October 19, 1973

From: John M. Nash, Geophysical Consultant
3958 S. Jasmine Street
Denver, Colorado 80237

To: Petro-Lewis Corporation
1600 Broadway
Denver, Colorado 80202

Attention: Mr. John E. Lucken
Manager of Geothermal Exploration

Subject: Report on Interpretation of Geophysical Data
Buena Vista Area, Colorado

Objective: To attempt to delineate the configuration of a possible fill area along the Arkansas River with the view of locating aquifers and traps.

Procedures:

1. Review published data
2. Interview and collect data and ideas from geologists and geophysicists at the United States Geological Survey and Colorado School of Mines, who have been involved with this area.
3. Interpret existing geophysical and geological data consisting of gravity, magnetic and resistivity surveys by U.S.G.S. plus one test hole to a depth of 1000 feet; Also geologic and topographic maps and publications.
4. Recommend any further geophysical work needed to locate additional test holes.

Results: Interviews

A. Dean Kleinkoph, Geophysicist U.S.G.S. - He stated that Jim Case, U. S. G. S. in Corpus Christi, had recently started to put together the geological and geophysical data in the Buena Vista area but had not progressed very far. He showed me a recent Bouger gravity map of the area contoured on 2.0 mgl interval. Would not let me have a copy. (Map used is contoured on a 5.0 mgl interval but appears to contain same data.)

B. Glen Scot, Geologist, U.S.G.S. had the same Bouger gravity map and was assembling geologic data to send to Case for interpretation. We discussed the lack of definition of any fault zone on the west side of the fill area by geophysical data. He stated the fault (Sawatch) was definitely shown on the surface.

C. Ogden Twedo, Geologist, U.S.G.S. has worked the Arkansas graben area for many years. He stated the density of the Mt. Princeton batholith, quartz monzonite, light granite, and porphyries, would be around 2.60. On fill density he said two measurements they made gave 1.81 and 2.02 for cores near surface. He stated the density on the east side of the fill would be around 2.70.

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On Plate I are shown the locations of Magnetic Profiles MA - MA', MB - MB', MC - MC', MD - MD', ME - ME', MF - MF'; Gravity Profiles GA - GA', GB - GB', GC - GC', along with the main points of interpretation. All interpretations from U.S.G.S. magnetic and gravity data, Plates II and III which also show the locations of the profiles.

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The data are quite sparse and it is difficult to know how to draw the gravity profile. The profile used can be considered only an approximation. However, there is enough data to indicate a strong probability of a fault. Using the same fill density as on the east side (2.20) and 2.60 for the Mt. Princeton complex, the density contrast of 0.4 provides a throw of 1400'. If we use a higher fill density, say 2.40, the density contrast of 0.2 gives a throw of 2800'.

Going further, it is possible from the gravity data that this fault profile could be as much as 9.0 milligals. Using this figure we get throws of 1750' and 3500', depending upon which density contrast used - 3500' throw goes with a density contrast of 0.2. This throw is considered a maximum figure

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Plate III U.S.G.S. Bouguer Gravity Map showing Profiles

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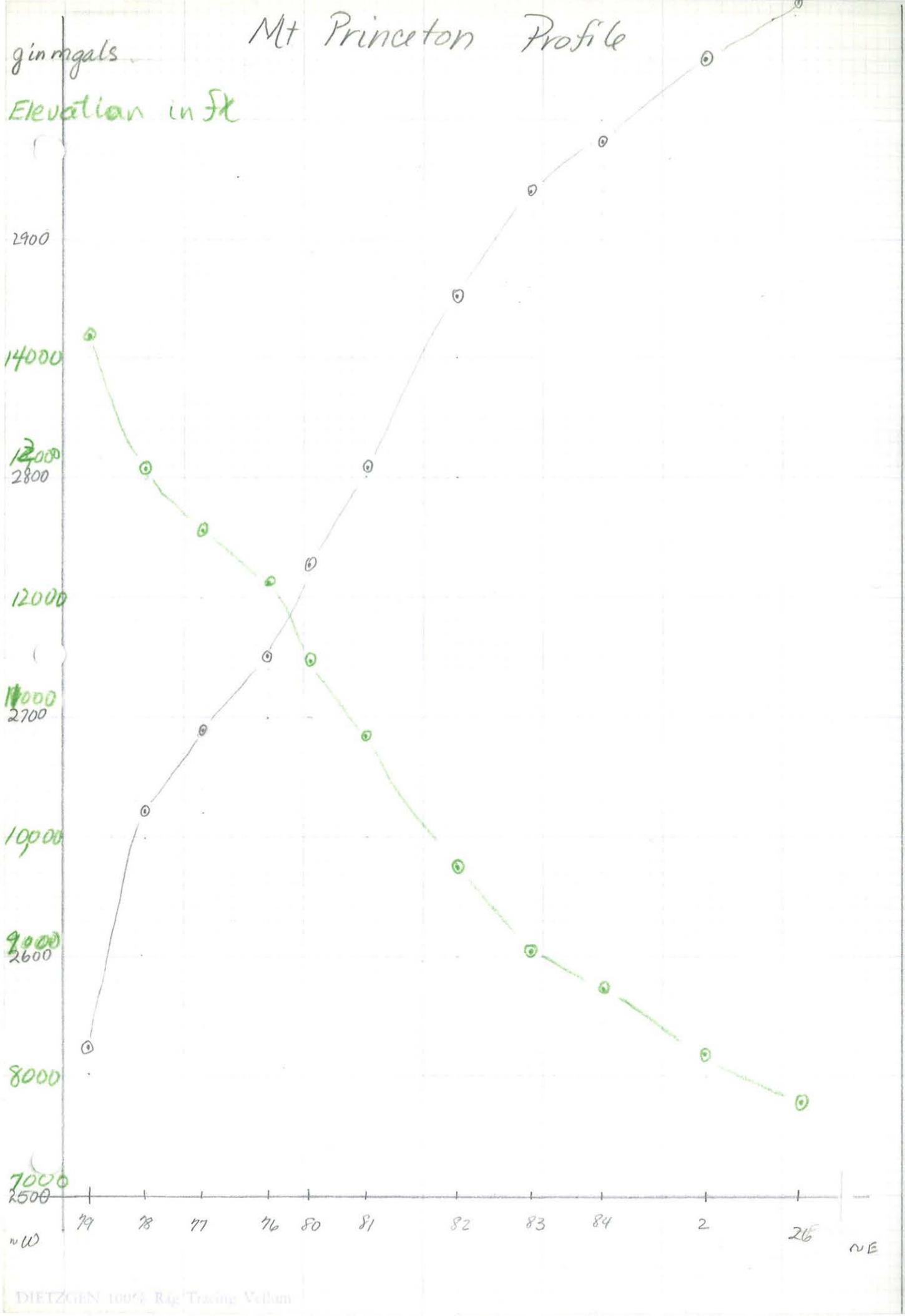
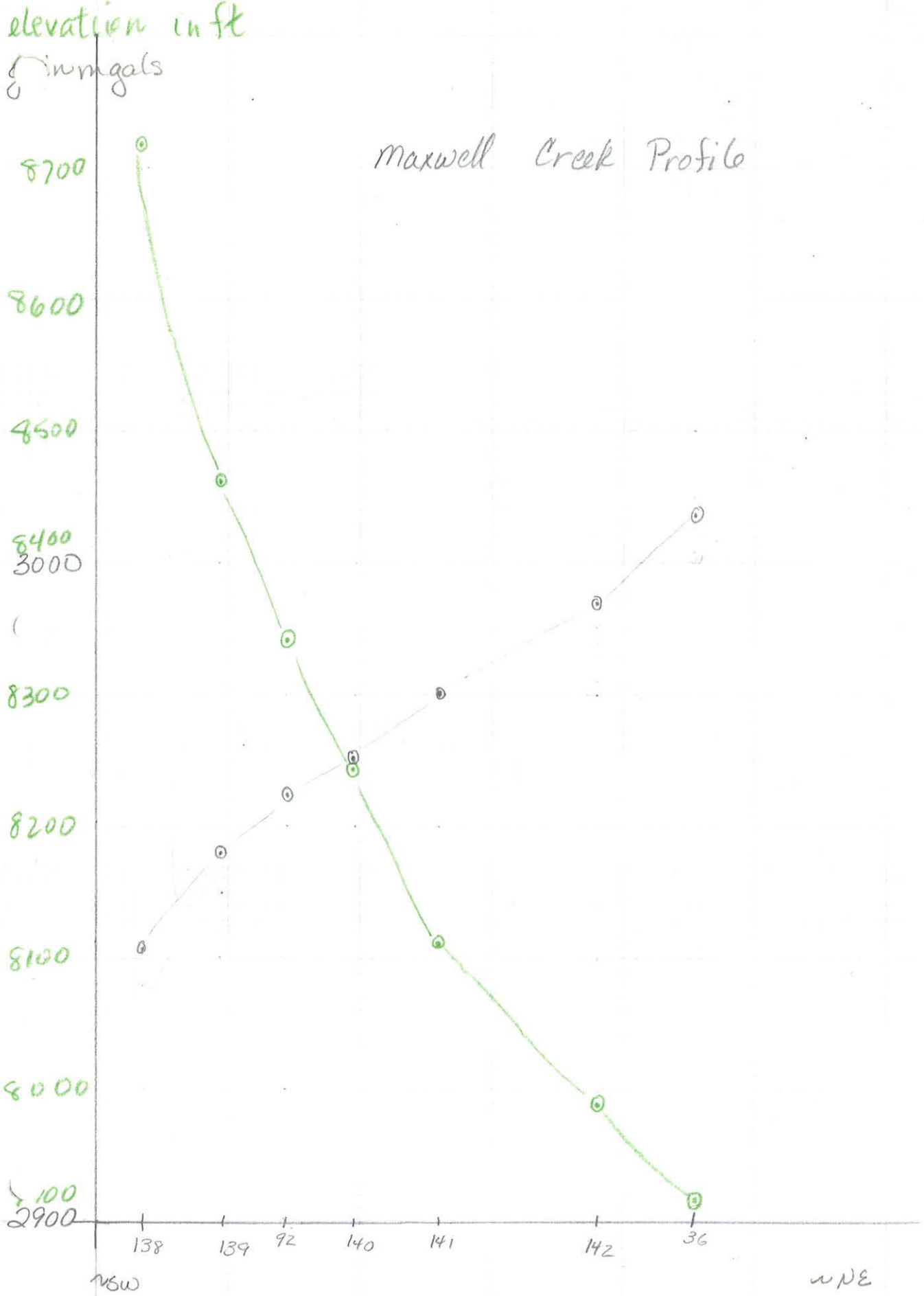

