ENGINEERING STUDY

SITE DEVELOPMENT

AND

FACILITIES REQUIREMENTS

FOR THE

VERY LARGE ARRAY

NATIONAL RADIO ASTRONOMY OBSERVATORY

OPERATED BY

ASSOCIATED UNIVERSITIES, INC.

UNDER CONTRACT WITH

THE NATIONAL SCIENCE FOUNDATION

DECEMBER 1969

LIMBAUGH ENGINEERS, INC.

ALBUQUERQUE, NEW MEXICO

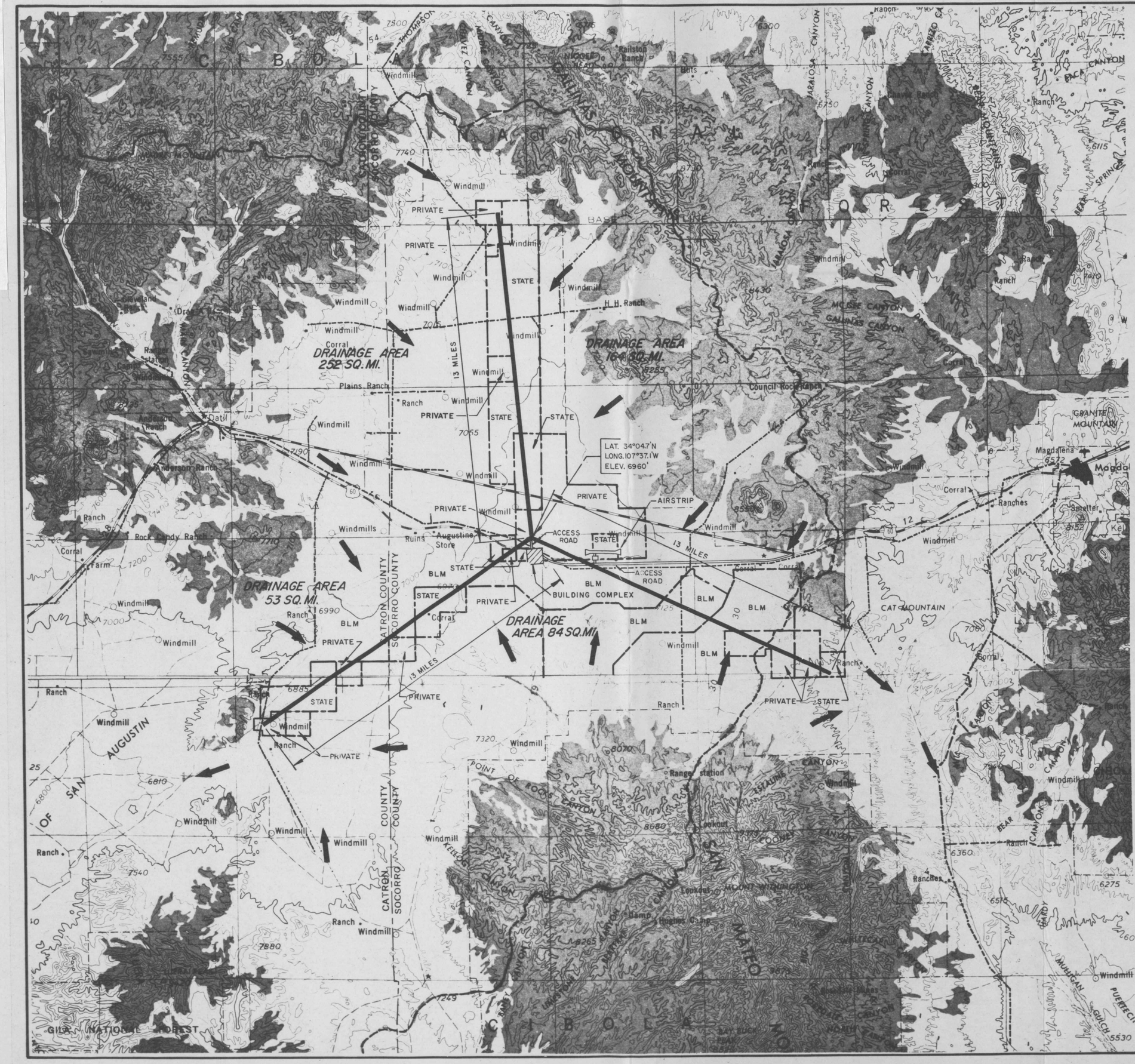
EXHIBITS

LIST OF EXHIBITS

1.	General Plan, Ownership	Hydrology and Drainage	Site Y-15 - New Mexico
2.	Plan and Profile	Southeastern Branch	Site Y-15 - New Mexico
3.	Plan and Profile	Southwestern Branch	Site Y-15 - New Mexico
4.	Plan and Profile	Northern Branch	Site Y-15 - New Mexico
5.	General Plan, Ownership	Hydrology and Drainage	Site Y-16 - Utah
6.	Plan and Profile	Northeastern Branch	Site Y-16 - Utah
7.	Plan and Profile	Southern Branch	Site Y-16 - Utah
8.	Plan and Profile	Northwestern Branch	Site Y-16 - Utah
9.	General Plan, Ownership	Hydrology and Drainage	Site Y-17 - Nevada
10.	Plan and Profile	Southeastern Branch	Site Y-17 - Nevada
11.	Plan and Profile	Southwestern Branch	Site Y-17 - Nevada
12.	Plan and Profile	Northern Branch	Site Y-17 - Nevada
13.	General Plan, Ownership	Hydrology and Drainage	Site Y-22 - New Mexico
14.	Plan and Profile	Northeastern Branch	Site Y-22 - New Mexico
15.	Plan and Profile	Southern Branch	Site Y-22 - New Mexico
16.	Plan and Profile	Northwestern Branch	Site Y-22 - New Mexico
17.	General Plan, Ownership	Hydrology and Drainage	Site Y-23 - Arizona
18.	Plan and Profile	Southeastern Branch	Site Y-23 - Arizona
19.	Plan and Profile	Southwestern Branch	Site Y-23 - Arizona
20.	Plan and Profile	Northern Branch	Site Y-23 - Arizona
21.	General Plan, Ownership	Hydrology and Drainage	Site Y-27 - Texas
22.	Plan and Profile	Southeastern Branch	Site Y-27 - Texas
23.	Plan and Profile	Southwestern Branch	Site Y-27 - Texas
24.	Plan and Profile	Northern Branch	Site Y-27 - Texas

25.	General Plan, Ownership	Hydrology and Drainage	Site Y-33 - Nevada
26.	Plan and Profile	Northern Branch	Site Y-33 - Nevada
27.	Plan and Profile	Southeastern Branch	Site Y-33 - Nevada
28.	Plan and Profile	Southwestern Branch	Site Y-33 - Nevada
29.	Typical Details		
30.	Typical Details		
31.	Typical Details		
32.	Building Complex Plot Plan		
33.	Laboratory Building Floor Plans		
34.	Laboratory building Elevations and Sections		
35.	Shops Building, Garages and Central Power Plant - Plan, Elevation and Section		
36.	Dormitory Building - Plan, Elevation and Section		





LEGEND

DRAINAGE FLOWS
WATERSHED
WYE BRANCHES
0-50 KV POWER LINE

0 1/2 1 2 3 4
SCALE: 1"=2 MILES

VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
SITE Y-15, NEW MEXICO

GENERAL PLAN, OWNERSHIP, HYDROLOGY & DRAINAGE

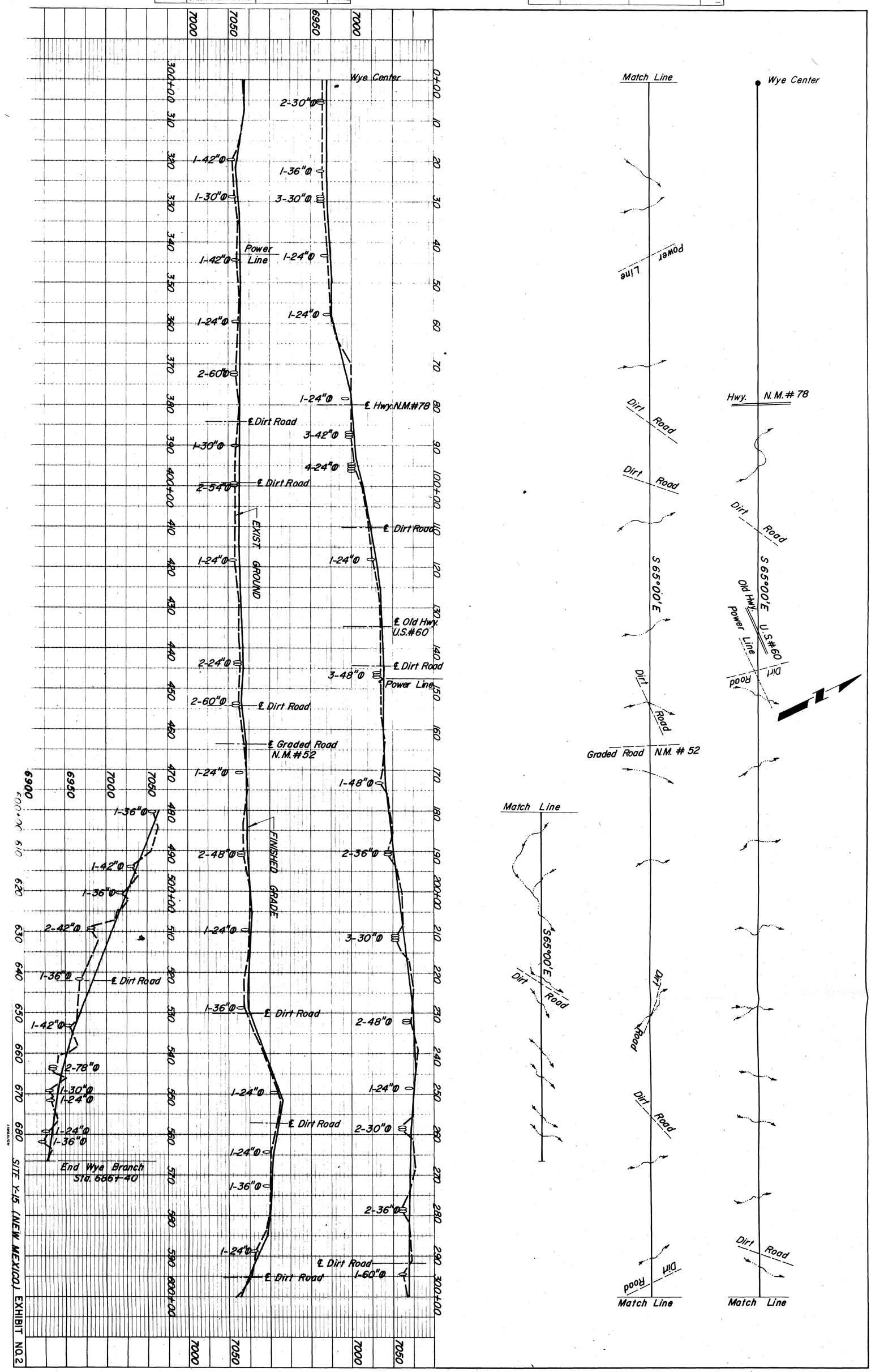
LIMBAUGH ENGINEERS, INC.

DRAWN BY R.M.
CHECKED BY B.H.
FILE NO. 2941
SCALE: 1"=2 MILES
DATE DEC. 1969
SHEET NO. 1 OF 36

EXHIBIT NO. 1

PROFILE	SURVEYED	BY	DATE
NOTE BOOK	PLOTTED		
NO.	GRADES CHECKED		
	B. M.'S NOTED		
	STRUCTURE NOTATNS CH'KD.		

PLAN	SURVEYED	BY	DATE
NOTE BOOK	PLOTTED		
NO.	ALIGNMENT CHECKED		
	RT. OF WAY CHECKED		



SITE Y-15 (NEW MEXICO) EXHIBIT NO. 2

PLAN
SURVEYED
PLOTTED
NOTE BOOK ALIGNMENT CHECKED
NO. RT. OF WAY CHECKED
BY
DATE

Wye Center

Power Line

Old U.S. Hwy. #60

S 55° 00' W

Gravel Road

Match Line

Match Line

S 55° 00' W

Match Line

Match Line

S 55° 00' W

Pond

PROFILE
SURVEYED
PLOTTED
NOTE BOOK GRADES CHECKED
NO. B.M.'S NOTED
STRUCTURE OUTLINES CH'KD
BY
DATE

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

7000
6950
6900

Wye Center
Power Line
℄ Old U.S. Hwy. #60
℄ Gravel Road
EXIST. GROUND
FINISHED GRADE

1-24"Ø
2-30"Ø
1-24"Ø
2-42"Ø
1-24"Ø
3-42"Ø
1-24"Ø
1-24"Ø
4-48"Ø
1-36"Ø
1-30"Ø
1-24"Ø
3-42"Ø
1-24"Ø

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

6950
6900

EXIST. GROUND
FINISHED GRADE

1-24"Ø
1-30"Ø
2-36"Ø
1-24"Ø
1-24"Ø
1-42"Ø
1-24"Ø
1-24"Ø
1-24"Ø
1-24"Ø
1-24"Ø
1-24"Ø
3-24"Ø
1-30"Ø
1-24"Ø

600+00 610 620 630 640 650 660 670 680

6950
6900

EXIST. GROUND
FINISHED GRADE
Pond
End Wye Branch Sta. 686+40

1-24"Ø
1-24"Ø
2-24"Ø
4-48"Ø
1-30"Ø

SITE Y-15 (NEW MEXICO) EXHIBIT NO. 3

LIMBAUGH ENGINEERS

PLAN | SURVEYED | PLOTTED | NOTE BOOK | NO. | ALIGNMENT CHECKED | RT. OF WAY CHECKED | BY | DATE

Wye Center

U.S. Hwy. 60

N 05° 00' W

Match Line

Match Line

Dirt Road

N 05° 00' W

Power Line

Dirt Road

Match Line

Match Line

Dry Lake

N 05° 00' W

PROFILE | SURVEYED | PLOTTED | GRADES CHECKED | ALIGNMENT CHKD | STRUCTURE NOTATNS CHKD | NOTE BOOK | NO. | BY | DATE

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

7000

6950

Wye Center

℄ U.S. Hwy 60

EXIST. GROUND

FINISHED GRADE

1-24"Ø

℄ Dirt Road

EXIST. GROUND

FINISHED GRADE

Power Line

℄ Dirt Road

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

EXIST. GROUND

FINISHED GRADE

Dry Lake

2-48"Ø

End Wye Branch Sta. 6867+40

600+00 610 620 630 640 650 660 670 680

SITE Y-15 (NEW MEXICO) EXHIBIT NO. 4

PLATE I — PLAN PROFILE & P. R. STANDARD

LIMBAUGH ENGINEERS INC

SHEET 4 OF 36

DESERT

DRAINAGE AREA 437 SQ. MI.

DRAINAGE AREA 1100 SQ. MI.

BLACK ROCK DESERT

BLACK ROCK VOLCANO 5282

NORTH TWIN PEAK 5878

KANOSH INDIAN RESERVATION

Kanosh Indian Village

CEDAR MOUNTAIN 5628

TABERNACLE HILL

PAVANT BUTTE

Delta

Fillmore

Meadow

Kanosh

Hatton

Greenwood

Clear Lake

Deseret

Oasis

Fort Deseret (abandoned)

Borden

Meter house

Bloom Siding

Lime and dolomite

Cabin

Cruz

Corral

Windmill

Abandoned

Tower

Ranch

Farm

Gravel

Cinder

Lava

Shack

Flowell

Causeway

Beacon

Neels

Van

McCormick

Hinckley

Ruins

Spring

Water

BUILDING COMPLEX

ACCESS ROAD

AIRSTRIP

LAT. 39°02.4'N
LONG. 112°40.8' W
ELEV. 4630'

UNION PACIFIC

46 KV

12.5 KV

13 MILES

T 17 S

T 18 S

T 19 S

T 20 S

T 21 S

T 22 S

R 7 W

R 8 W

R 9 W

R 10 W

LEGEND

DRAINAGE FLOWS
WATERSHED
WYE BRANCHES
0-50 KV POWER LINE
51-100 KV POWER LINE

0 1/2 1 2 3 4
SCALE 1"=2MILES

VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
SITE Y-16, UTAH

GENERAL PLAN, OWNERSHIP, HYDROLOGY & DRAINAGE

LIMBAUGH ENGINEERS, INC.

DRAWN BY R.M.
CHECKED BY B.H.
FILE NO. 2941
SCALE: 1"= 2 MILES
DATE DEC. 1969
SHEET NO. 5 OF 36

EXHIBIT NO. 5

PLAN | SURVEYED | DATE
NOTE BOOK | PLOTTED | BY
NO | ALIGNMENT CHECKED | GRADES CHECKED | BY | RT. OF WAY CHECKED

Wye Center

Dirt Road

N 66°00'E

Match Line

Match Line

Light Duty Road

N 66°00'E

Match Line

Match Line

N66°00'E

Dirt Road

Match Line

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

PROFILE | SURVEYED | DATE
NOTE BOOK | PLOTTED | BY
NO | GRADES CHECKED | BY | STRUCTURE ROUTE NO. CHKD

4700 4650 4600 4800 4750 4700

Wye Center

℄ Dirt Road

℄ Light Duty Road

EXIST. GROUND

FINISHED GRADE

EXIST. GROUND

FINISHED GRADE

1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-18"Ø 1-18"Ø 1-18"Ø 1-21"Ø 1-21"Ø 1-21"Ø 1-18"Ø 1-12"Ø 1-12"Ø 1-12"Ø 1-12"Ø

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

4700 4650 4600

℄ Dirt Road

End Wye Branch Sta. 6867+40

1-12"Ø 1-12"Ø 1-12"Ø

600+00 610 620 630 640 650 660 670 680

SITE Y-16 (UTAH) EXHIBIT NO. 6

PLATE I PLAN PROFILE B P R STANDARD

LIMBAUGH ENGINEERS INC.

SHEET 6 OF 36

PLAN
NOTE BOOK
NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED

DATE	BY

Wye Center

Dirt Road

S 06° 00' W

Match Line

Match Line

S 06° 00' W

Match Line

Match Line

S 06° 00' W

Dirt Road

PROFILE
NOTE BOOK
NO.
SURVEYED
PLOTTED
GRADES CHECKED
R/W STAKED
STRUCTURE NOTATIONS CH'KD

DATE	BY

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

4700
4650
4600
4750
4700

Wye Center

℄ Dirt Road

EXIST. GROUND

FINISHED GRADE

1-12"Ø

FINISHED GADE

EXIST. GROUND

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

4800
4750

℄ Dirt Road

End Wye Branch
Sta. 8869+40

600+00 610 620 630 640 650 660 670 680

4700
4650
4800
4750

SITE Y-16 (UTAH)

EXHIBIT NO. 7

PLATE PLAN PROFILE B. P. R. STANDARD

LIMBAUGH ENGINEERS INC

SHEET 7 OF 36

PLAN
NOTE BOOK
NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
R.W.'S NOTED
STRUCTURE NOTATNS CH'KD
BY
DATE

Wye Center

Telephone Line

N54°00'W

Union Pacific Railroad

Hwy. 257

Match Line

Match Line

Beaver River

Power Line

N54°00'W

Dirt Road

Match Line

Match Line

N54°00'W

PROFILE
NOTE BOOK
NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
R.W.'S NOTED
STRUCTURE NOTATNS CH'KD
BY
DATE

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

4650
4600
4650
4600

Wye Center

Telephone Line

1-12"Ø

EXIST. GROUND

FINISHED GRADE

℄ Union Pacific Railroad

℄ Hiway 257

℄ Beaver River

1-8'x 4' Box Culvert

Power Line

℄ Dirt Road

1-18"Ø

End Wye Branch Sta. 6865+40

2-18"Ø

4600
4550

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

4650
4600

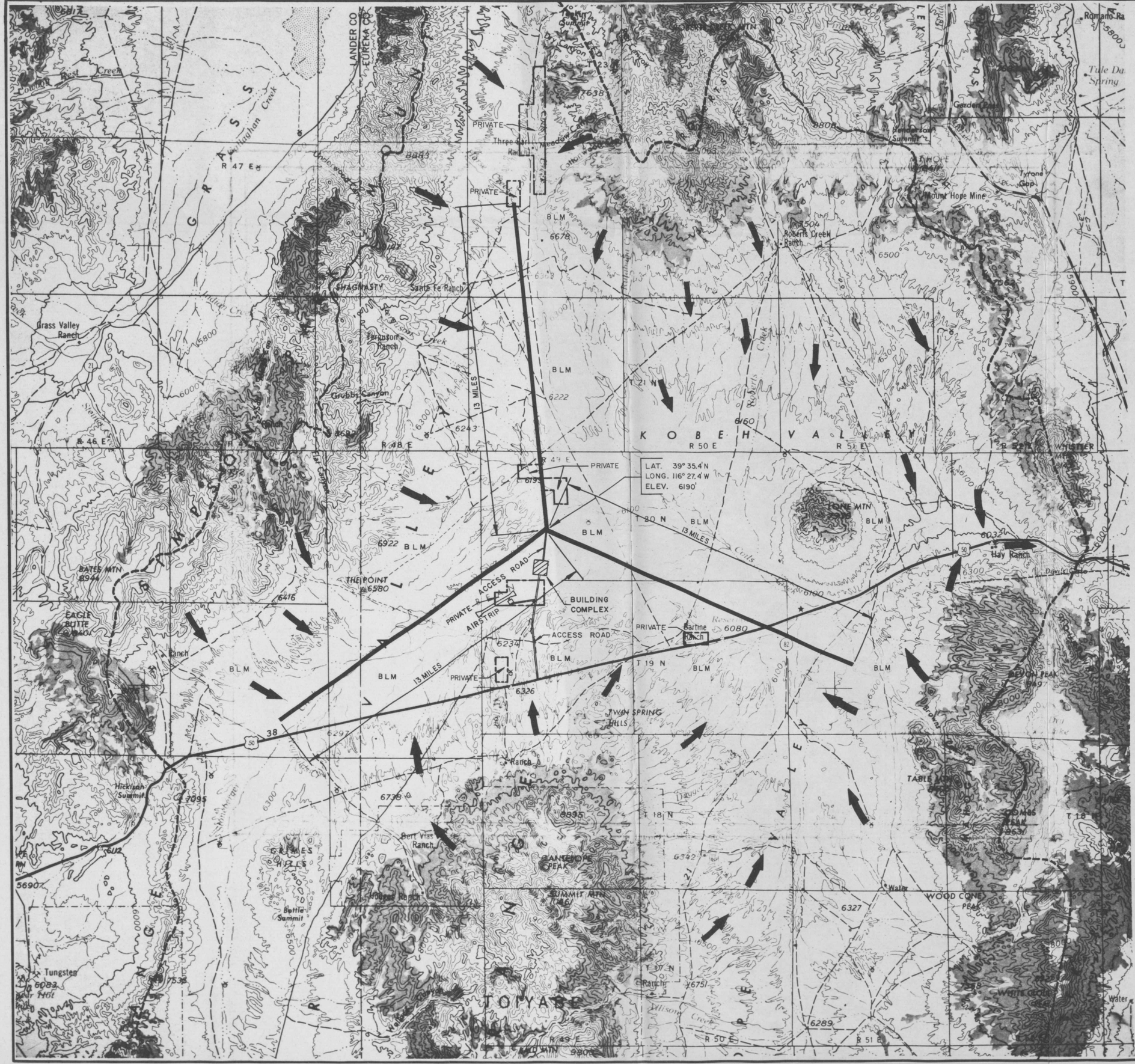
600+00 610 620 630 640 650 660 670 680

SITE Y-16 (UTAH) EXHIBIT NO. 8

PLATE I PLAN PROFILE & P. R. STANDARD

LIMBAUGH ENGINEERS INC.

SHEET 8 OF 36



N

LEGEND

DRAINAGE FLOWS
WATERSHED
WYE BRANCHES
0-50 KV POWER LINE

0 1/2 1 2 3 4
SCALE: 1"=2MILES

VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
SITE Y-17, NEVADA

GENERAL PLAN, OWNERSHIP, HYDROLOGY & DRAINAGE

LIMBAUGH ENGINEERS, INC.
CONSULTING ENGINEERS and PHOTOGRAMMETRISTS

DRAWN BY R.M.
CHECKED BY B.H.
FILE NO. 2941
SCALE: 1"=2 MILES
DATE DEC. 1969
SHEET NO. 9 OF 36

EXHIBIT NO. 9

Wye Center

Trail

S 66°00'E

Dirt Road

Hot Springs

Match Line

Match Line

Dirt Road

Dirt Road

S 66°00'E

Dirt Road

U.S. Hwy. 50

Dirt Road

Antelope Wash

Match Line

Match Line

S 66°00'E

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

6200
6150
6100
6050

Wye Center

℄ Trail

1-4'x20' Box Culvert

1-4'x20' Box Culvert

EXIST. GROUND

1-4'x20' Box Culvert

℄ Dirt Road

FINISHED GRADE

1-6'x30' Box Culvert

Hot Springs

℄ Dirt Road

℄ Dirt Road

℄ Dirt Road

EXIST. GROUND

℄ Dirt Road

℄ US Hwy 50

FINISHED GRADE

℄ Dirt Road

℄ Antelope Wash

1-4'x20' Box Culvert

1-8'x42" Box Culvert

End Wye Branch Sta. 6867+40

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

600+00 610 620 630 640 650 660 670 680

SITE Y-17 (NEVADA)

EXHIBIT NO. 10

SHEET 10 OF 36

LIMBAUGH ENGINEERS INC

PLATE 1 — PLAN PROFILE B P R STANDARD

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
AT. OF MAT CHECKED
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
NOTE BOOK
NO.
STRUCTURE NOTATNS CH'KD.
BY
DATE

PLAN
SURVEYED
PLOTTED
NOTE BOOK — LINE MAY CHECKED
NO. — RT. OF WAY CHECKED
BY
DATE

Wye Center — Dirt Road — S54°00'W — Dirt Road — Match Line

Match Line — Dirt Road — S54°00'W — Dirt Road — Dirt Road — Dirt Road — Match Line

Match Line — S54°00'W

PROFILE
SURVEYED
PLOTTED
NOTE BOOK — CHAINAGE CHECKED
NO. — B.M.'S NOTED
STRUCTURE NOTATIONS CHKD.
BY
DATE

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

6200 / 6150 / 6250 / 6200

Wye Center — ℄ Dirt Road — EXIST. GROUND — ℄ Dirt Road — FINISHED GRADE

1-12"Ø — 1-12"Ø — 1-12"Ø — 1-12"Ø — 1-12"Ø — 1-12"Ø

℄ Dirt Road — EXIST. GROUND — ℄ Dirt Road — FINISHED GRADE — ℄ Dirt Road

1-12"Ø — 1-12"Ø — 1-12"Ø — 1-12"Ø — 1-12"Ø — 1-12"Ø

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

6300 / 6250

End Wye Branch Sta. 606+40

1-12"Ø

600+00 610 620 630 640 650 660 670 680

SITE Y-17 (NEVADA) EXHIBIT NO. 11

PLATE I PLAN PROFILE B P R STANDARD

LIMBAUGH ENGINEERS INC

SHEET 11 OF 36

PLAN
SURVEYED
PLOTTED
NOTE BOOK
NO.
DATE
BY

PROFILE
SURVEYED
PLOTTED
CROSS SECTIONS CHECKED
B. M.'S NOTED
STRUCTURE NOTATIONS CHKD
NOTE BOOK
NO.
DATE
BY

Wye Center
TRAIL
N06°00'W
Dirt Road
Match Line
Dirt Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
Match Line
Match Line
N06°00'W
Dirt Road
Horse Creek

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00 610 620 630 640 650 660 670 680

6200
6150
6250
6200
6400
6350
6300
6450
6400

Wye Center
℄ Trail
EXIST. GROUND
℄ Dirt Road
FINISHED GRADE
℄ Dirt Road
1-4.5'x30' Box Culvert
℄ Horse Creek
End Wye Branch Sta. 8867+40
1-4.5'x30' Box Culvert
1-24"Ø

SITE Y-17 (NEVADA)

EXHIBIT NO. 12

PLATE PLAN PROFILE B.P.R. STANDARD

LIMBAUGH ENGINEERS INC.

SHEET 12 OF 36

DRAINAGE AREA 101 SQ. MI.

DRAINAGE AREA 187 SQ. MI.

DRAINAGE AREA 265 SQ. MI.

Windmill
LAT. 32°15.6'N
LONG. 108°24.2'W
ELEV. 4670'

LEGEND

DRAINAGE FLOWS
WATERSHED
WYE BRANCHES
0-50 KV POWER LINE
51-100 KV POWER LINE

0 1/2 1 2 3 4
SCALE: 1"=2 MILES

VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
SITE Y-22, NEW MEXICO

GENERAL PLAN, OWNERSHIP, HYDROLOGY & DRAINAGE

LIMBAUGH ENGINEERS, INC.

DRAWN BY M.Y.
CHECKED BY B.H.
FILE NO. 2941
SCALE: 1" = 2 MILES
DATE DEC. 1969
SHEET NO. 13 OF 36

EXHIBIT NO. 13

PLAN | SURVEYED | PLOTTED | ALIGNMENT CHECKED | PROFILE & MAT. CHECKED | NOTE BOOK | NO. | BY | DATE

PROFILE | SURVEYED | PLOTTED | GRADES CHECKED | B.M.'S NOTED | STRUCTURE NOTATIONS CHKD | NOTE BOOK | NO. | BY | DATE

Wye Center

Light Duty Road

N 67°00'E

Underground Pipeline

Dirt Road

Underground Pipeline

Match Line

Match Line

N 67°00'E

Dirt Road

Dirt Road

Dirt Road

Match Line

Match Line

N 67°00'E

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

4800 4750 4700 4900 4850

Wye Center

℄ Light Duty Road

1-4'x7.5' Box Culvert

EXIST. GROUND

1-4'x7.5' Box Culvert

2-18"Ø

1-4'x18' Box Culvert

2-18"Ø

4850

4800

FINISHED GRADE

4-18"Ø

℄ Dirt Road 1-4'x18' Box Culvert

℄ Underground Pipeline

4-18"Ø

℄ Dirt Road

℄ Dirt Road 1-4'x7.5' Box Culvert

℄ Underground Pipeline

1-4'x18' Box Culvert

End Wye Branch Sta. 6367+40

1-4'x18' Box Culvert

4850

4800

4850 4800 4900 4850

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

600+00 610 620 630 640 650 660 670 680

SITE Y-22 (NEW MEXICO) EXHIBIT NO. 14

PLATE I PLAN PROFILE B. P. R. STANDARD

LIMBAUGH ENGINEERS INC

SHEET 14 OF 36

PLAN | SURVEYED | PLOTTED | PLANS CHECKED | ALIGNMENT CHECKED | R/W MAP CHECKED | NOTE BOOK NO. | BY | DATE

PROFILE | SURVEYED | PLOTTED | PLANS CHECKED | B.M.'S NOTED | STRUCTURE NOTATNS CHKD | NOTE BOOK NO. | BY | DATE

Wye Center

S 07°00'W

Light Duty Road

Dirt Road

Dirt Road

Pacific Railroad

Pipelines

U.S. Hwy. 70 & 80

Telphone Cable

Southern Pacific Railroad

Underground Power Line

Underground

Dirt Road

Match Line

Match Line

Dirt Road

Dirt Road

S 07°00'W

Match Line

Match Line

S 07°00'W

Underground Pipeline

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

4650 4600 4550 4500 4450 4400 4350 4300

Wye Center

℄ Dirt Road

1-4'x15' Box Culvert

FINISHED GRADE

EXIST. GROUND

℄ Dirt Road

℄ Light Duty Road

1-4'x20' Box Culvert

℄ Dirt Road

℄ Dirt Road

℄ Southern Pacific Railroad

U.S. Hwy. 70 & 80

Power Line

Underground Pipelines

Underground Telephone Cable

1-4'x20' Box Culvert

℄ Dirt Road

1-4'x20' Box Culvert

1-4'x15' Box Culvert

℄ Underground Pipeline

End Wye Branch Sta. 8661+40

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

4550 4500 4450 4400 4350

600+00 610 620 630 640 650 660 670 680

PLATE I — PLAN PROFILE & P. R. STANDARD

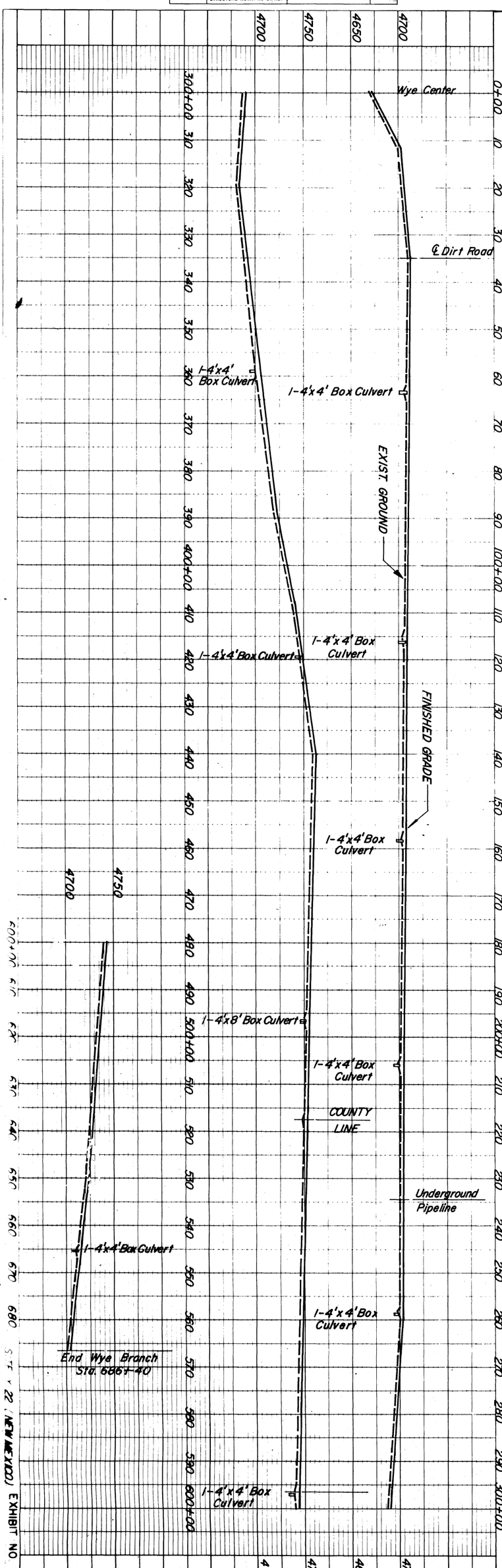
LIMBAUGH ENGINEERS, INC

SITE Y-22 (NEW MEXICO) EXHIBIT NO. 15

SHEET 15 OF 36

PROFILE		BY	DATE
NOTE BOOK NO.	SURVEYED PLOTTED GRADES CHECKED B. M.'S NOTED STRUCTURE NOTATNS CHKD.		

