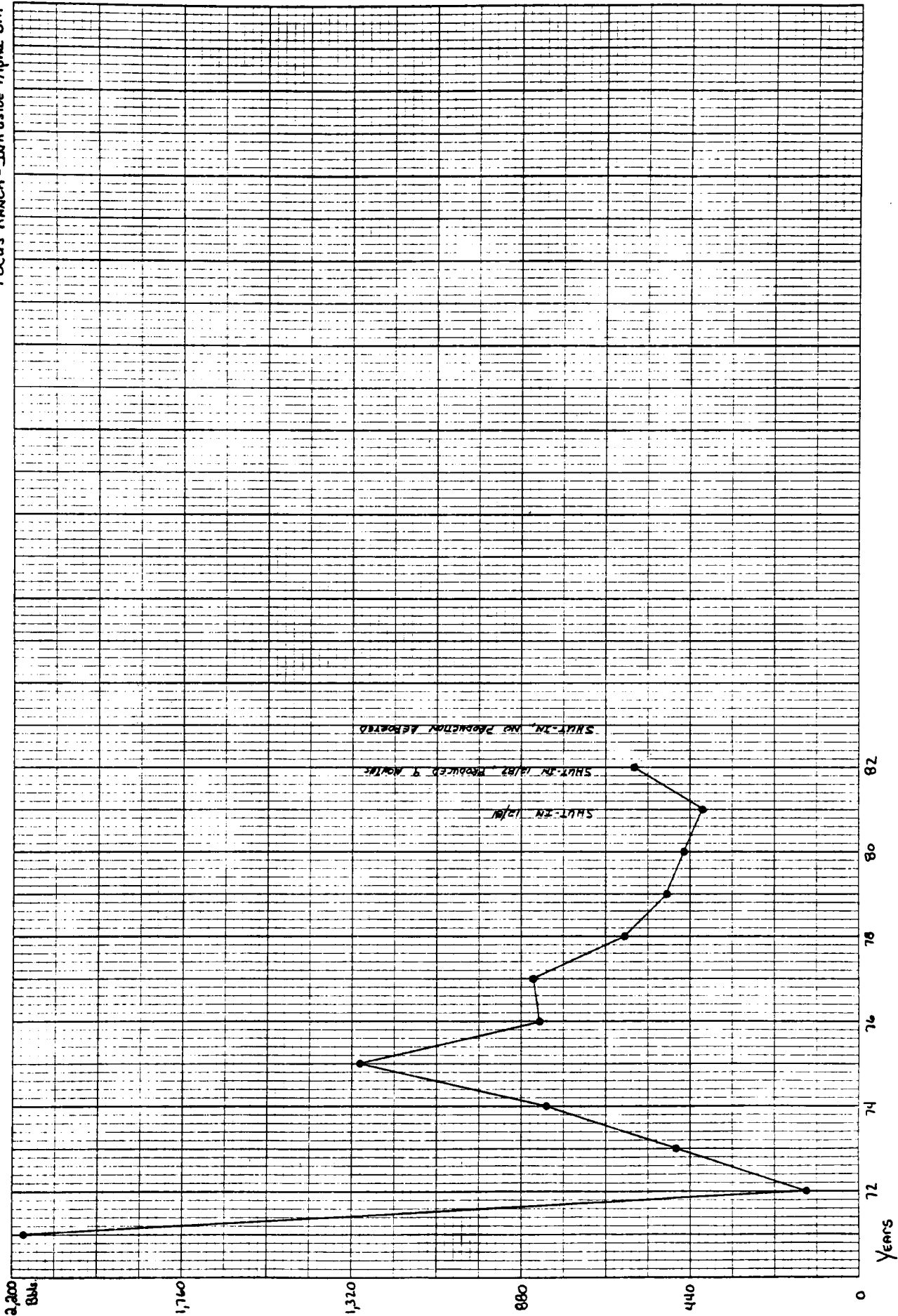


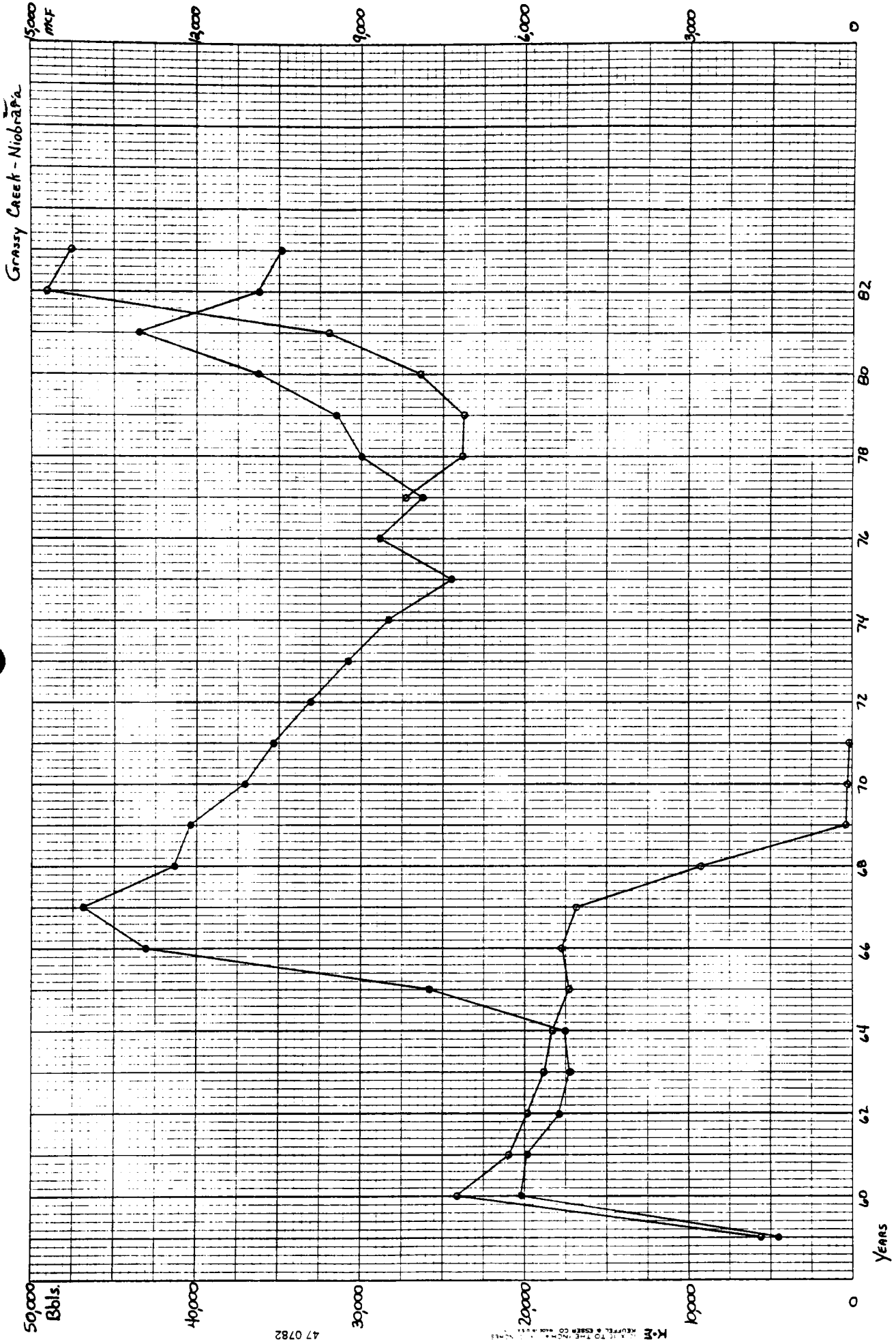
U.S. GEOLOGICAL SURVEY
 WATER RESOURCES DIVISION
 RESTON, VIRGINIA 20192

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