Mt Princeton Profile
gin mgals
Elevation in ft
2900
14000
12000
2800
2700
10000
2600
8000
7000
2500
79
78
77
76
80
81
82
83
84
2
26
NW
NE


elevation in ft
δ in mgals
Maxwell Creek Profile
8700
8600
8500
8400
3000
8300
8200
8100
8000
100
2900
138
139
92
140
141
142
36
NSW
NE

West Side Valley Profile

gravity in mgals

elevation in feet

2990
8300
80
70
8200
60
8000
50
8100
40
30
8000
20
7920
10
7900

89 65 66 67 68 69 70 71 21 72 73 75 74 90 91 92 93 94 95 96 97 98 99 100

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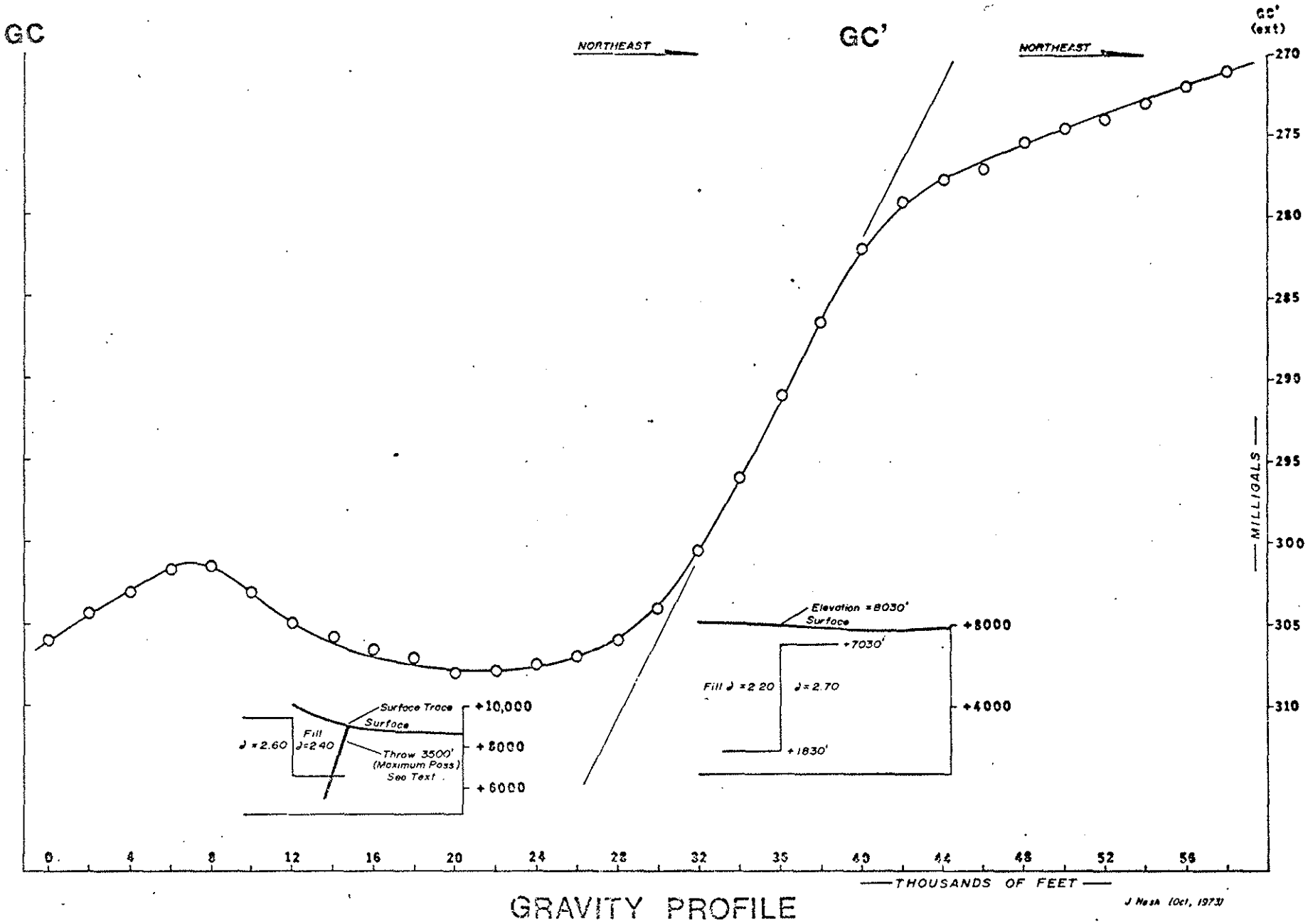
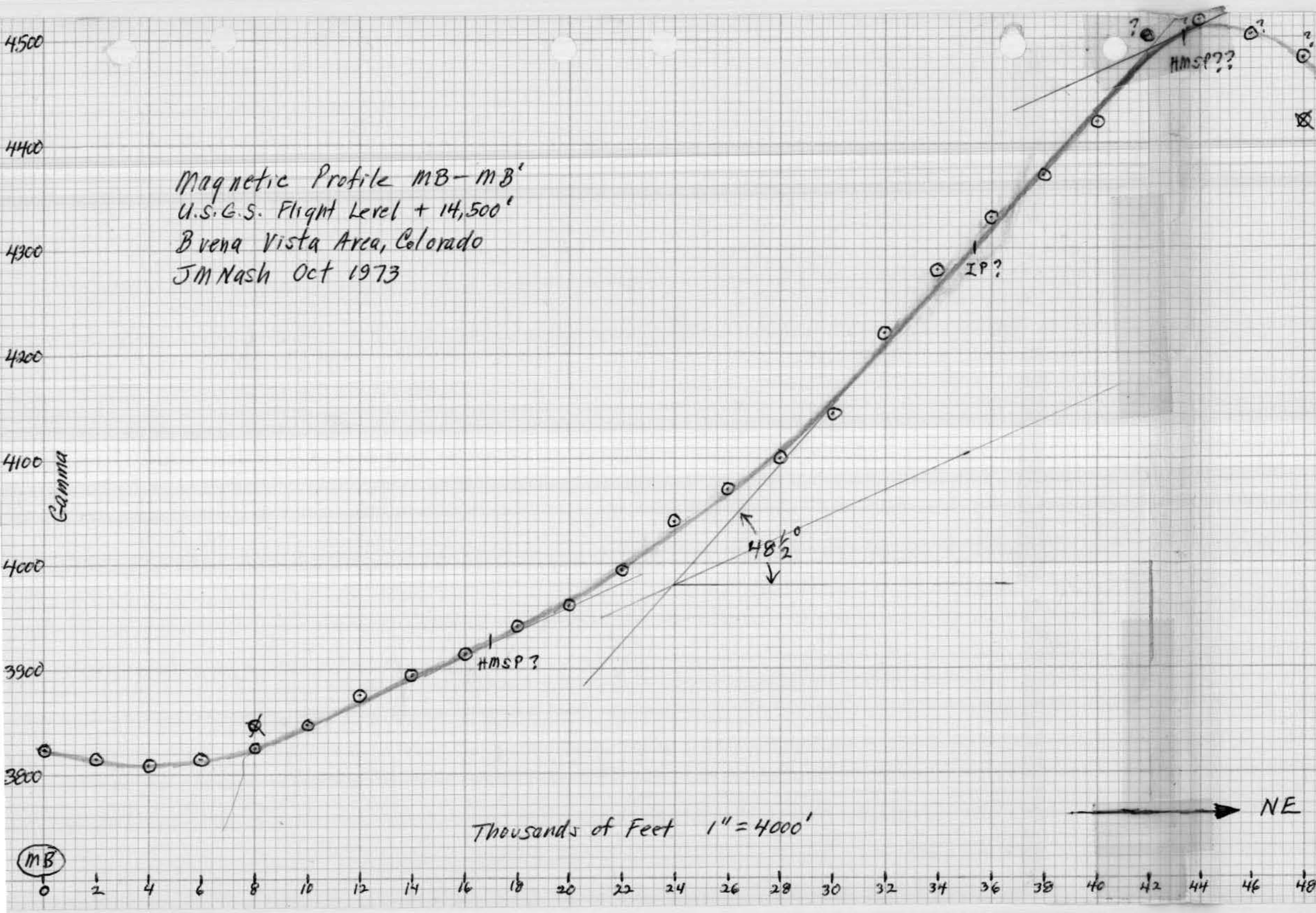


GRAVITY PROFILE

Magnetic Profile MB–MB'
U.S.G.S. Flight Level + 14,500'
Brena Vista Area, Colorado
JM Nash Oct 1973