PLAN		BY	DATE
NOTE BOOK NO.	SURVEYED PLOTTED ALIGNMENT CHECKED RT. OF WAY CHECKED		



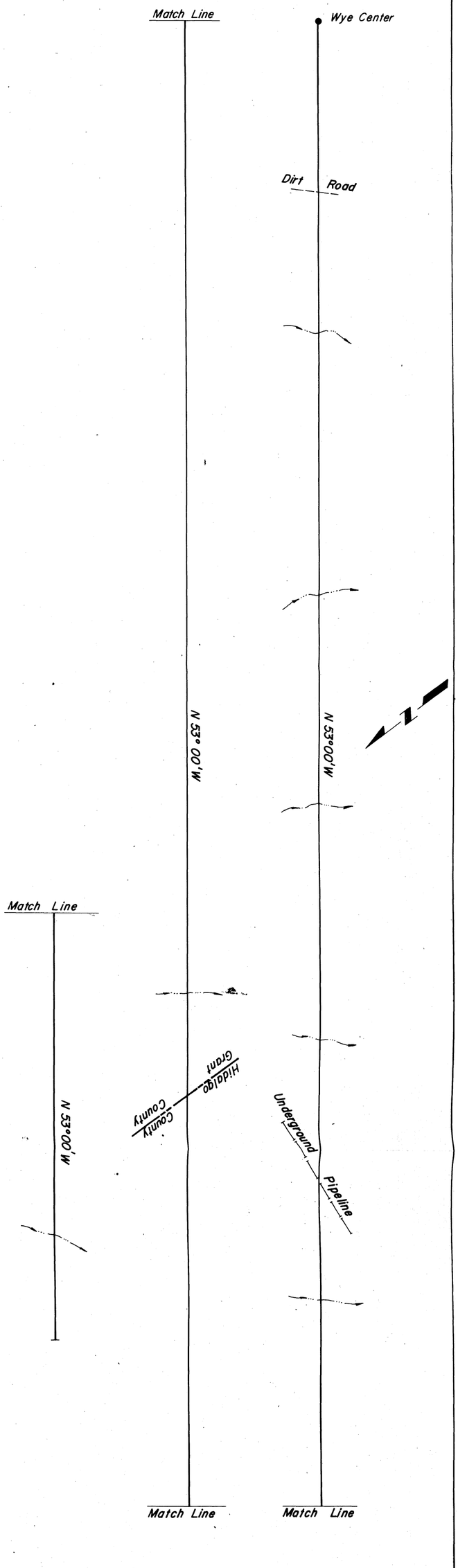
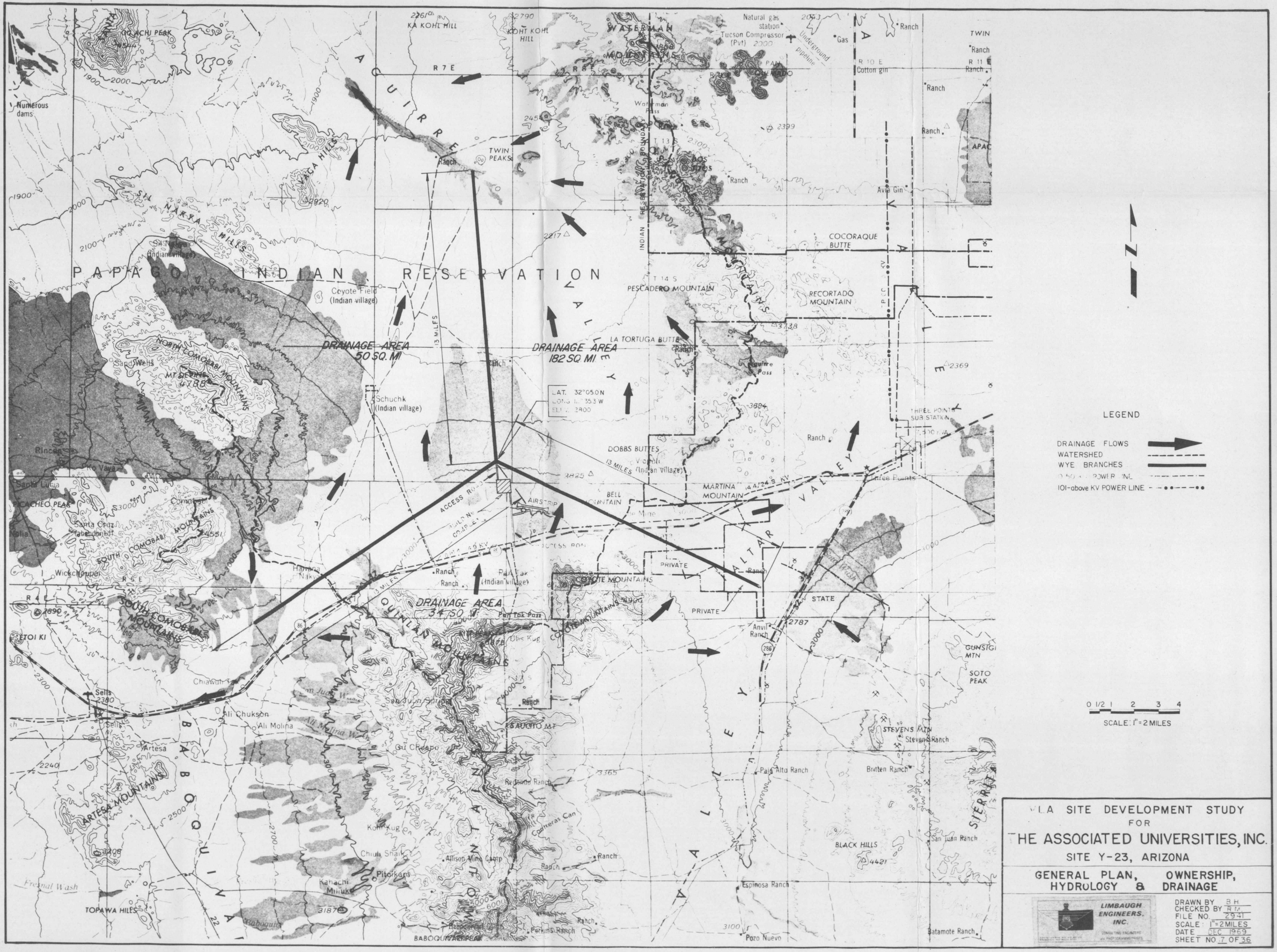


EXHIBIT NO. 16



V.L.A. SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
SITE Y-23, ARIZONA

GENERAL PLAN, OWNERSHIP, HYDROLOGY & DRAINAGE

LIMBAUGH ENGINEERS, INC.

DRAWN BY B.H.
CHECKED BY R.M.
FILE NO. 2941
SCALE 1"=2 MILES
DATE DEC. 1969
SHEET NO. 7 OF 36

EXHIBIT NO 17

PLAN
NOTE BOOK NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
BY
DATE

Wye Center
Dirt Road
S65°00'E
Dirt Road
Wash
Viapuli
Match Line
Match Line
Dirt Road
Power Line
U.S. Hwy. 86
Dirt Road
Power Line
S 65°00'E
Light Duty Road
Match Line
Match Line
S65°00'E

PROFILE
NOTE BOOK NO.
SURVEYED
PLOTTED
GRADES CHECKED
B. M.'s NOTED
STRUCTURE NOTATNS CK'KD.
BY
DATE

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00 3000

2900 2850 2800 2900 2850

Wye Center
1-54"Ø
6-48"Ø
℄ Dirt Road
2-48"Ø
3-42"Ø
2-42"Ø
3-48"Ø
2-54"Ø
℄ Hwy.US 86
6-60"Ø
1-36"Ø
3-42"Ø
℄ Dirt Road
1-36"Ø
3-10'x10' Box Culverts
2-54"Ø
1-48"Ø
4-66"Ø
2-48"Ø
Power Line
2-60"Ø
℄ Light Duty Road
3-60"Ø
2-48"Ø
EXIST. GROUND
FINISHED GRADE
℄ Dirt Road
VIDPULI WASH
2-42"Ø
4-10'x10' Box Culverts
3-42"Ø
1-36"Ø
2-48"Ø

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

2900 2850 2825 2800 2750 2700 2800 2750 2700 2800 2750 2700

1-54"Ø
1-30"Ø
1-30"Ø
1-36"Ø
2-60"Ø
Power Line
2-42"Ø
1-30"Ø
4-48"Ø
1-30"Ø
3-42"Ø
2-42"Ø
4-66"Ø
4-48"Ø
2-48"Ø
2-36"Ø
Power Line
3-54"Ø
5-60"Ø
6-66"Ø
EXIST. GROUND
FINISHED GRADE
1-48"Ø
1-36"Ø
2-36"Ø
2-48"Ø
2-42"Ø
4-10'x10' Box Culverts
3-42"Ø
1-36"Ø
2-48"Ø
1-30"Ø
1-36"Ø
3-48"Ø
2-42"Ø
2-42"Ø
2-36"Ø
2-42"Ø
2-42"Ø
5-48"Ø
2-36"Ø
2-36"Ø
End Wye Branch Sta. 6886+40

600+00 610 620 630 640 650 660 670 680

SITE Y-23 (ARIZONA) EXHIBIT NO. 18

PLATE I — PLAN PROFILE B P R STANDARD

LIMBAUGH ENGINEERS INC

SHEET 18 OF 36

PLAN | SURVEYED | PLOTTED | NOTE BOOK | NO. | DATE | BY | RIGHT OF WAY CHECKED | RIGHT OF WAY CHECKED

PROFILE | SURVEYED | PLOTTED | GRADES CHECKED | B. M.'S NOTED | STRUCTURE NOTATIONS CHKD. | NOTE BOOK | NO. | DATE | BY

Wye Center

S55°00'W

Light Duty Road

Power Line

Match Line

Match Line

S55°00'W

Dirt Road

Camobabi Wash

Match Line

Match Line

S55°00'W

Light Duty Road

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

FINISHED GRADE

EXIST. GROUND

2900

2850

2800

2750

2700

Wye Center

4-66"Ø 1-36"Ø 3-48"Ø 1-30"Ø 2-10'x8' Box 4-60"Ø 4-42"Ø 1-30"Ø 1-24"Ø 2-48"Ø 3-54"Ø 1-36"Ø 1-36"Ø 5-60"Ø 2-42"Ø 1-30"Ø 3-48"Ø 1-36"Ø 3-48"Ø 2-36"Ø 3-48"Ø 1-30"Ø 1-36"Ø Power Line 1-30"Ø 3-48"Ø 1-30"Ø 2-42"Ø 1-30"Ø 2-48"Ø 4-60"Ø

℄ Dirt Road

4-60"Ø 3-48"Ø 1-54"Ø 2-48"Ø 4-54"Ø 1-30"Ø 4-36"Ø 2-42"Ø 3-42"Ø 3-42"Ø 3-48"Ø 4-42"Ø 2-36"Ø 4-48"Ø 1-36"Ø 2-36"Ø 2-36"Ø 2-30"Ø 3-30"Ø 2-42"Ø 1-36"Ø 1-36"Ø 2-30"Ø 4-36"Ø 3-36"Ø 3-42"Ø 1-36"Ø

Camobabi Wash

2-10'x10' Box Culverts

4-60"Ø

FINISHED GRADE

EXIST. GROUND

End Wye Branch Sta. 6867+40

4-60"Ø 3-60"Ø 3-42"Ø 2-42"Ø 1-30"Ø 1-36"Ø 2-42"Ø 3-36"Ø 1-30"Ø

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00 610 620 630 640 650 660 670 680

SITE Y-23 (ARIZONA) EXHIBIT NO. 19

PLATE I - PLAN PROFILE & P R STANDARD

LIMBAUGH ENGINEERS INC

SHEET 19 OF 36

PLAN
NOTE BOOK NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
BY
DATE

Wye Center
N05°00'W
Match Line
Match Line
N05°00'W
Match Line
Match Line
N05°00'W
Match Line

PROFILE
NOTE BOOK NO.
SURVEYED
PLOTTED
GRADES CHECKED
R/W NOTED
STRUCTURE NOTA'NS CHKD
BY
DATE

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

2800 2750 2700 2550 2400 2350

Wye Center
CHANNEL EAST SIDE
EXIST. GROUND
FINISHED GRADE
6-60"Ø
EXIST. GROUND
FINISHED GRADE
3-4'x8' Box Culverts
3-42"Ø
CHANNEL WEST SIDE
EXIST. GROUND
FINISHED GRADE
3-8'x8' Box Culverts
EXIST. GROUND
FINISHED GRADE
4-4'x8' Box Culverts
EXIST. GROUND
FINISHED GRADE
4-10'x10' Box Culverts
CHANNEL EAST SIDE
6-48"Ø
EXIST. GROUND
CHANNEL WEST SIDE
FINISHED GRADE
4-48"Ø
6-54"Ø

2300 2250 2200 2100 2050

EXIST. GROUND
FINISHED GRADE
4-60"Ø
EXIST. GROUND
FINISHED GRADE
6-60"Ø
End Wye Branch Sta. 686+40

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

2050 2000

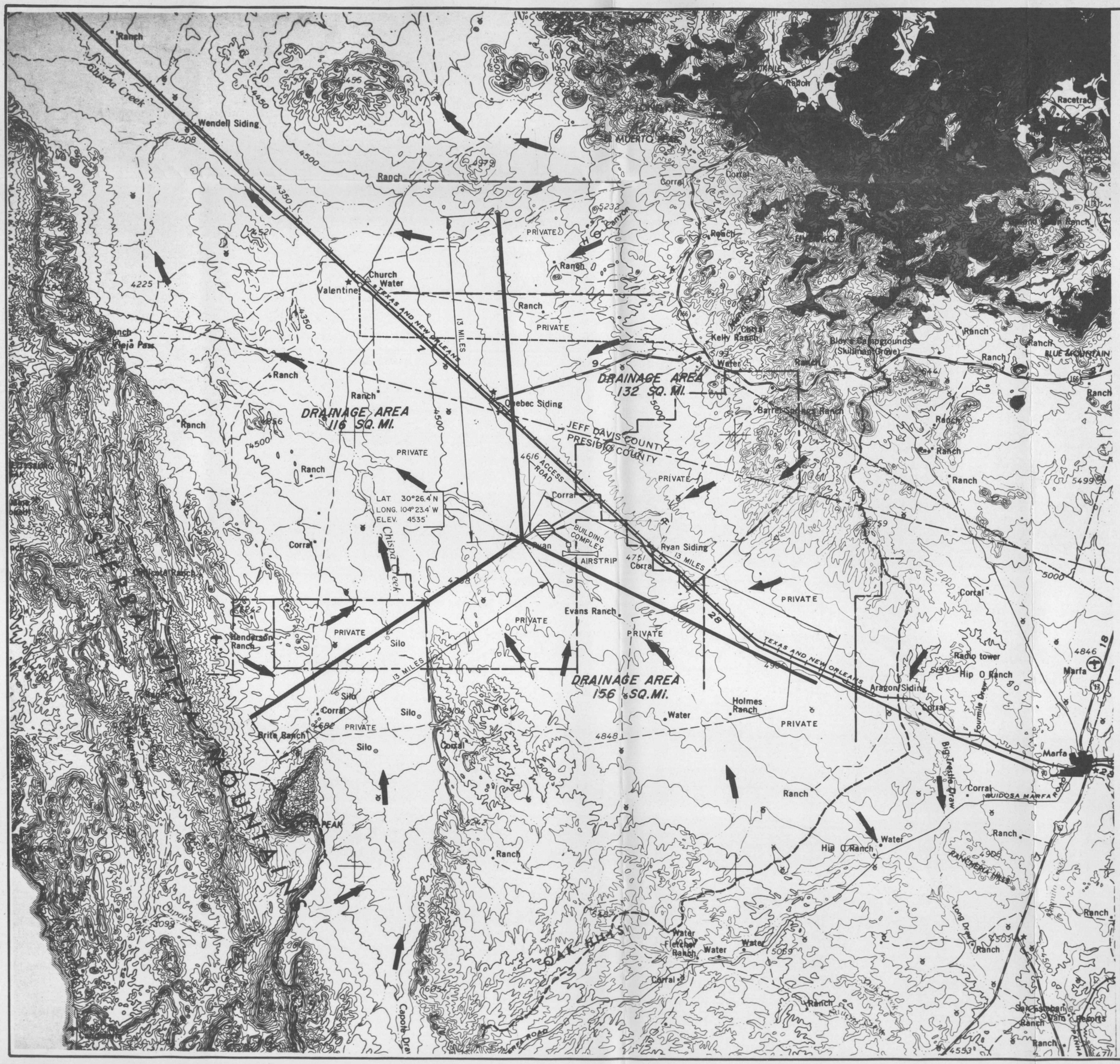
600+00 610 620 630 640 650 660 670 680

SITE Y-23 (ARIZONA) EXHIBIT NO. 20

PLATE I PLAN PROFILE 8 x 8 STANDARD

LIMBAUGH ENGINEERS INC

SHEET 20 OF 36


Ranch
Obispo Creek
Wendell Siding
4208
4500
4350
4225
4552
4456
4379
Ranch
Corral
Corral
MUERTO PASS
5232
Canyon
PRIVATE
Ranch
Church Water
Valentine
TEXAS AND NEW ORLEANS
13 MILES
Ranch
PRIVATE
Ranch
Reja Pass
Ranch
Ranch
DRAINAGE AREA 116 SQ. MI.
Ranch
4556
4500
PRIVATE
Ranch
Corral
LAT 30°26.4' N
LONG. 104°23.4' W
ELEV. 4535'
Chispa Creek
Quebec Siding
DRAINAGE AREA 132 SQ. MI.
5093
Water
Kelly Ranch
Corral
Blow Campgrounds (Skillman Grove)
Ranch
Ranch
Ranch
Ranch
BLUE MOUNTAIN
Ranch
Barrel Springs Ranch
Ranch
Ranch
5499
JEFF DAVIS COUNTY
PRESIDIO COUNTY
PRIVATE
46/6 ACCESS ROAD
Corral
BUILDING COMPLEX
AIRSTRIP
Ryan Siding
13 MILES
4751
Corral
5759
5000
PRIVATE
Corral
Evans Ranch
PRIVATE
PRIVATE
PRIVATE
Henderson Ranch
Silo
13 MILES
25
TEXAS AND NEW ORLEANS
Radio tower
Hip O Ranch
4846
Marfa
18
DRAINAGE AREA 156 SQ.MI.
Aragon Siding
Corral
Tourmile Draw
Silo
Corral
4682
PRIVATE
Brite Ranch
Silo
Holmes Ranch
Water
PRIVATE
4848
Corral
Big Treshe Draw
Marfa
Corral
GUIDOSA MARFA ROAD
Ranch
Water
Hip O Ranch
Ranch
RANCHERIA HILLS
4905
Long Draw
Ranch
5503
Ranch
4500
OAK HILLS
Water
Fletcher Ranch
Water
Water
5069
Corral
Ranch
San Esteban Ranch
Valle Resorts
Ranch
4553
Ranch
Corral
Ranch
Ranch
Ranch
Ranch

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
BK. OF MKS. CHECKED
NOTE BOOK
NO.
DATE
BY

Wye Center
Dirt Road
S 64°00'E
Match Line
Match Line
Road
Dirt
S 64°00'E
Match Line
Light Duty Road
S 64°00'E
Match Line

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
B.M.'S NOTED
STRUCTURE NOTATNS CH'KD.
NOTE BOOK
NO.
DATE
BY

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

4600 4550 4500 4750 4700

Wye Center
℄ Dirt Road
1-5'x10' Box Culvert
EXIST. GROUND
1-5'x10' Box Culvert
FINISHED GRADE
1-5'x10' Box Culvert
1-5'x50' Box Culvert
℄ Dirt Road
1-5'x10' Box Culvert
1-5'x60' Box Culvert
1-5'x10' Box Culvert
1-5'x10' Box Culvert

4650 4700 4900 4850 4800

1-5'x10' Box Culvert
1-5'x10' Box Culvert
EXIST. GROUND
FINISHED GRADE
1-5'x10' Box Culvert
1-5'x10' Box Culvert
1-5'x10' Box Culvert
℄ Light Duty Road
End Wye Branch Sta. 6867+40

4900 4850

1-5'x10' Box Culvert
1-5'x10' Box Culvert

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00 610 620 630 640 650 660 670 680

SITE Y-27 (TEXAS)

EXHIBIT NO. 22

PLATE I PLAN PROFILE B P R STANDARD

LIMBAUGH ENGINEERS INC

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
B.M.'S NOTED
STRUCTURE DETAILS CHKD
NOTE BOOK
NO.
BY
DATE

Wye Center
S 56° 00' W
Match Line
Match Line
S 56° 00' W
Dirt Road
Match Line
Match Line
S 56° 00' W

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

4600 4550 4500

Wye Center
1-8'x 7'0' Box Culvert
1-48"Ø
1-5'x 35' Box Culvert
EXIST. GROUND
FINISHED GRADE

4500 4550 4500

1-48"Ø
1-5'x 35' Box Culvert
1-48"Ø

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

4500 4450

1-48"Ø
1-5'x 35' Box Culvert
1-48"Ø
1-48"Ø
1-5'x 35' Box Culvert
1-48"Ø

4600 4700 4650 4600

1-48"Ø
1-48"Ø
EXIST. GROUND
℄ Dirt Road
FINISHED GRADE
1-48"Ø
1-48"Ø

4800 4750 4700

1-48"Ø
1-5'x 35' Box Culvert
+ 2.5%
End Wye Branch Sta 6867+40
+ 2.0%

600+00 610 620 630 640 650 660 670 680

SITE Y-27 (TEXAS) EXHIBIT NO. 23

PLATE I—PLAN PROFILE B. P. R. STANDARD

LIMBAUGH ENGINEERS INC

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
PT. OF INT CHECKED
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
BMKS NOTED
STRUCTURE NOTATNS CHKD.
NOTE BOOK
NO.
BY
DATE

Wye Center
Dirt Road
N 04° 00' W
U.S. Hwy. 90
Texas & New Orleans Railroad
Presidio County
Jeff Davis County
Match Line
Light Duty Road
Power Line
Dirt Road
N 04°00'W
Match Line
Dirt Road
N 04°00'W
Match Line

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

4600 4550 4500 4700 4650 4600

Wye Center
℄ Dirt Road
EXIST. GROUND
FINISHED GRADE
1-4'x 20' Box Culvert
1-4'x 20' Box Culvert
1-4'x 20' Box Culvert
1-4'x 20' Box Culvert
1-4'x 20' Box Culvert
1-4'x 20' Box Culvert
U.S. Hiway 90
Texas & New Orleans Railroad
COUNTY LINE
FINISHED GRADE
EXIST. GROUND
℄ Light Duty Road
1-5'x 60' Box Culvert
EXIST. GROUND
FINISHED GRADE
1-4'x 20' Box Culvert
Power Line
℄ Dirt Road
1-4'x 26' Box Culvert
1-4'x 20' Box Culvert
1-4'x 20' Box Culvert
1-4'x 20' Box Culvert

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

4650 4600 4800 4750 4700

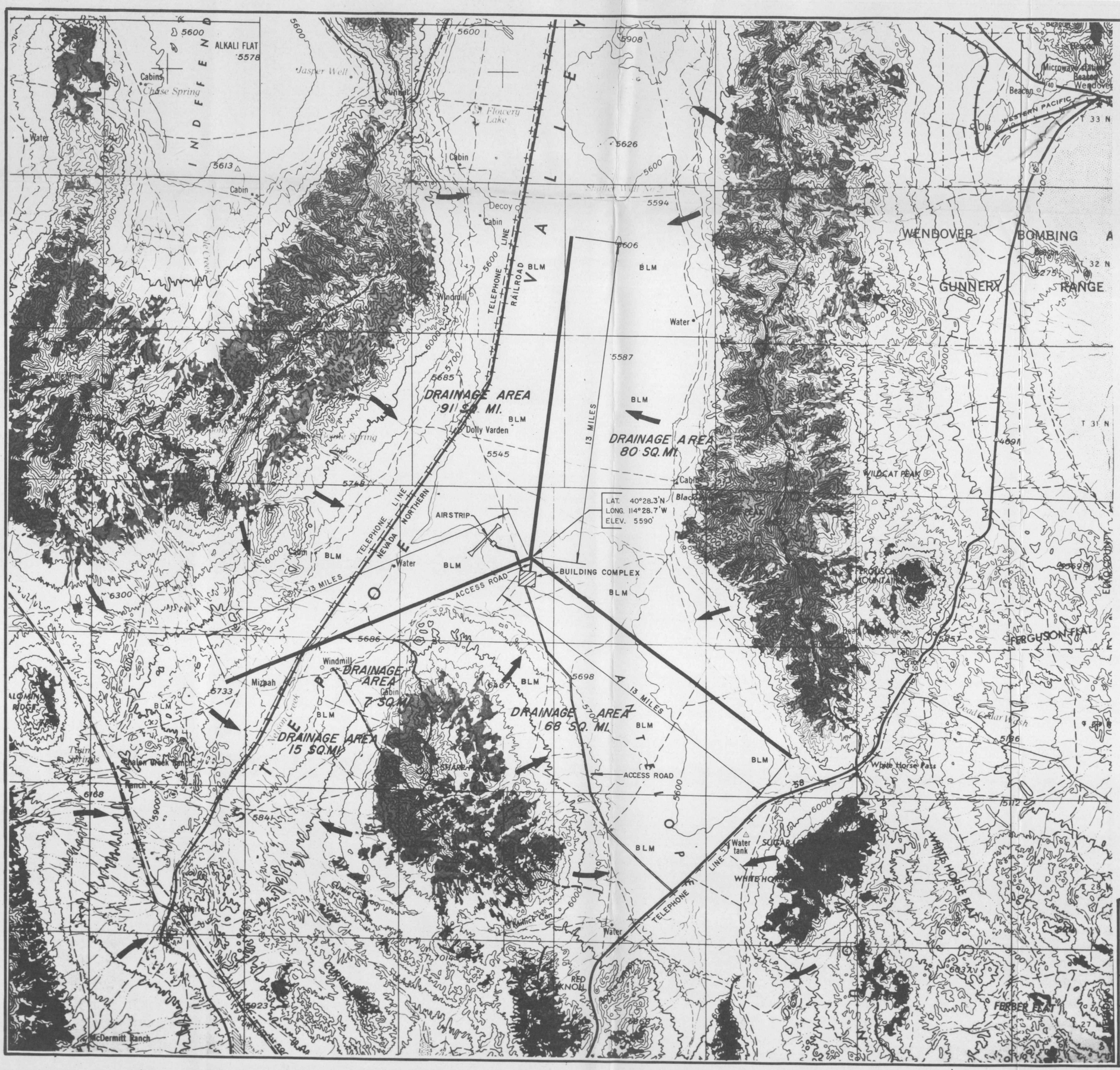
1-5'x 60' Box Culvert
℄ Dirt Road
1-4'x 20' Box Culvert
+ 2.5%
End Wye Branch Sta. 606+40
+ 2.0%

600+00 610 620 630 640 650 660 670 680

SITE Y-27 (TEXAS)
EXHIBIT NO. 24

PLATE I—PLAN PROFILE & P R STANDARD

LIMBAUGH ENGINEERS INC



VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
SITE Y-33, NEVADA

GENERAL PLAN, OWNERSHIP, HYDROLOGY & DRAINAGE

LIMBAUGH ENGINEERS, INC.
CONSULTING ENGINEERS AND PHOTOGRAMMETRISTS

DRAWN BY M.Y.
CHECKED BY B.H.
FILE NO. 2941
SCALE: 1"=2 MILES
DATE DEC. 1965
SHEET NO. 25 OF 36

EXHIBIT NO. 25

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
B. M.'S NOTED
STRUCTURE ROTATING CHKD.
NOTE BOOK
NO.
BY
DATE

Wye Center
Dirt Road
N 07° 00' E
Match Line
Match Line
N 07° 00' E
Match Line
N 07° 00' E
Dirt Road
Match Line

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

Wye Center
EXIST. GROUND
℄ Dirt Road
FINISHED GRADE
℄ Dirt Road
End Wye Branch Sta. 8869+40

5600
5550
5600
5550
5600
5550

1-15"Ø 1-15"Ø 1-15"Ø

PLAN
NOTE BOOK NO
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
BY
DATE

Wye Center
Dirt Road
S 53°00'E
Match Line

PROFILE
NOTE BOOK NO.
SURVEYED
PLOTTED
GRADES CHECKED
R.S. CHECKED
STRUCTURE NO(S) AS CHKD
BY
DATE

1-2'x14' Box Culvert
2-18"Ø
1-18"Ø
1-2'x3' Box Culvert
1-2'x3' Box Culvert
1-2'x9' Box Culvert
1-2'x14' Box Culvert
1-2'x3' Box Culvert
℄ Dirt Road
FINISHED GRADE
EXIST. GROUND
End Wye Branch Sta. 6867+40
+ 2.3%
+ 2.0%
5700
5650
5600

SITE Y-33 (NEVADA) EXHIBIT NO. 27

PLATE I - PLAN PROFILE B P R STANDARD

LIMBAUGH ENGINEERS INC.

SHEET 27 OF 36

PLAN
NOTE BOOK NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
BY
DATE

Wye Center
Dirt Road
S 67°00'W
Match Line
Match Line
Dirt Road
S 67°00'W
Dirt Road
Nelson Creek
Nevada Northern Railroad
Telephone Line
Dirt Road
Match Line
Match Line
S 67°00'W
Dirt Road

PROFILE
NOTE BOOK NO.
SURVEYED
PLOTTED
GRADES CHECKED
RT. OF WAY
STRUCTURE NOTATNS CH'KD
BY
DATE

0+00 10 20 30 40 50 60 70 80 90 100+00 110 120 130 140 150 160 170 180 190 200+00 210 220 230 240 250 260 270 280 290 300+00

5700 5650 5600 5700 5650

Wye Center
℄ Dirt Road
FINISHED GRADE
EXIST. GROUND
1-18"Ø
℄ Dirt Road
℄ Nevada Northern Railroad
Telephone Line
Nelson Creek
℄ Dirt Road
1-8'X8' Box Culvert
℄ Dirt Road
End Wye Branch Sta. 6861+40

300+00 310 320 330 340 350 360 370 380 390 400+00 410 420 430 440 450 460 470 480 490 500+00 510 520 530 540 550 560 570 580 590 600+00

5750 5700

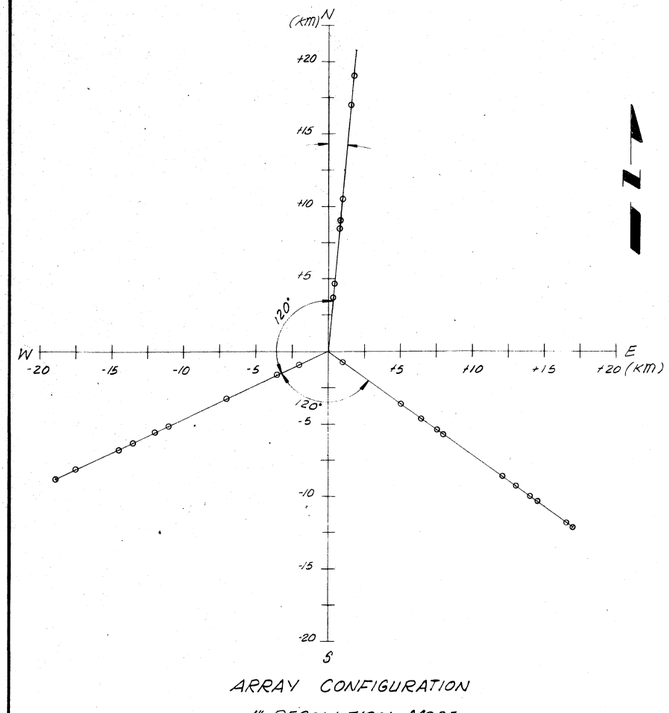
600+00 610 620 630 640 650 660 670 680

SITE Y-33 (NEVADA) EXHIBIT NO. 28

PLATE I — PLAN PROFILE & P R STANDARD

LIMBAUGH ENGINEERS INC

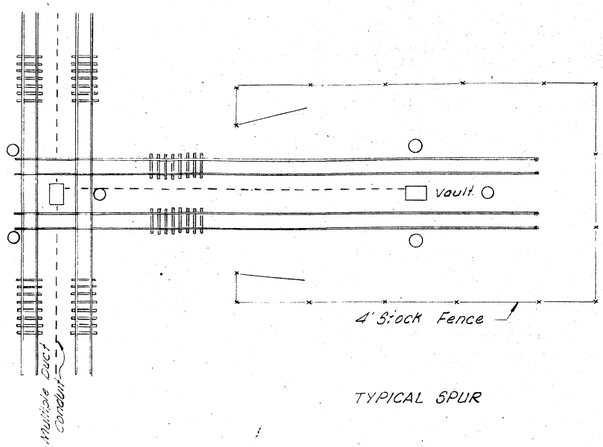
SHEET 28 OF 36



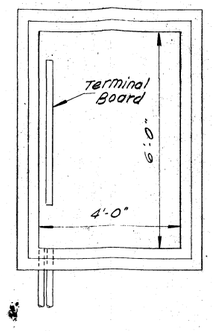
ARRAY CONFIGURATION
1" RESOLUTION MODE



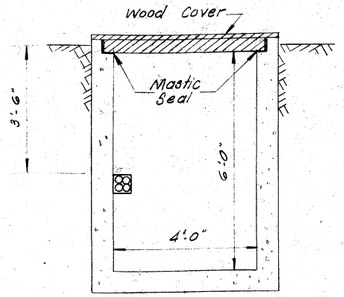
APEX PLAN



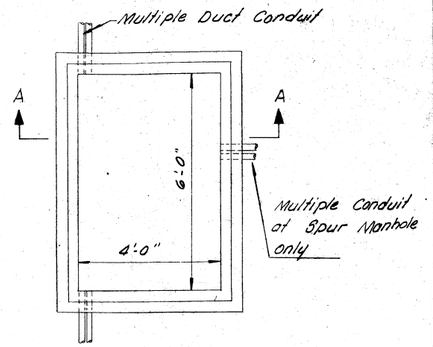
TYPICAL SPUR



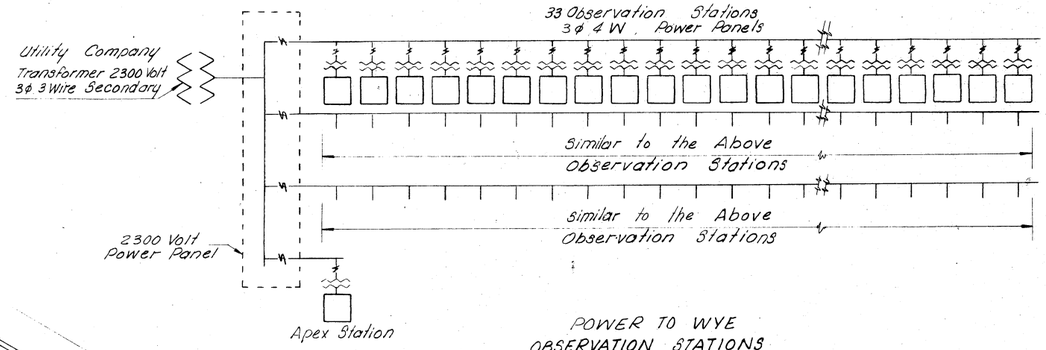
VAULT
PLAN VIEW
SCALE: 1"=2'



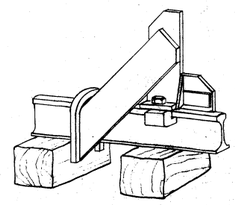
SECTION A-A



MULTIPLE DUCT CONDUIT
MANHOLE
SCALE 1"=2'



POWER TO WYE
OBSERVATION STATIONS
(SCHEMATIC)



RAILWAY STOP
(Not to Scale)

VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.