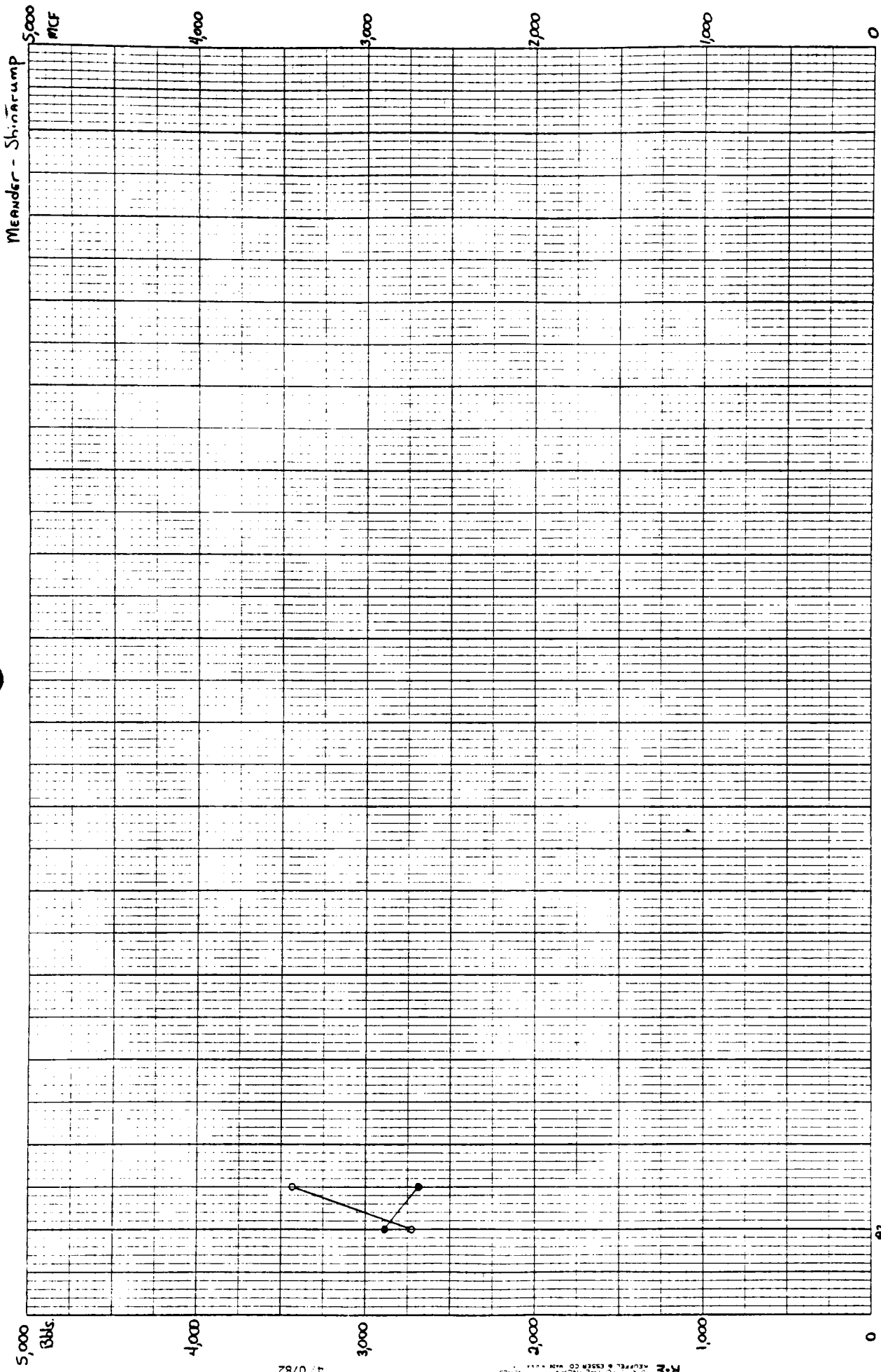
Focus Ranch - Intrusive Alpha Sill





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K-M REPORTED BY THE NCH & ASSOCIATES