Semi Infinite

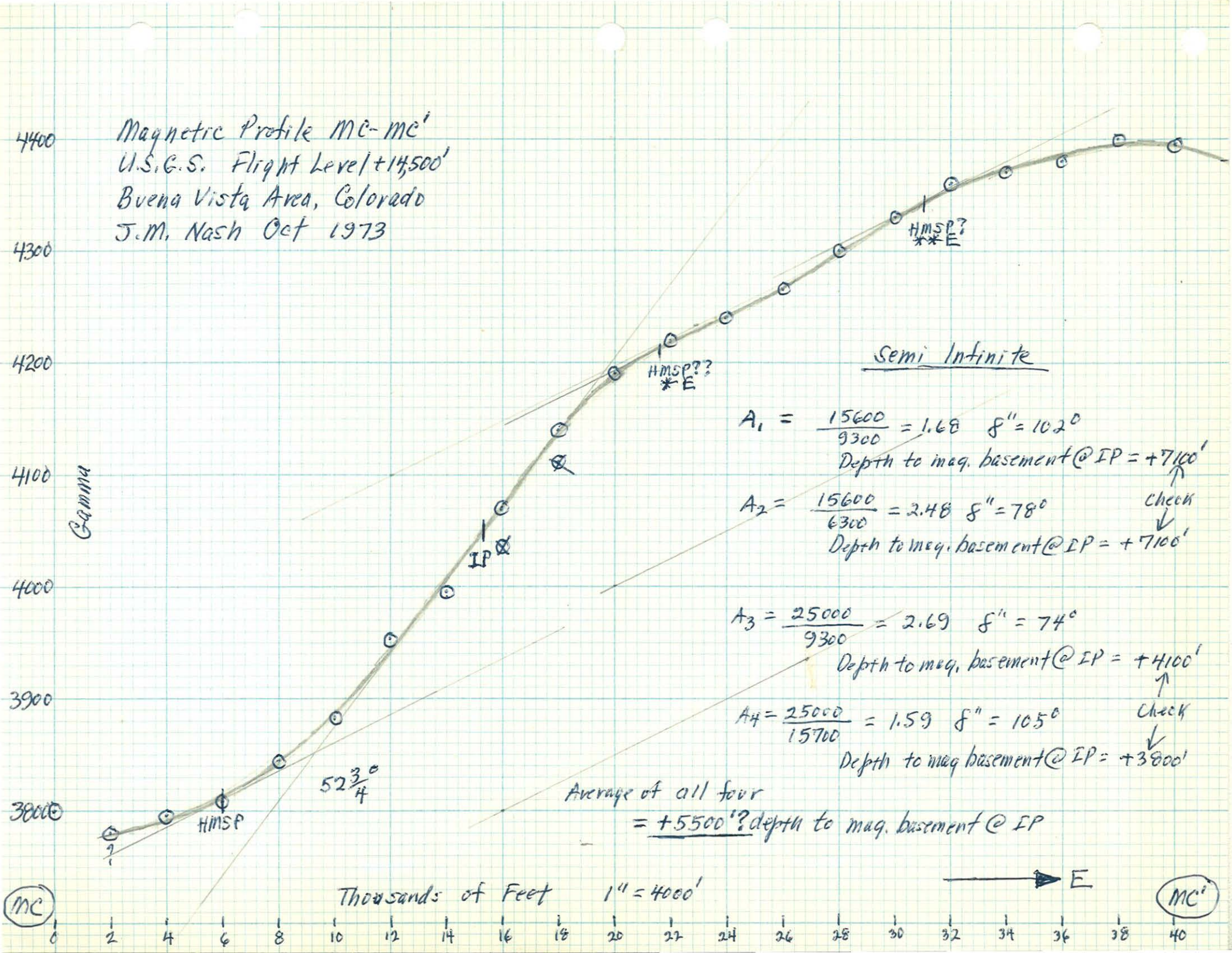
$A_1 = 26300/8100 = 3.25$ $\delta'' = 64°$

Depth to mag basement = 14500 − 11800 = +2700?
@ IP?

$A_2 = 26300/12000 = 2.19$ $\delta'' = 86°$

Depth to mag basement = 14500 − 12900 = +1600?
@ IP?

Average = $\frac{2700 + 1600}{2} = \underline{+2150?}$ @ IP?


Magnetic Profile MC-MC'
U.S.G.S. Flight Level +14,500'
Buena Vista Area, Colorado
J.M. Nash Oct 1973
4400
4300
4200
4100
4000
3900
3800
Gamma
HMSP?
**E
HMSP??
*E
IP
HMSP
52 3/4°
?
Semi Infinite
A1 = 15600/9300 = 1.68 θ" = 102°
Depth to mag. basement @ IP = +7100'
A2 = 15600/6300 = 2.48 θ" = 78°
Check
Depth to mag. basement @ IP = +7100'
A3 = 25000/9300 = 2.69 θ" = 74°
Depth to mag. basement @ IP = +4100'
A4 = 25000/15700 = 1.59 θ" = 105°
Check
Depth to mag basement @ IP = +3800'
Average of all four
= +5500'? depth to mag. basement @ IP
E
MC
MC'
Thousands of Feet 1" = 4000'
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

Magnetic Profile MF – MF'
U.S.G.S. Flight Level +14,500'
Buena Vista Area Colorado
J. M. Nash Oct 1973

$A_W = 10{,}200/4800 = 2.13$

$C_W = 11000/4800 = 2.29$

$W/D = 2.5$? $\delta'' = 135°$?

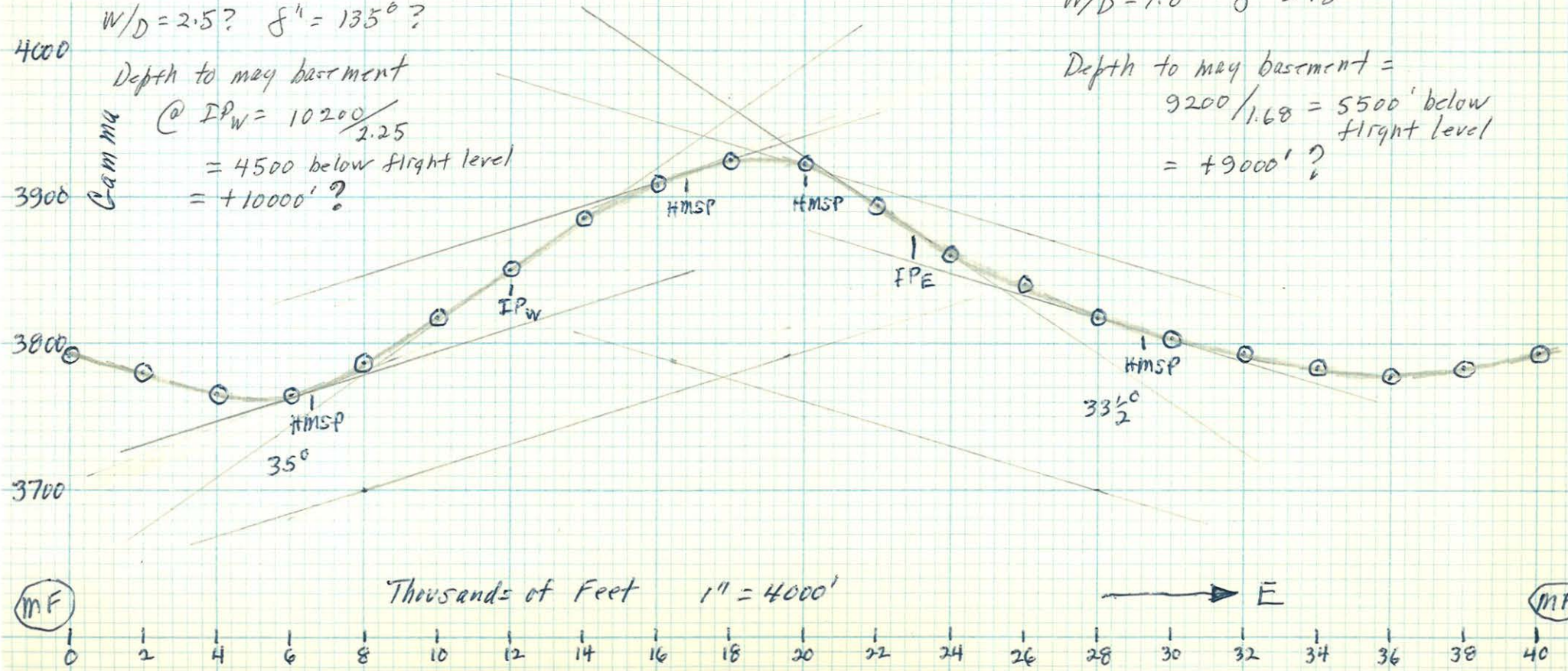
Depth to mag basement
@ $IP_W = 10200/2.25$
= 4500 below flight level
= +10000'?