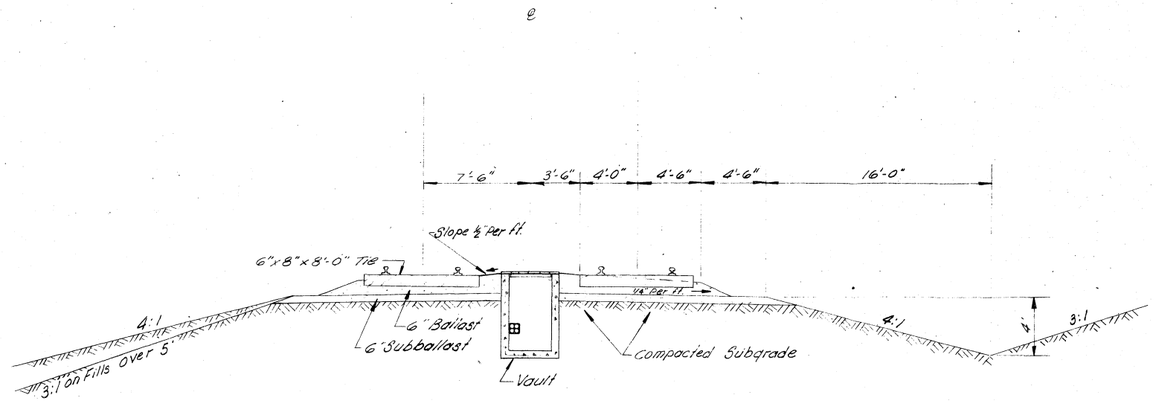
TYPICAL DETAILS

LIMBAUGH ENGINEERS, INC.
CONSULTING ENGINEERS and PHOTOGRAMMETRISTS

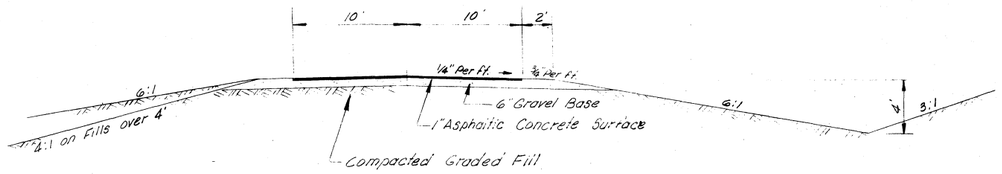
DRAWN BY R.M.
CHECKED BY B.H.
FILE NO. 294
SCALE: AS SHOWN
DATE DEC 1965
SHEET NO. 2 OF 26

NOTE: THIS DRAWING IS NOT TO SCALE, IT HAS BEEN REDUCED FROM THE ORIGINAL

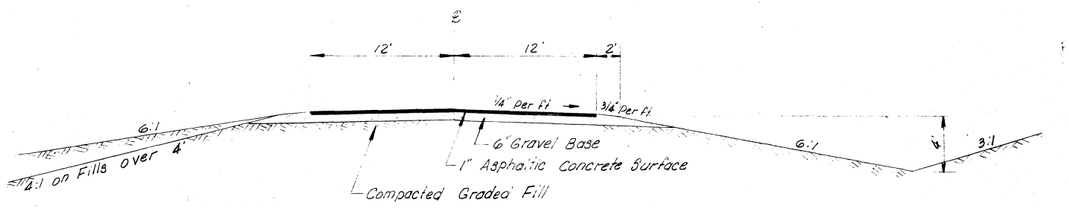
EXHIBIT NO. 29



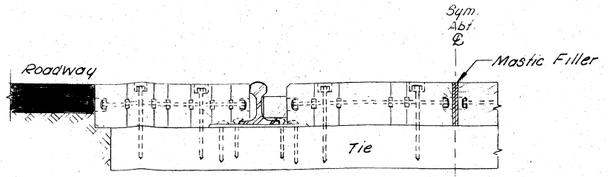
RAILWAY
TYPICAL SECTION
SCALE: 1" = 5'



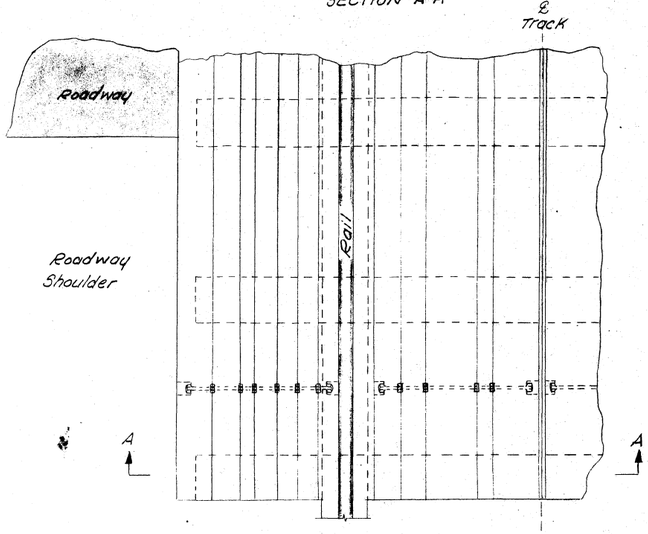
ACCESS ROAD
TYPICAL SECTION
(Not to Scale)



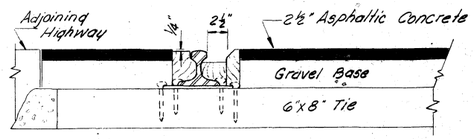
ENTRANCE ROAD
TYPICAL SECTION
(Not to Scale)



RAILWAY CROSSING
SECTION A-A



PREFABRICATED SECTIONAL TREATED
TIMBER RAILWAY CROSSING
(Not to Scale)



BITUMINOUS RAILWAY CROSSING
TYPICAL
(Not to Scale)

VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.

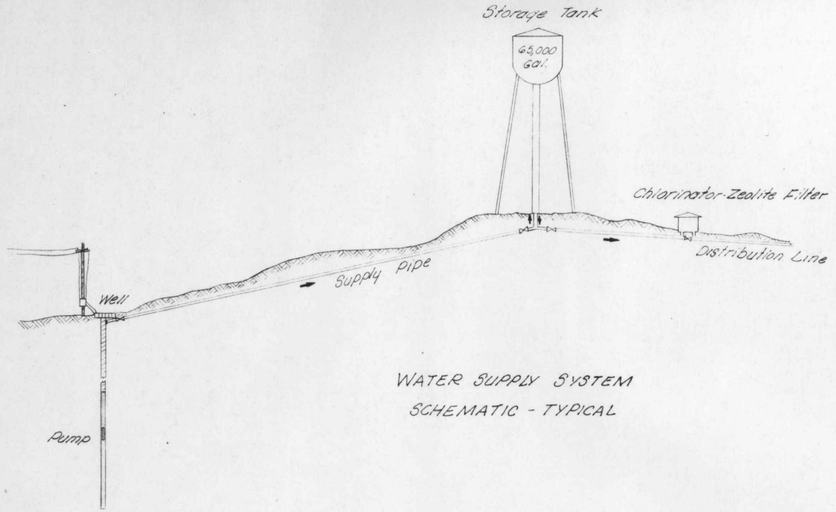
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CONSULTING ENGINEERS and PHOTOGRAMMETRISTS

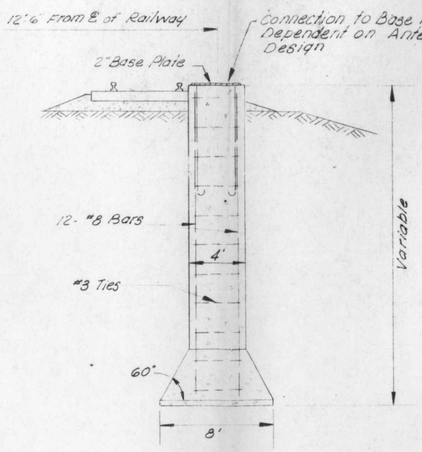
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CHECKED BY B.H.
FILE NO. 2941
SCALE AS SHOWN
DATE DEC. 1969
SHEET NO. 5 OF 26

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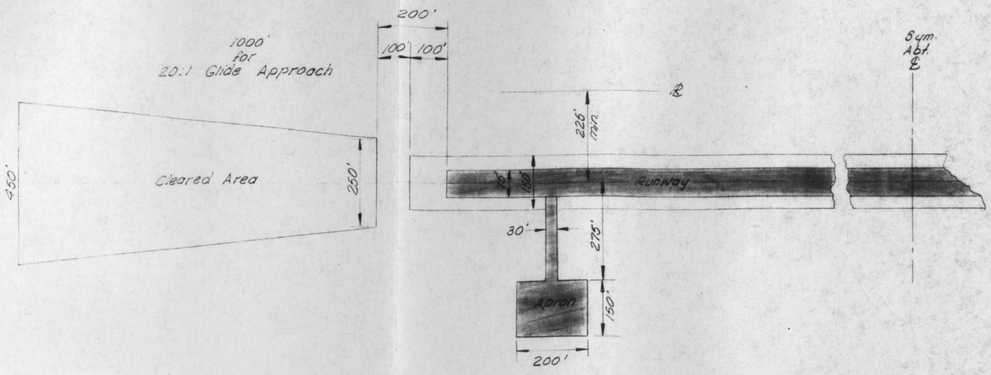
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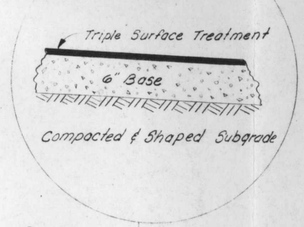
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SCHEMATIC - TYPICAL

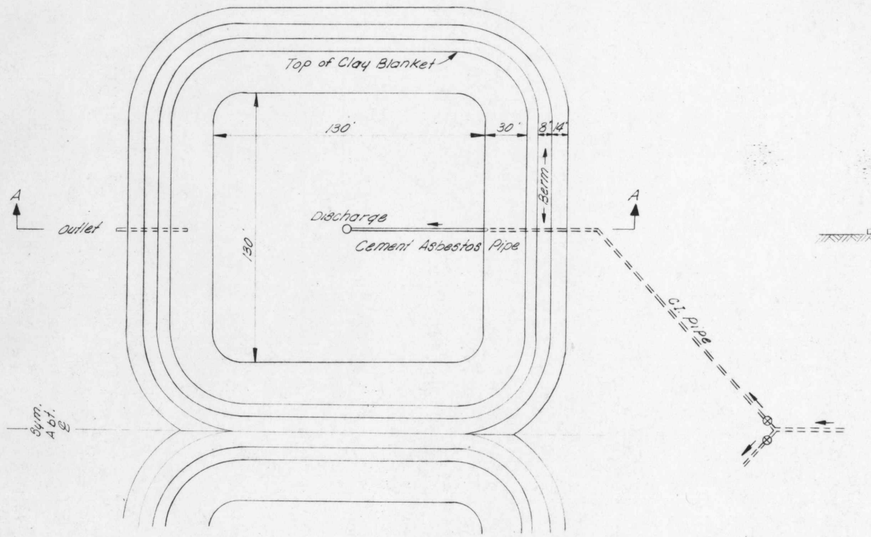


OBSERVATION STATION FOUNDATION
TYPICAL SECTION
(Not to Scale)

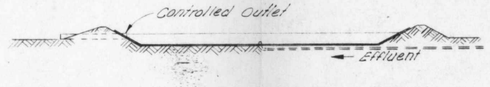


AIRSTRIP
PLAN TYPICAL
SCALE 1"=2000'

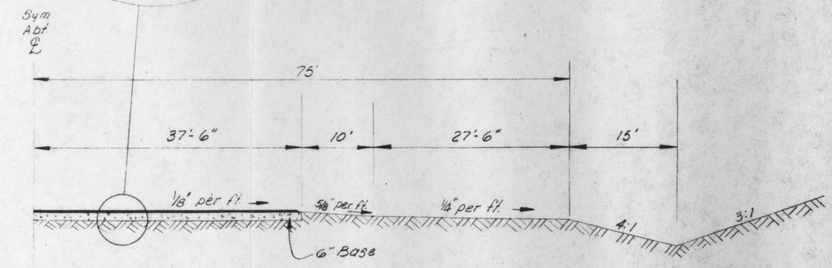




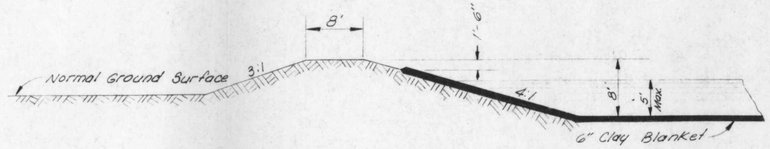
SEWAGE LAGOONS
PLAN
(Not to Scale)



SEWAGE LAGOON
SECTION A-A



AIRSTRIP
TYPICAL SECTION
SCALE 1"=10'



LAGOON BERM
TYPICAL SECTION
(Not to Scale)

VLA SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.

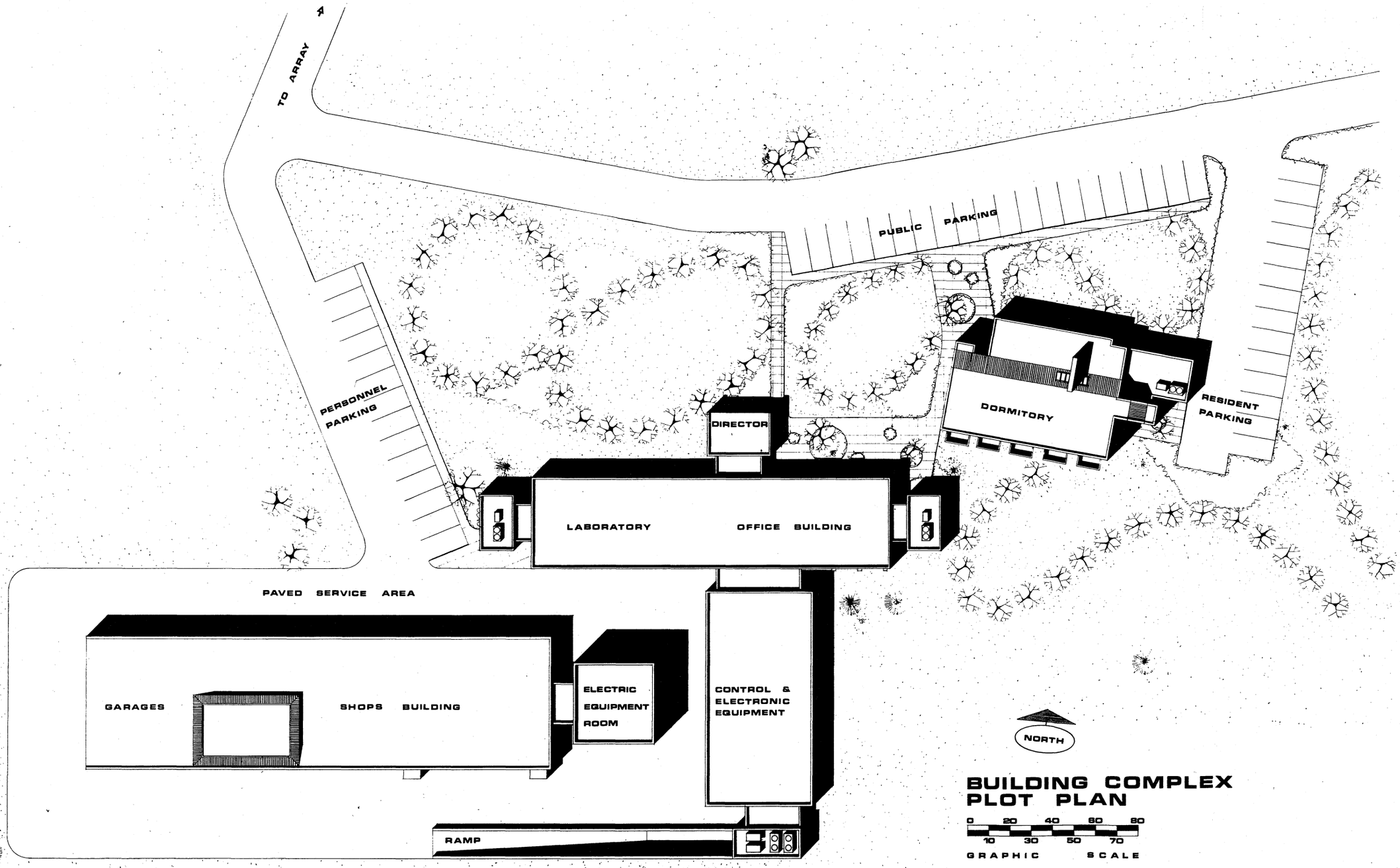
TYPICAL DETAILS

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SHEET NO. 1 OF 36

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EXHIBIT NO. 31



BUILDING COMPLEX PLOT PLAN

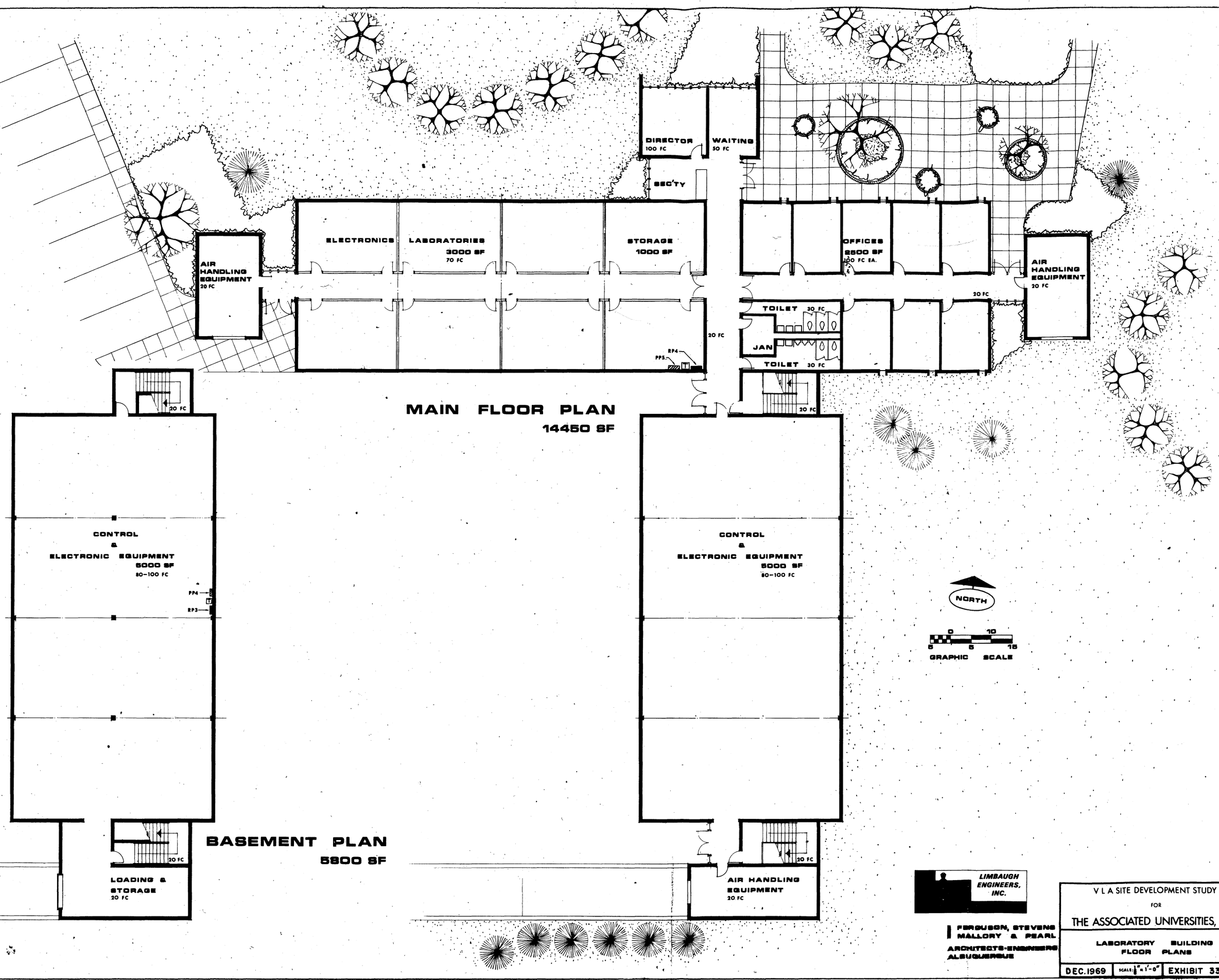
0 20 40 60 80
10 30 50 70
GRAPHIC SCALE

LIMBAUGH ENGINEERS, INC.

FERGUSON, STEVENS MALLORY & PEARL
ARCHITECTS-ENGINEERS
ALBUQUERQUE

V L A SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
BUILDING COMPLEX PLOT PLAN
DEC. 1969 | SCALE: 1" = 20'-0" | EXHIBIT 32

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MAIN FLOOR PLAN
14450 SF

BASEMENT PLAN
5800 SF

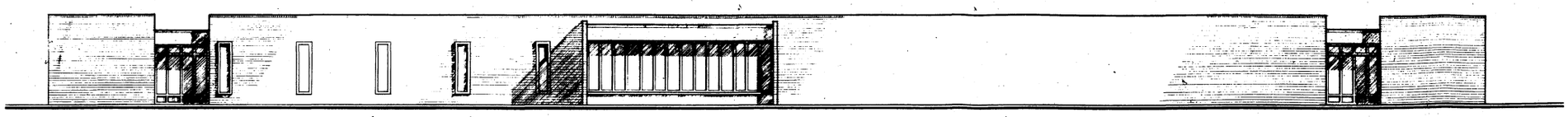
LIMBAUGH ENGINEERS, INC.

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ARCHITECTS-ENGINEERS
ALBUQUERQUE

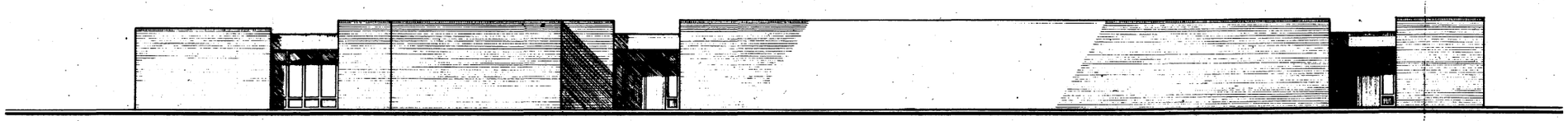
V L A SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
LABORATORY BUILDING
FLOOR PLANS

DEC. 1969 | SCALE: 1/8" = 1'-0" | EXHIBIT 33

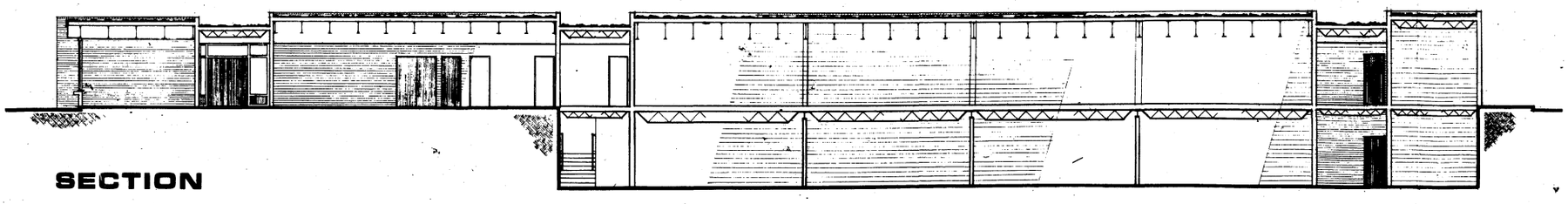
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NORTH ELEVATION



WEST ELEVATION



SECTION

NORTH

0 5 10 15

GRAPHIC SCALE

LIMBAUGH ENGINEERS, INC.

FERGUSON, STEVENS MALLORY & PEARL
ARCHITECTS-ENGINEERS
ALBUQUERQUE

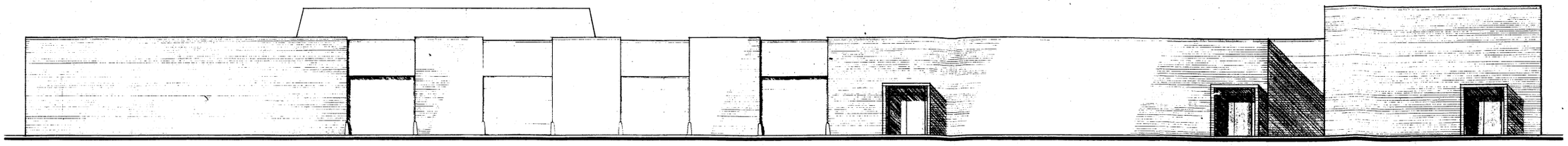
V L A SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.

LABORATORY BUILDING
ELEVATIONS & SECTION

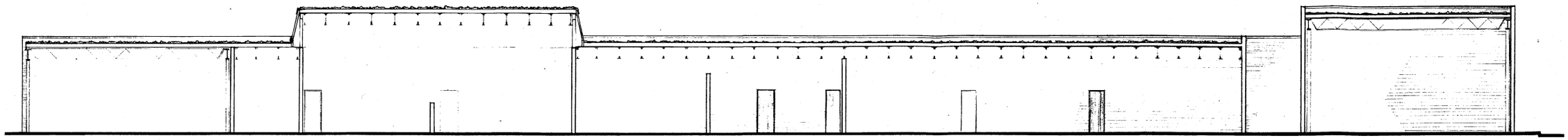
DEC. 1969 | SCALE: 1/8" = 1'-0" | EXHIBIT 34

SHEET 34 OF 36

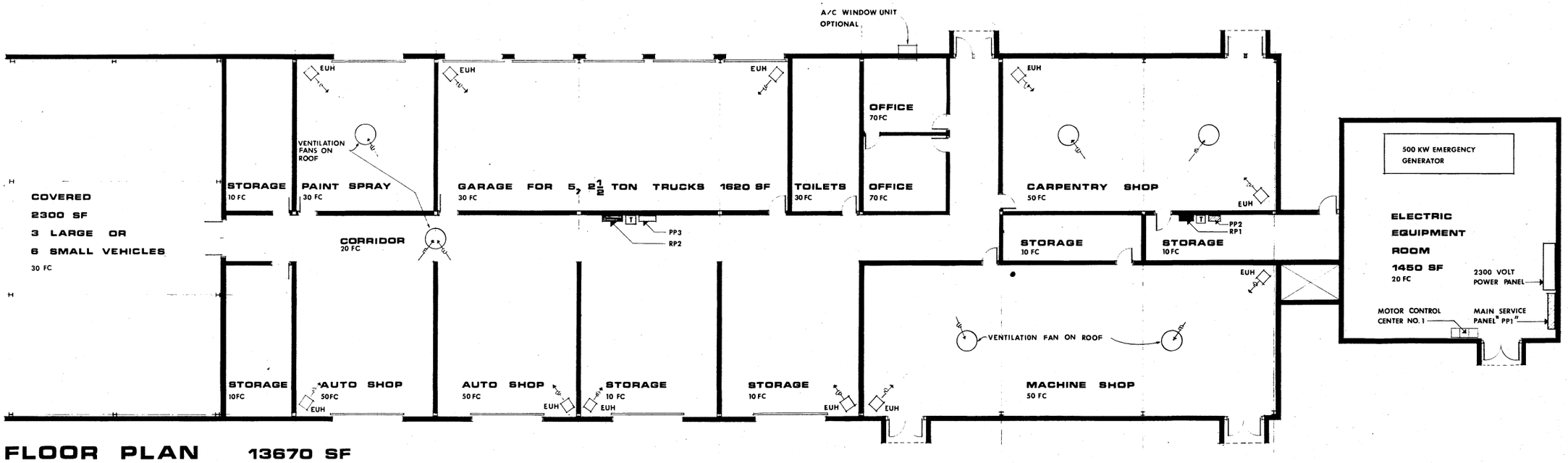
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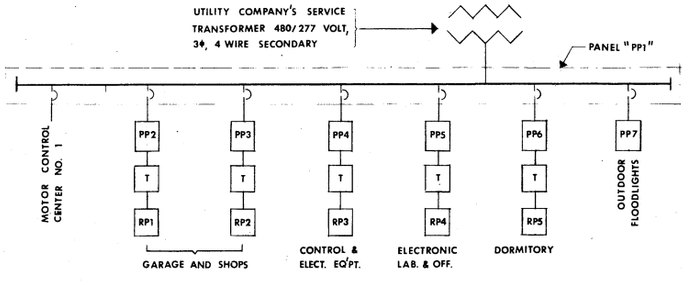
SOUTH ELEVATION



LONGITUDINAL SECTION



FLOOR PLAN 13670 SF



ELECTRIC DIAGRAM

480/277 V, 3φ, 4W PANELBOARD
480/120/208 V, 3φ, 4W TRANSFORMER
120/208 V, 3φ, 4W PANELBOARD

NORTH

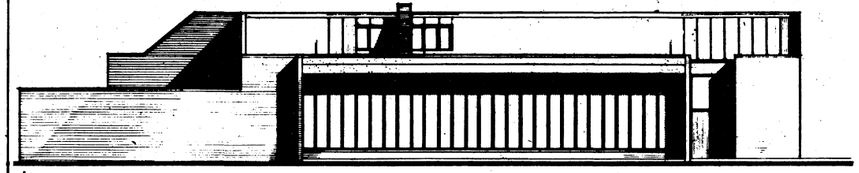
0 10
5 5 15
GRAPHIC SCALE

LIMBAUGH ENGINEERS, INC.