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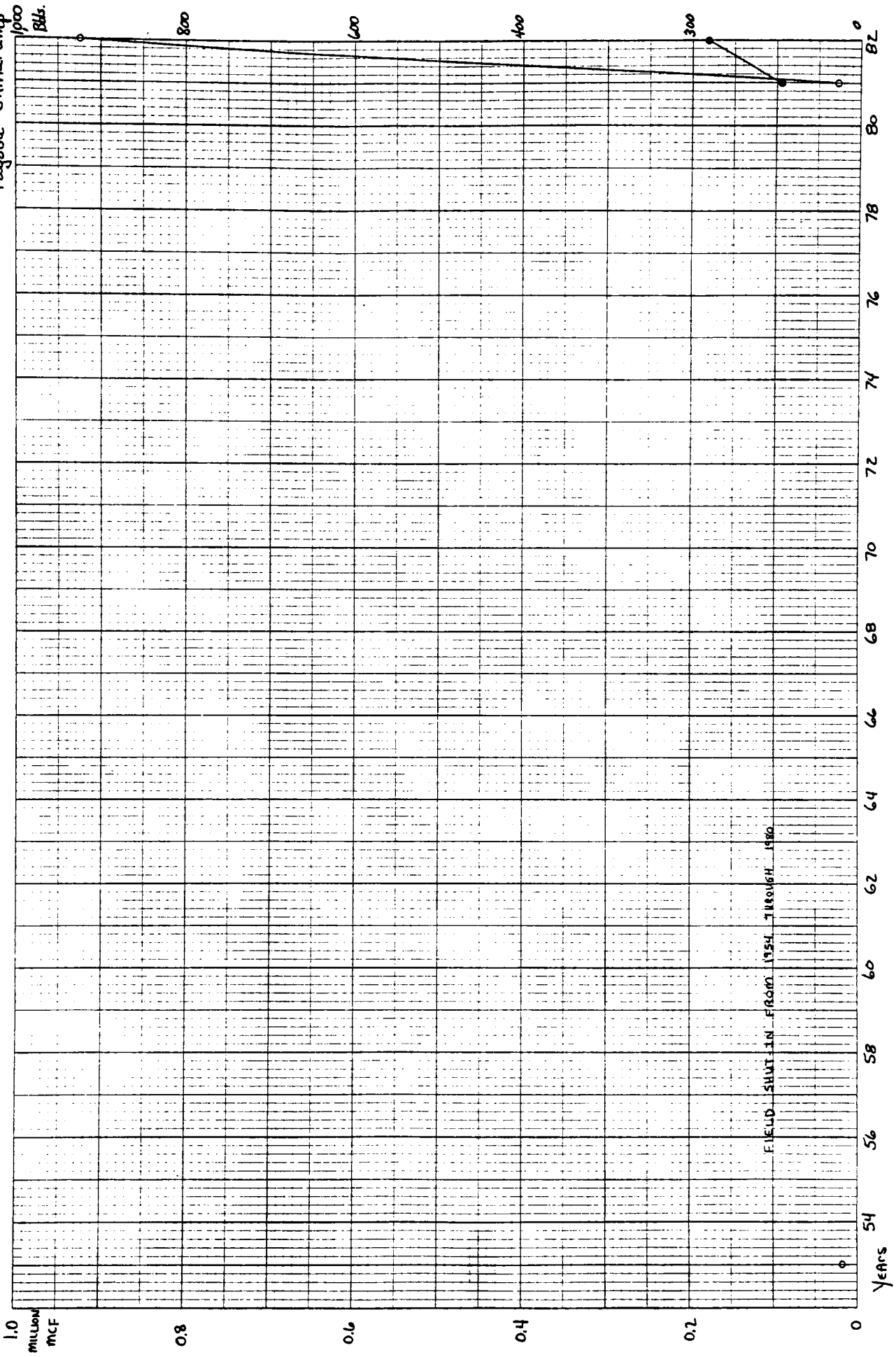
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