$A_E = 9200/3000 = 3.07$

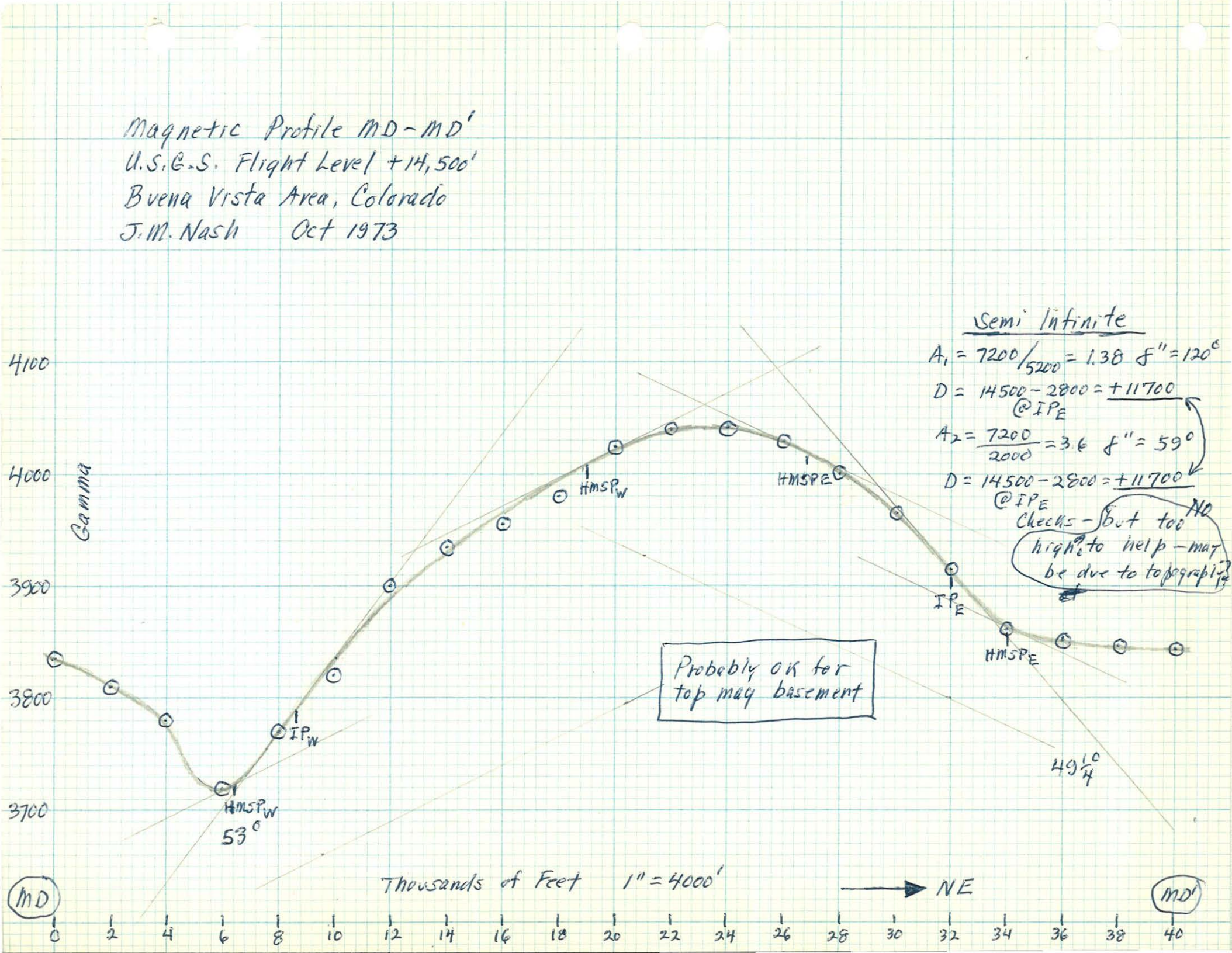
$C_E = 11000/3000 = 3.67$

$W/D = 1.8$ $\delta'' = 73°$

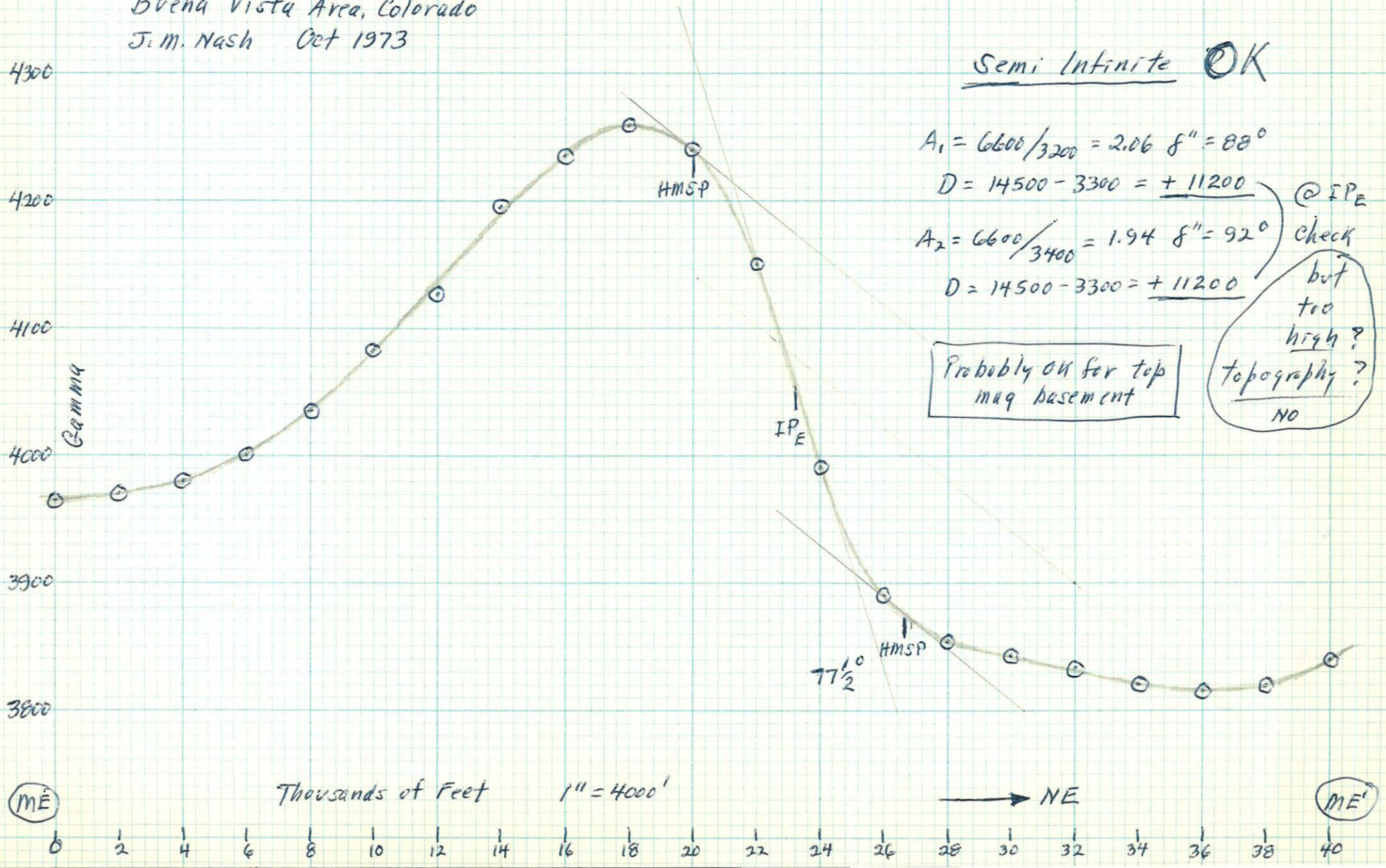
Depth to mag basement =
$9200/1.68 = 5500'$ below flight level
= +9000'?



Magnetic Profile MD - MD'
U.S.G.S. Flight Level +14,500'
Buena Vista Area, Colorado
J.M. Nash Oct 1973



Magnetic Profile ME-ME'
U.S.G.S. Flight Level +14,500'
Buena Vista Area, Colorado
J. M. Nash Oct 1973

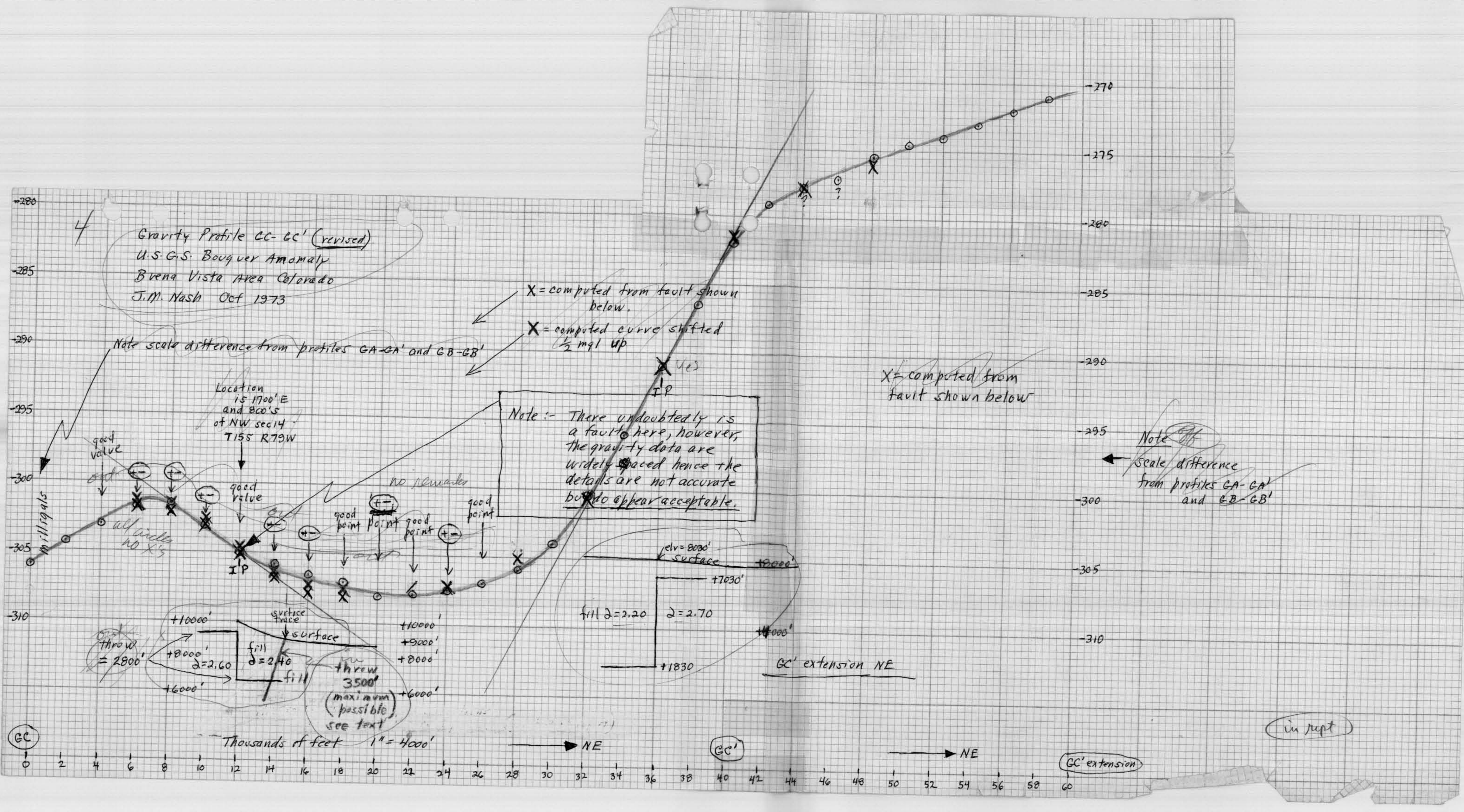


Semi Infinite OK

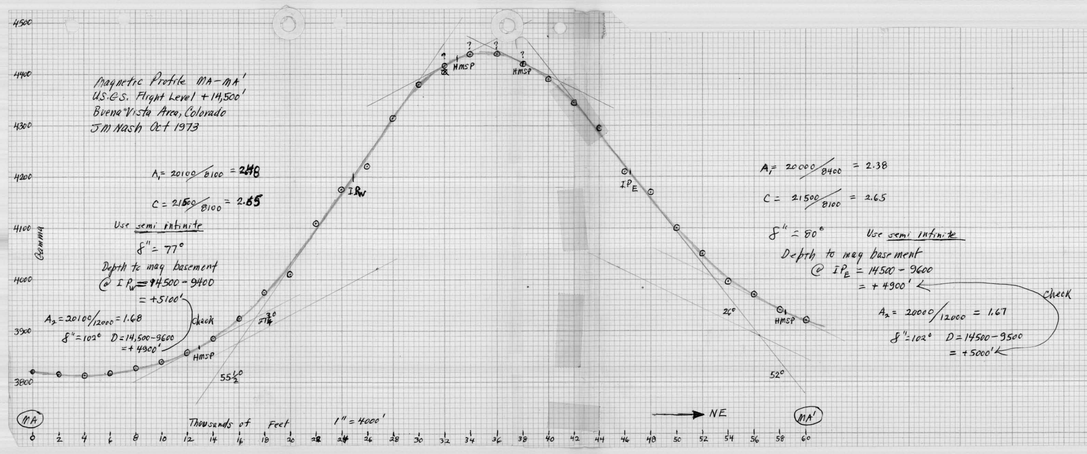
$A_1 = 6600/3200 = 2.06$ $\delta'' = 88°$
$D = 14500 - 3300 = +11200$
$A_2 = 6600/3400 = 1.94$ $\delta'' = 92°$
$D = 14500 - 3300 = +11200$
@ IP_E check