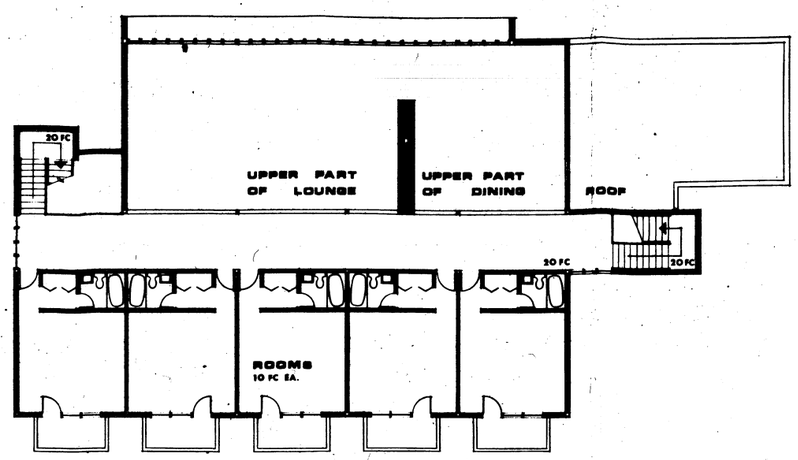
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ARCHITECTS-ENGINEERS
ALBUQUERQUE

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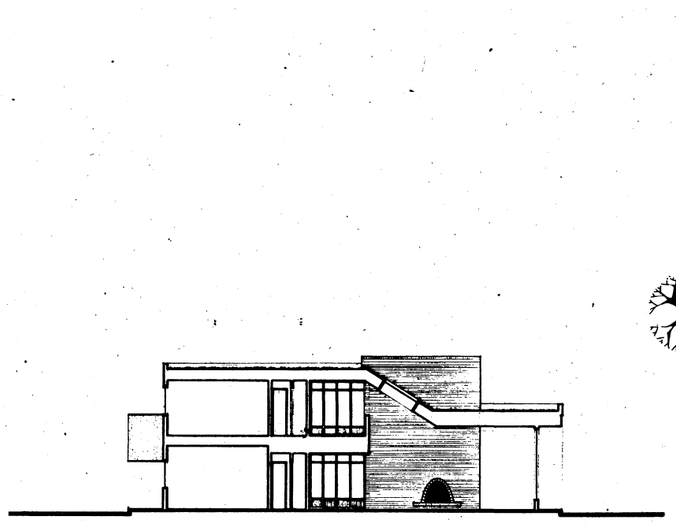
V L A SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
SHOPS BUILDING, GARAGES, & CENTRAL POWER PLANT
PLAN, ELEVATION & SECTION
DEC. 1969 | SCALE: 1/8" = 1'-0" | EXHIBIT 35



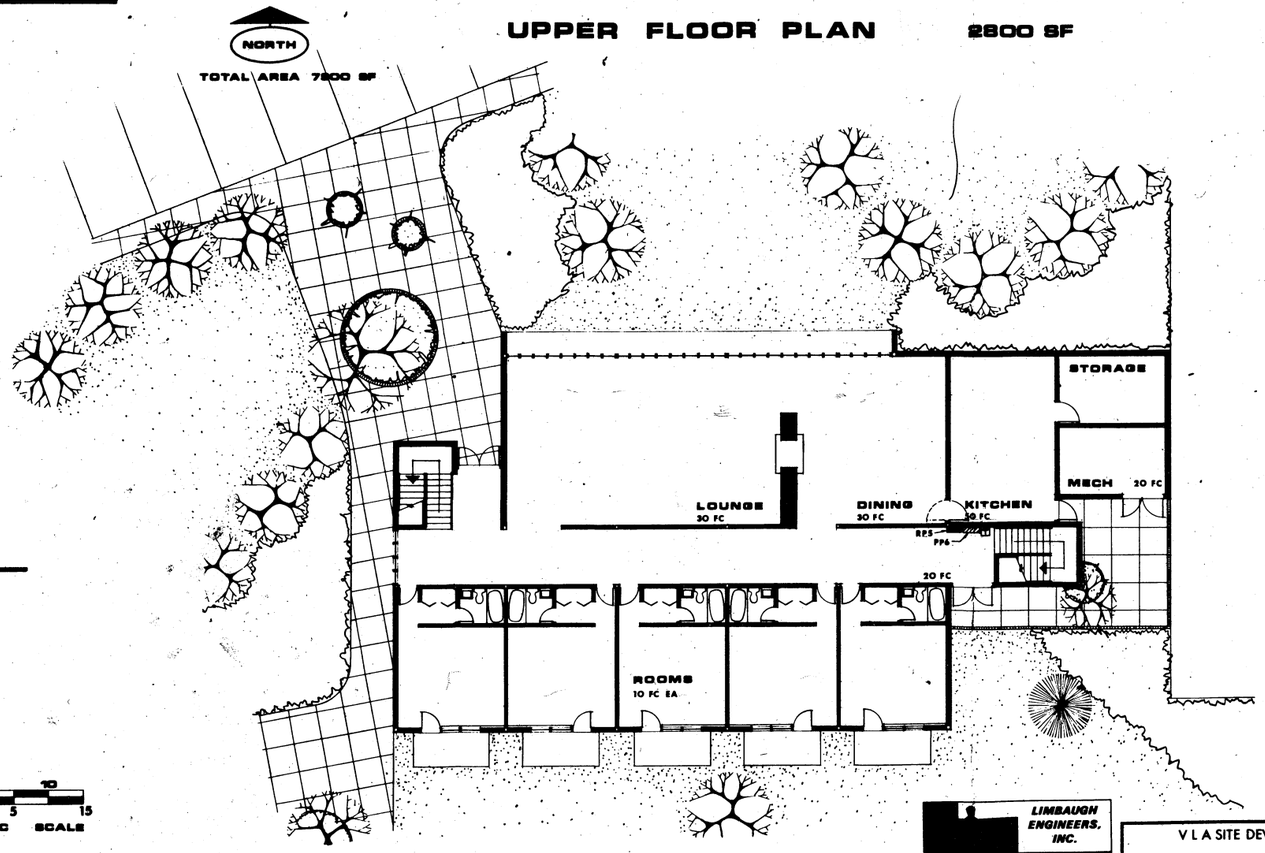
NORTH ELEVATION



UPPER FLOOR PLAN 2800 SF



CROSS SECTION



GROUND FLOOR PLAN 5100 SF

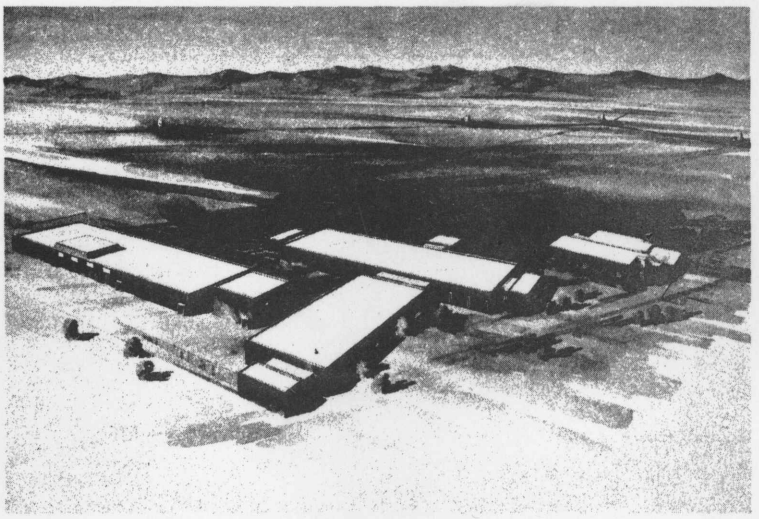
0 10
5 5 15
GRAPHIC SCALE

LIMBAUGH ENGINEERS, INC.

FERGUSON, STEVENS MALLORY & PEARL
ARCHITECTS-ENGINEERS
ALBUQUERQUE

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V L A SITE DEVELOPMENT STUDY
FOR
THE ASSOCIATED UNIVERSITIES, INC.
DORMITORY BUILDING
PLAN ELEVATION & SECTION
DEC. 1969 | SCALE: 1" = 1'-0" | EXHIBIT 36



ENGINEERING STUDY

SITE DEVELOPMENT

AND

FACILITIES REQUIREMENTS

FOR THE

VERY LARGE ARRAY

NATIONAL RADIO ASTRONOMY OBSERVATORY

OPERATED BY

ASSOCIATED UNIVERSITIES, INC.

UNDER CONTRACT WITH

THE NATIONAL SCIENCE FOUNDATION

DECEMBER 1969

LIMBAUGH ENGINEERS, INC.
ALBUQUERQUE, NEW MEXICO

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A. INTRODUCTION

The National Radio Astronomy Observatory is planning the design and construction of a large radio telescope complex to be known as the VLA ("Very Large Array"). This radio telescope facility will be used to investigate the most distant galaxies in our universe, as well as to contribute new information about known celestial bodies. The VLA, which is to be a part of the National Radio Astronomy Observatory (NRAO), will be operated by the Associated Universities, Inc., (AUI), under contract with the National Science Foundation.

The installation of the facility, as presently envisioned, will be made up of a centrally located headquarters, laboratory facilities, maintenance and shop complex; an airstrip; a staging and assembly area; and three branches radiating from a common apex with each being 13 miles in length. The branches will consist of a prepared roadbed with a pair of parallel standard gauge railroad tracks spaced 15 feet apart center to center.

There will be 100 observation stations positioned along the three branches, thus permitting various configurations of the movable antennae designed to be used with the facility. The observation stations will be located 100 feet to the right of the main track as viewed from the apex, and will be served by a short spur track laid at right angles to the main line. The antennae can be moved to any of the observation stations by a self-propelled transport vehicle. Transfer of the antennae from the main line to the spur track will be accomplished by the use of jacks and swiveling trucks. Each transport vehicle is a self-contained unit and can also be used for service and maintenance functions.

The operating criteria for the VLA makes necessary the selection of a site in which the following specifications have been considered and weighed in importance.

1. Located within the continental United States west of the Mississippi and south of latitude 41° (the dampness of the atmosphere, the population

density, and the available viewing area of the sky makes necessary these restrictions).

2. Located on reasonably level, solid ground that would permit the extension of three Wye branches at approximately 120° spacing for a distance of 13 miles from a common apex.
3. Located in an area not extensively populated, cultivated, or used for any other purposes that might make land acquisition difficult and expensive.
4. Located at an altitude and place such that the atmospheric conditions are satisfactory for radio telescope observations.
5. Located in reasonable proximity to a community where members of the operating staff could live, where adequate nationwide transportation facilities are available, and where supporting research and scientific agencies might also be located, but which location isadequately shielded by mountains from interference that might arise from such a large community.

The National Radio Astronomy Observatory (NRAO) staff initially selected 29 possible site locations in the Southwestern United States based on their evaluations of small scale topographic maps. Further studies, both in the office and in the field, narrowed the number of satisfactory sites to seven, three of which appeared especially suitable.

Limbaugh Engineers, Inc. of Albuquerque, New Mexico, received the assignment from AUI to study these three sites in detail and then submit their findings in an interim report. The interim report wassubmitted on August 1, 1966, and from this information the NRAO staff selected two sites for further study. The Site Development Report was submitted in November 1966. In October, 1969, Limbaugh Engineers, Inc. received a further assignment to update thestudy of the three original sites and to study four additional sites. The purpose of these studies is to provide sufficient preliminary engineering, design, cost analysis and other pertinent data

to enable the NRAO staff to assess the sites and establish a firm order of suitability.

The factors considered in this report for the evaluation of each site were as follows:

1. General Site Features
2. Climatology
3. Geology and Foundation Investigation
4. Topography and Drainage
5. Railway Design
6. Access Roads
7. Aircraft Landing Field Design
8. Water Supply
9. Utilities
10. Real Estate Ownership and Acquisition
11. Preliminary Building Designs
12. Sewage Treatment and Disposal
13. Cost Analysis

Information contained in this report is a composite of published and unpublished information gleaned from various government and private sources as well as from educational institutions in the area. Original design work was performed in conformance with accepted engineering and architectural standards. Field investigation was performed to obtain geologic information, drainage data, physical aspects, developable natural resources, conflicting activities and support data.

B. GENERAL DISCUSSION

1. General Site Features

The general site features consist of such items as exact location and access to the site, general description of the land and vegetation and availability of commercial transportation. Information concerning the surrounding towns and cities is presented to give a brief indication of their suitability to the needs of scientists and technicians who would be working at the site.

On two of the sites, Y-16 and Y-33, the only maps available were USGS quadrangle sheets at the scale of 1:250,000 and a contour interval of 200 feet. In order to obtain more accurate terrain data, profiles of critical areas of the sites were developed using a Wild B-8 plotter with positive prints of aerial photography obtained from the U. S. Geological Survey office in Washington, D.C.

Comparison charts listing each of the seven VLA site locations were developed for: 1 - Climatology; 2 - Physical Characteristics; 3 - Developable Natural Resources; 4 - Conflicting Activities; 5 - Accessibility; 6 - Industrial Support; and 7 - Site Preparation Costs.

2. Climatology

Climatic data for the various siteswere obtained by field visitations to the State Climatologists, Atmospheric Physic Laboratories, Local Weather Bureaus, Soil Conservation Service, Bureau of Land Management, Federal Aviation Agency, airports and local private weather stations. Additional information was obtained from the Environmental Science Services Administration, The American Society of Civil Engineers, the Federal Aviation Administration, the New York Academy of Sciences and the Crop Hail Insurance Actuarial Association. In obtaining climatological data for each site, six major categories were considered. These were temperature, precipitation, winds, air pollution, relative humidity, and sky cover.

The United States Department of Commerce, Environmental Science Services Administration, publishes a comprehensive climatological coverage for the principal cities of the country; however, in the lesser populated cities and towns of the country this coverage is proportionately limited. This lack of data is particularly apparent in the more remote areas of the West, especially in the areas of Nevada where two of the sites are located. Temperature and precipitation data are generally available for most areas, but information on such items as thunderstorms, fog, wind and sky cover are usually unavailable. Data on the frequency and predominant types of cloud cover were not found for any of the site areas. Some interpretation was developed from the thunderstorm activity, precipitation and other data, but it was felt that the results were too uncertain for inclusion in this report.

It was necessary to develop the rainfall intensity data for any one period of time because precipitation records that have been kept were on the basis of total rainfall in 24 hour periods only. (See Figures 1 thru 7). The U.S. Weather Bureau has developed isopluvials of two-year, six-hour precipitation in some of the areas. All data collected and/or interpreted were on the basis of a 50-year storm. Design criteria formulations, charts, drafts and technical data available in Design of Small Dams, Bureau of Reclamation; Rainfall Intensity, Duration, Frequency, U.S. Weather Bureau; Transactions, American Society of Civil Engineers; Civil Engineers Handbook, Urquhart and others (see Bibliography) were studied and analyzed for application to the various sites.

3. Geology and Foundation Investigation

Surface geological field investigations were made at each of the sites. The purpose of these studies was to evaluate each area as to the stability of the soil types, the magnitude and effect of surface drainage, and the availability of sand, clay, gravel and aggregate to be used in concrete and for construction purposes. Subsurface soil investigations were carried out at three of the sites, Y-15, Y-23

and Y-27, during the summer of 1966. At the remaining site areas only surface soil investigations were performed.

Information concerning the developable natural resources was obtained from published information, from state and federal agencies, and from field investigation.

4. Topography and Drainage

The suitability of the terrain for construction of the Wye varies from satisfactory to good. Grades in excess of 2 percent occur for short intervals on four of the sites. In general, the sites are open and flat to gently rolling with gradients of less than 1.5 percent. The drainage design as noted on the profile exhibits is planned to accommodate this runoff in its existing channels. The Wye branches are not intended to act as dikes to retard, divert or hold runoff water, although in some sections this will occur during peak runoff from heavy precipitation.

In developing the drainage demands for the VLA sites many factors were considered which contribute to the determining of runoff volume and flooding in these areas, namely; topography; geology; climate; watershed size and shape; percolation and infiltration of the soil; altitude; vegetation; anticedent storms; base flow and precipitation. The maps utilized in the drainage studies were U. S. Geological Survey quadrangle sheets, aerial photographs and the state geologic maps covering site areas. Precipitation and flood records were obtained from the U. S. Weather Bureau. Consultations were held with the U. S. Geological Survey Surface Water Division and Water Resources Division, Department of Commerce, Weather Bureau climatologists, State Highway drainage engineers and with hydrologists from various Universities. Site visitations were made to observe existing surface conditions and record the effects of recent floods, if any.

Many formulas have been evolved to develop runoff volumes. Some of these considered were by McMath, Jarvis-Myers, Talbot, Fanning, Bremmer, Dun, Pettis, and Potter. Some are utilized for only small areas; some for large watersheds; some

for particular conditions; some for only certain parts of the country. The "C" coefficient in the various formulas is extremely important since it is dependent on the type of country in the drainage area and is an interpretive value generally made by observation, but is deceptive in that proper evaluation requires a very extensive detailed hydrological study for each application. Values of "C" for earth surface are varied by degree of saturation, compaction, surface irregularity, slope, character of subsoil and by presence of frost, snow or ice. (Supplemental runoff data may be found in Appendix C).

5. Railway

The railway section was developed to enable the mobile radio telescope units to be transported to different locations on the Wye. The tracks will also serve to carry personnel and maintenance equipment to the units. There will be no access road serving the Wye observation stations. (Exhibits No. 29 and 30).

The Wye configuration utilizes the observation positions for the radio telescopes on spurs with the center of these observation stations 100 feet from the center line of the Wye tracks. All spurs are at right angles from the Wye tracks. With the radio telescope stations being located on the spurs, the main tracks are clear for other vehicular movement. Transfer from one branch to another branch for the units is accomplished at the Wye apex where the tracks meet to form a railway junction.

The major railway-highway crossings will be accomplished with bituminous base course over railway ballast and covered with 2-1/2 inches of asphaltic concrete surface. Minor railway-road crossings will be accomplished by normal timber crossing methods. Railway crossings will follow AREA practice and methods.

Railroad type cattle guards are used where existing fences will cross the Wye branches.

The design of the railway was based on the following criteria:

a. Use standard gauge railroad track.

b. Distance between center lines of double tracks to be 15'-0".

c. Observation stations to be established at ends of spur tracks.

d. Trackage to support 225 ton radio telescopes in transit with minimum deflection.

e. Radio telescopes to be supported in transit by four, four wheel bogies.

f. Each bogie wheel to have 25,000 lb. maximum load.

g. Maximum allowable track grade is 2 percent.

h. Railway intersection to provide for movement of radio telescopes to each of the three branches.

i. Spur track to be at right angles to main track.

j. Mobility wind is 35 mph maximum.

The observation stations on each of the spurs have three foundations--one for each leg of the radio telescope. These foundations are located with one centered between the tracks and the other two outside of the tracks and straddling them. The foundations are to prevent overturning of the units as well as to support them in a fixed position.

Each observation station will be enclosed with a 4 foot high open mesh stock fence. Two 15 foot long gates across the railway tracks will lock together at the center line when in a closed position. Design criteria include the following:

a. Radio telescope weight is 314,000 lbs.

b. Foundations to support 135,000 lbs. each.

c. Foundations to resist 100,000 lbs. overturning.

d. One foundation to be located centered between tracks and the other two to be outside of tracks.

e. Area to be enclosed with fence and gates.

The staging area is developed to provide a location for field erection of the radio telescopes. The units will be erected on rails which are an extension of a

spur track near the apex, thus permitting access to the Wye. After the array becomes operational this staging area will be utilized for maintenance. The design criteria include trackage, hard stand for crane operation, assembly and storage areas.

6. Access Roads

The roads which serve the VLA sites are the entrance road, the access road to airstrip and the access road to the Wye apex. (Exhibit No. 30). The design of these roads is based on the following:

a. All weather surface

b. 45 mph speed

c. Adequate drainage

d. 300 foot sight distance

e. Seven percent maximum grade

7. Airstrip

The airstrip for each of the siteswill be classified as a Basic Utility Airport and follows the FAA design criteria, Stage 11B. (Exhibit No. 31). This type of Basic Utility Airport accommodates about 95 percent of the general aviation fleet and meets all general aviation needs except transport types and a few types of critical twin-engine aircraft.

8. Water Supply

The water supply will be a "High Pressure Storage" system composed of a well, elevated storage tank, chlorinator and softener. (Exhibit No. 31). Water supply requirements for the VLA sites are basedon 5,000 gallons per day potable water and 50,000 gallons reserve for fire. Investigation of existing wells on each of the sites indicates that this quantity probably is obtainable in each area. The sites generally are situated in alluvium-filled valleys where the alluvial material serves as the acquifer. The quality of the water at the seven sites varies from satisfactory to marginal. Limits for fluoride, chloride, sulfate and total dissolved solids may

exceed the U.S. Public Health Service standards at two or more of the sites. There is insufficient information to give a firm indication of the water quantity and quality in several of the areas.

9. Utilities

The utility companies that would supply power to the sites were contacted to determine the availability and reliability of electric power.

This study was based on a normal load of 800 KW with a 90% load factor utilization. Demand load is considered as 1600 KW. Based on this demand the buildings will be heated electrically. Thiswill eliminate the need for a natural or bottled gas supply source.

At each site a completely automatic 500 KWdiesel driven emergency generator set is to be installed for stand-by equipment. This unit will be complete with the necessary cleaners, filters, indicators, instrument panel, fuel tanks, lines and pumps, coolant system, shut-off safety devices, governor, 32-volt automatic starting system and batteries, control panel for the generator and 800 amp automatic transfer switch.

Electrical service to the observing stations will be supplied by overhead lines from an outdoor transformer supplied bythe utility company. (Exhibit No. 29). The outdoor transformer shall have the following secondary characteristics: 2300 volts, three-phase, three wire, 60 cps. This secondary side of the transformer shall serve 2300 volt switch gear which in turn will distribute power to the three overhead lines which parallel the three Wye branches. At each observing station, there will be a three-phase primary fused switch, transformer and panel board which will drop the voltage to 277/480 volts.

10. Real Estate

A number of basic assumptions are made concerning the land acquisition necessary for the VLA.

The embankment or excavation for the roadways between the observing stations will probably be less than 100 feet in total width. However, as there is some disturbance of adjacent land during construction and as the observing stations are on spur tracks that require approximately 150 feet additional width and as there is a power pole line along the spur side of the railway, it is anticipated that a strip 200 yards wide, the full length of the roadway should be acquired.

This strip 200 yards wide averages 72.7 acres per mile or a total of 2,835 acres required for the Wye branches. The building complex area, access road to the site, staging area, sewage treatment areas and landing strip will require an additional 55 to 225 acres, depending on the length of the access roads and the airstrip. Consideration of the total area required is included in the land acquisition costs.

Land acquisition for such a facility is normally accomplished by one or more of the following methods:

a. Perpetual easement - This is a lump sum, one time payment. It gives the right to use but not to title. Usually 75 percent to 90 percent of the purchase price. Amount is based on the worth of land taken plus damages to the surrounding land.

b. Term year leases - These are from 5 to 50 years with annual payments renewable at the AUI option.

c. Open end lease normally costs more than the term lease.

d. Purchase outright - This is thefee approach whereby the land is valued, as well as damages to surrounding land, and then purchased.

e. Co-use agreement - This type of acquisition has been used when the surface of the land is not permanently changed, such as for missile ranges, drop areas, bombing ranges, etc. when the government only needs to use the land on specific days. It would not apply in this case.

It is assumed that the land acquired will not be fenced with the exception of small

areas at the observing stations, and perhaps the building complex. It is also assumed that where fences are crossed by the facility, adequate gates or livestock guards will be installed to provide protection for the rancher's operations.

The current land utilization in the area is predominantly livestock grazing. Sales of grazing land are usually in large sized blocks of land at a price per acre which includes all improvements, all leased lands or grazing rights within the unit, and are usually between a willing seller and a willing buyer with no severance or other damages being involved in the transaction. The nature of taking small parcels from a larger tract for a special use such as the VLA will require, generally disrupts the normal operation of the parent tract, interrupts and complicates the continuity of its title, usually creates a nuisance, and in some cases causes a severance damage. In some instances a change in operation of the parent unit is made necessary as a result of the acquisition of the smaller parcel. As a consequence the acquisition of these types of small or irregular shaped and erratically located parcels generally are higher in price per acre than the market price of regular size, larger plots of land. As a general rule, it has been noted that acquisition of right-of-way for highway, utility lines, and railways usually costs from two to four times the per acre price found in normal ranch sales or leases.

There are numerous advantages to purchasing the land outright rather than leasing. When purchasing, all recurring costs associated with leasing are deleted. Assuming there will be an unwilling seller, it is much easier to exercise the right of eminent domain and put a sale price on the land in order to determine a fair lease price. However, the Papago Indian Reservation lands of Site Y-23 will need to be leased as that appears to be the only method of obtaining use of Indian lands. The lands on Site Y-27 apparently will also have to be leased.

It is understood that the National Science Foundation has the right of eminent domain. However, it is believed that possibly the required land can be

obtained without litigation with the exception of Site Y-27. It is recommended that consideration be given to utilizing the services of the Corps of Engineers, U.S. Army, in the acquisition of the selected site. This agency has staff personnel who are experienced in negotiating with ranchers in the Southwest and are familiar with this type of acquisition.

11. Building Complex

The building complex is composed of a Laboratory Building, Shops, Garage, and Dormitory. These four units will house all the on-site support functions for the VLA. While the technical requirements, and therefore the physical configurations, will possibly change during the design stages, it is felt that the total square footage is adequate as originally envisioned. (Exhibits 32, 33, 34, 35 and 36).

The Laboratory Building serves not only asthe headquarters of the facility, but also as the Control Building, Office area. This building also contains the Experimental Laboratory and Storage Areas.

The Shops and Garage functions are combined into a common unit for equipment maintenance.

The Dormitory is for transient scientists involved with current observations and is not intended to house permanent personnel. However, the kitchen and dining hall facilities are to provide hot food to all, including permanent personnel, who might be on the site at meal times.

12. Sewage Treatment

Sewage treatment by use of oxidation "lagoons" is a satisfactory method used in the areas where sites are located. Design criteria, which are in conformance with the Ten State Standards, are based on effluent originating from the domestic use of 50 people. This type of sewage treatment requires a minimum of maintenance which generally consists of keeping the area clean from external debris, keeping plant growth controlled, particularly along the berms, and maintaining correct pond depth. (Exhibit 31).

C. Y-15, NEW MEXICO SITE

1. General Site Features

The VLA site Y-15 (Exhibit 1) is located approximately 22 miles west of Magdalena, New Mexico, in the plains of San Augustin. The apex of the array is slightly more than a mile south of relocated U. S. Highway 60, and is at latitude 34°04.7'N, longitude 107°37.1'W, elevation 6,960 feet above mean sea level. The branches of the Wye are spaced at 120° angles from a common apex with a true azimuth of 355° for the northern branch. (Exhibits 2, 3 and 4).

The terrain at Y-15 is gently rolling in the center of the broad, southwesterly trending valley, but becomes moderately rolling around the valley perimeter where broad ridges extend into the basin. The elevation of the valley floor averages about 7,000 feet. Many of the mountain peaks surrounding the basin attain elevations of over 9,500 feet.

This site lies within the FAA restricted area designated as R-5112 on the Albuquerque Sectional Aeronautical Chart, third edition, dated June 26, 1969. (Chart A). This area has been used by the U. S. Air Force as the second stage recovery zone for missiles fired from Green River, Utah, to the White Sands Missile Range in New Mexico. This restricted area was returned to the FAA for unlimited civilian use as of October 1, 1969.

The Federal Aviation Administration has reported that approximately 44 miles north-northwest of site Y-15 there is an area at 4,000 feet above the ground elevation in which "substantial magnetic disturbances" have been noted. The area in question is shown in the Albuquerque Sectional Aeronautical Chart dated June 26, 1969.

A low altitude federal airway designated as V264-1905 crosses over the site approximately 2 miles north of the end of the northern branch of the Wye.

There are no railroads in the site area, but the northern branch of the Wye

would cross U. S. Highway 60 approximately 2 miles north of the apex. Abandoned U. S. Highway 60 would be crossed by both the southeastern and southwestern branches of the Wye at distances from the apex of 2 miles and 1 mile respectively.

Radio navigational aids, radar, relay stations and electronic installations are listed on Chart A. There are no known satellite communications facilities that would conflict with the operations at the site.

There are no underground nuclear tests occurring in the region nor are there any military or defense activities in the area closer than White Sands Missile Range, which lies about 60 miles southeast of the site.

Electrical transmission lines cross all 3 branches of the Wye at a total of 6 locations. The line voltages for these transmission lines vary from 14.4 KV to 24.9 KV. These lines are shown on the New Mexico Public Service Commission's Schematic Sectional Drawings.

The old alignment of U. S. Highway 60 is just south of the Wye apex and can be used for an access road as can State Highway 78 which runs generally north-south about 2 miles east of the Wye apex. U. S. Highway 60 is a two-lane highway that runs generally east-west across the plains of San Augustin from Datil, New Mexico, on the western edge of the plains to Magdalena in the mountains east of the plains and thence on to Socorro in the Rio Grande Valley 25 miles east of Magdalena.

Datil, roughly 12 miles from the apex of the Wye, has a population of less than 100 and as might be expected, has minimum facilities.

Magdalena, New Mexico, to the east of the site, has a population of 1,500. There is an Indian School located there as well as a district office of the U. S. Forest Service. There are two reasonably modern motels and restaurants in Magdalena. A public school system serves Magdalena and the surrounding area. There are no resident physicians or medical facilities in the town.

Socorro, the nearest town of any size, is located about 50 miles east of the

site at the junction of U. S. Highway 60 and Interstate Highway 25. It has a population of 6,000 and an economic background of cattle raising and mining. (Chart D).

The Atchison, Topeka and Santa Fe Railway provides freight service to Socorro on the line that connects Albuquerque, and El Paso. Socorro is also the switchpoint for a branch line which runs to Magdalena, thus providing rail service 25 miles from the center of the site.

Socorro is on the Chicago-El Paso route of the Continental Trailways Bus Line. There is a municipal airport with lights for night landing. The nearest commercial airline service is 75 miles to the north at Albuquerque, which is served by TWA, Continental, Frontier and Texas International Airlines. (Chart C).

Socorro is also the home of the New Mexico Institute of Mining and Technology, which offers degrees in all of the basic sciences as well as Masters and PhD programs in several courses. The Institute is basically a research center for metallurgy, geology, atmospheric physics, ground water hydrology, and for many other phases of the braod field of earth sciences.

Socorro has three public grade schools, one parochial grade school, one junior high school and one high school. There are over 2,000 students enrolled in the public school system. The high school isaccredited by the North Central Association.

As this is a junction point of major highways, there is a good selection of motels and restaurants for a town of this size. Socorro has a mayor-council type of government with the mayor elected everytwo years and the councilmen serving staggered four-year terms.

There are 4 medical doctors, 3 osteopaths, 1 dentist and 1 optometrist as well as a modern county hospital with 46 beds. The county office of the State Health Department is located in Socorro. The town has a normal complement of churches,

service clubs, banking facilities, and businesses. Recreation in the area is generally of the outdoor type and includes golfing, hunting for birds, large and small game, and fishing.

A surplus of unskilled labor exists in the Socorro area, but probably a good part of the skilled labor required for construction and operation of the array would be drawn from other communities up and down the Rio Grande Valley. As a wage scale indication, base wage rates for skilled construction workers in the Socorro area are $6.35 per hour. (Chart D).

The contractors in New Mexico have a wage agreement for highway construction which utilizes lower wage scales than for building construction. It is hoped that these labor rates can be negotiated for all VLA construction except the building complex.

2. Climatology

At the Y-15 site the average daily maximum temperature is 72°F and the average daily minimum temperature is 31°F. (Chart E). The highest recorded temperature is 104°F and the lowest recorded is -22°F. Monthly mean temperature is 52.5°. (Chart E).

The average yearly precipitation is 12 inches with a maximum daily and monthly recorded in a four year period of 2.25 inches and 4.66 inches respectively. The relative humidity average is 53 percent for the year. The sun shines approximately 70 percent of the time. One tornado has been recorded since 1860 and this occurred in 1929 at a location somewhat south of the site. Dust storms are infrequent and not severe, and there has been no hail recorded in the last 16 years. Average solar radiation is 490 Langleys. Prevailing wind direction is from the west with an average velocity of 9.6 miles per hour. Maximum 50 year wind expectancy is 77 mph.

There is a fairly high incidence of thunderstorms in the area with an average

of 45 recorded in the summer and 35 in the winter. Because of the high rate of activity, the Langmuir Laboratory for Atmospheric Physics has been located in the mountains east of the Y-15 site for thunderstorm and lightning research.

3. Geology and Foundation Investigation

The Y-15 site is located in an area of low relief and sparse vegetation, at the northeastern end of the San Augustin Plains. Geologically, the region is a southwesterly trending valley that has been formed by erosion cutting deeply into volcanic rocks of the Datil formation. The valley floor in the vicinity of the Y-15 apex lies at an average elevation of 7,000 feet. Bordering the valley on the northwest and northeast are the Datil and Gallinas Mountains, which have peaks reaching elevations of 9,500 feet. To the south and southwest the boundary is formed by peaks of the Luera and San Mateo Mountains that tower to an even loftier 10,000 feet. On the eastern side, the southeastern branch of the Wye extends out of the San Augustin Plains and into an area of moderately dissected terrace deposits within the Mulligan Gulch drainage system.

No significant faulting is known to occur in the San Augustin Plain, but the thick alluvial cover may mask some faulting. Two small intrusive rock units occur about six miles west of Augustine. The scarcity of such intrusive bodies in view of their abundance in other sections of southern and central New Mexico suggests that the area is a reasonably stable one. (Chart B).

Nearly all of the strong earthquakes in New Mexico and a majority of the weaker ones have occurred along the Rio Grande Valley between Albuquerque and Socorro (Northrup, 1961). The most active area lies just west of Socorro where 2 or 3 micro-earthquakes are recorded each day (Sanford, 1963). The Magdalena area is more stable and these small tremors are not recorded there.

Four damaging earthquakes with an intensity of VII or greater (on an increasing scale from 1 to 12) have occurred in Socorro, although the last such tremor was in

1906. Since instrumentation of the central New Mexico area was completed in 1962, the strongest tremor in the area was a 2.9 on the Richter intensity scale recorded in 1963. It is believed by Allen Sanford of the New Mexico Institute of Mining and Technology Geophysics Department that the maximum ground acceleration experienced in the Magdalena area has been only about $3cm/sec^2$ or 0.003g (Sanford, written communication). (Chart B).

Unconsolidated Quaternary terrace and alluvial material underlie the entire Y-15 site. The surrounding mountains are made up of crudely stratified beds of rhyolite and latite tuffs, flows and breccia, which are overlain in scattered localities by Quaternary basalt and basaltic andesite flows. The Tertiary volcanic units appear to have provided the source for most of the Quaternary and Recent sand and gravel deposits.

Because of lack of drainage, a lake developed in Quaternary time filling most of the present plains area. The lower sand and gravel benches probably developed while the lake surface was high and were later partly dissected as the lake level dropped to the stage where it coveredonly the lower portions of the valley. The floor of the lower lake, such as the apex for Y-15, is underlain by high plasticity, impervious clays.

In the last stages of development, the sands on the shorelines around the lake were formed into dunes as theregion became more arid. These sands have been widely distributed and now cover most of the lower elevations of the basin to a depth ranging from a few inches to over 10 feet.

The surface sand deposits at the Y-15 site generally occur in the form of dunes composed of very fine to silty sand that is poorly graded. This type of sand would not be satisfactory for use in concrete mixtures.

A highway borrow pit located about one-half mile north of U.S. Highway 60 and just west of the Catron-Socorro County line contains a large stockpile of well

graded sand of up to medium grain size. This material was screened from the surficial deposits in an old stream channel, suggesting that sand could be obtained also in other areas where the sands have been concentrated and washed by the action of ancient streams.

Fine grained, silty gravel deposits cover most of the San Augustin Plains. This gravel would be satisfactory for embankment material, but ranges from fairly satisfactory to unsatisfactory for use asbase course or aggregate. Generally this material contains up to 15 percent silty fines and a maximum of 20 percent fine gravel. The gravel size usually is less than 1 inch.

Two borrow pits have been developed in the area adjacent to the Catron-Socorro County line and north of U. S. Highway 60. Deposits in these areas contain less than 10 percent fines and up to 50 percent gravel; however, the average gravel size is less than 2 inches and the pebbles are fairly well rounded. As mentioned above, these deposits probably have been more actively washed and sorted by ancient stream action than the average surficial material.