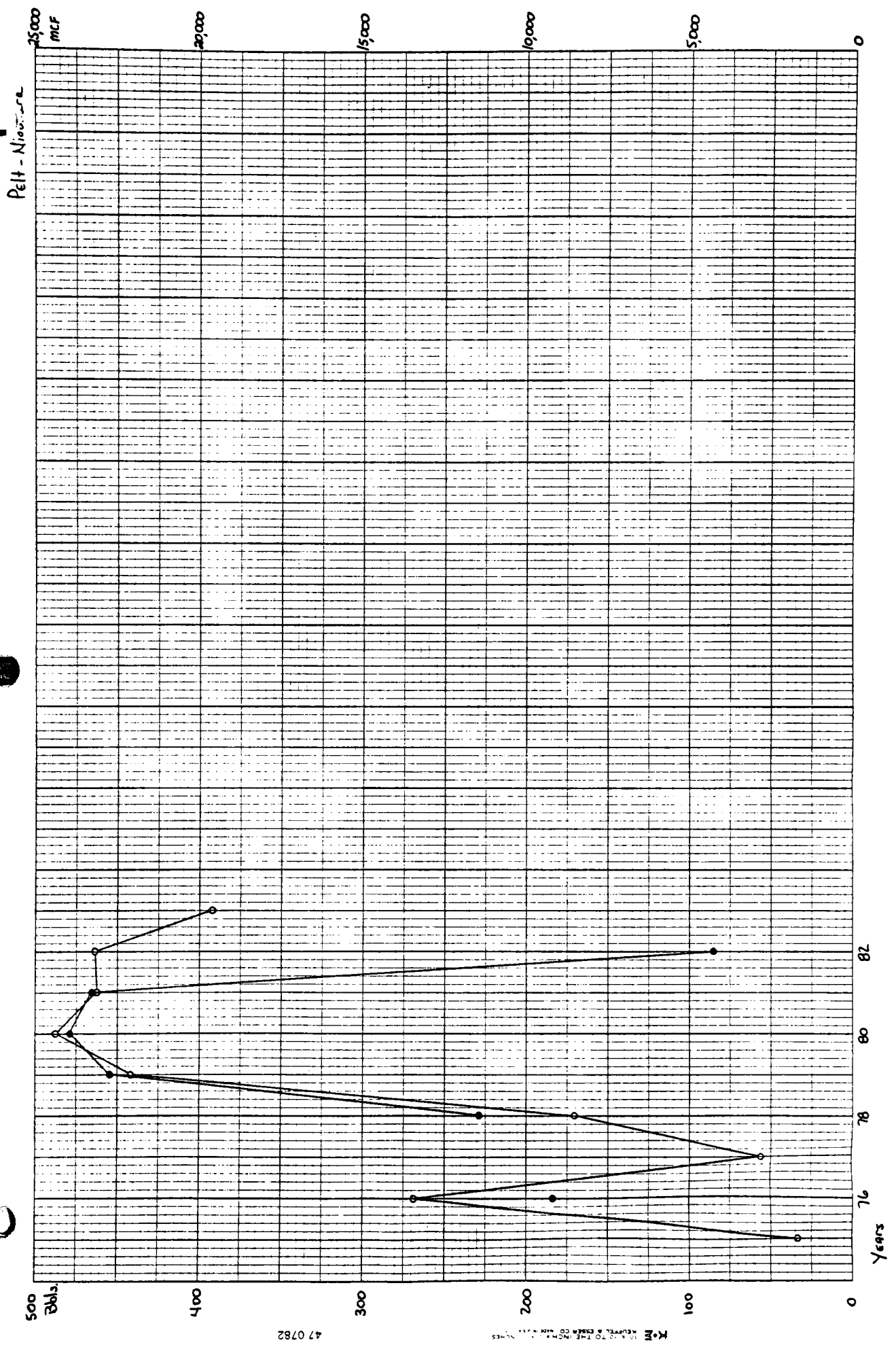
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Years