Probably ok for top mag basement

but too high? topography? NO

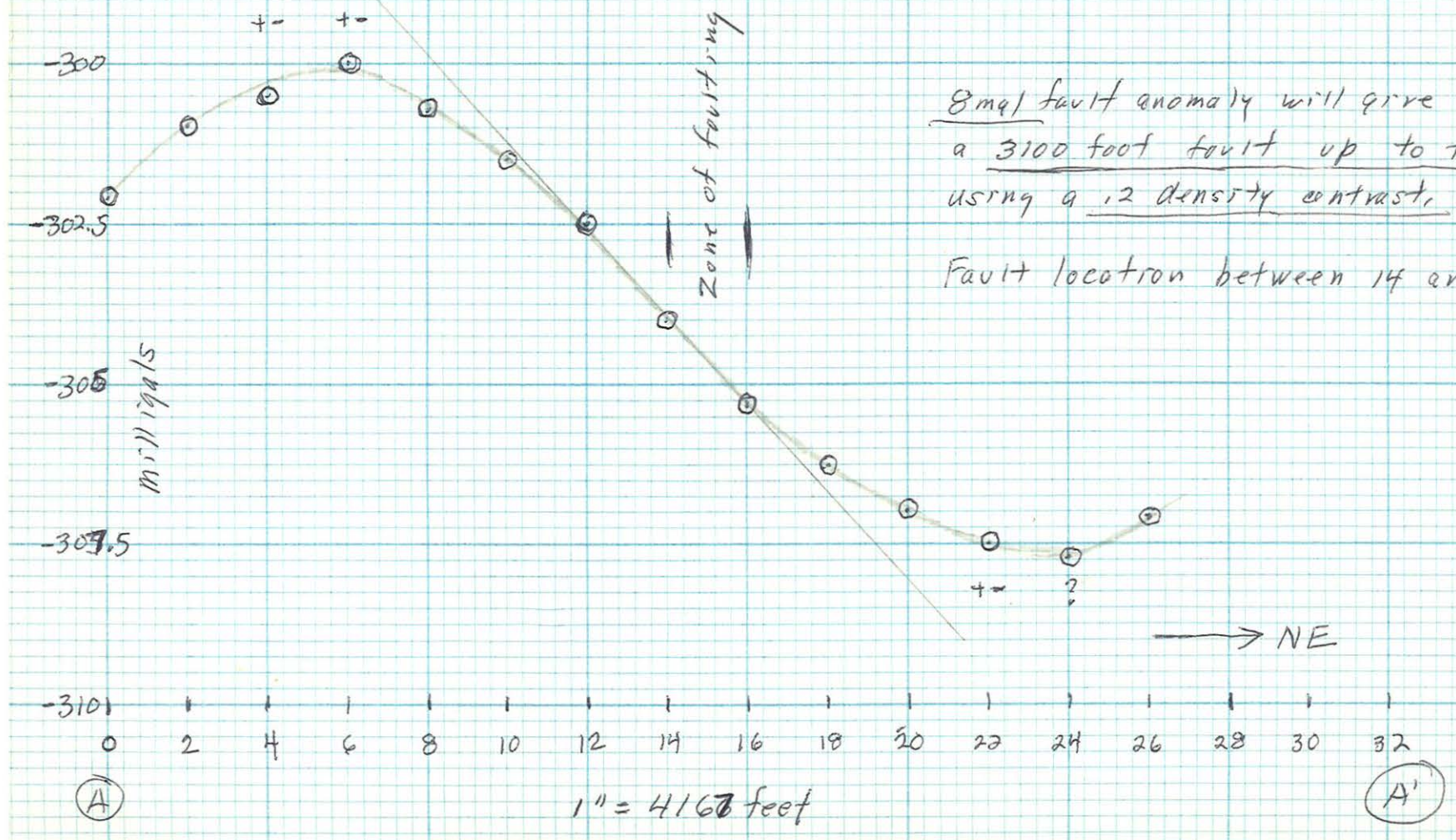


4
Gravity Profile CC-CC' (revised)
U.S.G.S. Bouguer Anomaly
Buena Vista Area Colorado
J.M. Nash Oct 1973
Note scale difference from profiles GA-GA' and GB-GB'
X = computed from fault shown below.
X = computed curve shifted ½ mgl up
Location 12,1700' E and 800's of NW sec14 T15S R79W
Note:- There undoubtedly is a fault here, however, the gravity data are widely spaced hence the details are not accurate but do appear acceptable.
X = computed from fault shown below
Note Scale difference from profiles GA-GA' and GB-GB'
good value
good point
milligals
throw = 2800'
throw 3500' maximum possible see text
d=2.60
d=2.40
fill d=2.20
d=2.70
surface
+7030'
+1930
CC' extension NE
Thousands of feet 1" = 4000'
NE
CC
CC'
CC' extension
in rept


Magnetic Profile MA–MA'
U.S.G.S. Flight Level +14,500'
Buena Vista Area, Colorado
J.M. Nash Oct 1973
A1 = 20100/8100 = 2.48
C = 21500/8100 = 2.65
Use semi infinite
δ" = 77°
Depth to mag basement
@ IPW = 14500 - 9400
= +5100'
A2 = 20100/12000 = 1.68
δ" = 102° D = 14,500 - 9500
= +4900'
check
HMSP
IPW
IPE
A1 = 20000/8400 = 2.38
C = 21500/8100 = 2.65
δ" = 80°
Use semi infinite
Depth to mag basement
@ IPE = 14500 - 9600
= +4900'
check
A2 = 20000/12000 = 1.67
δ" = 102° D = 14500 - 9500
= +5000'
MA
MA'
NE
Thousands of Feet
1" = 4000'
Gamma

Bouguer Gravity Anomaly
Jim Case map - U.S.G.S. Oct 1973
J.M. Nash

See location on Jim Case USGS map



8 mgl fault anomaly will give
a 3100 foot fault up to the SW
using a .2 density contrast.

Fault location between 14 and 16 ±

Gravity Profile GA – GA'
U.S.G.S. Bouguer Anomaly
Buena Vista Area, Colorado
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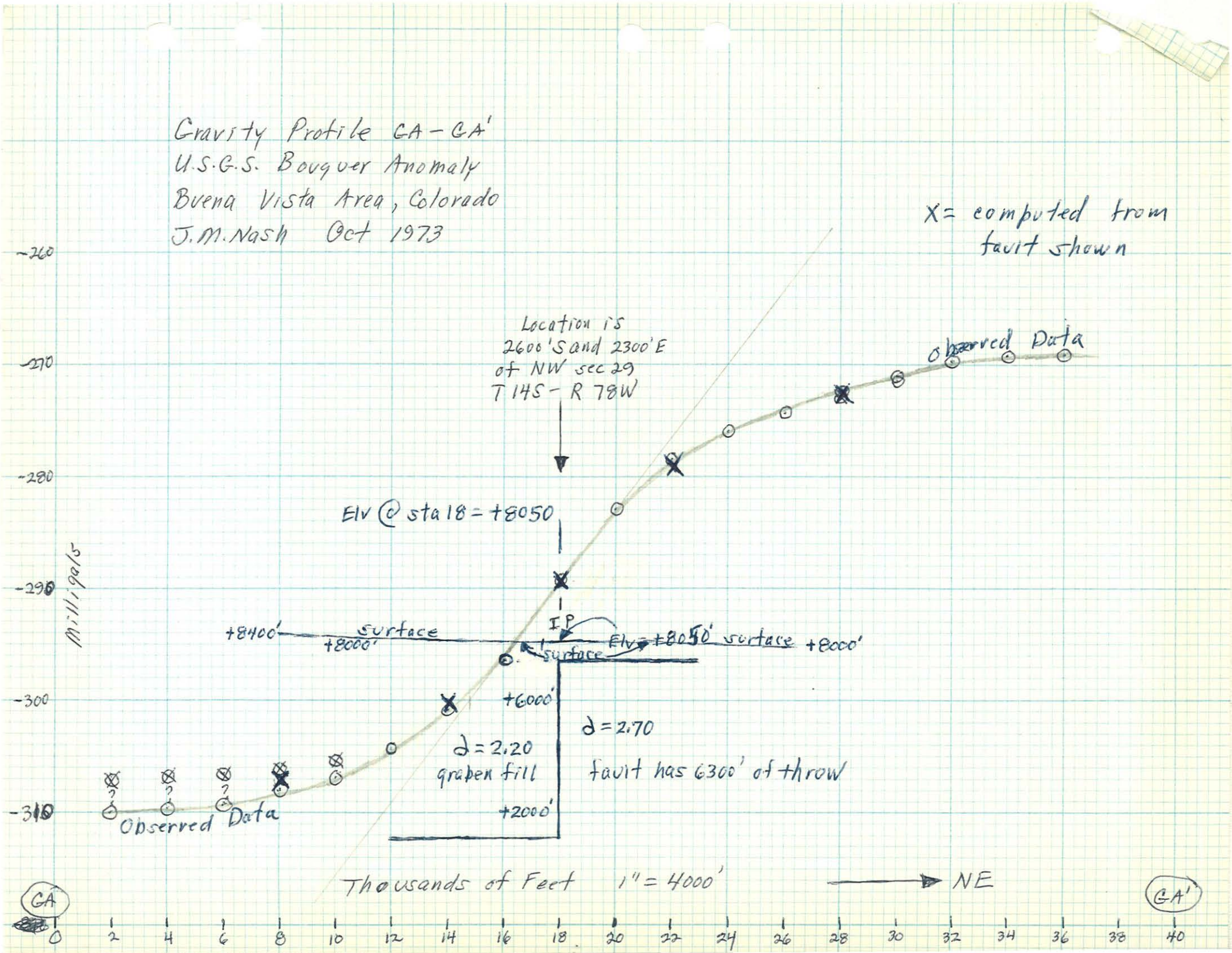
X = computed from fault shown