Surface evidence indicates fairly good concentrations of gravel similar to those mentioned above at selected locations in the low hills just west of the midpoint of the southwestern branch of Y-15.

The best gravel sources would be from outcrops of the Gila Conglomerate. These occur along U. S. Highway 60, a short distance east of the site, and also at a shallow depth beneath the surficial deposits near the end of the southeastern branch. In most of the exposures, the gravel fraction is over 60 percent. The gravel is well graded up to about 3 inches and the maximum size is about 14 inches. These pebbles and cobbles are sub-rounded to sub-angular and should be satisfactory to crush for use as aggregate. The matrix is composed of fairly clean, angular sand that is rather tightly cemented with calcium carbonate.

The nearest commercial source of aggregate would be at Socorro, a distance

of approximately 50 miles. Local sources of rock will have to be chosen with care, as flow banded rhyolite or tuff compose a large percentage of the hard rock outcrops in the region. Both of these rock types probably would be unsuitable for crushing in order to obtain aggregate.

Rock that is suitable for crushing isavailable at 3 locations. The best and most centrally located deposit is a dark gray, andesitic volcanic rock that is dense and very hard. It occurs just north of U. S. Highway 60 at the eastern edge of the plains. The rock is rather massively bedded but has been quite well fractured so that material suitable forcrushing should be readily available, even though blasting will be required. The over-burden is negligible, and the surface outcrops suggest that the deposit could be expected to yield more than 200,000 cubic yards of rock.

A source of high plasticity clay was located about 1-1/2 miles southwest of the apex of Y-15. The obvious extent of the deposit is an area of about 150 feet by 400 feet and 2 feet or more in thickness. It is believed that similar deposits probably underlie much of the low elevations in the vicinity of the apex.

In summary, all of the needed mineral construction materials can be obtained within a 15-mile radius of the Y-15 apex. Test drilling and laboratory testing will be necessary in order to ascertain the extent of the usable deposits and the quality of the materials for various applications.

Ten test borings were performed along the three branches of the Wye in localities where it was felt that a representative sampling could be obtained. A visual inspection was also made of each branch.

Along the northern branch the soil is composed of silty sand and sandy silt with intercalated high plasticity clayey lenses. Near the apex the surface material consists of clay covered by wind-blown silt and sand. Hummocky sand dune terrain prevails from just south of U. S. Highway 60 for about 3 miles to the north. In

places, these sands are moderately loose and may be as much as ten feet in thickness. Except near the apex, the sediments underlying the northern branch contain from 5 to 20 percent fine gravel. The sieve analyses from the test borings indicate a maximum gravel content of 9 percent in the samples tested; however, those results do not appear to be typical of the majority of the surface material. Using a 100 pound hammer with a 30 inch drop, the penetration resistance tests showed a blow count per foot of from 4 to 39 at a depth of two feet, 6 to 41 at five feet, and 17 to 62 at ten feet with refusal in one hole. The rather wide variation was a result of the varied typesof material and changes in density. In all four holes a blow count of 20 or more was attained consistently below 12 feet.

Soils along the first 9 miles of the southeastern branch are composed of sandy silt and silty sand with varying amounts of gravel up to 25 percent. The remainder of the branch crosses an area where detritus has been washed down from the adjacent mountain slopes, causing the soil to contain more clay as well as an abundance of small, angular rock fragments. The penetration resistance tests showed a blow count per foot of from 20 to 39 at a depth of two feet, from 7 to 14 at five feet, and from 35 to 50 at ten feet. A consistent blow count of 20 or more was attained in the three holes at depths ranging from seven to ten feet.

Along the southwestern branch, fine-grained sand and silty sand are the most prevalent soil constituents, but locally the branch crosses low ridges that are underlain by gravel. Wind-blown sand masks the soil along much of the distance; however, the sand has not been formed into well developed dunes and probably the deposits are not thick. The penetration resistance tests showed a blow count per foot of from 9 to 14 at a depth of two feet, 1 to 33 at five feet, and 70 at ten feet with refusal in two holes.

No difficulty should be encountered in the excavation of the alluvium, and

this material should be satisfactory for embankments when properly compacted. The high degree of compressibility of some of the samples tested indicates the need for special attention to compaction, particularly in those low areas subject to ponding.

The bearing capacity determinations indicate that the placement of footings could be a problem at shallow depths because of the critical defelction requirement. This problem can be circumvented if the footings are placed deeper. A careful soil test drilling program must be undertaken in order to avoid locating footings in zones of low bearing capacity, forthe penetration resistance tests indicate a wide range of values, including some that are quite low. The compressibility factor of the soils under saturated conditions should also be given careful consideration.

One deep oil well was drilled a short distance from the end of the southwestern branch of the Wye. The test proved to be dry and was abandoned. The future petroleum potential of the San Augustin Plains probably is not especially good. There are several areas of possible uranium activity in the surrounding mountains, but none directly adjacent to the site. At the present time there are no active mining operations in the area.

4. Topography and Drainage

The vegetation of the Y-15 site consists primarily of sparse stands of low gramma grass. The density of the grass is somewhat greater in the bottom-lands where the water is retained more effectively; however, the growth still cannot be termed lush. In most places the grass cover is sufficiently dense to prevent the sand and dust from blowing except during the strongest winds. In the areas of wind-blown sand, there are scattered growths of small sagebrush intermised with very sparse grass.

Observations made during the two-week field investigation indicate that the

New Mexico site has a fairly limited fauna, consisting primarily of birds, prairie dogs, ground squirrels, coyotes, rabbits, lizards, and an occasional antelope. One or more varieties of snakes probably inhabit the region, but none were observed.

The northern branch of this Wye has almost a flat grade crossing the plains as it rises only 50 feet in the first 62,000'. North Lake begins at station 620+00 and runs to station 680+00. Here the branch will be on a 15 foot fill to accommodate any ponding which may occur in the normally dry lake bed. The area from station 680+00 to 686+40 is the only area requiring protection from runoff which develops in the Gallinas Mountains and flows southerly along the western side of the branch.

The drainage requirements on this branch are: thirty-three 24" diameter and two 48" diameter pipe culverts.

The southeastern branch of this Wye is crossed by the drainage flow from Mount Withington on the south. The gradient from the apex of the Wye to station 530+00 is consistent and relatively flat with no major drainage structures involved. From station 530+00 to station 552+00, the branch rises 40 feet crossing a saddle between two hills and then drops 90' to station 686+40. This section has numerous washes and gullies which develop from the mountains on both sides of the branch. The drainage flow from station 600+00 to station 686+40 is in the same general direction as the branch, eventually emptying into Mulligan's Gulch. Some realignment of this part of the branch will improve both the gradient and lessen the drainage demand.

The drainage requirements on this branch are: twenty 24" diameter, thirteen 30" diameter, eleven 36" diameter, nine 42" diameter, eight 48" diameter, two 54" diameter, four 60" diameter, and two 78" diameter pipe culverts.

The southwestern branch crosses the normal drainage lines from Mount Withington and has a low gradient for practically the entire length. The drainage demands

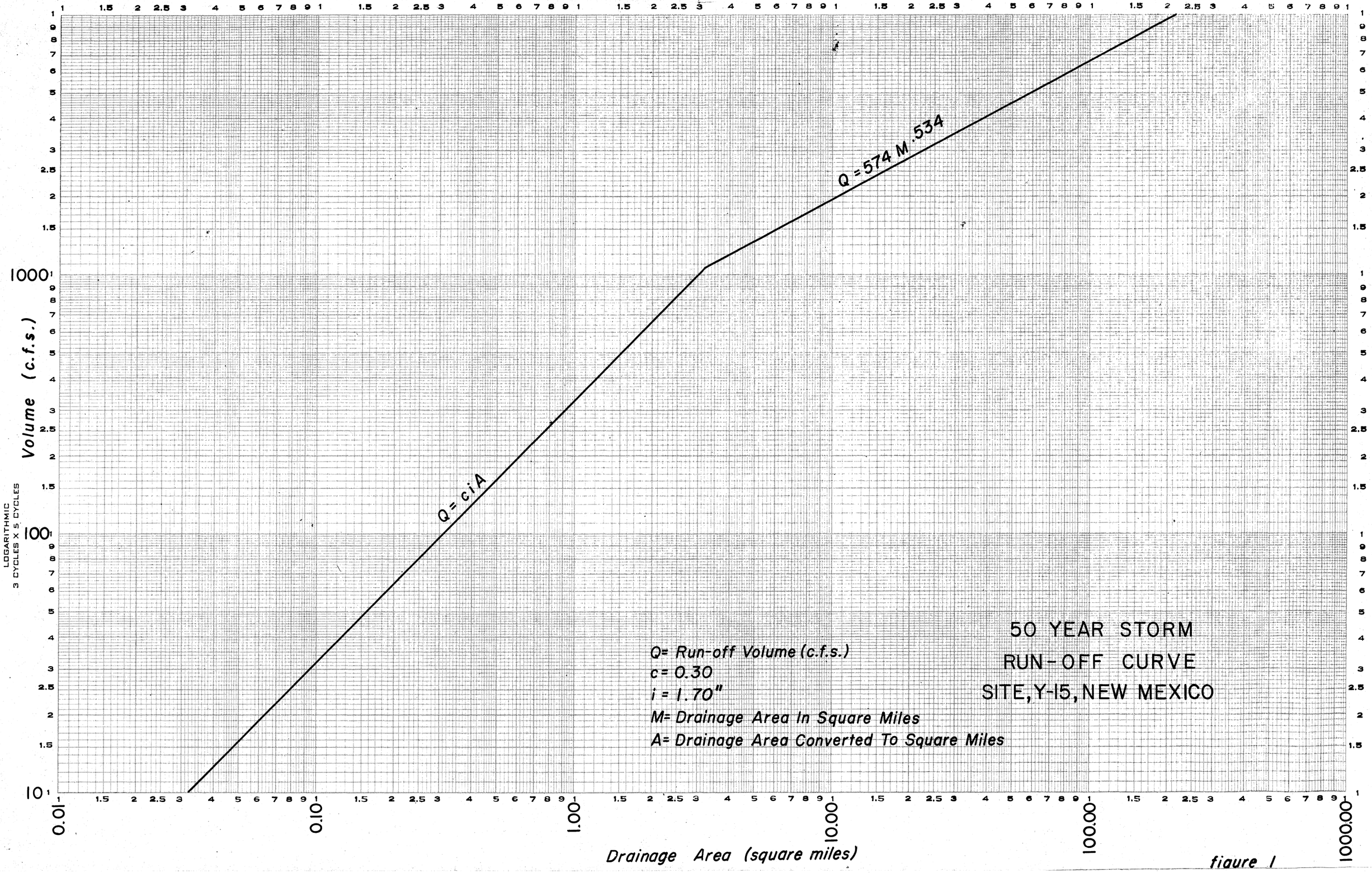

Q = 574 M.534
Q = ciA
Q= Run-off Volume (c.f.s.)
c = 0.30
i = 1.70"
M= Drainage Area In Square Miles
A= Drainage Area Converted To Square Miles
50 YEAR STORM
RUN-OFF CURVE
SITE, Y-15, NEW MEXICO
Volume (c.f.s.)
LOGARITHMIC
3 CYCLES X 5 CYCLES
Drainage Area (square miles)
1000
100
10
0.01
0.10
1.00
10.00
100.00
1000.00

figure 1

are light except where sheet flooding from the hills on the northern side affect this branch from stations 650+00 to 686+40. No major drainage structures are necessary.

The drainage requirements on this branch of the Wye are: twenty-four 24" diameter, six 30" diameter, three 36" diameter, nine 42" diameter, and eight 48" diameter pipe culverts.

Drainage requirements were obtained from Area Runoff Chart (see Figure 1) with a 'c' value of 0.30 and rainfall intensity for one hour as 1.7".

Riprap will be used at a wash area on the southeastern branch where erosion protection will be required.

5. Railway

The railway tracks will consist of 90# relayer rails on untreated hardwood, random cut, industry grade ties. Ties will be at28 inch spacing and will be supported by 6 inches of gravel ballast. Tie plates and joint bars will be used material, with other accessories being new. The tracks and ballast section will be constructed by approved methods and procedures to meet AREA specifications. All rails will have terminal stops. The sub-grade shall have a rating CBR-10 or better. Borrow material is expected to be obtained within the right-of-way and within free haul distance in most cases. Gravel will be obtained from sources now existing in the area and from newly developed locations to reduce haul distance. These pits are generally negotiated between the contractor and the land owner. Water for construction may require new wells to supplement those existing in the area.

The stripping of 6 inches deep ofground surface in the Y-15 site is required to remove existing vegetation prior to placing embankment material.

The observation station foundations will be constructed of poured-in-place concrete and will be the under-reamed bell type. Soil bearing with minimum

settlement potential for the observation station foundations indicate 10,000 psf at 10 ft. + depths for the New Mexico site. For most of the observing station foundations bell bottom concrete footings at 15 foot depths will be used. The shaft will be 4 feet in diameter and bell bottom 8 feet in diameter. One footing will be located for each leg position at the observing stations. Similar foundations will be constructed at the spur intersections for transfer of the antenna from the main branch.

The staging area covers 24,000 square feet. The area will be paved as follows: hardstand area to have 2-1/2 inch asphaltic concrete over a 6 inch gravel base on prepared sub-grade; remaining area to have bituminous double surface treatment over 4 inches gravel base on prepared sub-grade. Material and construction to meet Asphalt Institute Specifications. The access to the staging area from the building complex will be by gravel road. This road will be 500 feet long for Y-15. Drainage will be minimal and existing flow delineations will generally be crossed by construction of dips through the washes.

6. Access Road

The entrance road from the main highway to the building complex will have a wearing course of asphaltic concrete on a 6 inch gravel base. The roadway will be 24 feet wide with 2 foot wide shoulders. It is 500 feet long for Y-15. This road is designed for the traffic classification designated "light" and based on the average daily number of equivalent 18,000 lbs. single axle load applications expected. Mix design criteria, specificationsand construction methods are MS-2 and SS-1 from the Asphalt Institute.

The access road to the airstrip, from the Wye to the building complex and those servicing the building complex area, including the parking lot, vary from the entrance road design only in width: design section is the same. Total length of all Y-15 access roads is 3,700 feet. Drainage for Y-15 access roads is provided

by 1-30" diameter pipe culvert.

7. Airstrip

The airstrip will run approximately east and west to face the prevailing wind on the site. The landing strip will be 150 feet wide with a paved runway 75 feet wide and 5,200 feet long.

A 1,000 foot clear zone precedes the airstrip at each end to provide for a 20:1 glide approach. The length of the runway isdetermined by the altitude (6,900 feet above sea level) and the mean maximum temperature (85°F.).

A 30 foot wide paved taxiway and 150 foot x 200 foot paved apron are located at one end of the airstrip. The runway, taxiway and apron are surfaced with bituminous triple surface treatment ongranular base. The mix, placing, shaping and consolidation of the paved areas shall be to the Asphalt Institute specifications and modified Proctor of 90%(AASHO - T180-57). The paved areas can accommodate a 15,000 lb. wheel loading which is equivalent to DC3 class aircraft. The airstrip will be equipped with a wind cone and serviced by a paved access road. Drainage is provided for with 6-36" diameter and 3-48" diameter pipe culverts.

8. Water Supply

The source of the water supply is an underground acquifer which will be tapped by drilling a 10 inch diameter well and casing the well to 8 inches. Delivery of the water will be by an electric, submersible, centrifugal pump in the well. The pumped water is conveyed by pipe to anelevated 65,000 gallon storage tank. This tank will contain a three-day domestic supply and 50,000 gallons of water for fire delivered at the rate of 400 gallons per minute for a two-hour duration. Distribution from the storage tank is by gravity through a chlorinator and zeolite filter prior to consumption at the building complex.

The acquifer underlying the San Augustin Plains is not too well defined but it appears that water will be encountered at depths of 50 to 100 feet. Wells from 75

feet to 250 feet deep should provide an adequate supply of water to meet the site demand. The well water should be potable with hardness ($CaCO_3$) in the neighborhood of 90 ppm.

9. Utilities

Electric power in the general vicinity of the New Mexico site is supplied by the Socorro Electric Cooperative, Inc., P. O. Box H, Socorro, New Mexico 87910.

This Cooperative has a 69 KV circuit with overhead static protection from Socorro into Magdalena, New Mexico. This line has a very high grade of continuity. From the transformer station in Magdalena, the Cooperative has a 25 KV circuit that runs westerly and passes adjacent to the proposed building complex. This circuit serves about 600 miles of distribution lines from its source in Magdalena all the way to the Arizona state line. The main circuit has static protection but the feeders are connected through oil circuit reclosers. This provides a reliable service that has proven quite satisfactory for the existing users but may lack the absolute continuity required for the VLA. Socorro Electric Cooperative will also have a 69 KV running past the site by 1974.

Included in Appendix A of this report are letters from Mr. Gallagher, Manager of Socorro Electric Cooperative, Inc., dated September 22, 1966, and October 30, 1969. These letters include a "large power" rate schedule and a copy of a Standard User Contract. The letters indicate that the existing 25 KV circuit is capable of supplying the normal operating requirements of 800 KW and possible surge to 1,600 KW without excessive voltage drop. It also indicates costs and investment requirements should it be determined later that the 69 KV circuit needs to be extended to serve the VLA. The budget estimate included as a portion of this study assumes the existing 25 KV circuit will be adequate and that no financial contribution will be required by the AUI.

A completely automatic 500 KW diesel driven emergency generator set is included

in the budget estimate for this site.

Telephone service in the general vicinity of the site is supplied by the Mountain States Telephone & Telegraph Company which is a part of the Bell System. They will provide service for the VLA facility with no financial participation by the AUI.

10. Real Estate

This site is located on the San Augustin Plains of Socorro and Catron Counties, New Mexico, crossing U. S. Highway 60 about halfway between Magdalena and Datil, New Mexico. The elevation is approximately 7,000 feet above sea level and the topography is gently rolling covered with native grasses and shrubs. The soil appears to be mostly a deep sandy loam. (Chart B).

The land is utilized for cattle grazing and is estimated to carry from ten to twelve head per section. Waterings are by windmills and steel tanks with occasional surface tanks.

The northern branch of the proposed facility appears to be within the boundary of a ranch belonging to Jay Taylor. Most of the land affected is owned by the State of New Mexico and controlled bythe Land Commissioner in the New Mexico State Land Office, Santa Fe, New Mexico. Two of the sections crossed by this branch of the facility appear to be privately owned lands in the name of Jay Taylor.

The southeastern branch of the proposed facility crosses a portion of the Michael Harriet ranch, the Magdalena Stock Driveway, which is controlled by the Bureau of Land Management, a portion of the Thomas R. James Ranch, the northeasterly corner of the B. E. Walker Ranch, and the westerly portion of the Malcolm S. Major Ranch.

The southwestern branch crosses theeastern end of the W. W. Benton Ranch, the Magdalena Stock Driveway, the northwest corner of the Michael Harriet White Lake Allotment Ranch and across the northwesterly corner of the Marvin Ake C. N.

Ranch. All of the land on these three ranches affected by this branch of the Wye appear to be land owned by the State of New Mexico with the exception of one small tract of the Marvin Ake Ranch near the end of thefacility, and it appears to be privately owned.

It is understood that land controlled bythe Bureau of Land Management when desired by another governmental agency can be acquired by an administrative transfer without cost.

New Mexico state land controlled by the Land Commissioner is leased for grazing purposes at various rates depending on the carrying capacity of the land. It is estimated that state lands for grazing purposes in this area would lease for approximately ten cents (10¢) per acre per year.

Leases of land for grazing purposes between individuals appears to be about fifty cents (50¢) per acre per year in the area of the subject site. Taking into consideration the type of proposed facility and the interruption of normal cattle operations by the facility, it is estimated that the land 600 feet wide through these ranches could be leased for approximately seventy-five cents (75¢) per acre per year, or $51.65 per mile per year which would pay for the land actually leased and for damage to the adjacent lands byreason of the construction. (Chart G).

Value Conclusions

Private Land

827 acres @ $50 = $41,350.00

State Land

687 acres @ $12.50 (Compensationto Lessee) = $ 8,587.50

State Land

543 acres @ $8.35 (Compensation to Lessee) = $ 4,534.05

BLM Land

517 acres @ $12.50 = $ 6,462.50

BLM Land

355 acres @ $8.35 = $ 2,964.25

State Land

1,230 acres @ $10.00 (Compensation to State) = $13,904.00

TOTAL $76,198.30

CALLED $77,000.00

D. Y-16, UTAH SITE

1. General Site Features

The VLA site Y-16 is located approximately 22 miles south of Delta, Utah in the area known as Black Rock Desert. (Exhibit 5). The apex of the array is located at latitude 39°02.4'N, longitude 112°40.8'W, elevation 4,630 feet above mean sea level. The branches of the Wye are spaced at 120° angles from a common apex and the true azimuth of the southern branch is186° (Exhibits 6,7 & 8).

The site is situated in the bottom of a broad, northerly trending, alluvium-filled valley defined by the House Range on the west and the Pavant Range on the east. Local geologic features such asthe Cricket Mountains and the lava flows adjacent to Pavant Butte form more localized boundaries of the area known as Black Rock Desert. The terrain varies from quite flat to gentle rolling except along the northeastern branch where slopes along the lava ridge are moderately steep.

This site lies directly under the low altitude airways designed as federal airways V21 and V257. (Chart A) The Union Pacific Railroad (single Track) intersects the northwestern branch of the Wyeat a point approximately 5 miles from the apex. A total of 16 trains daily operate along this section of track. State Highway 257, which is directly adjacent to the railroad, intersects the northwestern branch of the Wye at approximately the same point. The site is approximately 35 road miles south of Delta, Utah, along State Highway 257, a two-lane paved highway.

Radio navigational aids, radar relay stations, and electronic installations are shown on Chart A. There appear to be no satellite communication facilities, military defense activities or underground nuclear testing, which would appear to affect the operation of the facility.

Two utility lines cross the northwestern branch of the Wye. A telephone line of the Mountain States Telephone and Telegraph Company intersects the branch

at a point approximately 1 mile from theapex and a 46 KV electric line crosses about 4 miles from the apex.

The site is approximately 35 miles from Delta, Utah by State Highway 257. This highway is a paved two lane road that follows the alignment of the Union Pacific Railroad southward from Deseret, Utah. Presently, there are 8 trains each way daily on the railroad.

Delta is predominatly an agriculture community with a population of 2,000. The town has 2 physicians, 1 dentist, and a 34 bed hospital built in 1963 and valued at $500,000. The hospital is adding a new addition to the present section to accomodate administrative and record facilities. There are 5 motels and 3 restaurants in the town. Neither bus nor railroad passenger service is available, but there is a local aircraft charter service located at the Delta Airport. Dixie Airlines has commercial service to and from Salt Lake City with one flight per day (chart C).

The town of Delta has had an average growth increase of 3 percent over the past 8 years with most of this coming in the last 2 years due mainly to the beryllium mine that is located 45 miles to the northwest. It is apparently the largest open pit beryllium mine in the world and is owned by Brush Beryllium.

At the time the Brush Beryllium plant was built, the town was able to house 150 persons, but most of the available facilities are now taken up by permanent residents working for the Corporation. It does not appear that the town could abosorb even a modest increase as the number of available houses and apartments is extremely limited.

Fillmore, Utah, is located approximately wo miles east of the proposed site on U.S. Highway 91. This town is an agricultural community with a population of 1,650. At present the town has 5 motels and 4 restaurants.

The Union Pacific Railroad, which runs through Fillmore, has only freight service. Passenger transportation service isprovided by two interstate bus companies with six buses each way daily. The airport has a paved runway and is equipped with

fueling facilities and night landing lights.

Fillmore has a modern 42 bed hospital owned by the Church of the Latter Day Saints. There are 2 physicians and 1 dentist in residence in the town. Fillmore is without industry and has shown little growth in the last decade. The stability of the population has resulted invery little new housing construction, and consequently there are very few housing units available.

The school system for Millard County includes both Delta and Fillmore with administrative offices in Delta. There isa high school in each town and both are accredited by the Northwest Accrediting Association. The student-teacher ratio is 27.

In the site area construction workers wages would be $6.05 per hour plus subsistance and electricians wages are $7.20 per hour. (Chart D)

The State of Utah has 9 colleges and universities with the closest being Brigham Young University (BYU). BYU is located atProvo, Utah, approximately 100 miles to the northeast of the site. BYU offers undergraduate degrees in 68 different fields in 13 colleges. Master's degrees are available in44 fields and doctoral studies are offered in some fields.

The nearest commercial air facilities other than the Dixie Airlines out of Delta is in Salt Lake City, 160 miles north of site Y-16. The salt Lake City airport is served by United, Frontier, Western and Air West Airlines.

Utah's terrain varies between 2,000 feet and 13,000 feet above mean sea level and offers a great variety of outdoor activities. In immediate area of the site there is camping, fishing, hiking, and skiing. Hunting in the area includes elk, deer, antelope, mountain lion, ducks, geese, quail, and pheasants. Within a day's drive of the site are the scenic attractions of Lake Powell, Canyon Lands National Park, Zion National Park, Bryce National Park and Cedar Breaks National Monument.

2. Climatology

Climatic information for the Y-16 site in Utah was obtained from the Clear Lake ildlife Refuge weather station, which isjust north of the apex of the site, the eather bureau, the Salt Lake City weather bureau, and the state climatologist at ogan, Utah. (Chart E) The average daily maximum temperature for Y-16 is 73.02°, nd the average daily minimum temperature is 38.25°. The highest recorded tempera- ure was 101° and the lowest recorded temperature was -32°. The average yearly recipitation is 8.41 inches with 11.33 inches being the greatest annual precipi- ation on record. The greatest monthly precipitation recorded is 2.88 inches and he mean yearly snow is 23.08 inches with 14.2 inches as a record maximum snowfall. he mean annual relative humidity is 55 percent. The sunshine possible throughout he year is 69 percent. Two tornados have been recorded in Millard County over a eriod of 18 years. While data on dust days is lacking, it is known that the dust ccurrence can be considered "heavy." Hail is infrequent, with maximum size up to half inch. Prevailing wind direction isfrom the southwest and the estimated verage hourly speed for the year is 10.4 miles per hour. The maximum wind expec- ancy is estimated to be 90 miles per hour in a 50 year period. Thunderstorms ccur an average of 35 times per year. Average solar radiation '421 Langleys.

3. Geology and Foundation Investigation

The Y-16 site is situated in the southeastern part of the Sevier Desert in an rea that is locally termed the Black Rock Desert because of the extensive basalt lows that form the eastern boundary of the area. Geologically the region is a tructural basin formed by an upward faulting of the Pavant Range on the east and he House Range on the west. The Cricket Mountains on the western side of the site re a local bedrock feature within the basin most likely caused by a north-south ault located a short distance west of the Union Pacific Railroad.

The fault systems that created the basin in which the Severier Desert formed probably date back to the beginning of Tertiary time. The only known earth fracture that has occurred in the region in historic times was in Hansel Valley of northwestern Utah in 1934. At least two small earth fractures occur in the site area, one near the end of the northeastern branch in the volcanic rock and the other near the end of the southern Wye Branch in the lake bed sediments. Based only on very limited information, it would appear that these fractures, although they have occurred in relatively recent geologic time are only minor earth adjustments probably due to a consolidation and shrinking of the lake beds following the retreat of the lake waters from the Sevier Desert.

The region as a whole is moderately active with regard to earthquake activity. From 1850 to 1965 there have been at least 609 earthquakes in Utah, 38 of which could be termed damaging (Cook and Smith, 1965). From 1950 to 1965 there have been 13 damaging earth tremors. Since the first recording equipment was installed at the University of Utah in 1909, there have been 21 earthquakes with epicenters located within Millard County. The centers, which have been located primarily along the eastern border of the county have had an average magnitude of about 3.5 on the Richter scale but tremors with intensities up to 6.9 have been recorded. One epicenter has been recorded within the site and it lies on the northwestern branch of the Wye about 2 miles from the apex. Based on the available data, it appears reasonable to assume that periodic earth tremors will be experienced in the Sevier Desert, but that the intensities should be only slight to moderate as the epicenters are located primarily along the west faceof the Pavant Range.

Several Tertiary and Quaternary geologic units of local to regional extent were deposited in the basin after it was formed and prior to the inundation of the basin by the waters of Lake Bonneville, an extinct lake that covered most of northwestern Utah, parts of northern Nevada, and southern Idaho during Pleistocene time.

Pavant Butte, which is a volcanic cinder cone, forms the northern extent of a ridge comprised of volcanic deposits that extend for approximately 24 miles and separate the Sevier Desert from the Pavant Valley to the east. In the northeastern part of the site area, the ridge is formed primarily of dark-gray, hard, vesicular basalt in the form of relatively level lava beds. These may be interbedded with sediments, but exposures are not sufficient to be certain. In the last stages of volcanic activity, the cinder cones such as Pavant Butte were formed. At one time Pavant Butte was an island in Lake Bonneville, and consequently much of the cinder material has been eroded and washed down over the adjacent lava flows masking their extent.

The surficial deposits throughout the site are reworked Lake Bonneville sediments that were originally deposited in the huge lake. As a result the typical soil is fine to medium grained poorly graded silty sand. The gravel fraction generally is under 5 percent and the average size is less than one inch in diameter. The volume of fines is estimated to vary between 5 and 25 percent with most of the samples having rapid dilatancy, low plasticity, and veryslight dry strength. The Unified soil classification of the fines would be ML. There may be a few bars of fine gravel deposited in the lake, but none of any significance were noted during the field inspection. The fine sandy sediments in the southern part of the site area have been formed into dunes elongated in a northeasterly direction. A number of these dunes are actively moving and during heavy winds a combination of the fine sands from the dunes and the silts from the playa beds north and northwest of Clear Lake cause intense dust contamination in theair. All of the soil contains some alkalai salts, the amount varying with the volume of water discharged through evaporation.

Rock for railroad ballast possibly can be obtained in the site area by crushing lava flow rock from a location along the northeastern branch. A more likely source of good quality rock for crushing is a jointed, fractured intrusive volcanic neck

that occurs about 2 miles northwest of the Clear Lake siding. Another possible source would be limestone beds that could be quarried in the Cricket Mountains. Gravel for road base material probably would have to be hauled from gravel terrace deposits that occur 5 miles northwest of the town of Fillmore. Sand could also be obtained in that area, although the deposits are quite fine grained and poorly graded.

Footing conditions should be quite similar in all of the lowland areas because of the apparent similarity of the underlying deposits of silty sand. It is also likely that beds of clay occur beneath the surface of the basin. Soil testing would have to be performed in order to be certain of the foundation conditions; however, it would appear that shallow footings would not be feasible due to the silty nature of the deposits. This type of material would not tend to have a high bearing capacity in the upper soil horizons and probably would be quite compressible under saturated conditions.

All of the northwestern and southern branches lie on soils that would be quite similar to that described above. The northeastern branch where it crosses the volcanic ridge would be the main area where there would be a difference in the soil type. In some places the lava would be exposed at the surface, whereas in others the cinder material has covered the lava to a considerable depth. In general, the bearing capacity of the areas underlain by sediments should be fair to moderately good. The cinder material is quite firm and would have very low compressibility when saturated, and should have good bearing capacity. The permeability of the cinder material is high.

Footings in the lowland areas should be planned to be set at depths of at least 12 feet. Where the soil is to be used for embankment material, it should be carefully compacted and adequate drainage provided.

At the present time there is no mineral exploration or exploitation activity in the immediate site area. (Chart F) The only possible future mineral development

would center around mining of the cinder material for building block. The possibility of oil resources in the area cannot be entirely discounted, and at present there is seismograph exploration activity in the Fillmore and Delta areas. It is unlikely, however, that the prospects can be favorable with a barren section of Tertiary rocks and relatively recent volcanic activity. Two oil tests have been drilled in the region, one about 25 miles north of Clear Lake and one 22 miles southwest of Clear Lake; neither test was productive.

Other areas of possible future mineral activity are the potential potash deposits of the playa beds, particularly Sevier Lake where there are several active mining permits. There has in the past been coal mining activity in the Pavant Mountains, but there is little or no activity at the present time. According to Mr. Wilson of the U.S. Bureau of Mines, the limestone and dolomite rocks of the Cricket Mountains have been investigated for possible use as flux in the steel mill operations. There is no current activity.

4. Topography and Drainage

The Y-16 site lies on an open, slightly undulating basin ranging in elevation from about 4,600 feet to almost 4,800 feet above sea level. Except along the northeast branch, slopes are generally less than 1 percent. The entire northeast branch lies on relatively flat ground that has an overall northwesterly slope of under 0.5 percent. There probably is no location onthat branch where the slope would exceed 1 percent. Vegetation along the northwestern branch consists of scattered clumps of sagebrush generally less than 18 inches in height.

The southern branch crosses relatively level terrain that varies from being quite flat near the center to slightly rolling along the southern half. About 8 miles from the apex there is a valley area a little over 3 miles wide that has a number of rather large, active sand dunes crossing in a northeasterly direction. Where the branch enters and exits from the valley, the slopes may exceed 2 percent

for short distances. The end of the southern branch is on relatively flat terrain. The vegetation, which is primarily sagebrush 12 to 20 inches high, is rather scattered near the center, but becomes slightly dense towards the southern end.

The northeastern branch crosses about 2 miles of rather level terrain covered with scattered low sagebrush before encountering the lava beds that border the Sevier Desert on the east and form the divide separating it from the Pavant Valley to the east. Most of the lava beds have been mostly covered by lake sediments or wind-blown deposits; however, there are about 3 miles along the western edge of the flow where the hard, dark gray vesicular volcanic rock crops out and would create a moderate obstacle to construction. For the next 5 miles the branch crosses an area underlain by lava beds partly covered by sand and cinders. The vegetation of this area consists of moderately dense brush to 24 inches with scattered small Juniper trees that reach about 12 feet in height. The initial 3 miles of this section is on a rolling incline of about 1 percent grade. The last 2 miles of this section is down the backside of the ridge at slopes which were estimated to be as great as 4 percent. Grades in excess of 2 percent may occur over a distance of about 8,000 feet. The end of the branch crossesrelatively flat land with a moderately dense covering of brush up to 3 feet in height. The height and density of brush is an indication of a relatively shallow water table.