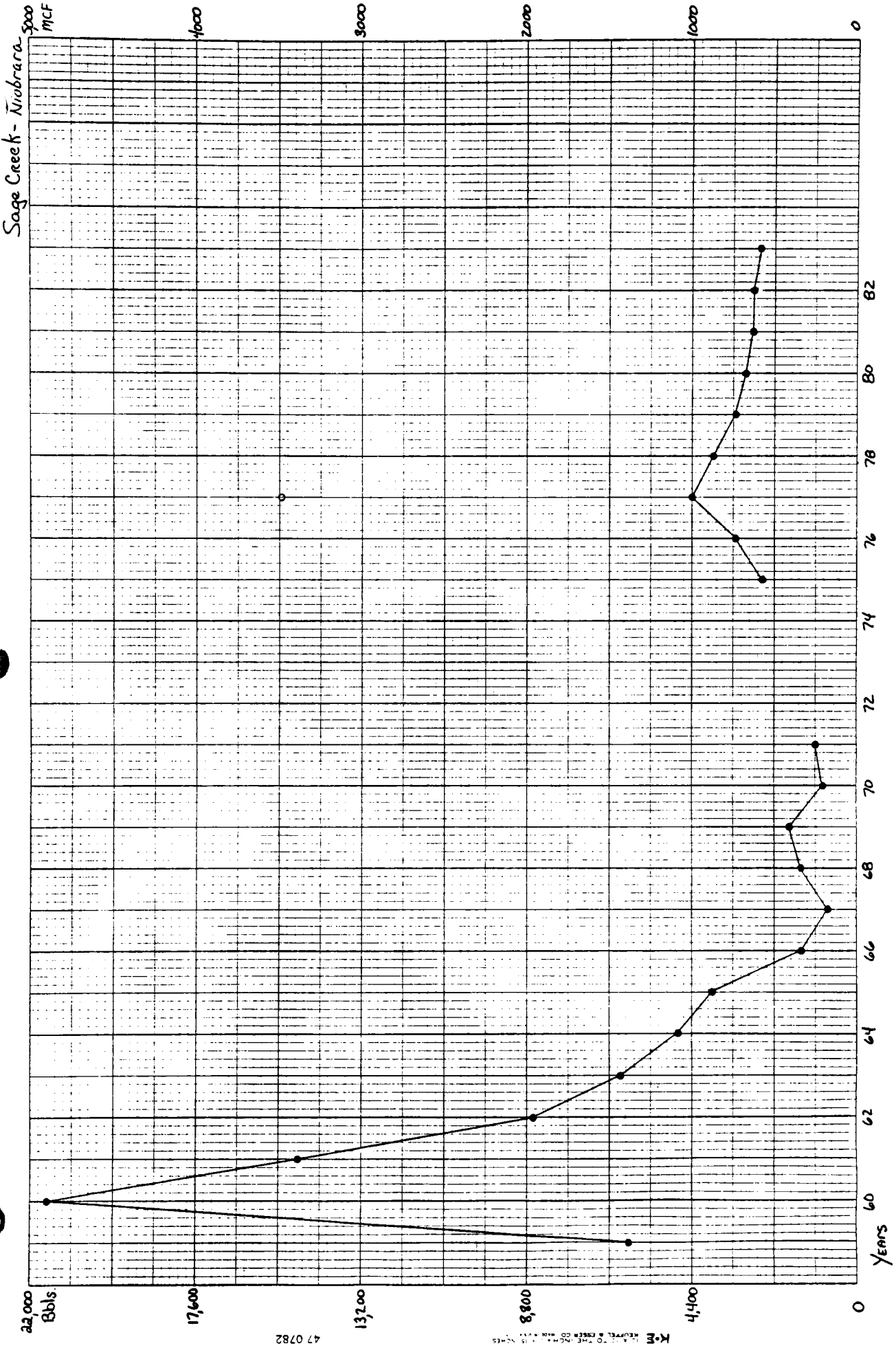
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Pagoda - Shinarump
Bbls.