Gravity Profile GB-GB'
U.S.G.S. Bouguer Anomaly
Buena Vista Area, Colorado
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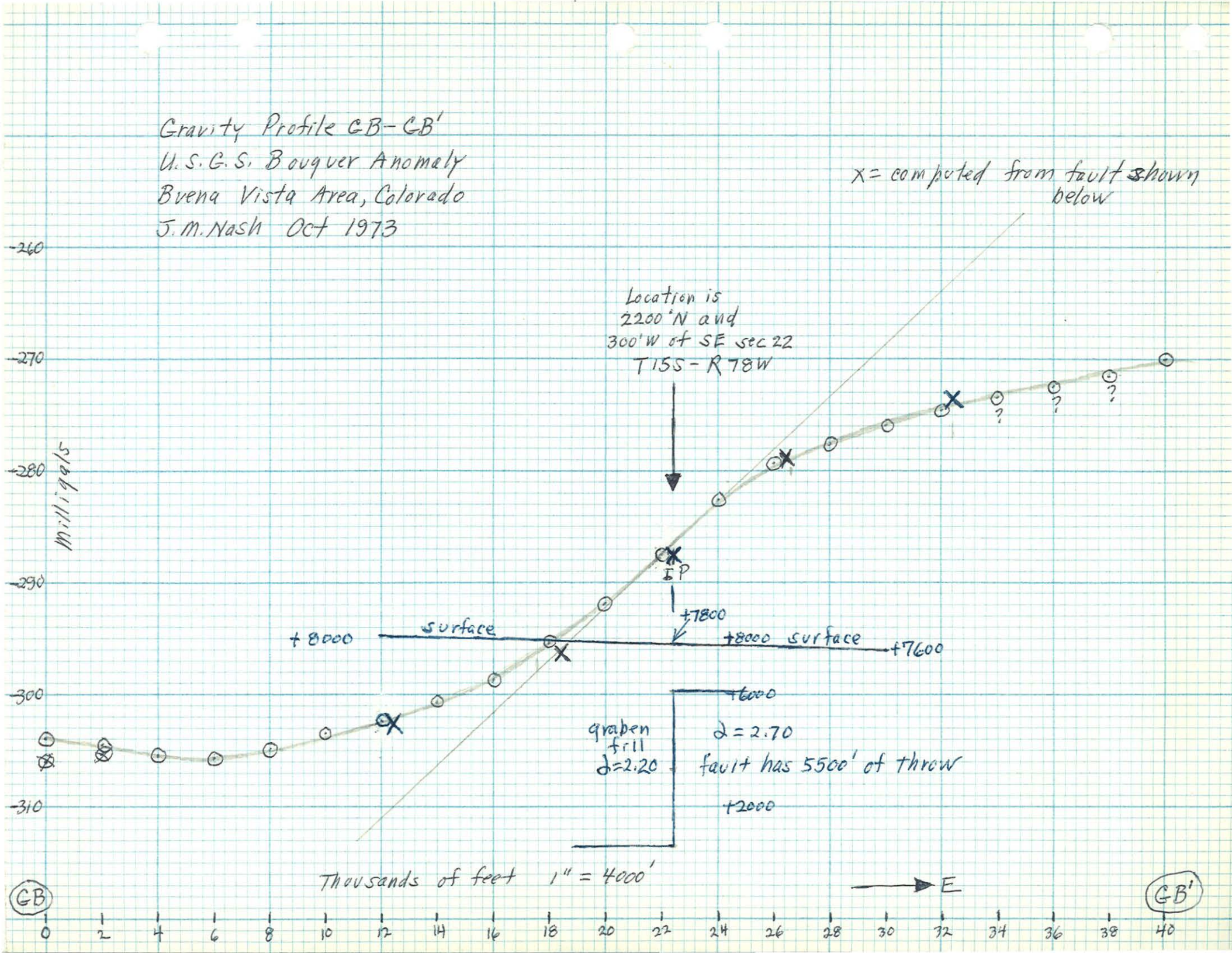
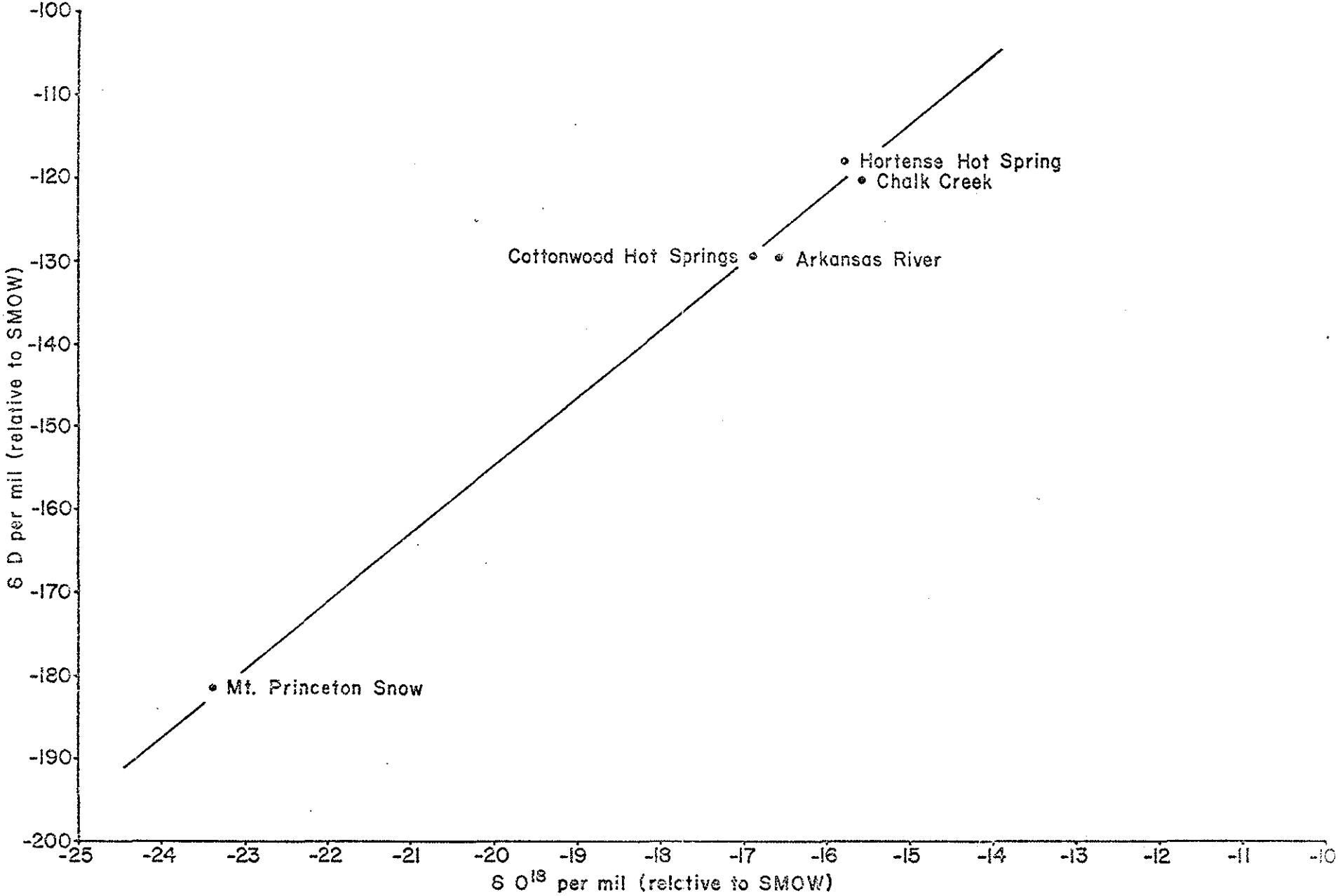
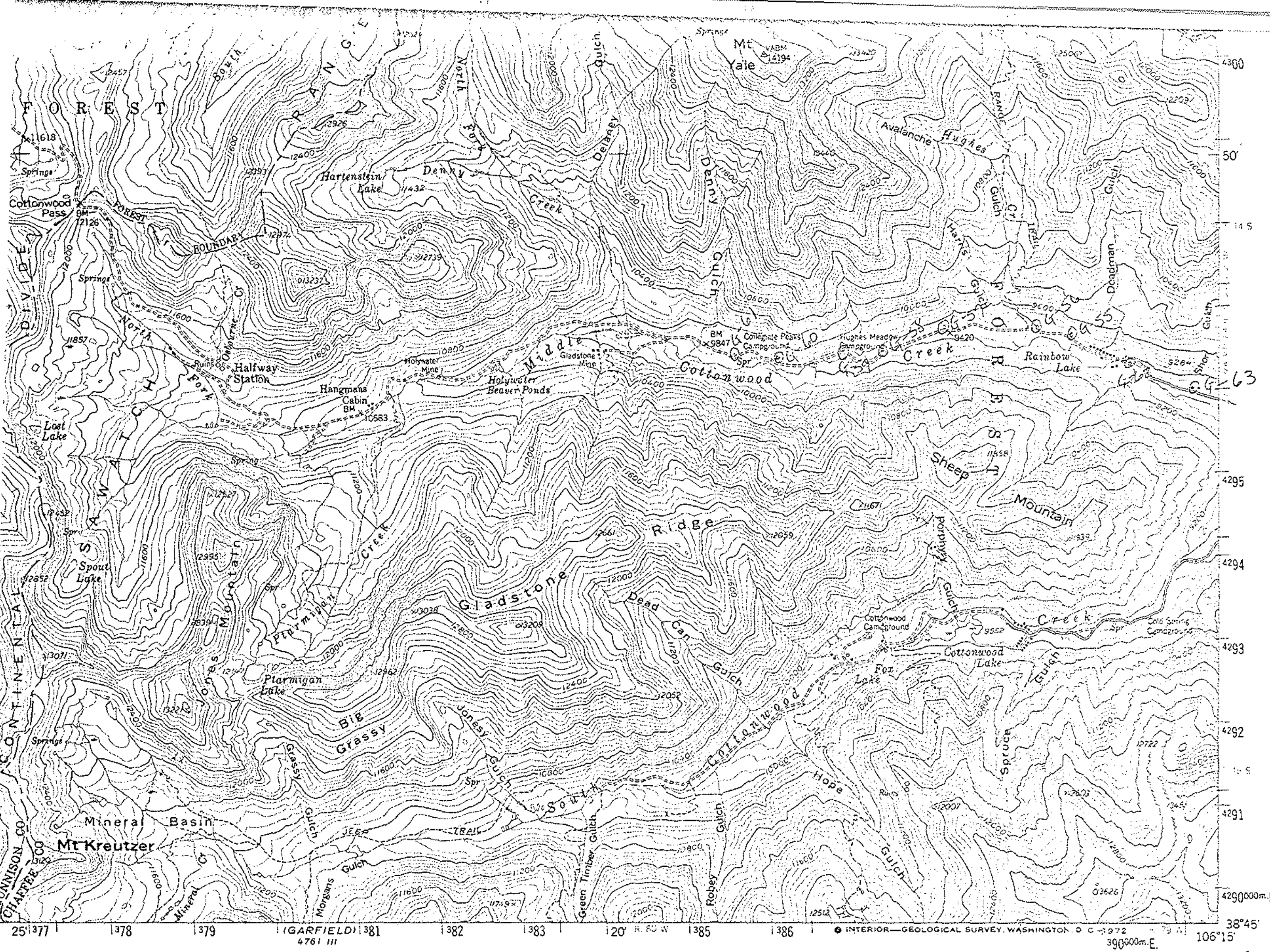