Drainage channels at the Y-16 site are not well developed and the only perennial source of surface water in the region is at the Clear Lake Wildlife Refuge where there are natural springs in the basalt outcrops. The only branch of the Wye that crosses a drainage of any significance is the northwestern one. About midway through its length there is a low area with no clearly defined channel, and this drainage, called Beaver River, drains water northwesterly toward the Sevier River. Most of the region where slopes are slight and the soil relatively impermeable there is a tendency for water to pond or for sheet flow to occur during periods of heavy rain.

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c = 0.10
i = 2.80"
M = Drainage Area In Square Miles
A = Drainage Area Converted To Square Miles

50 YEAR STORM
RUN-OFF CURVE
SITE, Y-16, UTAH

0.01 0.10 1.00 10.00 100.00 1000.00

Drainage Area (square miles)

figure 2

As the average annual rainfall is only 6-8 inches, there probably are only a very few times a year when there would be any significant amounts of flowing surface water. The flow of surface water is further reduced by thepresence of sand dunes ranging up to 10 feet in height, particularly along the southerly half of the southern branch. Even though no well defined drainage channels exist, provision will have to be made at intervals of about 2,000 to 3,000 feet to allow water to pass under the Wye roadbed which would otherwise act as a dam. (The drainage structures required for the Wye are shown on Exhibits 6, 7 and 8). This would be particularly true along the northeastern branch where it crossed the volcanic ridge. In the central and northwesterly parts of the site the slopes are quite uniform over long distances and borrow ditches could be graded to channel water along the sides of the roadbeds for considerable distances. (Figure 2).

Embankments heights on the low lying areas of the northwestern and southern branches should be 2 to 3 feet whereas 2 feet should suffice for the remainder of the northwestern branch and 1 to 2 feet should be adequate for the remainder of the southern branch. The end of the northeastern branch where it crosses the lowlands should be about 2 feet in height, but those areas on the slope of the volcanic ridge need be only about one foot except where crossing drainages.

Vegetation in the site area consists of scattered clumps of low sagebrush and allied botanical types that are able to grow in the semi-arid, alkaline soil. Some low grass occurs, but it is quite sparse. Juniper trees up to about 12 feet in height grow on the lava ridge that forms the eastern boundary of the Black Rock Desert. The sparse vegetation is not adequate to hold the surface soil, and consequently there are moderately heavy dust storms in the area and the abundant active sand dunes.

5. Railway

The railway tracks will consist of 90# relayer rails on untreated hardwood,

random cut, industry grade ties. Ties will be at 28" spacing and will be supported by 6" of gravel ballast. Tie plates and joint bars will be used material, with other accessories being new. The tracks and ballast section will be constructed by approved methods and procedures to meet AREA specifications. All rails will have terminal stops. The sub-grade shall have a rating CBR-10 or better. Borrow material is expected to be obtained within the right-of-way and within free haul distance in most cases. Gravel will be obtained from the closest available sources in order to reduce haul distance. These pits are generally negotiated between the contractor and the land owner. Water for construction may require new wells to supplement those existing in the area.

The stripping of 3 inches of ground surface on the Y-16 site is required to remove existing vegetation prior to placing embankment material.

The observation station foundations will be constructed of poured-in-place concrete and will be the under-reamed bell type. For most of the observing station foundations bell bottom concrete footings at 15 feet depths will be used. The shaft will be 4 feet in diameter and bell bottom 8 feet in diameter. One footing will be located for each leg position at the observing stations. Similar foundations will be constructed at the spur intersection for transfer of the antenna from the main branch.

The staging area will cover 24,000 square feet. The area will be paved as follows: hardstand area to have 2-1/2 inches of asphaltic concrete over 6 inches of gravel base on prepared sub-grade; remaining area to have bituminous double surface treatment over 4 inches of gravel base of prepared sub-grade. Material and construction to meet Asphalt Institute Specifications. The access to the staging area from the building complex will be by gravel road. This road will be 4,750 feet long for Y-16. Drainage will be minimal and existing flow delineations will be generally crossed by construction of dips through the washes.

6. Access Road

The entrance road from the main highway to thebuilding complex will have a wearing course of asphaltic concrete ona 6 inch gravel base. The roadway will be 24 feet wide with 2 foot wide shoulders. It is 6 miles long for Y-16. This road is designed for the traffic classification designated "light" and based on the average daily number of equivalent 18,000 lbs. single axel load applications expected. Mix design criteria, specifications and construction methods are MS-2 and SS-1 from the Asphalt Institute.

The access road from the building complex to the airstrip, the staging area and the Wye vary from the entrance road design only in width; design section is the same. Total length of all Y-16 access roads is7.5 miles.

7. Airstrip

The airstrip will run approximately southwest-northeast to face the prevailing wind on the site. The landing strip will be 150 feet wide with paved runway 75 feet wide and 5800 feet long.

A 1,000 foot clear zone precedes the airstrip to each end to provide for a 20:1 glide approach. The length of the runway isdetermined by the altitude (4,630 feet above sea level) and the mean maximum temperature (90°).

A 30 foot wide paved taxiway and 150 foot x 200 foot paved apron are located at one end of the airstrip. The runway, taxiway and apron are surfaced with bituminous triple surface treatment on granular base. The mix, placing, shaping and consolidation of the paved areas shall be to the Asphalt Institute specifications and modified Proctor of 90%(AASHO - T180-57). The paved areas can accommodate a 15,000 lb. wheel loading which is equivalent to DC3 class aircraft. The airstrip will be equipped with a wind cone and serviced by a paved access road.

8. Water Supply

If a satisfactory acquifer can be located, it will be tapped by drilling a 10 inch diameter well and casing the well to 8 inches. Delivery of the water will be

by an electric, submersible, centrifugal pump in the well. The pumped water is conveyed by pipe to an elevated 65,000 gallon storage tank. This tank will contain a three-day domestic supply and 50,000 gallons of water for fire delivered at the rate of 400 gallons per minute for a two-hour duration. Distribution from the storage tank is by gravity through a chlorinator and zeolite filter prior to consumption at the building complex.

The water resources of the Pavant Valley to the east (mower, 1965) and the Sevier Desert to the north (Mower and Feltis, 1968) have been quite well studies; however, except for the study of the Clear Lake Springs (mower, 1967), there has been little published information on water resources within the site area. The basic reason is the limited use of the area and the fact that very few wells have been drilled.

According to the published information, groundwater moves northward through the southeastern Sevier Desert area and westerly to northwesterly from the Pavant Valley. The springs that feed the Clear Lake area are supplied by water that seeps through fractures and joints in the Pavant basalt flow. The source of the water is partly from precipitation on the volcanic rock, but mostly from groundwater flowing westerly from the Pavant Valley. Most of the water in the Pavant Valley enters the acquifers on the west slope of the Pavant Range approximately 20 miles east of Clear Lake. Consequently, the quality of the groundwater deteriorates as an increasing number of dissolved solids are picked up when the water migrates westerly across the valley. Total recharge to the basalt acquifer is estimated by Mower (1967) to be about 17,000 acre feet per year. whereas the discharge of the springs at Clear Lake are estimated to be approximately 14,900 acre feet per year. This would appear to indicate an untapped reservior potential of over 2,000 acre feet per year.

Extensive farming takes place in the Pavant Valley and most of the Cultivated land is irrigated with well water. It has been found that the discharge of the Clear

Lake Springs varies almost in direct proportion to the amount of well pumpage in the Pavant Valley, and thus this factor could place a definite limitation of the availability of water from the Pavant Valley.

Quality of water at clear Lake Springs has deteriorated from a dissolved solids content of 1,003 ppm (parts per million) and a specific conductance of about 1,900 (micomhos per cm. at 25°C.) in 1900 to values of 2,330 ppm. and 3,540 spec. cond. in 1964. The deterioration apparently isdue to irrigation water returned to the acquifer. The water is described as slightly saline and with a moderately high sodium chloride content.

If the Clear Lake Spring were used as a source of water, a pipeline 5 miles in length would be required. The nearest place a well could be drilled to tap the basalt acquifer would be 3 to 4 miles northwest of the apex.

An alternate source of water would be the acquifers of the lake bed deposits beneath the apex. The closest wells from which to interpret information are at the Neels and Clear Lake sidings along the Union Pacific Railroad. These wells have been drilled up to 1,998 feet in depth and have yielded as much as 35 gpm (gallons per minute) on pumping tests, but indications are that the acquifer permeability is moderately low. The basic problem is the quality of the water, for generally water with over 500 ppm and dissolved solids is considered undesirable for domestic uses. The wells in the Neels and Clear Lake sidings areas contain from 4,300 ppm to 9,000 ppm and as such would be classified as moderately saline. A well near the end of the southern branch is reported to have a dissolved solids content of over 67,000 ppm and thus is classified as a brine. In the area of the apex water probably could be expected to be moderately saline with a dissolved solids content of 5,000 ppm to 10,000 ppm, and thus unsuitable for domestic purposes. Because the soil is rather impermeable and impermeable clay zones most likely occur in the subsurface, recharge from precipitation in the immediate area of the apex is unlikely.

9. Utilities

Electric power in the general vicinity of the Y-16 Utah site is supplied by the Utah Power and Light Company, Richfield, Utah 84701.

The Utah Power and Light Company has an existing 46 KV line west of the apex from which approximately 12 miles of 46 KV line would be built through the apex at a cost of approximately $160,000. There will be no need to increase the existing system to carry the requirements for the Wye. If the expected power bill of approximately $5,500 monthly were guaranteed revenue annually for 5 years, there would be no cost in furnishing the electric facilities to the site.

Included in Appendix A is a letter from Mr. J. F. Gardner of Utah Power and Light Company dated November 25, 1969, which includes the company's minimum charge and billing schedule.

A completely automatic 500 KV diesel driven emergency generator set is included in the budget estimate for this site.

The area is served by the Utah Telephone Company which is part of the Continental System with an office at 390 W. 100 N. Delta, Utah.

10. Real Estate

This area is generally known as the Black Rock Desert region of Utah. The area is close to Clear Lake (migratory water fowl area) and along the Beaver River. The site is located approximately twenty (20) miles south of Delta. (Chart B)

The Black Rock Desert has an elevation of approximately 4700 feet. The southern branch of the Wye extends along the desert floor, which is primarily an alkali flat. The northeastern branch extends through some minor lava beds, blow sand areas, and a small area of salt flat marshes. The northwestern branch crosses the highway and railroad just south of the abandoned farming community of Clear Lake. This branch extends generally along the bed of the Beaver River (old irrigation ditch).

To the west of the highway much of this land wasutilized for minimal irrigated farming in years past; however, farming was uneconomical and the lands have been returned to a grazing status.

Approximately 125 acres of private land are affected by this taking. This private land is located at the extreme northern end of the northwestern branch. This land might have been farmed at one time, but it is now similar to the surrounding country and is considered no better than grazing land.

A Bureau of Land Management Stock Driveway crosses the site in a northeasterly direction immediately southeast of the apex. The driveway is used mainly for moving flocks of sheep from one grazing range to another.

It is assumed that the BLM land could be obtained through an interagency transfer without cost and that the compensation to leaseholders would be $3 to $10 per acre depending on whether the land is in the alkali flats or along Beaver Creek where there is better grazing land. The purchase price for the state and private lands would be $45 per acre including any damages.

It is estimated that the private land consists of approximately 125 acres. State land is approximately 275 acres, and land controlled by the Bureau of Land Management is approximately 2572 acres. The value of land in this area is divided between grazing land lying in the alkali flats, better quality grazing land, and lands along the Beaver River (and the Beaver River) which could experience some damage and could require for reworking of the irrigation system. (Chart G)

1435 acres @ $10 =	$14,350
1137 acres @ $ 3 =	$ 3,411
400 acres @ $45 =	$18,000
Total Called	$36,000

E. Y-17, NEVADA SITE

1. General Site Features

The VLA site Y-17 (Exhibit 9) is located approximately 20 miles west of Eureka, Nevada, in Monitor and Kobeh Valleys. The apex of the array is situated five miles north of U. S. Highway 50 and is at latitude 39°35.4'N, longitude 116°27.4'W, elevation 6,190 feet above mean sea level. The branches of the Wye are spaced at 120° intervals from a common apex with a true azimuth of 354° for the northern branch. (Exhibits 10, 11, and 12)

The coordinates for this array center have been adjusted to obtain an improved gradient for the southeastern branch and elimination of the intersection between the terminus of the southwestern branch and U. S. Highway 50.

The terrain in the bottomlands of the valleys is quite flat. The surrounding low benches of an old alluvial surface are moderately dissected, and the terrain is slightly to moderately rolling. Around the perimeter of the valley, the alluvial fan deposits slope steeply upward to the bases of the adjacent mountains that rise to elevations between 8,000 and 10,000 feet above sea level.

There are no trees on that part of the site occupied by the Wye. The vegetation is mostly grass on lowlands and scattered to moderately dense sagebrush on the uplands. Most of the vegetation is less than 24 inches in height.

There are no airways or railroads inthe area. (Chart A) U. S. Highway 50 intersects the southeastern branch of the Wye approximately 9 miles from the apex and comes close to the southeast branch at itstermination point.

Radio navigational aids, radar relay stations, and electronic installations are shown on chart A. Apparently there are no satellite communication facilities which would affect the operation of this facility.

The nearest military or defense activities are the Wendover Bombing and Gunnery Range 150 miles to the east and the Las Vegas Bombing and Gunnery Range 125 miles

south of the site.

The Central Nevada test area of the AEC is located at latitude 38°30'N and longitude 116°10'W and lies within 80 miles of the site and nuclear blasts would cause seismic effects described by the AEC as being "definitely perceptible".

This area is quite remote and the nearest towns to the site location are Austin and Eureka, Nevada, both of which are primarily mining communities. These towns are located on U. S. Highway 50 but any future growth will depend mainly on an expanding mining economy.

Austin, with a population of 300, is located approximately 42 miles west of the apex. (Charts C and D) Eureka is located approximately 24 miles east of the apex and has a population of about 500. The nearest town with a population of over 2,000 is Ely which is 105 miles east of the site and has a population of 7,000. The town has 2 dentists and 4 doctors all located in a newly constructed clinic. There is a recently built 40 bed hospital valued at 1.2 million dollars. This hospital is adjacent to the old hospital which was a 40 bed unit and is now a nursing home. The major source of income for Ely is derived from the Kennecott Copper Corporation, from the Nevada Northern Railroad which is a wholly owned Kennecott subsidiary, and from agriculture. The city has 18 motels, 7 restaurants and 2 gambling casinos. The educational system in Ely includes 3 elementary schools and 1 high school. The student-teacher ratio is 18. There is 1 parochial grade school, an evening school, and an off-campus center of the University of Nevada. The community has a year-round swimming pool and a 9-hole golf course.

The growth rate for the past 7 years in Ely has been less than 2.2 percent a year. Kennecott Copper Corporation has created a fairly stable employment situation in Ely for many years. The local employment office lists an annual average of 600 new applicants per year with 99 percent being employed by Kennecott Copper. More than half the applicants are women and they would constitute the available local labor.

The community has a very serious housing shortage and trailer houses have become the homes for many families. The FHA has a program of developing land for additional needed housing for the local residents. The unskilled wage rate in the area is $2.65 per hour.

The Nevada Northern Railway Company is a common carrier but has no passenger service available; however, three bus companies offer service to Reno and Wells, Nevada, and Salt Lake City, Utah. The city of Ely hasan airport with both charter and commercial service available. United Airlines has two flights daily that connect with other commercial flights at Reno, San Francisco and Salt Lake City.

The city of Ely has a city council-mayor form of government. The city has its own municipal water supply that is obtained from 8 artesian wells located in the mountains above the city. The community has recently constructed a modern sewage treatment plant.

Elko, Nevada with a population of 10,500 is located approximately 106 miles north of the Y-17 site. This city has a growth increase of over 13 percent per year. It has a city council form of government with four councilmen and an elected mayor. The sources of income for Elko are from tourism, ranching, and mining.

Elko is located on Interstate Highway 80 that runs between Reno and Salt Lake City. It has several fine motels and restaurantsand three large gambling casinos. The medical facilities appear to be adequate with six physicians and two medical specialists, 4 dentists and an 80 bed hospital.

Because of the rapid growth rate of Elko housing facilities are lacking and practically the only available accomodation are in motels. The city has recently added a water reservoir with attendant water mains and laterals, and a new sewage treatment plant. Water is obtained from subterranean wells located in and around the city. Apparently there is an adequate water supply to meet existing demands since no shortages have been noted to date.

The school system is operated on a county wide basis with administrative

offices in Elko. There are 2,200 students with a student-teacher ratio of 27 in the elementary system and 22 in the secondary system. There are 4 elementary schools, 1 junior high school, and 1 senior high school which is accredited by the Northwest Central Association. In addition, there is a city community college.

Because of Elko's size and diversified income it does have an available labor source. Approximately 2,100 new applications per year are received in the office of the Security Commission.

Both the Western Pacific Railroad Company and the Southern Pacific Railroad have passenger service and Greyhound and Continental Trailways bus lines connect to all major cities in the West. United Airlines has two scheduled flights per day through Elko with connections to other commercial airlines at Salt Lake City, Reno, and San Francisco. There are two private charter services available at Elko.

Labor in Nevada is highly unionized. Electricians receive $7.25 per hour plus subsistence and construction workers $5.55 per hour plus $9 per day subsistence. (Chart D)

Elko has a new 18 hole golf course and is planning an indoor-outdoor swimming complex.

The University of Nevada is locatedin Reno with a branch in Las Vegas. The various colleges in the undergraduate program are Agriculture, Arts and Sciences, Business Administration, Education and Engineering.

There is hunting, fishing, hiking and camping, water skiing and snow skiing in the area. Within a few hours driving time there are several national forests and two national recreational areas, one being Hoover Dam (Lake Mead) and the other Lake Tahoe on the Nevada-California border.

2. Climatology

Due to the remoteness of the Y-17 site and the lack of stations to record a comprehensive coverage of weather, it was necessary in some categories to interpo-

late, analyze and estimate, the data obtained. (Chart E)

At the Y-17 site the average daily maximum temperature is 60.8° and the average daily minimum temperature is 22.0°. The highest recorded temperature is 98.0° and the lowest recorded temperature is -34.0°. The average yearly precipitation is 6.32 inches with 10.57 inches being the greatest annual precipitation. The mean annual snow fall is 30 inches with a record maximum single snowfall of 37 inches. The mean annual relative humidity is 50 percent. The sun shines 76 percent of the time. There is an average of one tornado every two years for the state. Dust storms are infrequent and hail occurs approximately 4 times a year. The prevailing wind direction is from the southwest with an estimated average velocity of 10 miles per hour. Average solar radiation is 460 langleys.

The maximum expected wind speed in 50 years is estimated at 70 miles per hour. Thunderstorm activity is quite low with an average of only twenty thunderstorms per year.

3. Geology

The Y-17 site is situated in the central part of Nevada in the midst of the geologically complex Basin and Range Province. The northerly trending mountains have been formed primarily by a system of faulting some of which has been low angle thrusting that has caused considerable folding and brecciation of the bedrock.

The faults along which the mountainsringing the where uplift have long since been buried beneath the alluvial material that mantles the valley lowlands. In the relatively recent geological past, the entire Kobeh Valley was covered to a depth of up to several hundred feet by sand and gravels deposits that formed a nearly level surface. The base level for the area has subsequently been lowered causing extensive erosion of the old alluvial surface and the forming of a new relatively stable level as typified by Bean Flat. Much of the northern branch as well as parts of the other two branches are underlain by remnants of the old alluvial surface.

Within a 40-mile radius of theWye Apex 10 earthquakes have been recorded since 1852 as shown on the Nevada Bureau of Mines Map 29. The magnitude of the tremors generally has been less than 5 on the Richter scale, but at least two of the shocks have had a magnitude of between 5 and 6 and thus probably caused damage to buildings near the earthquake epicenters. There are no active fault scarps in the Kobeh Valley, but about 100 miles to the west the area in a north-south belt between Fallon and Frenchman Station is one of high earthquake activity and has been accompanied by active faulting, including a vertical offset of 5.5 feet along a short section of U. S. Highway 50 in 1954. In addition to the natural seismological activity, tremors from some of the nuclear underground tests probably would be felt at the Y-17 site, according to the Nevada Operations Office of the Atomic Energy Commission. The actual magnitude of the nuclear shocks is not known and thus far, there has been only one test within a 100-mile radius of the site. (Chart B)

The older alluvial deposits should be entirely satisfactory for embankment material and at least in some areas should prove adequate for use as road base. The gravel fraction in these deposits probably varies from 20 to 50 percent and the individual clasts usually are less than one inch in diameter. There are good exposures of this material in a pit a short distance northeast of the apex where the gravel was excavated for embankment material and surface graveling of the road that runs near the center of the site.

The Nevada Highway Department has been excavating material for road base and surfacing from pits along U. S. Highway 50 over a period of many years. The pits are located on the lower base level near the end of the southwestern branch of the Wye. The bottomlands generally are underlain by at least 1 to 3 feet of silty or clayey sand. In the area of the pits these fine-grained sediments average about two feet in depth and are underlain by gravel-sands that contain from 3 to 6 percent

silty fines. The volume of the gravel fraction ranges from about 30 to 40 percent. It is likely that this type of gravel was deposited in an old stream bed and thus may be localized so that similar deposits could not necessarily be expected to underlie the bottomlands in other areas.

If ballast material were to be obtained locally, it would have to be crushed rock from a quarry in one of the nearby mountain ranges. Brecciation of the bedrock by faulting has occurred in the Mahogany Hills near the end of the southeastern branch and also on Lone Mountain. The brecciated limestone has been re-cemented, but it appears that the rock would have a tendency to shatter when crushed.

It is possible that limestone beds suitable for crushing could be found at some location around the perimeter of the valley.

Foundation conditions in the sand and gravel of the old alluvial surface should be good. The bearing capacity should be quite high and the compressibility under saturated conditions should be only moderate. In the lowland areas, particularly those that are poorly drained the bearing capacity probably is only fair and the compressibility of the soil under saturated conditions may be moderately high. A soils drilling and testing program would be required to determine the actual bearing capacity information.

There has been no petroleum activity anywhere in the vicinity of this site. The geologic section in the area may be favorable for the accummulation of petroleum, but the structural complexity has discouraged exploration activity. (Chart F)

The nearest mining activity isat Lone Mountain only 8 miles east of the apex. According to statistics in the Nevada Bureau of Mines Bulletin 64, more than $100,000 worth of zinc ore has been produced in theLone Mountain District. The Mount Hope Mining District, which lies14 miles north of Lone Mountain, has also produced more than $100,000 worth of zinc ore. About 27 miles northwest of Lone Mountain is the Roberts Mountain Mining District where substantial amounts of lead

ore have been mined. The Eureka Mining District 17 miles east of Lone Mountain has the greatest known potential for future development. To date well in excess of $100,000,000 of gold and silver ore has been mined. There is only a limited amount of activity in the established mines at the present time.

In November of 1969 a major mining company had staked a minimum of 100 mining claims covering 2,000 acres near the southwestern branch of the Wye. Neither the exact location, extent, nor the type of development activity could be determined. A test drilling program was in progress at the time the site was visited in November, and there is a possibility that the mining claim could conflict with parts of the southwestern and northern branches of the Wye.

4. Topography and Drainage

The Y-17 site is located primarily in the Kobeh Valley, a broad and nearly equidimensional area at the heads of the Monitor and Antelope Valleys. The base of the valley areas such as Bean Flat and along Coils Creek have very low relief and are quite poorly drained. They are surrounded by an old relatively flat alluvial surface that is 20 to 30 feet above the present base level of the valley. Around the perimeter of the area the old alluvial surface merges with moderately steeply rising alluvial fans. The base level is at an elevation of about 6,100 feet and the base of the alluvial fans is approximately 6,300 feet.

On the north the Roberts Mountainsrise to elevations of over 10,000 feet. The site is bounded on the west by theSimpson Park Mountains that attain elevations of over 9,000 feet. The Monitor Range on the south has areas of over 10,000 feet in elevation, and along the eastern boundary of Kobeh Valley, the Whistler Mountains and the Mahogany Hills have areas with elevations of over 8,000 feet. There is one isolated peak rising out of the eastern edge of Kobeh Valley, it is about 8,000 feet in elevation at the top, having a vertical relief of over 1,800 feet from the valley floor.

Slopes along the Wye Branches are generally subdued in the central part of the site but approach the maximum permissable grades on the ends of the northern and southeastern branches. The northern branch may have a grade of about 1 percent for a short distance just north of the apex. The last 2 miles the grade would vary between 1 and 1.5 percent. Along the remainder of the branch, the grade would vary from 0.5 percent to 0.75 percent.

The grade along most of the southeastern branch would not exceed 0.5 percent. About 2 miles southeast of the U. S. Highway 50 crossing the grade increases to as much as 1.5 percent over a distanceof about 1 mile.

The first 4 1/2 miles of the southwestern branch cross the low sand and gravel benches that have moderate local relief causing grades of at least 2 percent over short distances. The remainder of the alignment has grades of 0.5 to 0.75 percent. It is not felt that the localized steepgrades are a problem because the underlying material can be readily excavated and used for embankment material in the low areas to the southwest. Also, the roadbed canbe curved around areas where excavation to reduce the grade might prove burdensome.

There are no perennial streams within the site area, but there are a substantial number of stream channels that carry water during periods of moderate to heavy rainfall. Except near the base of the mountains surrounding the valley, the drainages are broad and rather poorly defined due to the slight gradient and the sandy character of the soils. Coils Creek, which is the primary drainage, carries water from the Simpson Park Mountains to the west, the Roberts Mountains to the north, and the Monitor Range to the south. During periods of heavy runoff, the surface flow in coils Creek extends entirely across the site area from northwest to southeast and empties through Devils Gap at the eastern edge of Kobeh Valley. In 1964 a flow of 8 cubic feet per second was measured on Coils Creek in the northern part of Kobeh Valley during a period of heavy precipitation.

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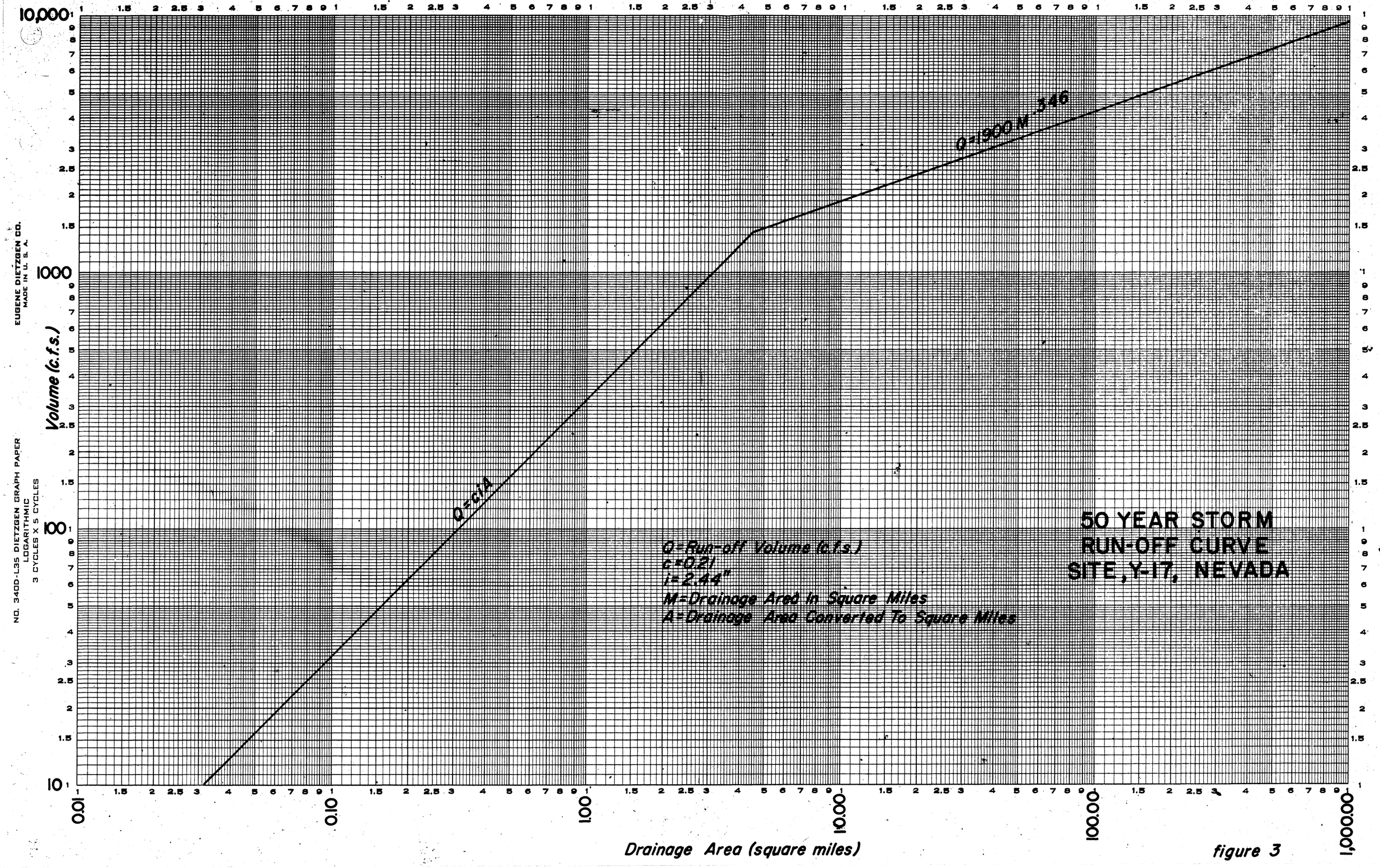


figure 3

The northern branch of the Wye would require a minimum embankment elevation for the roadway over most of the length because theunderlying area is an old alluvial bench that is made upprimarily of moderately permeable sand and fine gravel. The low area just north of the apex and the relatively low areas along the last two miles of the branch would necessitate somewhat higher embankments. Probably 2 feet would be satisfactory for the area at the end and 2 to 4 feet through the lowland areas. (The drainage structures required for the Wye are shown on Exhibits 10, 11 and 12).

In the lowland area in which most of the southwestern branch lies, the drainage patterns are discontinuous and during heavy rainfall the water would tend to pond and then slowly drain off to the east. The underlying sediments are composed primarily of sand and gravel, but in the lowland areas there is a 2 to 3 foot zone of relatively impermeable soil. Embankments should generally be about 2 feet in height except in areas of substantial ponding where the height should be increased to at least 23 feet. (Chart B)

About 60 percent of the southeastern branch crosses well drained sand and gravel bench deposits and in these areas only a minimum embankment elevation would be required. An embankment of about 3 feet should be used on most of the remainder of the roadbed. Near where the Wyecrosses U. S. Highway 50, there is a particularly low area that is adjacent to the confluence of several drainages, including the main channel of Coils Creek. Several moderate sized culverts will be needed to carry what could be sizeable flood flows from Monitor Ridge and the Mahogany Hills. (Figure 3)

5. Railway

The railway tracks will consist of 90# relayer rails on untreated hardwood, random cut, industry grade ties. Ties will be at 28 inch spacing and will be supported by 6 inches of gravel ballast. Tie plates and joint bars will be used material,

with other accessories being new. The tracks and ballast section will be constructed by approved methods and procedures to meet AREA specifications. All rails will have terminal stops. The sub-grade shall have a rating CBR-10 or better. Borrow material is expected to be obtained within the right-of-way and within free haul distance in most cases. Gravel will be obtained from sources now existing in the area and from new developed locations to reduce haul distance. These pits are generally negotiated between the contractor and the land owner. Water for construction may require new wells to supplement those existing in the area.

Stripping of a 3-6 inch deep layer of ground surface of the Y-17 site will be required to remove existing vegetation prior to placing embankment material.

The observation station foundations will be constructed of poured-in-place concrete and will be the under-reamed bell type. For most of the observing station foundations bell bottom concrete footings at 15 foot depths will be used. The shaft will be 4 feet in diameter and the bell bottom 8 feet in diameter. One footing will be located for each leg position at the observing stations. Similar foundations will ɔe constructed at the spur intersections for transfer of the antenna from the main ɔranch.

The staging area covers 24,000 square feet. The area will be paved as follows: ıardstand area to have 2-1/2 inches of asphaltic concrete over 6 inches gravel base ɔn prepared sub-grade; remaining area to have bituminous double surface treatment ɔver 4 inches of gravel base on prepared sub-grade. Material and construction to ıeet Asphalt Institute Specifications. The access to the staging area from the uilding complex will be by gravel road. This road will be 8,400 feet long for -17. Drainage will be minimal and existing flowdelineations will generally be rossed by construction of dips through thewashes.

6. Access Road

The entrance road from themain highway to the building complex will have a

wearing course of asphaltic concrete ona 6 inch gravel base. The roadway will be 24 feet wide with 2 foot wide shoulders. It is 4 miles long for Y-17. This road is designed for the traffic classification designated "light" and based on the average daily number of equivalent 18,000 lbs. single axle load applications expected. Mix design criteria, specifications and construction methods are MS-2 and SS-1 from the Asphalt Institute.

The access road from the building complex to the airstrip, the staging area and the Wye vary from the entrance road design only in width; design section is the same. Total length of all Y-17 access roads is 6.7 miles.

7. Airstrip

The airstrip will run approximately southwest-northeast to face the prevailing wind on the site. The landing strip will be 150 feet wide with paved runway 75 feet wide and 7,000 feet long.

A 1,000 foot clear zone precedes the airstrip at each end to provide for a 20:1 glide approach. The length of the runway is determined by the altitude (6,180 feet above sea level) and the mean maximum temperature (80°F.).

A 30 foot wide paved taxiway and 150 feet x 200 feet paved apron are located at one end of the airstrip. The runway, taxiway and apron are surfaced with bituminous triple surface treatment on granular base. The mix, placing, shaping and consolidation of the paved areas shall be to the Asphalt Institute specifications and modified Proctor of 90%(AASHO - T180-57). The paved areas can accommodate a 15,000 lb. wheel loading which is equivalent to DC3 class aircraft. The airstrip will be equipped with a wind cone and serviced bya paved access road.

8. Water Supply

The source of the water supply isan underground acquifer which will be tapped by drilling a 10 inch diameter well and casing the well to 8 inches. Delivery of the water will be by an electric, submersible, centrifugal pump in the well. The

pumped water is conveyed by pipe to anelevated 65,000 gallon storage tank. This tank will contain a three-day domestic supply and 50,000 gallons of water for fire delivered at the rate of 400 gallons per minute for a two-hour duration. Distribution from the storage tank is by gravity through a chlorinator and zeolite filter prior to consumption at the building complex.