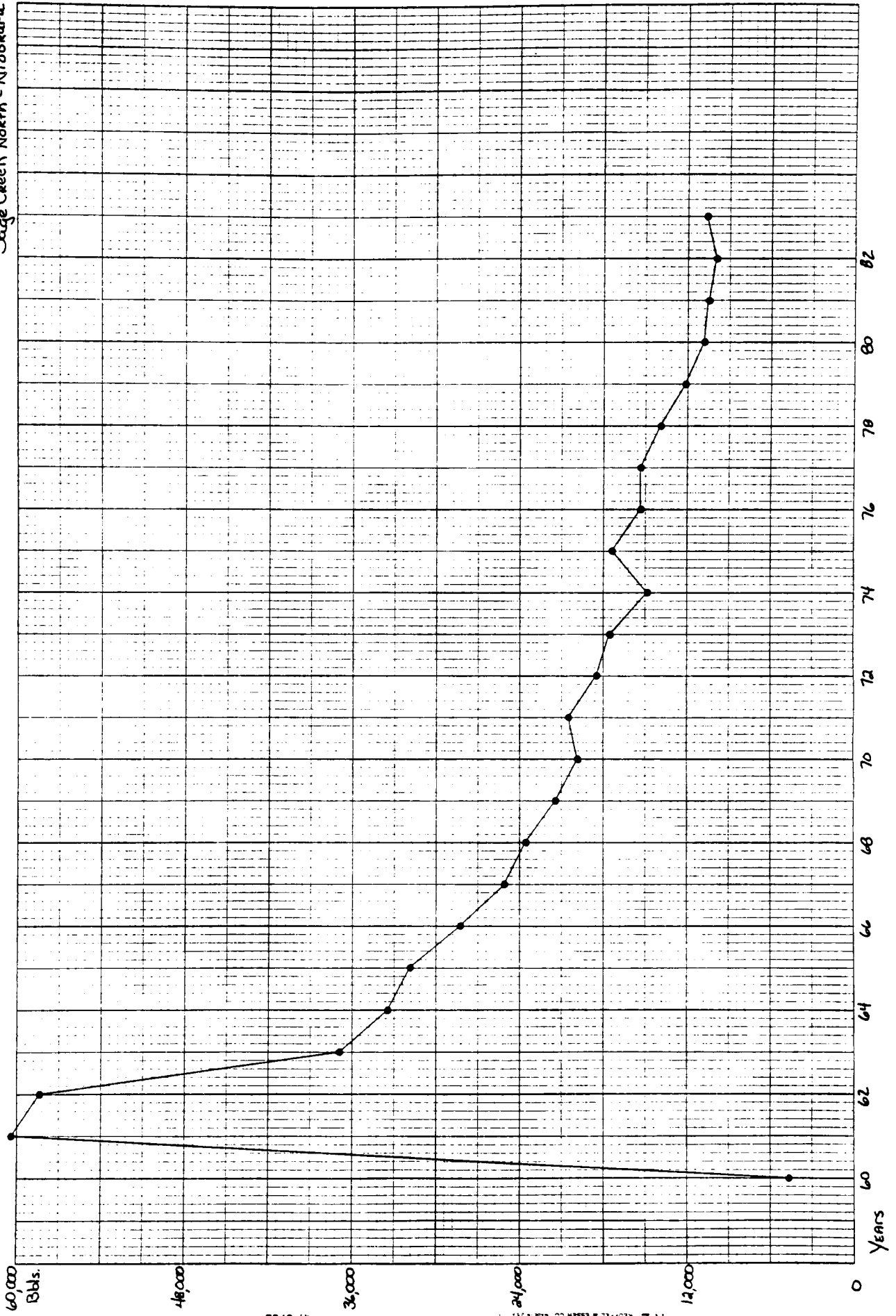
FIELD SHUT-IN FROM 1954 THROUGH 1980





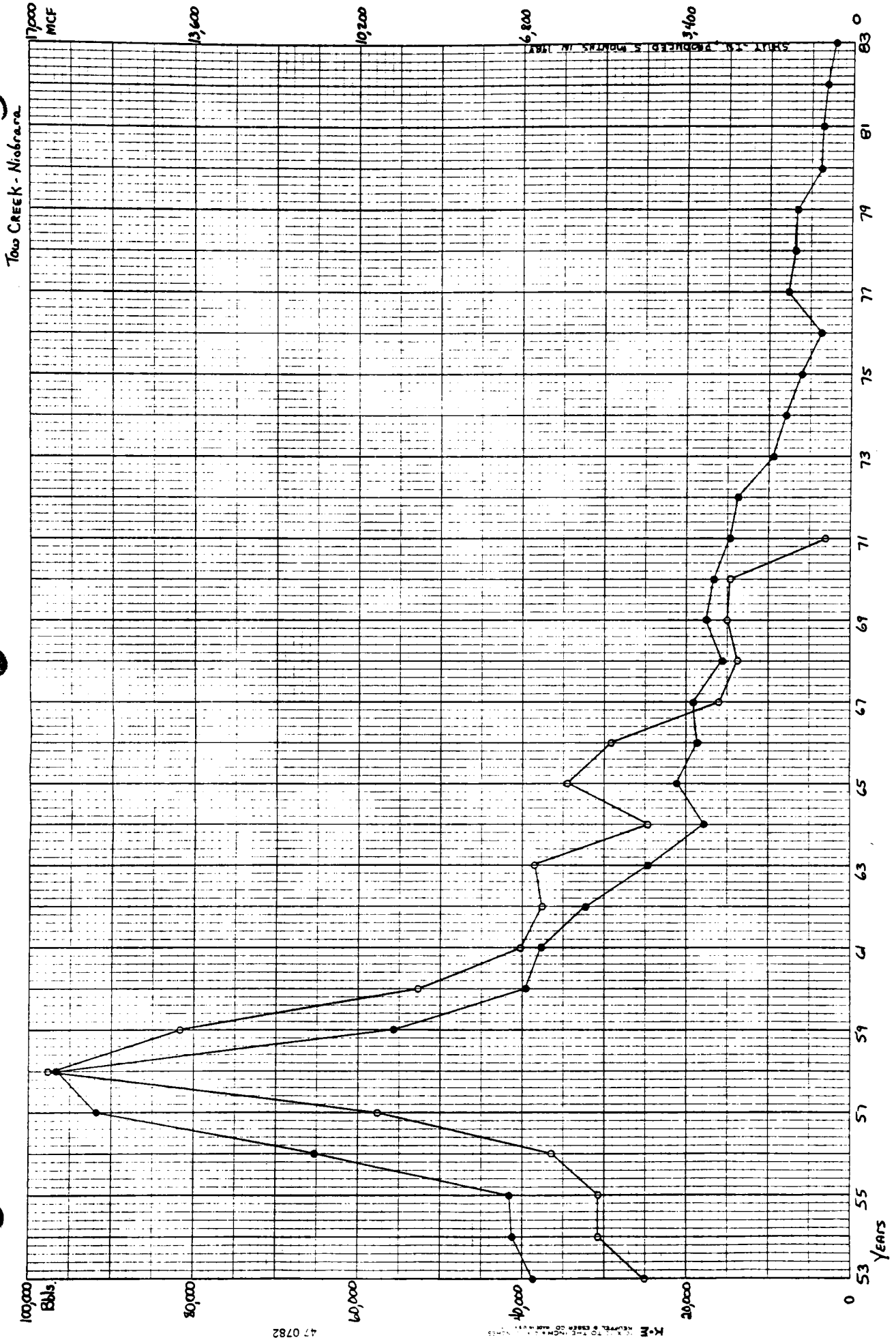
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 L. E. KEMP, JR. ENGINEER
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Sage Creek North - Niobrara