-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
δ D per mil (relative to SMOW)
-25
-24
-23
-22
-21
-20
-19
-18
-17
-16
-15
-14
-13
-12
-11
-10
δ O18 per mil (relctive to SMOW)
Hortense Hot Spring
Chalk Creek
Cottonwood Hot Springs
Arkansas River
Mt. Princeton Snow



SCALE 1:62500

1 ½ 0 1 2 3 4 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

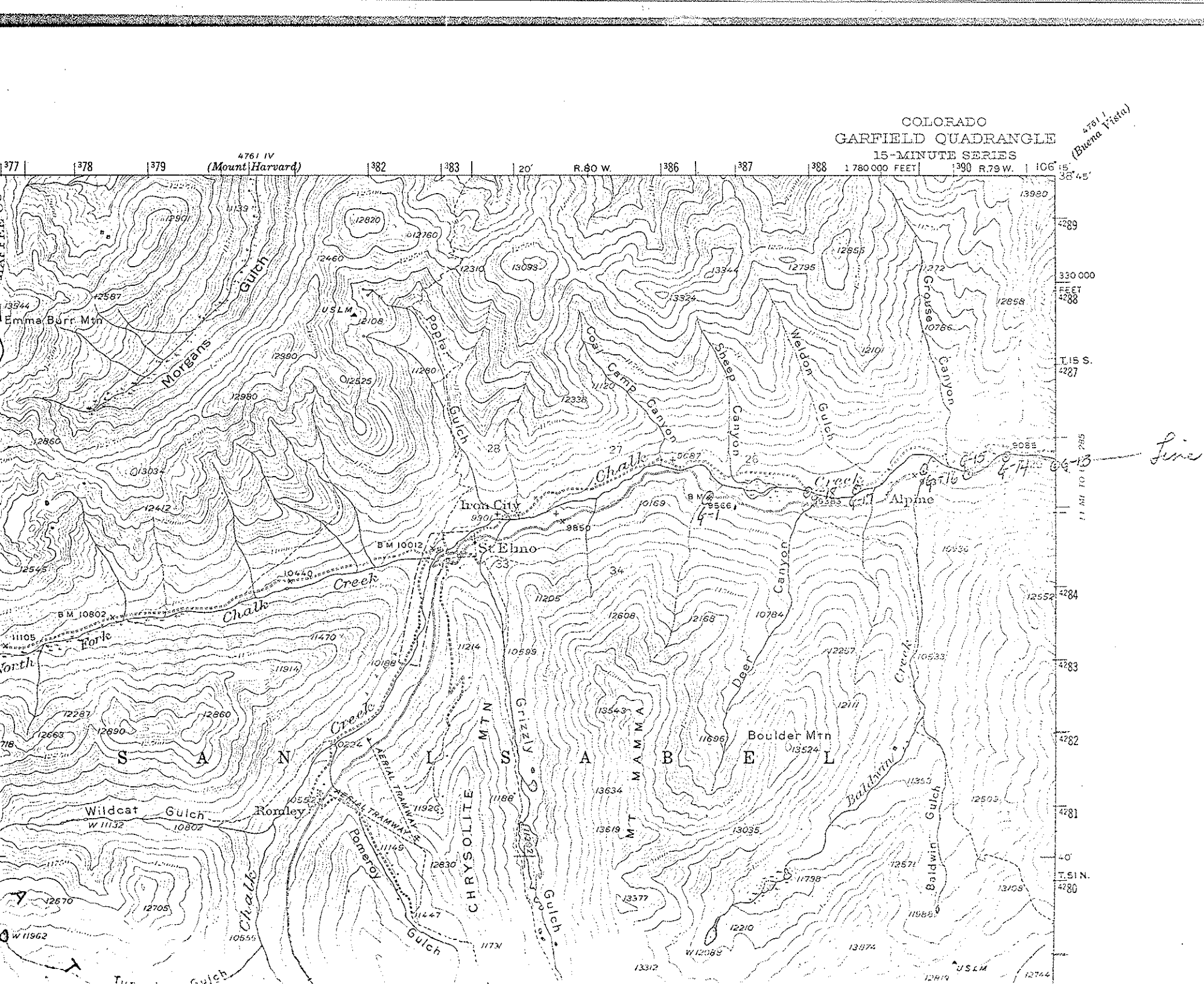
COLORADO

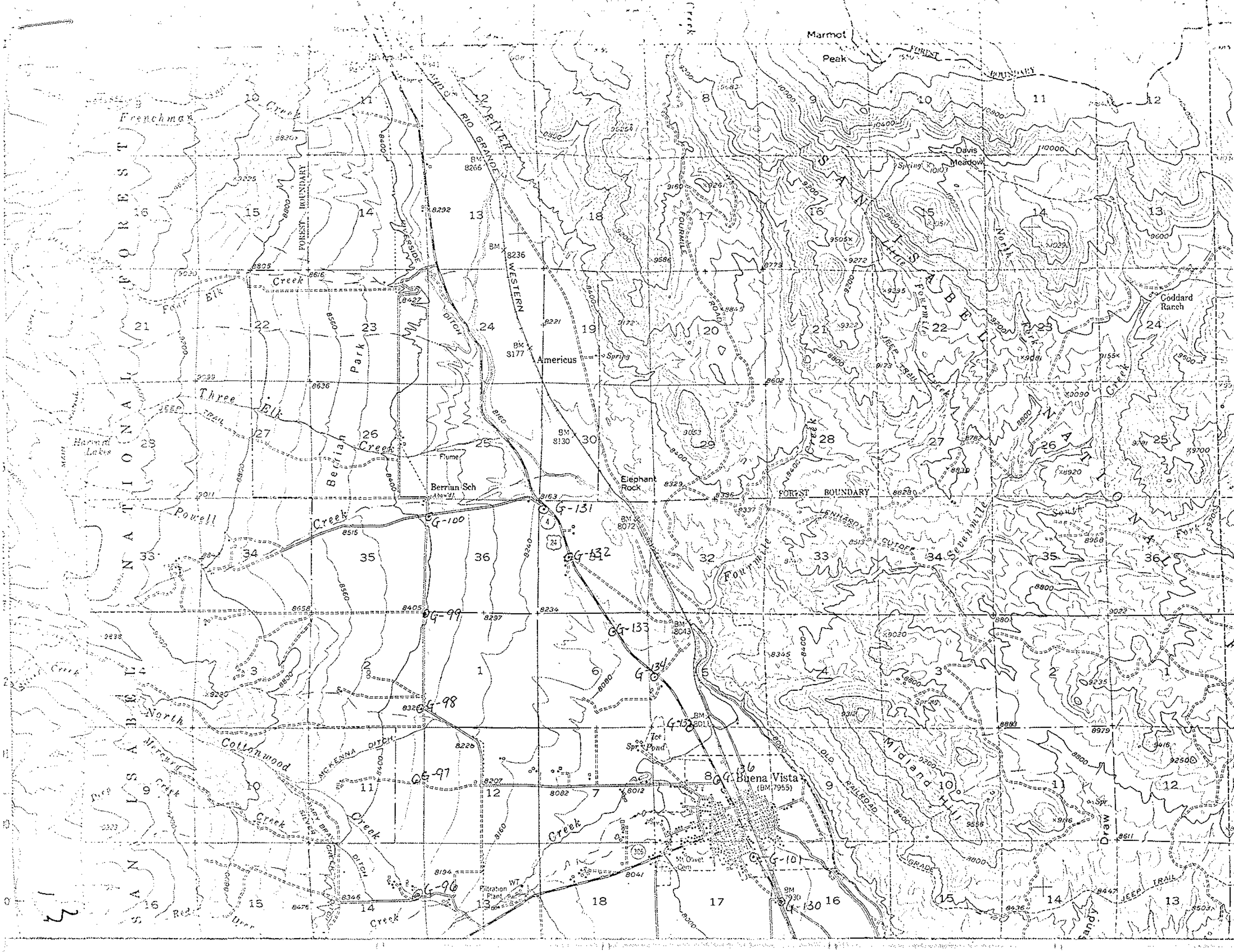
QUADRANGLE LOCATION

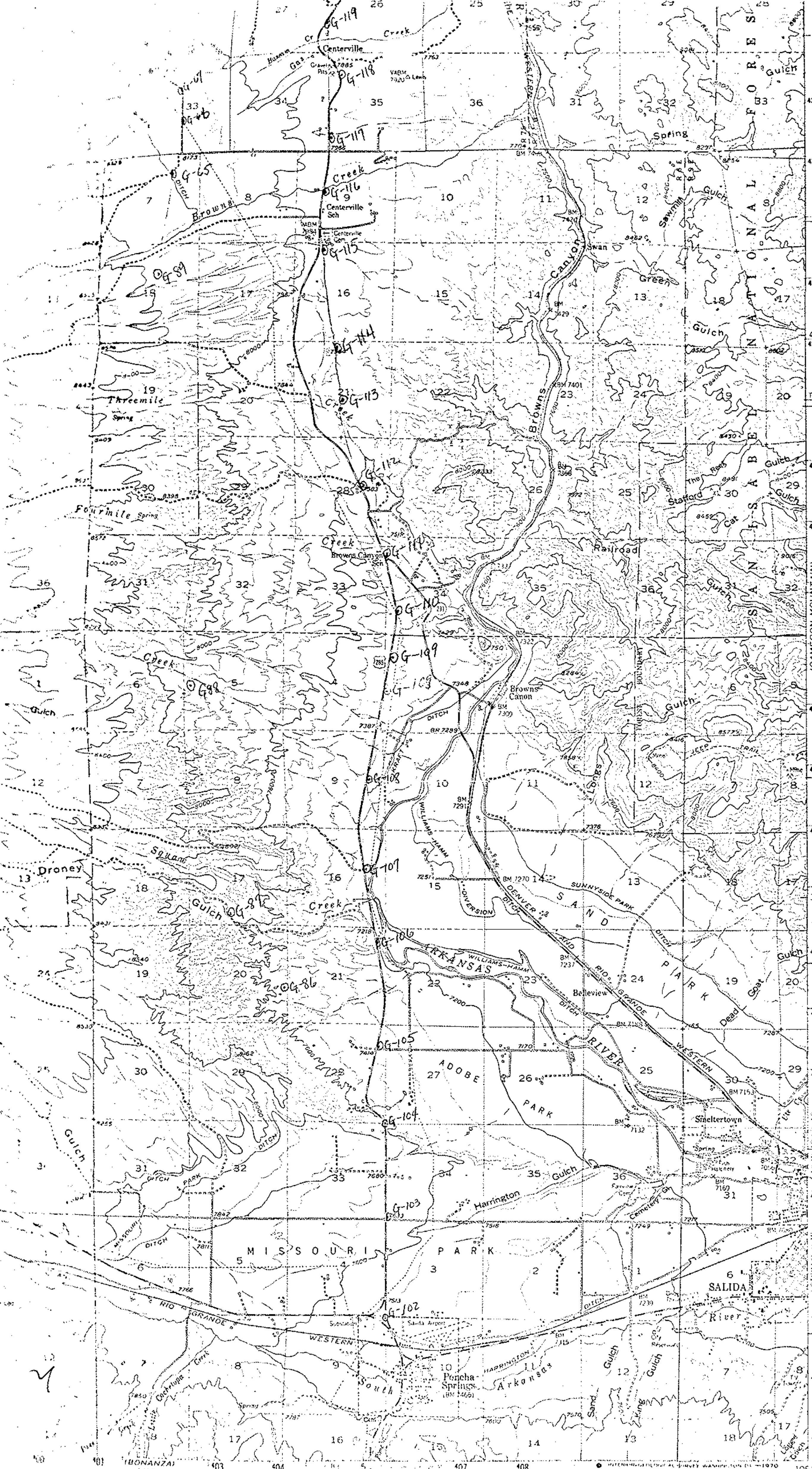
ROAD CLASSIFICATION

Light-duty ——— Unimproved dirt - - - - -

MT. HARVARD, COLO.


COLORADO
GARFIELD QUADRANGLE
15-MINUTE SERIES
4761 IV
(Mount Harvard)
4761 I
(Buena Vista)
1 780 000 FEET
20'
R.80 W.
R.79 W.
106°15'
38°45'
377
378
379
382
383
386
387
388
390
330 000 FEET
T.15 S.
T.51 N.
4289
4288
4287
4284
4283
4282
4281
4280
Emma Burr Mtn
Morgans Gulch
Poplar Gulch
Coal Camp Canyon
Sheep Canyon
Weldon Gulch
Grouse Canyon
Chalk Creek
Iron City
St Elmo
Alpine
Deer Canyon
Baldwin Gulch
Wildcat Gulch
Romley
Pomeroy Gulch
Grizzly Gulch
CHRYSOLITE MTN
MT MAMMA
SAN ISABEL
Boulder Mtn
AERIAL TRAMWAY
BM 10012
BM 10802
BM 9566
USLM
Line


Marmot
Peak
FOREST BOUNDARY
Davis
Meadow
Goddard
Ranch
SAN ISABEL NATIONAL FOREST
Frenchman Creek
Four Elk Creek
FOREST BOUNDARY
RIVERSIDE DITCH
ARKANSAS RIVER
RIO GRANDE WESTERN
Park