The streams in the central part of the site area flow only intermittently. The primary source of water would be wells drilled in the valley alluvium. According to Rush and Everett (1964), the Kobeh Valley has a subsurface water storage potential of 2.7 million acre feet. The acquifer is recharged by rainfall and by runoff from the surrounding mountains; the amount of recharge is estimated to be 17,000 acre feet per year.

There is one stock well near the apex, but no information concerning it is available. The water has satisfactory color and taste. There is a slight buildup of salts around the outflow pipe indicating to some extent a hard water. The flow from the well as drawn by a wind-powered pump was estimated to be 2 gpm at the time the site was visited in November of 1969. It is probable that a yield of 10 gpm could be obtained from a well in the area. The depth to the water table in the bottomland is estimated to be 50 feet to 100 feet. (Chart D)

9. Utilities

The area of site Y-17 at present isnot served with power; however, the Mount Wheeler Power, Inc. has made application for a certificate from the Public Service Commission in Nevada with anticipated approval in December 1969. Indications are that after approval of this certificate, service cannot begin in the area until April of 1971.

The length of power line that would have to bebuilt to serve site Y-17 is approximately 29 miles at a cost of $146,870.00. The VLA facility power requirements for site Y-17 would require an increase inthe conductor size for about 13

miles of line for the proposed Diamond Valley substation. Capacity of the Diamond Valley substation will be adequate. The minimum monthly charge for service for Y-17 would be $2,203 per month. The average monthly charge is determined by the demand and energy charge. This would be estimated at approximately $10,373.00 per month. A letter from Associated Engineers, Inc., 2520 State Street, Salt Lake City, Utah, concerning the Mount Wheeler Power, Inc., isenclosed along with a copy of the breakdown of cost and billing schedule. (Appendix A)

A completely automatic 500 KV diesel driven emergency generator set is included in the budget for this site.

The area of the site is served by the Bell Telephone Company of Nevada with offices at 689 Lyons Avenue, Eureka, and 115 W. 5th Street, Austin, Nevada.

10. Real Estate

The Y-17 site lies approximately 20miles west of Eureka, Nevada. It is in an area devoted primarily to cattle ranching; however, there are some sub-irrigated pastures and haying meadows in the lowareas along the draws. There is also an extensive area that cuts through the western portion of the taking that is referred to as Bean Flat, and this land is typically a wide alkali draw with sparse ground cover.

The BLM office in Battle Mountain, Nevada, reports that applications to acquire public lands in Kobeh Valley totalling 6,400 acres are presently pending under provisions of the Desert Land Act.

This property is quite complex since each of the Wye branches cross different types of land. It is anticipated that there may be extensive damage to both public and private lands since a public highway is crossed, two (2) watering stations are affected, several county maintained roads are materially disrupted, and irrigated haying pastures will be bisected.

It is estimated that there will be approximately 140 acres of private land and 2820 acres of BLM land affected by the taking in this instance. A breakdown by

classification of the land required reveals approximately 140 acres of irrigated hay land, 500 acres of sub-irrigated pastures, and approximately 2320 acres of grazing land.

Haying land is estimated to have a value of approximately $300 per acre. Since the fields will be damaged, we have utilized an estimate of $450 per acre for the haying land that would be taken. Sub-irrigated land has an estimated value of from $30 to $40 per acre. We have utilized a $40 per acre figure since this should cover any damages to the property. Grazing land isestimated to have a value of $15 per acre. (Chart G)

Irrigated Hay Land	
140 acres @ $450 =	$ 63,000
Sub-irrigated Meadows	
500 acres @ $40 =	$ 20,000
Grazing Land	
2,320 acres @ $15 =	$ 34,800
TOTAL CALLED	$117,800

F. Y-22, NEW MEXICO

1. General Site Features

The VLA site Y-22 (Exhibit No. 13) is located approximately 19 miles east of Lordsburg, New Mexico. The apex of the array is 4-1/2 miles north of Separ, New Mexico, which is situated on Interstate Highway 10. The apex is at latitude 32°15.6'N, longitude 108°24.2'W, elevation 4,670 feet above mean sea level. The branches of the Wye are spaced at 120° angles from a common apex and with a true azimuth of 108° for the southern branch. (Exhibits 14, 15, and 16)

The Y-22 site is located mainly on the northern slope of a broad, east-west valley. The regional slope is southerly from thebase of the Burro Mountains at an average gradient of slightly over 1.5 percent. The base of the mountains is at an elevation of about 5,200 feet whereas the bottom of thevalley lies about 4,300 feet above sea level. The terrain varies from quite flat towards the center of the valley to moderately rolling near the mountains.

The San Simeon-Deming and San Simeon-Columbus controlled air spaces cross over the 13 mile radius circle encompassing the site. A lowaltitude federal airway designated as V94 crosses over the northeastern and northwestern branches of the Wye. (Chart A)

The southern branch of the Wye intersects the Southern Pacific Railroad (single track) and Interstate Highway 10 at a point approximately 4 miles south of the apex.

Radio navigational aids, radar relay stations, and electronic installations are shown on Chart A. There appear to be no satellite communication facilities which would conflict with the operation of this site.

There is a "defense area" associated with the Mexico-United States border located approximately 40 miles southeast of the site. When military activity is taking place in that general area, the FAA is informed and air traffic is routed away from

the area.

There does not appear to be any underground nuclear testing which would affect the area.

El Paso Natural Gas underground pipelines intersect the northwestern and northeastern branches of the Wye as well as the extremity of the southern branch. A southern Pacific products pipeline intersects the southern branch of the Wye at the intersection of the branch and the railroad.

Lordsburg, New Mexico, is 24 miles west of the proposed site. It has a population of 3,000 with the major income derived from tourism, farming, mining and ranching. (Charts C and D). Most of the mining is done at the Federal Resources Mine, Inc., located 5 miles south of Lordsburg. The mine employs about 150 people in the production of copper. Lordsburg isserved bythe Southern Pacific Railroad with one passenger train each way daily. Both the Continental Trailways and Greyhound bus lines serve Lordsburg and operate a total schedule of 20 bus departures daily.

There are 11 motels and 15 restaurants in the town. The community has a 25 bed hospital built in 1963, 2 physicians and 1 dentist.

The public school system serves 1,200 students and is accredited by the North Central Association. The student-teacher ratio is 24. The community has a mayor-council form of town government. The growth rate has been approximately 2 percent per year for the last 7 years. The town could probably absorb about 15 families by using available motels and trailer space. Available local labor is scarce and would be classified generally as unskilled. Recently a large gas line was constructed through the town and many workers on this job had to commute from Silver City, Deming, Wilcox, and Tucson. There appears to be an adequate supply of potable water in the town. The airport consists of a small dirt runway, no lighting facilities and with practically no services.

The town of Deming, New Mexico, which has a population of about 10,000, is approximately 45 miles east of the proposed site, and it is served by the same bus lines and railroad as Lordsburg. The Santa Fe Railway also has a line that runs through Deming but has freight service only. This branch line connects with the main line which runs between Albuquerque and El Paso and the Kennecott Copper Mine in the Silver City area.

Deming has a 40 bed hospital which was built in 1957. The town has 4 physicians and 3 dentists in residence.

The public school system in Deming serves approximately 3,540 students enrolled in 5 elementary schools, 1 junior high, and 1 senior high, which is accredited by the North Central Association. The student-teacher ratio of this system is 23.

Deming would appear to have available housing for 60 families. A recent survey indicated that the preponderance of the work force would be women who outnumber the men 1.6 to 1. There is an apparent supply of labor in the unskilled classification.

The city of Deming is governed by an elected city council and an elected mayor. The community has an airport with a 4,300 foot paved runway and medium intensity lighting. There are no commercial air facilities but local aircraft charter service is available. The nearest commercial air service for the Y-22 site is the Grant County Airport located near Hurley, New Mexico. Driving time to the airport is one hour and 20 minutes. Frontier Airlines has2 flights daily that connect with other major airlines in Tucson and Albuquerque. The El Paso International Airport is 2-1/2 hours driving time east of site Y-22 and is served by Frontier, Texas International, American and Continental Airlines. Tucson Airport is 3 hours driving time from the site with service available on American, Frontier, TWA, and Air West airlines.

The wage rates for skilled labor in the area are $6.35 an hour for construction workers and $5.50 an hour for electricians, plus subsistence. The unskilled rate is $3.78 per hour.

Two universities are located within 100 miles of the site. New Mexico Western University is located in Silver City, New Mexico, and has 4-year undergraduate programs in Arts and Sciences, Teacher Education and also offers Pre-Professional programs in several fields. Master's degree programs are offered in School Administration, Teaching, Guidance and Counseling and Business Administration. New Mexico State University is a Land Grant Institute located in Las Cruces, New Mexico. Undergraduate programs at the University include Agriculture, Arts, Commerce, Education, Engineering, Homemaking, Humanities, Industry, and Sciences. Master's programs are available in the Arts, Science, Engineering, Business Administration, and Education. Doctoral programs are offered in Education, Engineering, Philosophy and Science. The Clinton P. Anderson Physical Science Laboratory, an excellent research facility, is located at this university.

2. Climatology

The average daily maximum temperature at the Y-22 site is 78.3 degrees, and the average daily minimum temperature is 44.6 degrees. The highest temperature recorded is 110 degrees and the lowest recorded temperature is -9 degrees. (Chart E)

The average annual precipitation is 10 inches with a record maximum daily of 3.08 inches and a maximum monthly recorded as 6.46 inches. The mean yearly snowfall is 4.3 inches with a record maximum snowfall of 10.0 inches. The mean annual relative humidity is 45 percent. The amount of sunshine possible throughout the year averages 80 percent. The dust days per year for the site are estimated to average a total of 20. (Chart E) Hail occurs about 1 to 2 times per year. The prevailing wind direction for Y-22 is from the southwest. The average hourly wind speed for the year is 10.0 miles per hour with a maximum 50 year wind expectancy of 75 miles per hour. One tornado has been recorded in the area in the last 52 years. There are an average of 46 thunderstorms per year. The average solar radiation is 487 Langleys.

3. Geology and Foundation Investigation

The Y-22 site is located on thesouthern flank of the Burro Mountains in a broad, alluvium-filled valley that stretches from Lordsburg eastward beyond Deming. The branches of the Wye do not cross outcrops of bedrock, but there are a number of isolated volcanic hills and ridges bordering the eastern, southern, and western sides of the site. To the north, exposures of volcanic rock and granite occur a short distance north of the northwestern branch.

Since 1855 more than 600 earthquakes have been recorded in New Mexico, although only since 1959 have reports been based on instrumentation within the state of New Mexico. Most of the tremors have occurred in a narrow belt along the Rio Grand trough, and the Y-22 site probably has been subjected to only a few of the strongest earthquakes with epicenters in areas remote from the site. There are no known active faults in the region. (Chart B)

The northwestern branch lies on an alluvial fan radiating outward from the southern margin of the Burro Mountains. The bedrock of the mountains is primarily granite that is deeply weathered and fractured. As a result the alluvial outwash deposits are a relatively fine-grained decomposed granite with the gravel fraction varying from 10 to 40 percent. The maximum size is about 6 inches and the average is less than 1 inch. The matrix is silty sand with the fines constituting up to 15 percent by volume. This branch of the Wye lies close to the edge of the mountains where there are a great number of small washes that discharge water during the periods of heavy precipitation.

The northeastern branch is underlain by deposits of silty and clayey sand and gravel. In the exposures observed, the gravel fraction appeared to be 10 percent or less, and much of the terrain in this area appears to be more of an old alluvial surface rather than a fan deposit. Scattered outcrops of volcanic bedrock occur in the deeper arroyos that cross the western part of the branch. The rock is not

very resistant and in many places iscovered by at least 3 feet of alluvium.

The southern branch crosses an alluvial surface that slopes rather uniformly to the south. The alluvial sediments appear to decrease somewhat in size as the distance from Burro Mountain increases. The gravel fraction is not over 10 percent and is generally of pea size. The silty fines constitute 10 to 15 percent by volume, and the soil is slightly cemented with caliche in the zone 1 to 3 feet beneath the surface.

Embankment material can be obtained locally along all the branches of the Wye. The quality cannot be rated better than fair because of the fine texture and the content of silty fines. Good quality gravel does not appear to be readily available in the vicinity of the site. Poorly graded sand and gravel deposits occur at several localities around the base of the mountain. Theyare slope wash deposits which appear quite thoroughly coated with carbonate material.

Crushed stone for aggregate or ballast can be obtained from limestone outcrops in an isolated hill 1.5 miles north of the junction of Interstate Highway 10 and New Mexico Highway 81. According to Mr. D. K. Moore, District 1 Highway Engineer, of the New Mexico State Highway Commission, the limestone from this site has been crushed satisfactorily for highway construction purposes.

The bearing capacity of the soils throughout the site are estimated to range from very good on the northwestern and northeastern branches to good on the southern branch. Near the end of the southern branch in the ponding areas, the surface material bearing capacity may rate only fair.

The soil underlying the Wye branches generally has fair permeability except near the southern end where an impermeable surface layer has been built up in the areas of ponding.

An oil well has recently been drilled about 6 miles south of Separ, and there may be as much as one million acres under lease in the area south of Interstate

Highway 10. (Chart F). The well apparently was dry and has been abandoned. There are extensive exposures of granite to the north and widely scattered outcrops to the southwest and southeast, indicating that the sedimentary section is not very promising with regard to petroleum potential.

The largest mineral activity in the region is at Tyrone where the Phelps-Dodge Corporation is developing an open pit copper mine with large long term reserves. This operation is situated about 28 miles north of the Y-22 site apex. There have been numerous mining operations in the Burro Mountains between Tyrone and the site, but most of these were quite small and are not now active. The Lordsburg-Pyramid Mountains Mining District lies 20 mileswest of the site and there is some activity at the present time. A potential for uranium development occurs in the granite on the south edge of Burro Mountain a short distance north of the northwestern branch.

4. Topography and Drainage

Y-22 is centered on the northern side of a broad, east-west semi-arid valley covered with sparse grass and scattered sagebrush of several varieties. On the slopes directly adjacent to the mountains, the vegetation is primarily greasewood and mesquite with lesser amounts of low sagebrush. The only trees at the site are located in areas of habitation.

The apex of Y-22 lies at an elevation of approximately 4,700 feet. The base of the adjacent mountains to the north is about 5,200 feet and the highest parts of the mountain exceed 6,800 feet in elevation. The lowest part of the site is near the end of the southern branch where the elevation is about 4,340 feet.

From Interstate Highway 10 toward the Burro Mountains, the terrain becomes more sharply rolling and the drainages are more pronounced and deeply incised. This is particularly true along the northwestern branch because it lies directly adjacent to the edge of the mountains. In that area the branch crosses a succession of low ridges separated by narrow stream channels. The vertical relief between

adjacent high and low points would generally be 5 to 10 feet.

The first 6 miles of the northeastern branch is the most rugged terrain in the site because of the larger arroyos that occur along this section. The vertical relief along the margins of the Ninetysix Creek and in the Burro Cienega exceeds 40 feet and the resulting gradients in those particular areas before adjustment for cut and fill would be 3-1/2 to 5 percent. For the most part the grade along the 6 miles would not exceed 2 percent. The remainder of the northeastern branch would have slopes not exceeding 1 percent.

The first 3 miles of the southern branch would have a negative slope of 1.5 to 2 percent and then would taper off to less than 1 percent at a point about 9 miles from the apex. Near the end of the southern branch there is a section in the valley bottom of 3 miles where the gradient isvery slight. About the last mile of the branch has a positive grade of slightly less than 1 percent.

No perennial streams are found in the Y-22 site, and there are only 3 major drainages. Black Mountain Draw is the name given to the drainage in the center of the large valley in which the site is situated. (Chart B). Except during periods of heavy rainfall, the water is confined to a narrow ditch. Adjacent to the ditch are local ponding areas that tend to collect local rainfall and also to prevent sheet flow from reaching the ditch until the ponding areas overflow.

Ninetysix Creek, which is the largest drainage at the site, runs through the central part of the area in a southwesterly direction. Near the apex the stream conyon is over 1,000 feet in width and about 50 feet deep. The present streambed normally covers only a small part of the canyon bottom, although during periods of flooding, water may cover the entire canyon bottom. Burro Cienega would also carry substantial flows during flood periods. It has a width of approximately 600 feet and a depth of about 40 feet.

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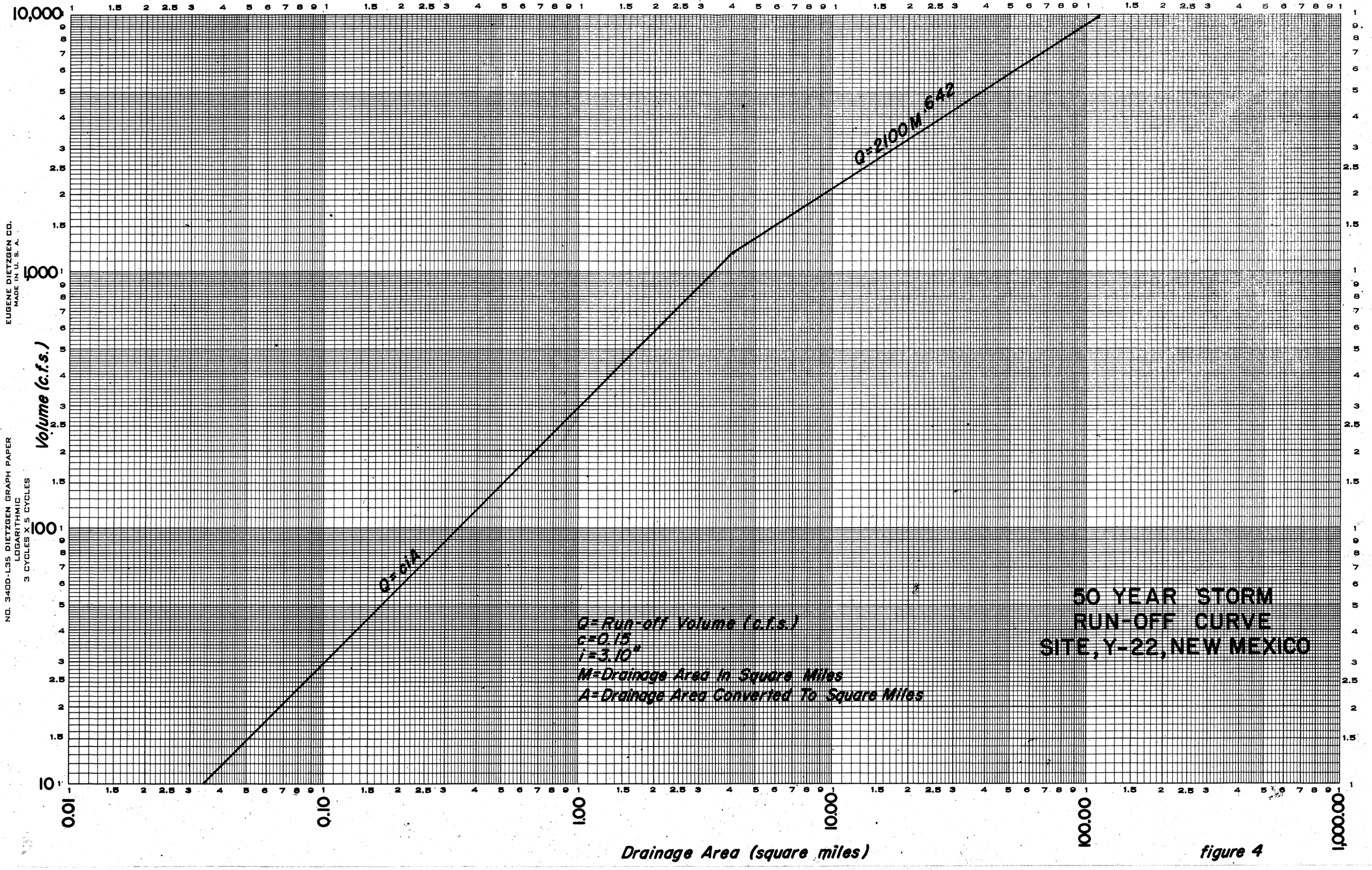


figure 4

In addition to the drainages mentioned above, there are a great many others, particularly along the northwestern branch. The stream canyons are typically narrow and have sandy bottoms. A visual inspection of the area gives the impression that these drainages very seldom receive enough water to maintain a surface flow. Within a distance of 3 to 4 miles from the edge of the mountains, this type of drainage rapidly disappears as the slope decreases.

During periods of heavy rainfall sheet flooding would occur in the areas of intermediate elevation. Protection against this type of flow can be taken care of by a combination of channelization and raising of embankment heights.

Along the northwestern branch embankment heights of 1 to 2 feet should be adequate, providing large enough culverts are emplaced to carry the expected flood flows beneath the roadway. Substantial fills will be required to minimize the grade of the roadway along the first 6 miles of the northeastern branch. In addition, an average embankment height of 1 to 2 feet should be maintained. A height of 1 to 2 feet should also be satisfactory along the southern branch except for a stretch of about 3 miles where the Black Mountain Drawis crossed. A 3 foot embankment would be required for this low area. (The drainage structures required for the Wye are shown on Exhibits 14, 15, and 16).

5. Railway

The railway tracks will consist of 90# relayer rails on untreated hardwood, random cut, industry grade ties. Tieswill be at 28" spacing and will be supported by 6" of gravel ballast. Tie plates and joint bars will be used material, with other accessories being new. The tracks and ballast section will be constructed by approved methods and procedures to meet AREA specifications. All rails will have terminal stops. The sub-grade shall have a rating CBR-10 or better. Borrow material is expected to be obtained within the right-of-way and within free haul distance in most cases. Gravel will be obtained from sources now existing in the

area and from newly developed locations to reduce haul distance. These pits are generally negotiated between the contractor and the land owner. Water for construction may require new wells to supplement those existing in the area.

The stripping of 3" deep of ground surface in Y-22 site is required to remove existing vegetation prior to placing embankment material.

The observation station foundations will be constructed of poured-in-place concrete and will be the under-reamed bell type. For most of the observing station foundations bell bottom concrete footings at 15 foot depths will be used. The shaft will be 4 feet in diameter and bell bottom 8 feet in diameter. One footing will be located for each leg position at the observing stations. Similar foundations will be constructed at the spur intersections for transfer of the antennae from the main branch.

The staging area covers 24,000 square feet. The area will be paved as follows: hardstand area to have 2-1/2 inches asphaltic concrete over 6 inches gravel base on prepared sub-grade; remaining area to have bituminous double surface treatment over 4 inches gravel base on prepared sub-grade. Material and construction to meet Asphalt Institute Specifications. The access to the staging area from the building complex will be by gravel road. This road will be 3.700 feet long for Y-22. Drainage will be minimal and existing flow delineations will generally be crossed by construction of dips through the washes.

6. Access Road

The entrance road from the main highwayto thebuilding complex will have a wearing course of asphaltic concrete on a 6 inch gravel base. The roadway will be 24 feet wide with 2 foot wide shoulders and is 3.7 miles long for Y-22. This road is designed for the traffic classification designated "light" and based on the average daily number of equivalent 18,000 lbs. single axle load applications expected. Mix design criteria, specifications and construction methos are MS-2

and SS-1 from the Asphalt Institute.

The access road from the building complex to the airstrip, the staging area and the Wye vary from the entrance road design only in width; design section is the same. Total length of all Y-22 access roads is 6 miles.

7. Airstrip

The airstrip will run approximately southwest-northeast to face the prevailing wind on the site. The landing strip will be 150 feet wide with paved runway 75 feet wide and 5,800 feet long.

A 1,000 foot clear zone precedes the airstrip at each end to provide for a 20:1 glide approach. The length of the runway is determined by the altitude (4,700 feet above sea level) and the mean maximum temperature (92°F.).

A 30 foot wide paved taxiway and 150 foot x 200 foot paved apron are located at one end of the airstrip. The runway, taxiway and apron are surfaced with bituminous triple surface treatment on granular base. The mix, placing, shaping and consolidation of the paved areas shall be to The Asphalt Institute specifications and modified Proctor of 90%(AASHO - T 180-57). The paved areas can accommodate a 15,000 lb. wheel loading which is equivalent to DC3 class aircraft. The airstrip will be equipped with a wind cone and serviced by a paved access road.

8. Water Supply

The source of the water supply isan underground acquifer which will be tapped by drilling a 10 inch diameter well and casing the well to 8 inches. Delivery of the water will be by an electric, submersible, centrifugal pump in the well. The pumped water is conveyed by pipe to an elevated 65,000 gallon storage tank. This tank will contain a three-day domestic supply and 50,000 gallons of water for fire delivered at the rate of 400 gallons per minute for a two-hour duration. Distribution from the storage tank is by gravity through a chlorinator and zeolite filter prior to consumption of the building complex.

A study of the water resources of the area has been performed by the U. S. Geological Survey. There are several wells in the general vicinity of the apex of the site, but most are stock wells and very little information is available concerning the production capabilities, acquifers, and water levels.

A well drilled in the vicinity of the apex could be expected to yield 5 to 50 gallons per minute and the water level probably would occur at a depth of less than 100 feet. (Chart D). The alluvial material and possibly the Gila Conglomerate form the potential acquifer, and these units wedge out against the granite core of the Burro Mountains about 3 miles to the north. It is possible that higher yields can be obtained from wells drilled at a greater distance from the bedrock outcrops.

Quality of the ground water varies from satisfactory to marginal. The total dissolved solids probably would not exceed 600 parts per million, but some wells in the region have sulphate contents at the upper limit of the acceptable scale and the fluoride content frequently exceeds the acceptable limit. At least one well in the region produces water with an abnormally high temperature.

9. Utilities, Y-22

The Columbus Electric Cooperative, Inc., of Deming, New Mexico, services the area for site Y-22. The existing electric service, which goes through Separ about 4-1/2 miles south of the apex of Y-22, isnot adequate to service the Wye and a new line from the sub station 8 miles south of Separ would berequired. This sub station is serviced by a 69 KV line. The distance from the sub station to the Y-22 site is approximately 13 miles which will require an estimated installation cost of $118,000.00. In addition to the estimated construction cost, which would apparently be borne by the VLA facility, there would be a monthly charge estimated at $3,000. (Letter of December 22, 1969, from Mr. B. Slover, Jr., manager of Columbus Electric Cooperative, Inc., Appendix A). It appears that a contract could be worked out which would enable the original installation charge to be paid off on a monthly basis by a

guarantee of a minimum number of use years.

A completely automatic 500 KW diesel driven emergency generator set is included in the budget estimated of the site.

The area is presently served by the Mountain States Telephone and Telegraph Company, with offices at 212 South Main, Lordsburg, and 120 West Maple, Deming, New Mexico.

10. Real Estate, Y-22 Site

The Y-22 site is in southern Grant County, New Mexico, approximately halfway between the towns of Lordsburg and Deming. The area is basically southwestern desert ranch land.

The property in the site area lies along the western slope and close to the Continental Divide. Near the apex of the Wye, there is a small ranch house. The southern branch crosses Interstate Highway 10, approximately 3/4 of a mile east of the community of Separ. This branch extends southerly within 1/4 of a mile of one windmill and 3/4 of a mile of a second windmill, aswell as within 1-3/4 miles of a ranch house. (Chart B).

The northeastern branch extends to within 1/4 of a mile of a windmill at the eastern extremity while the northwestern branch affects virtually no improvements.

Land in this area is typically sandy loam withwestern grama grasses, mixed browse, and interspersed with cacti.

The ownership pattern consists of approximately 800 acres of private land, 900 acres of BLM land, and 1,150 acres of State land.

There are no material problems affecting acquisition of the State land or the BLM land. These lands have been valued at $12 per acre (compensating for any damages to the lessees or permittees). Private lands have been valued at $50 per acre including compensation for damages. (Chart G)

Private Land	
820 acres @ $50 =	$41,000
BLM Land	
935 acres @ $12 =	$11,220
State Land	
1170 acres @ $12 =	$14,040
TOTAL Called	$67,000

G. Y-23, ARIZONA SITE

1. General Site Features

The VLA site Y-23 is located 40 miles west of Tucson along Arizona Highway 86. (Exhibit 17). The apex of the array is approximately 4 miles north of this highway and almost due north of the highway that branches southerly from Arizona 86 to Kitt Peak Observatory. The array apex is at latitude 32°05.0'N, longitude 111°35.3'W, elevation 2800' above mean sea level. All branches of the Wye are spaced at 120° angles from a common apex with a true azimuth of 355° for the northern branch. (Exhibits 18, 19, and 20).

The site lies primarily in the Aguirre Valley, a broad, sandy area that slopes off to the north with a gradient of slightly less than 1 percent. The apex of the Wye is about five miles south of the base of the steeply sloping Kitt Peak. Many small drainages cross the area tending to create a rolling topography.

Both the low altitude federal airways V105 (Chart A) and the low altitude approach pattern for the Tucson Municipal Airport cross this site. There are no railroads in the area of site Y-23.

Radio navigational aids, radar relay stations and electronic installations are shown on Chart A. There appear to be no satellite communication facilities which would interfere with the operation of this site.

The southern border domestic air defense identification zone between the United States and Mexico lies approximately 38 miles south of the site, and FAA restricted area R-2303A lies approximately 60 miles southeast of the site.

There is no underground nuclear testing which would appear to conflict with or affect this site.

Arizona Highway 86 is well aligned, reasonably high speed, two-lane highway connecting Tucson and Ajo, Arizona. (Chart C). This highway would be crossed by the southeastern branch of the Wye approximately 6-1/2 miles from the apex of

the array. A powerline parallels the highway in the area where the southeastern branch crosses.

The southwestern branch lies approximately 2 miles north of Highway 86 and parallels it for a considerable portion of its length. The northern branch does not conflict with any existing roads or utility lines.

The vegetation of the Y-23 site ranges from moderately dense stands of tall greasewood along the outer ends of the northern and southwestern branches to moderately dense to dense concentrations of Mesquite trees, Palo Verde trees, Cat Claw bushes, and Saguaro cactus along the remainder of the Wye branches. In many areas, such as around the apex, visibility is restricted to approximately 200 feet by thick stands of vegetation reaching about 20 feet in height. The only grass land of consequence occurs on the King Ranch and on the Papago Hereford Ranch where the native vegetation has been removed.

The nearest railhead to the site is in Tucson where the Southern Pacific Railroad provides direct or connecting service to all major rail centers.

The airport in Tucson provides the closest airline connection to the site. Air West, American, TWA and Frontier Airlines provide frequent flights, including jet service to New York, Chicago, Houston and the West Coast. Aeronaves de Mexico offers daily flights to major cities south of the border terminating in Mexico City.

The closest existing small airstrip to the site is located in Sells, Arizona, where there is a 2,700 foot long dirt runway.

The town of Sells is the nearest settlement of any size and is the headquarters of the Papago Indian Agency, Bureau of Indian Affairs, Department of the Interior. The population of Sells is approximately 750, mostly Papago Indians. The Bureau of Indian Affairs maintains a small hospital in Sells and there are a limited number of general merchandise stores, filling stations, grocery stores, etc., to

support the inhabitants themselves as well as the populace of the surrounding countryside. The Sells school comprisesgrades 1 through 10.

Tucson, 40 miles east of the site, has a population in excess of 300,000. It is an old historic city established in 1776 and still maintains the flair of its Spanish and Mexican heritage. There is a good selection of restaurants, hotels, motels, apartments, and housing developments which could more than adequately provide for the permanent and temporary personnel assigned to the VLA.

The public school system in Tucson is considered one of the finest in the country, providing curricula in both general and college preparatory courses. In the greater Tucson area, there are eight senior high schools and 88 junior high and elementary schools. There are four parochial senior high schools and twenty elementary and junior high schools. In addition, the highly accredited University of Arizona located in Tucson has an enrollment of more than 21,000 students in its 16 colleges and schools. Masters' Degrees are offered in 71 areas of study and Doctorates in 42 fields. The University has a wide and varied cultural program, which is shared with the public, consisting of programs in Art, Music and Theater, as well as forums and lectures.

Tucson has 5 large community hospitals with specialists in many fields of medicine practicing in the area. It also has a wide variety of churches, civic groups, recreation opportunities for both active and spectator sports, art museums, banking and stock brokerage firms, and shopping facilities.

As could be expected of a city the size of Tucson, there is an adequate supply of skilled labor available. Construction worker wages are $5.60 per hour; however, the construction trades are highly unionized and require portal to portal pay when working outside of Tucson. (Chart D).

2. Climatology

The climate at the Y-23 site is simlar to that in Tucson. (Chart E). The

average daily maximum temperature is 81.4 degrees and the average daily minimum is 58.6 degrees. The record high temperature is 117 degrees and the record low is 19 degrees. The average yearly precipitation is 12.8 inches with a maximum of 6.0 inches falling in any one day or 6.30inches falling in any one month in the last 24 years.

The area is subjected to local extremely heavy downpours. During one such storm in September, 1962, over 6 inches of rain fell on the site in a 24 hour period. This storm created severe flooding in the site area for three days. (See Exhibit 17).

The average relative humidity is 44 percent with the amount of sunshine possible averaging 86 percent. The maximum wind velocity reported in the last 18 years was 58 mph with a maximum 50 year expectancy of 67 mph. Average wind velocity is 7.8 mph. Tornadoes in the area are almost non-existent, although there was a tornado in the Tucson area in 1964. In the past 25 years, there has been an average of 35 thunderstorms per year. These thunderstorms produce infrequent hail, and the maximum size reported was 1/2 inch.

The area is occasionally dusty as can be expected in a relatively arid climate. Average solar radiation is 513 Langleys.

3. Geology and Foundation Investigation

The Y-23 site is situated primarily within the upper part of the Aguirre drainage system, although the southwestern and southeastern branches of the Wye extend into the Baboquivari and Altar Valley drainages.

The apex lies on a sloping alluvial surface at an elevation of about 2,800 feet. The area is ringed on three sides by mountain peaks that reach elevations of up to 6,875 feet. The North and South Comobabi Mountains border the area on the west, the Roskruge Mountains form the eastern boundary, and on the south the

area is bounded by the Quinlan Mountains. To the north the Aguirre Valley slopes off at a rate of about 50 feet per mile.