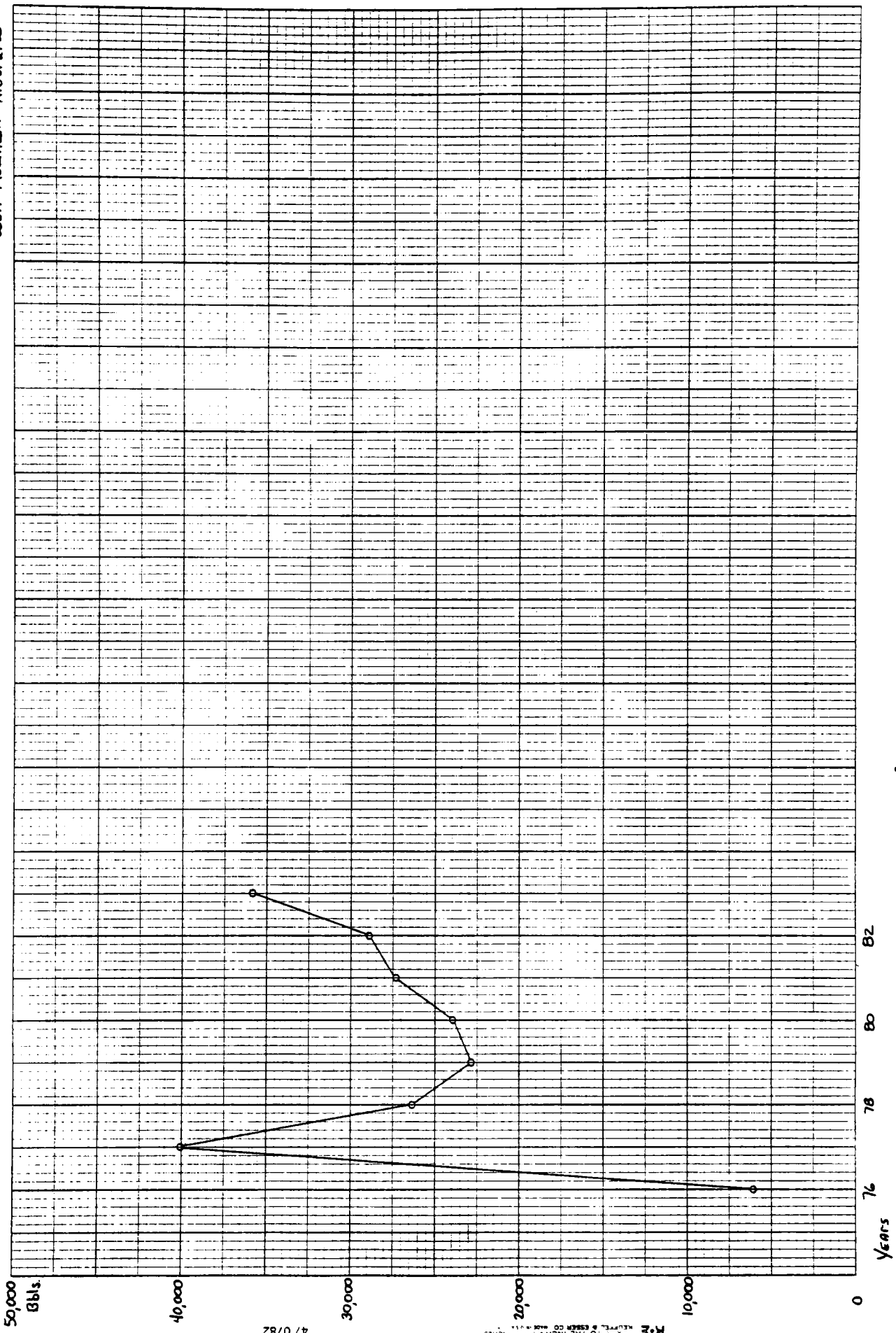


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PL 82-417 TO THE INCOME TAX ACT OF 1981



Wolf Mountain - Niobrara



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K.M. EQUIVALENT TO THE INCHES

Years

Other Publications

INFORMATION SERIES 18--Oil and Gas fields of Colorado: Statistical Data through 1987.

MAP SERIES 22--Oil and Gas fields map of Colorado. 1983, (1:500,000).

OPEN-FILE REPORT 84-3: Estimated Oil and Gas Reserves for Washington County, Colorado;

OPEN-FILE REPORT 84-4: Estimated Oil and Gas Reserves for Rio Blanco County, Colorado.

OPEN-FILE REPORT 84-5: Estimated Oil and Gas Reserves for Adams County, Colorado;

OPEN-FILE REPORT 83-6: Estimated Oil and Gas Reserves for Weld County, Colorado;

OPEN-FILE REPORT 84-7: Estimated Oil and Gas Reserves for Arapahoe County, Colorado;

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OPEN-FILE REPORT 84-10: Estimated Oil and Gas Reserves for Garfield County, Colorado;

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OPEN-FILE REPORT 84-12: Estimated Oil and Gas Reserves for Moffat County, Colorado;

OPEN-FILE REPORT 84-13: Estimated Oil and Gas Reserves for Elbert County, Colorado;

OPEN-FILE REPORT 84-14: Estimated Oil and Gas Reserves for Mesa County, Colorado;

OPEN-FILE REPORT 84-15: Estimated Oil and Gas Reserves for Routt County, Colorado;

OPEN-FILE REPORT 84-16: Estimated Oil and Gas Reserves for Yuma County, Colorado.

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