Americus
Three Elk Creek
Harvard Lakes
Berrian Creek
Flume
Berrian Sch
Elephant Rock
FOURMILE ROAD
Little Fourmile Creek
North Fork Creek
JEEP TRAIL
LENHARDY CUTOFF
Sevenmile
South Fork
Fourmile
Powell Creek
G-131
G-100
GG-132
G-99
GG-133
G-134
G-135
G-98
GG-97
G-136
G-101
G-96
G-130
North Cottonwood
Mercury Creek
MCKENNA DITCH
Cottonwood Creek
Ice Pond
Buena Vista
(BM 7955)
OLD RAILROAD GRADE
Midland Hill
Draw
Sandy
Filtration Plant
Mt Olivet Cem
Creek
SILVER CREEK
DITCH
Red Deer Creek
Pine Creek
SAN ISABEL

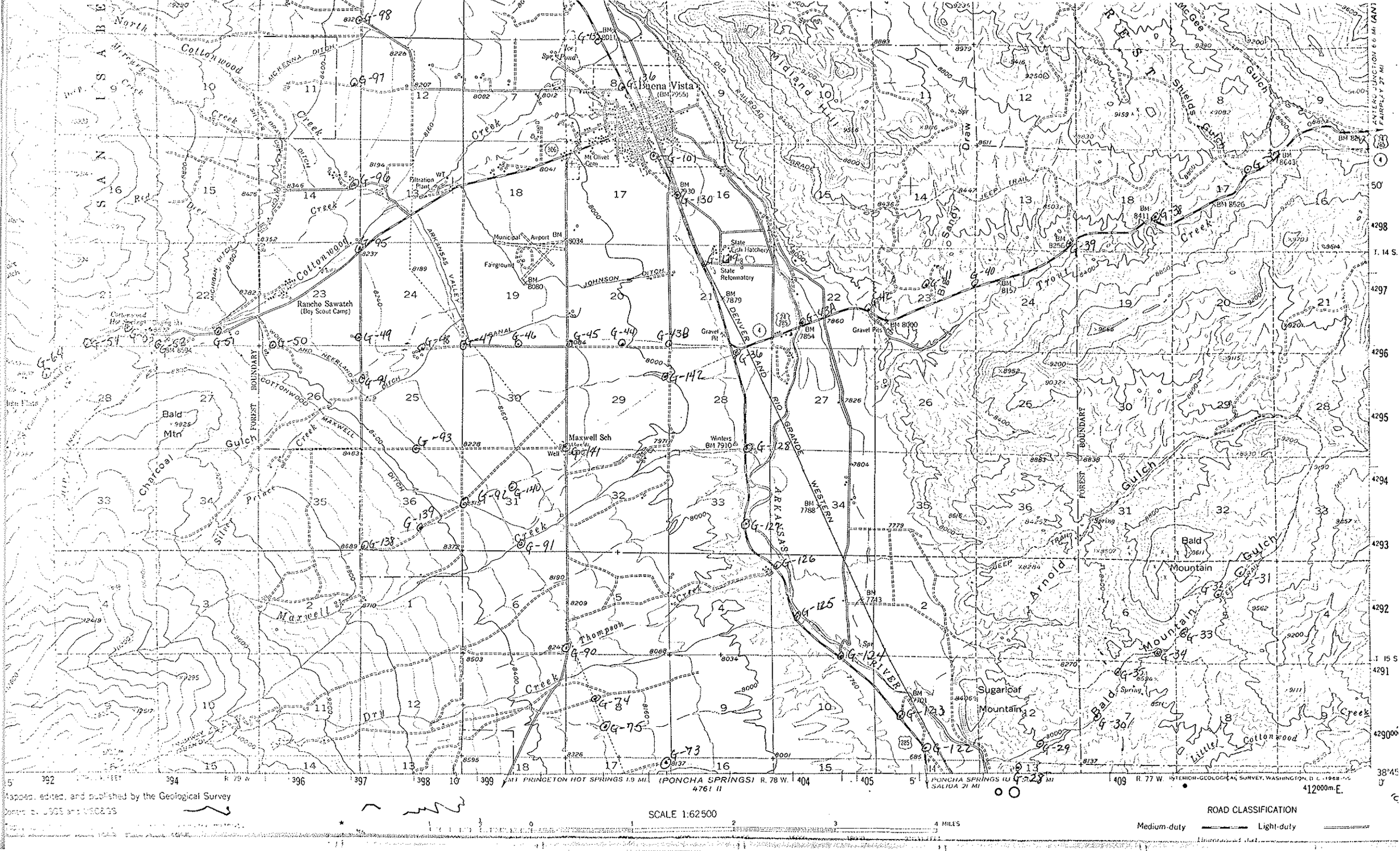

Centerville
Centerville Sch
Browns Canyon
Browns Canon
Browns Canyon Sch
Threemile
Fourmile
Droney
Squaw
ARKANSAS
RIVER
WILLIAMS-HAMM DITCH
DIVERSION
SUNNYSIDE PARK DITCH
SAND PARK
ADOBE PARK
Belleview
DENVER AND RIO GRANDE WESTERN
Smeltertown
SALIDA
Harrington
MISSOURI PARK
Poncha Springs
South Arkansas
Railroad
Stafford
Cat
Dead Goat
Swan
Green
FOREST BOUNDARY
SAN ISABEL NATIONAL FOREST
(CAMERON MOUNTAIN) 4861 III
(HOWARD) 4860 IV
(BONANZA) 4760 I
G-119
G-118
G-117
G-116
G-115
G-114
G-113
G-112
G-111
G-110
G-109
G-108
G-107
G-106
G-105
G-104
G-103
G-102
G-65
G-89
G-88
G-87
G-86

SCALE 1:62500

CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION
Medium duty
Light duty
Unimproved dirt
U.S. Route
State Route

COLORADO



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