The pre-Tertiary formations in the area west of Tucson have a predominant northwesterly alignment. This alignment is reflected in both the faulting pattern and the geological outcrop pattern. The area has been considerably affected by faulting, folding, and the intrusion of various types of igneous bodies, some of which have been emplaced as recently as Tertiary time.

According to Dr. John Sumner, a professor of Geophysics at the University of Arizona, the Tucson area is subjected to periodic small intensity earth tremors. The last reported earthquake that caused extensive damage to buildings occurred in 1877; however, it is believed by experts that high intensity, damaging earth tremors possibly accompanied by earth fracturing, could occur in the Tucson area at some time in the future. (Chart B). There are no active faults in the area at the present time.

In recent geologic time the region has been subjected to extensive erosion that has carved deep valleys and then filled them with up to several hundred feet of sand and gravel. Most of the Cretaceous and Tertiary strata have been removed from the upland areas and these eroded materials have undoubtedly provided the source for a large percentage of the alluvial deposits.

Good quality, angular, well graded, relatively clean sand can be obtained from the surficial deposits that underlie much of the area covered by Y-23.

The sandy material is comprised primarily of decomposed granite derived from granitic rocks that underlie the Quinlan and Coyote Mountains. Because of this fact, the best source areas for sand would be the alluvial deposits that radiate outward from these mountains.

Quaternary terrace deposits are the best source of gravel. Good exposures of this material occur in road cuts along State Highway 86 about 7.5 miles south-

west of the Kitt Peak Junction. The material is up to 20 feet thick and lies directly on a truncated bedrock surface. It is light brown to light gray, moderately consolidated conglomerate with 3 to 4 foot lenticular beds containing up to 70% well graded gravel. The matrix is silty sand with calcium carbonate veining. The conglomerate clasts generally are sub-rounded and average 3 to 4 inches in size, but occasionally range up to 14 inches in maximum dimension. The thin intercalated sandstone beds are composed of silty sand containing up to 15% fines. The conglomerate probably could be crushed satisfactorily to make concrete aggregate.

Other exposures of this material occur extensively along the east side of Baboquivari Valley, but in many places the conglomerate constitutes such a thin veneer over the bedrock that excavation would not be feasible.

Scattered deposits of the terrace material also occur north of Kitt Peak, and although they appear to be thin and discontinuous, a test drilling program might locate a pit area of satisfactory size within 4 miles of the Y-23 apex.

The best source for crushed rock is in the area of low hills just east of Sells. The rock is a hard, greenish-gray andesite that has been moderately well fractured. There is a minor amount of alteration in some areas.

The most centrally located source for crushed rock would be near where the southeastern branch crosses State Highway 86. The rock is a greenish-gray andesite somewhat similar to that in the Sells area, but the amounts of fracturing and alteration are somewhat greater suggesting that there would be considerably more waste in the quarrying operation.

About 6 miles northwest of the apex there are two isolated hills underlain by hard, black basalt. The rock is veryresistant and possibly would be difficult to break into small enough fragments for crushing.

Moderately good aggregate can be obtained by crushing gravel from the terrace deposits. The angularity of the aggregate would not be nearly as good as that

from one of the sources of crushed rock.

No clay deposits of good quality were located in the Y-23 area; however, a silty clay with medium plasticity and moderate dilatancy occurs along State Highway 86 about three miles east of Sells. The permeability of the silty fraction might make necessary the addition of sealing compounds in order to use the silty clay as a pond lining.

Additional test drilling and laboratory testing will be necessary in order to determine the extent of usable deposits and thequality of the materials for various applications.

Visual inspections were made of the soils, vegetation, and drainage features along each of the branches of Y-23. In addition, six test holes were drilled in order to study the sub-surface soil characteristics.

In the vicinity of the apex, the soil is a rather cohesionless silty sand consisting primarily of granitic detritus. This type of material will require a moderate amount of compaction during roadway construction. Some caving probably will occur in the upper part of footing excavation. About five miles north of the apex, the soil contains considerably more fines and as a result is more cohesive. The percentage of clayey and silty material appears to increase progressively outward along the northern branch of the Wye until the Aguirre Wash is reached. Surfician silt is widespread as a result of periodic flooding in the low areas.

Along the southeastern branch sandysoil prevails throughout most of the section from the apex to State Highway86. About two miles northwest of the highway this branch crosses bedrock exposures of a fractured andesite. The andesite outcrops are continuous almost the entire distance to the highway. Blasting will be required along at least 1,000 feet of the line during the roadway construction; however, because the roadway design is quite flexible, it

might be more practical in most places to construct a shallow fill section over the bedrock.

The southwestern branch of Y-23 is underlain by soils grading from sandy at the apex to moderately cohesive silty and clayey sand at the southwestern extremity. Gravel is present in varying amounts along the middle of this branch as a result of reworking of the Quaternary terrace deposits exposed along the valley perimeter. About three miles southwest of the village of Haivana Nakya, this branch crosses a low area within the upper reaches of the Sells Wash. The soil is stable when dry, but there are indications that silt has accumulated in the area due to flooding in recent years.

During field work, which was conducted in September of 1966, there were heavy rains that rendered much of the rugged, gullied terrain of the northern branch impassable to 4-wheel drive vehicles. This was particularly true of the area adjacent to Aguirre Wash where thick silt deposits have been built up. Flash flooding was common along the highway between Tucson and Sells, and unpaved roads were nearly impassable due to muddy conditions.

Three test holes drilled adjacent to the southwestern branch of Y-23 encountered silty sand with some intercalated beds of silty, sandy gravel and silt. The highest gravel percentage was about 40; however, the actual percentage in some areas probably is somewhat higher as the small diameter of the auger did not permit the large sized clasts to be sampled. The penetration resistance tests in the three holes showed a blow count per foot of from 20 to 44 at a depth of 2 feet, from 12 to 26 at 5 feet with refusal in one hole, and 34 at 10 feet with refusal in 2 holes.

Three test holes were drilled along the southeastern branch of Y-23 and the soils in these holes were predominantly silty sand with minor amounts of fine gravel. A hole near State High 86 was drilled through clayey deposits that

LOGARITHMIC
3 CYCLES X 5 CYCLES

Volume (c.f.s.)

1000

100

10

$Q = 1000 M^{.431}$

$Q = cIA$

Q= Run-off Volume (c.f.s.)
c = 0.40
I = 2.50"
M= Drainage Area In Square Miles
A= Drainage Area Converted To Square Miles

50 YEAR STORM
RUN-OFF CURVE
SITE, Y-23, ARIZONA

0.01 0.10 1.00 10.00 100.00 1000.00

Drainage Area (square miles)

figure 5

probably are an alteration product of the andesite bedrock that crops out to the northwest. The penetration resistance tests showed a blow count per foot of 18 to 52 at a depth of two feet, 13 at five feet with refusal in two holes, and 12 at 10 feet with refusal in two holes.

No test holes were drilled along the northern branch because access was denied at the time the drilling program was performed.

Mineral activity in the Y-23 site area is minimal at the present time although several copper, manganese and tungstenprospects arelocated on the northeastern and southwestern flanks of Kitt Peak. The tungsten deposits, which occur about 12 miles southwest of the apex, have the greatest potential for future development. A large group of active mines are situated about 24 miles north of the Wye apex. (Chart F).

4. Topography and Drainage

The ground elevation along the northern branch of this Wye has a differential of 735 feet. This occurs as a gradual decline from the intersection of the Wye to station 686+40 at Aguirre Wash. The surface of the ground along the axis is broken with occasional washes although the drainage flow is in the same general direction as the branch.

Drainage provision for the northern branch will require that the railway surface be elevated above the existing ground for the entire length. The embankment will need erosion protection on the upstream side. It must be noted that this branch will be inundated for most of its length with a reoccurrence of a flood of similar or greater magnitude than the one in September, 1962. Diversion channels and dikes must be constructed at several areas along this branch to assist in flood control. (Chart B).

The drainage requirements on this branch are: four 10'x10', three 8'x8'

and seven 8'x4' box culverts; three 42" diameter, ten 48' diameter, six 54" diameter, and sixteen 60" diameter pipe culverts. (Figure 5).

The southeastern branch is crossed by drainage washes and gullies which carry the runoff from the Coyote Mountains. Erosion protection will be required along the upstream side of the embankment from station 640+00 to station 686+40.

The drainage requirements for the southeastern branch are: seven 10'x10' box culverts; five 30" diameter, seventeen 36" diameter, thirty-one 42" diameter, forty-five 48" diameter, nine 54" diameter, eighteen 60" diameter, and fourteen 66" diameter pipe culverts.

The southwestern branch of this Wye will cross many well-defined washes and gullies carrying drainage from the Quinlan Mountains and Comobabi Mountains. The major wash encountered is the Comobabi Wash at station 592+00 just above its junction with Sells Wash. The Comobabi Wash is one area of possible flooding from high intensity precipitation. It is interesting to note that the Sells Wash developed 17,200 cfs peak discharge at the Village of Sells in the September 1962 flood.

The drainage demand on this branch is: two 10'x8', and two 10'x10' box culverts; one 24" diameter, nineteen 30" diameter, thirty-five 36" diameter, thirty-two 42" diameter, thirty-one 48" diameter, eight 54" diameter, seventeen 60" diameter and four 66" diameter pipe culverts.

Channels and dikes will be required to assist in drainage control for sections of the northern branch and the southeastern branch of Y-23. The erosion protection will be provided by gabions, riprap and fencing.

Should this site be selected for the VLA installation, additional criteria should be determined to develop more pertinent drainage divisions in regard to flash flooding.

5. Railway

The railway tracks will consist of 90# relayer rails on untreated hardwood, random cut, industry grade ties. Ties will be at 28" spacing and will be supported by 6" of gravel ballast. Tie plates and joint bars will be used material, with other accessories being new. The tracks and ballast section will be constructed by approved methods and procedures to meet AREA specifications. All rails will have terminal stops. The sub-grade shall have a rating CBR-10 or better. Borrow material is expected to be obtained within the right-of-way and within free haul distance in most cases. Gravel will be obtained from sources now existing in the area and from newly developed locations to reduce haul distance. These pits are generally negotiated between the contractor and the land owner. Water for construction may require new wells to supplement those existing in the area.

The stripping of 12 inches deep of ground surface on Y-23 site is required to remove existing vegetation prior to placing embankment materials.

The observation station foundations will be constructed of poured-in-place concrete and will be the under-reamed bell type. Soil bearing with minimum settlement potential for the observation station foundations indicate 10,000 psf at 10 ft plus depths for the Y-23 site. For most of the observing station foundations with bell bottom concrete footings at 15 foot depths will be used. The shaft will be 4 feet in diameter and the bell bottom 8 feet in diameter. One footing will be located for each leg position at the observing stations. Similar foundations will be constructed at the spur intersections for transfer of the antenna from the main branch. It is anticipated that the last 12 observation stations on the north branch of the Wye may require special investigation due to deteriorating foundation conditions in the Aguirre Wash and adjacent areas.

The staging area covers 24,000 square feet. The area will be paved as follows: hardstand area to have 2-1/2 inches of asphaltic concrete over 6 inches of gravel base

on prepared sub-grade; remaining area to have bituminous double surface treatment over 4 inches of gravel base on prepared sub-grade. Material and construction to meet Asphalt Institute Specifications. The access to the staging area from the building complex will be by gravel road. This road will be 2,000 feet long for Y-23. Drainage will be minimal and existing flow delineations will generally be crossed by construction of dips through the washes.

6. Access Roads

The entrance road from the main highway to the building complex will have a wearing course of asphaltic concrete on a six inch gravel base. The roadway will be 24 feet wide with 2 foot wide shoulders. It is 14,800 feet long for Y-23. This road is designed for the traffic classification designated "light" and based on the average daily number of equivalent 18,000 lbs. single axle load applications expected. Mix design criteria, specifications and construction methods are MS-2 and SS-] from the Asphalt Institute.

The access road to the airstrip from the Wye to the building complex and those servicing the building complex area, including the parking lot, vary from the entrance road design only in width; design section is the same. Total length for Y-23 access roads is 21,350 feet. Drainage for Y-23 access roads is provided by one 30" diameter, four 42" diameter, four 48" diameter; and one 54" diameter pipe culverts.

7. Airstrip

The airstrip will run approximately west-northwest to face the prevailing wind on the site. The landing strip will be 150 feet wide with a paved runway 75 feet wide and 4,200 feet long. A 1,000 foot clear zone precedes the airstrip at each end to provide for a 20:1 glide approach. Thelength of the runway is determined by the altitude (2,900 feet above sea level) and the mean maximum temperature (100 degrees F.).

A 30 foot wide paved taxiway and 150 foot x 200 foot paved apron are located

at one end of the airstrip. The runway, taxiway and apron are surfaced with bituminous triple surface treatment on granular base. The mix, placing, shaping and consolidation of the paved areas shall be to the Asphalt Institute specifications and modified Proctor of 90%(AASHO-T180-57). The paved areas can accommodate a 15,000 lb. wheel loading which is equivalent to DC3 class aircraft. The airstrip will be equipped with a wind cone and serviced by a paved access road. Airstrip drainage is provided with one 42 inch diameter, two 72 inch diameter, and three 84 inch diameter pipe culverts.

8. Water Supply

The source of the water supply is an underground acquifer which will be tapped by drilling a 10 inch diameter well and casing the well to 8 inches. Delivery of the water will be by an electric, submersible, centrifugal pump. The pumped water is conveyed by pipe to an elevated 65,000 gallon storage tank. This tank will contain a three day domestic supply and 50,000 gallons of water for fire delivered at the rate of 400 gallons per minute for a two hour duration. Distribution from the storage tank is by gravity through a chlorinator and zeolite filter prior to consumption at the building complex. (Chart D).

The acquifer in the Aguirre Valley is estimated to occur at a depth between 400 feet and 700 feet with a subsurface flow to the north. The drainage divide between the Aguirre Valley and Baboquivirre Valley is roughly along an east-west line just north of the Village of Haivana Nakya.

Potable water in sufficient volume to fulfill the VLA site requirement probably can be obtained in the vicinity of the Y-23 apex from a well drilled to a depth of from 600 to 800 feet. Water supply prospects are less favorable to the southeast as the water-bearing strata apparently wedges out south of the Haivana Nakya area.

9. Utilities

Electric power in the vicinity of the Arizona site is supplied by Trico Electric Cooperative, Inc., 1144 W. Miracle Mile, Tucson, Arizona.

This Cooperative presently has a 25,000 volt, 3 phase power line along State Highway 86 approximately 2.5 miles south of the planned building complex. This 25,000 volt distribution circuit feeds from a 7,500 KVA sub-station at Three Points. The Three Points voltage is regulated by a TCUL transformer. The sub-station is served by a 115,000 volt transmission line owned and operated by Trico.

Trico serves the National Observatory installation at Kitt Peak, the Sells Indian Agency, nine missile complexes around Tucson, three television stations atop Mount Lemmon and all other types of electrical consumers. Their service seems to be reliable and they use radio-equipped vehicular equipment on an around-the-clock service basis.

Included in Appendix A of this report are letters from Mr. McDonald, Office Manager of Trico, dated September 30, 1966, and November 14, 1969, indicating a construction cost of $34,000 to extend their present system to the building complex including the required transformers and circuit breakers. They propose that AUI pay Trico this sum of $34,000 asa refundable connection charge prior to the construction of the line. This cost then would be refunded at a rate of 15 percent of each monthly bill on the amount the bill exceeds the minimum charge. The monthly minimum charge will be based upon $0.75 per KVA of installed transformer capacity.

Trico is under the jurisdiction of the Arizona Corporation Commission and the approved large power rate is as follows:

Demand Charges

$1.75 per month per KW of billing demand

Plus Energy Charges

$0.02 per KWH for the first 50 KWH used per month per KW of billing demand.

$0.015 per KWH for the next 100 KWH used per month per KW of billing.

$.008 per KWH for all remaining KWH used per month.

A completely automatic 500 KW diesel driven emergency generator set is included in the budget estimate for this site.

Electrical service to the observing stations will be supplied by overhead lines from an outdoor 2,300 volt transformer. The secondary side of the transformer shall serve 2,300 volt switchgear which in turn will distribute power to three overhead lines which parallel the Wye branches. At each observing station there will be a 3 phase primary fused switch, transformer and panel board which will drop the voltage to 277/480 volts.

Telephone service in the general area of the Arizona site is by the Mountains States Telephone and Telegraph Company, a part of the Bell System. They will construct the required facilities into the site with no financial contribution by the AUI.

10. Real Estate

The Y-23 site is in Pima County, Arizona, approximately forty (40) miles west of Tucson, Arizona, near State Highway 86.

With the exception of approximately 4.4 miles of the southeastern branch of the Wye, all of the proposed site is within the exterior boundaries of Papago Indian Reservation. About 4.2 miles of the Wye outside of the Indian Reservation is on land that is privately owned by the King Ranch. The other 0.2 miles appear to be land owned by the State of Arizona. If the extreme end of this branch could be swung southwesterly approximately 3 miles, the major portion of the facility outside of the Indian Reservation would be on lands owned by the State of Arizona and it

is anticipated that negotiations would be much simpler than with the private land owners.

Land sales appear to be very active between Tucson and Three Points (junction of State Highway 86 and State Highway 286), with several sales as high as $350 per acre in lots of approximately 1,000 acres. There have been no sales west of Three Points within recent years; however, it is reasonable to assume that approximately $150 per acre would be required to purchase this land.

The customary lease of state land for grazing purposes is fifty cents (50¢) per animal unit month and estimating this land to carry approximately six to ten head of livestock per year per section would indicate about ten cents (10¢) per acre per year average lease for grazing purposes; however, it is estimated that a facility such as the subject would require approximately thirty cents (30¢) per acre per year to effect negotiations with the State Land Commissioner or $20.66 per mile of right of way 600 feet wide. It is also estimated that this figure would be the value of the right of way needed onthe Indian Reservation. Information was obtained that the name of the Deputy Land Commissioner in the State Land Office, Phoenix, Arizona, is Mr. Lewis Duncan and histelephone number is 271-4621, Phoenix, Arizona.

If private land is to be acquired for this facility, it is estimated that the lease on this land could not be negotiated for less than $1.00 per acre per year and might even be higher; therefore, it is recommended that consideration be given to shifting this portion of the facility southward to avoid as much privately owned land as possible. (Chart G).

Portion To Be Purchased

Private Land	
301 acres @ $150 =	$45,150.00
State Land	
28 acres @ $10 =	$ 280.00
TOTAL	$45,430.00
CALLED	$46,000.00

Portion To Be Leased

1349 acres @ $20.00 =	$26,980.00
1253 acres @ $ 0.30 =	$ 375.90
TOTAL	$27,355.90
CALLED	$28,000.00
TOTAL LEASE AND PURCHASE	$74,000.00

H. Y-27 TEXAS SITE

1. General Site Features

The VLA site Y-27 (Exhibit 21) has its center 23 miles west of Marfa, Texas, and approximately 1-1/4 mile south of U. S. Highway 90 and the Texas and New Orleans Railroad right-of-way. The apex of the array is at latitude 30°26.4'N, longitude 104°23.4'W, elevation 4,535 feet above mean sea level. The branches of the Wye are spaced at 120° angles from a common apex with a true azimuth of 356 degrees for the northern branch. (Exhibits 22, 23 and 24).

This site covers topographic areas ranging from generally sloping plains to low foothills. In the latter areas the vegetation types are controlled by the soil types. Where volcanic rock occurs on or near the surface, such as in the central part of the northern branch of the Wye and the end of the southwestern branch, the foothills are covered by sparse to moderate dense stands of greasewood growing up to four feet in height. In places where alluvial deposits occur, there is a moderately dense cover of low grass dotted with scattered yucca.

The plains areas are almost exclusively covered by grass varying from low and sparse in dry areas to "knee" deep and very thick in areas of high moisture. Most of the southwestern and southeastern branches cross this type of grass land. The central portion of the southeastern branch crosses several low ridges underlain by gravel deposits. In these areas there is a moderate covering of mesquite bushes with scattered yucca.

There appears to be no airways crossing the Y-27 site (Chart A). The Texas and New Orleans Railroad (single track) intersects the northern branch of the Wye at a point approximately 4-1/2 miles from the apex. This same railraod parallels the southeastern branch of the Wye at a distance of less than 1/4 mile for approximately the last 3-1/2 miles of the branch.

U. S. Highway 90 intersects the northern branch of the Wye at a point

approximately 4-1/2 miles from the apex. State Road 166 intersects the northern branch of the Wye at a point approximately 5 miles from the apex.

Radio navigational aids, radar relay stations and electronic installations which might conflict with operations at the site are shown on Chart A. McDonald Observatory, located at the approximate coordinatesof 30°30'N, 104°01'W, operates a transmitting and receiving station for laser beam operations to and from the recently installed apparatus (by Apollo 11) on the moon. There appears to be no satellite communication interference which would conflict with the site operation. The site lies within 40 miles of the southern border Domestic ADIZ between the United States and the Mexican border. There is no underground nuclear testing that would affect this site.

U. S. Highway 90 is a good, high speed, two-lane roadway which is being increased to four-lane in a number of sections between the site and the City of El Paso, 165 miles to the west. (Chart C).

As noted above, the Texas and New Orleans Railroad passes through the array and there is a rail siding approximately 5 miles east of the apex.

Marfa, with a population of 3,000, is the nearest town and is 23 miles east of the apex. It is served by The Texas and New Orleans Railroad and Continental Trailways Bus Line, but there are no scheduled airlines operating from the small municipal airport. The nearest available commercial air service is in Midland, Texas, which is 150 miles away. However, charter air service is available in Marfa.

The Marfa school system has approximately 800 students. The 1 high school is accredited by the Southern Association of Colleges and Secondary Schools. The town has a city library and municipal golf course. There are 7 churches and several civic clubs. There are 2 physicians and a private clinic in Marfa, but the nearest hospital is in Alpine, 28 miles farther east. This hospital, the Brewster County Memorial Hospital, has 52 beds. It serves all of Jeff Davis County, Presidio

County, and Brewster County. Seven doctors are on the staff and facilities are considered quite up to date.

Alpine, with a population of 5,000, is the home of Sul Ross State College, which offers a four year curriculum in the Arts, Education and Science fields. Alpine seems to be the cultural center in the area. Housing availability could probably absorb 25 families.

Ford Davis, which is 21 miles north of Marfa, has a population of slightly over 1,000. It is the closest town to the McDonald Optical Observatory on Mount Locke and also the Harvard Air Force Radio Observatory at Cook Flat.

It is expected that skilled labor would need to be drawn from a wide area for the construction and operation of the VLA facility. As an example of wage scales in the Midland, Texas, area, construction workers receive $5.10 per hour base rate. (Chart D)

2. Climatology

The average daily maximum temperature is82.5 degrees with the average daily minimum temperature of 57.3 degrees. (Chart E). The high and low temperatures are 111 degrees and -5 degrees, respectively. The prevailing wind direction is from the southeast with an average velocity of 10.4 mph and a maximum 50-year expectancy of 67 mph. The sun shines 67 percent of possible through the year. There are fairly severe dust storms several times per year. Relative humidity averages 60 percent over the year. The greatest daily rainfall recorded is 4.50 inches and the average annual rainfall is 17.83 inches. Solar radiation averages 528 Langleys.

The most interesting aspect of the climatology at site Y-27 concerns the incidence and severity of hail storms. Four severe hail storms have been recorded within the past 9 years. Hail stones from the 1966 storm were "golf-ball" size; in 1965, hail the size of "tennis balls" was recorded; and the 1962 records list

hail up to "baseball" size. Hail up to 12 inches in depth was recorded in 1966 and was 4 inches deep in the 1965 storm.

Tornado activity averages 1 per year.

3. Geology Investigation

The apex of the Y-27 site is situated about 12 miles southeast of Valentine, Texas, in a northwesterly trending structural and topographic basin of interior drainage that encompasses parts of Presidio and Jeff Davis Counties. The floor of the basin lies at an average elevation of about 4,500 feet.

On the northeast the basin is bounded by the sawtooth peaks of the Davis Mountains that rise to elevations in excess of 8,000 feet. The Sierra Vieja Mountains are a linear, tilted fault block that forms a prominent barrier on the southwest side of the basin. Peaks in the Sierra Vieja attain elevations of up to 6,400 feet. Low drainage divides on the gently sloping valley floor constitute the northwestern and southeastern boundaries of the basin.

Although there may be faulting of small to moderate scale within the basin, it is not readily apparent because of thelack of good outcrops. Some structural instability is indicated by the strong earthquake which was recorded on August 16, 1931. The intensity of this tremor as evidenced by measurements and an evaluation of surface damage was rated as 8 on a scale of increasing intensity from 1 to 12. In Valentine there was minor cracking of the earth and rather substantial cracking of concrete, brick, and adobe structures (Sellards, 1932). (Chart B)

The mountains surrounding the basin are composed primarily of bedded volcanic flows, tuff and agglomerate with interbedded tuffaceous sandstone and conglomerate, and thick conglomerate beds. The best section of the volcanic rocks is exposed near the Brite Ranch headquarters where over 1,800 feet of white-to-red colored, thick-bedded tuff deposits form a steep mountain face that is capped by about 100 feet of hard, gray rhyolite porphyry. In the Davis Mountains the volcanic rocks

have been intruded by a light gray, medium-grained, moderately micaceous granitic rock that appears to be a syenite according to its mineral composition.

Overlying rocks of the volcanic series are old terrace gravels, which in turn are mostly obscured by recent outwash deposits from the local mountains. The alluvial material generally contains gravel in percentages ranging from less than 10 to over 50. Near the center of the basin the deposits become progressively finer grained and consist primarily of silt, clay and sand.

The only local source of sand is from decomposed tuffaceous sand beds. It is doubtful that this source of sand would be of any value for use in concrete mixtures because of the unstable glass constituents. Sand could be obtained from local gravel deposits, but the cost of screening and washing the material might be prohibitive. The closest established commercial sources are at Gifford Hill (near Van Horn) and Fort Stockton -distances of 55 and 135 miles respectively. It is quite possible that other sources outside of the Valentine area could be developed, but further investigations would have to be made in order to determine the feasibility of such sources.

Gravel suitable for use as base course in road construction can be obtained locally from several places. A U. S. Highway90 resurfacing project in Jeff Davis County utilized caliche cemented gravels taken from a pit excavated in a low ridge situated about 4 miles west of Valentine. Laboratory analyses made by the Texas Highway Department show that of 104 tests of stockpile material crushed for use as flexible base, the average liquid limit and plasticity index were 33.5 and 11.7 respectively. The design criteria for this material called for a liquid limit not to exceed 35 and an allowable plasticity index of 12. According to Mr. Andrew Jones of the El Paso District Highway Office, 1 percent lime was added in order to meet the specifications. This step was necessitated due to the presence of high plasticity clay lenses within the gravel beds. Mr. Jones indicated

that material from the pit described above is typical of caliche gravel deposits from other pit locations between Valentine and Marfa.

Similar gravel deposits to those just described occur north of the end of the southeastern branch of Y-27. The results of a visual inspection of an old pit in that area indicates that the material to be quite similar to material in the pit west of Valentine. The deposit is a conglomerate that is white-colored due to the abundance of caliche cement. About 60 percent of the material is composed of sub-angular to subrounded clasts averaging 3 to 4 inches in size, but varying up to 12 inches in maximum dimension. The matrix is made upof caliche and sand with thin lenses of clay. Overburden along the ridge top is negligible. Other exposures in the same general area consist of caliche cemented conglomerate with thin, lenticular beds of fresh water limestone, thick bedded sandstone, conglomeratic sandstone, and sandy siltstone.

Conglomerate also occurs underlying the low hills south of the southwestern branch of the Wye at about the 7 mile point. Generally the material looks similar to that described above except that the conglomerate occurs in association with beds of white tuff and tuffaceous sandstone.

There is no local commercial source of aggregate in the Valentine area; however, igneous rocks exposed in the Davis Mountains should be suitable for aggregate if economic factors justify the cost of excavation and crushing. Large, resistant outcrops of granite occur in the Davis Mountains but are about 25 miles from the center of Y-27. Aggregate from volcanic rock outcrops probably could be developed within 12 miles of the apex. The main problem with the volcanic rocks is that the beds are not extremely thick and in many places the rocks have been folded, fractured, and have suffered alteration effects that would tend to minimize their usefulness. A core drilling program would need to be undertaken in order to determine the amount of usable rock available at each potential quarry site. Added to the

cost of the core drilling would be the cost of drilling and "shooting" the rock in order to prepare it for the crusher.

The current road project at Valentine utilizes aggregate transported by truck from the commercial plant at Gifford Hill, a haul of about 55 miles. This material is dense, reddish-colored rhyolite that occurs as an intrusive body within older rocks that crop out in the area west of Van Horn. The rhyolite crushes to a slightly tabular form, but it has proved satisfactory for Highway Department use.

A commercial rock crusher is located at Fort Stockton, and in this plant limestone deposits are used. The rock is light gray to white, dense, and crushes into angular, rather equidimensional forms.

Because of the volume of aggregate required for the Y-27 site development, it is believed that the location of a local aggregate source would be warranted. Laboratory analyses should be made of each potential quarry location before making a final decision as to the acceptability of the material.

In order to obtain as good an indication aspossible concerning the engineering qualities of the native soil, visual inspections were made along each of the Wye branches and 10 locations for test borings were selected in areas believed to be underlain by soils typical of the several typespresent in the basin.

Test borings along the northern branch of the Wye indicate that the soil consists mainly of sandy silt with percentages of fine gravel ranging from 0 to 45. The visual inspection reveals that adjacent to the present drainages the surface material is composed of sandy clays. The penetration resistance tests showed a blow count per foot of from 25 to 59 at a depth of 2 feet, 28 to 42 at 5 feet with refusal in one hole, and 45 at 10 feet with refusal in 3 holes.

Along the southeastern branch of the Wye, the soil varies from sandy silt on both ends to silty sand and gravel in thecentral portions. The sieve analyses of two samples show a gravel percentage that varies from 0 at the apex to 29 at the

midpoint of the branch. Surface indications are that in a few areas the gravel percentage may be even higher. The penetration resistance tests showed a blow count per foot of from 14 to 29 at a depth of 2 feet, 33 to 57 at 5 feet, and 45 to 58 at 10 feet with refusal in 2 holes.

Visual determinations and test borings along the southwestern branch of the Wye indicate the soil to be sandy silt except in the valley areas adjacent to drainage features where the deposits are clayey. Some sandy and rocky areas occur where the branch crosses outcrops of tuff or resistant volcanic beds. The penetration resistance tests showed a blow count per foot of from 35 to 37 at a depth of 2 feet with refusal in 1 hole, 29 at 5 feet with refusal in 2 holes, and 33 at 10 feet with refusal in 2 holes. Two of the tests were made adjacent to bedrock outcrops of rather limited extent, and the high penetration resistance obtained is not indicative of the branch as a whole.

Excavation of the alluvial material should be relatively easy along the three branches of the Wye. Some difficulty may be encountered locally where the branches cross exceptionally dense caliche zones or in the several areas where bedrock outcrops occur. Some ripping and even a minor amount of blasting probably will be required. In general the native soil should be satisfactory for use as embankment material when it is satisfactorily compacted. The high degree of compressibility of the saturated soil samples should be noted, for the volumes of water generated by the high intensity rainfalls in the area may cause parts of the roadway fill to approach a saturated condition.

An investigation of mineral exploration activity revealed that at least 3 oil wells have been drilled in the southern part of the site. (Chart F). All of the wells were dry and abandoned. Another well was drilled about 1 mile northeast of Valentine, and it also was dry and abandoned. There are no active mining claims in the immediate vicinity of the site.

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Volume (c.f.s.)

Q=560 M.393

Q=CiA

Q = Run-off Volume (c.f.s.)
c = 0.25
i = 3.00"
M = Drainage Area in Square Miles
A = Drainage Area Converted To Square Miles

50 YEAR STORM
RUN-OFF CURVE
SITE, Y-27, TEXAS

Drainage Area (square miles)

figure 6

4. Topography and Drainage

The northern branch of Y-27 rises gradually 265 feet from the Wye intersection to Station 686+40. It crosses U. S. Highway 90 at Station 240+28 and the Texas and New Orleans Railroad at Station 250+35. The country traversed by this branch and the southeastern and southwestern branches are mostly gently sloping and grass covered.

All three branches of Y-27 are subject to sheet flooding produced by the heavy rainfalls on the sloping mountain areas. This is apparent along the railroad where there is a four foot dike along the upper side to protect the trackage for the entire length of the southeastern branch of the Wye. (Chart B)

Control of the marshy areas and similar conditions could be easily accomplished but channelizing would be in conflict with the land usage, which is to purposely spread the water to produce better grass land. The Wye branch drainage system is designed to continue this practice. (Figure 6).

The preliminary drainage requirements of the northern branch consist of: two (2) 5'x60' box culverts to be located at approximately Stations 348+50 and 623+00; also, thirteen (13) 4'x20' box culverts to be spaced approximately every mile.

The southeastern branch follows the highway and railroad, having a gradual vertical rise of 355 feet from the apex to Station 560+00. The ground cover changes from the grassland to mesquite and yucca vegetation along the eastern half of this branch.

The preliminary drainage requirements consist of: two (2) 5'x50' box culverts to be placed approximately at Stations 132+00 and 356+40; also, thirteen (13) 5'x10' box culverts to be spaced approximately every mile.

The southwestern branch of Y-27 crosses 6 major drainage channels in its 13 mile length. This branch rises from the Wye intersection 80 feet to Station 120+50 where it then descends 150 feet to a major stream crossing at Station

330+75. From Station 330+75 the branch rises 375 feet to Station 686+40, where it terminates. The stationing for the 6 drainage channels are listed in the following paragraph.

The preliminary drainage requirements consist of: one (1) 8'x70' box culvert placed at Station 5+60; five (5) 5'x35' box culverts at Stations 79+00, 188+00, 237+50, 337+50, and 660+00 respectively.

5. Railway

The railway tracks will consist of 90# relayer rails on untreated hardwood, random cut, industry grade ties. Tieswill be at 28 inch spacing and will be supported by 6 inches of gravel ballast. Tie plates and joint bars will be used material, with other accessories being new. The tracks and ballast section will be constructed by approved methods and procedures to meet AREA specifications. All rails will have terminal stops. The sub-grade shall have a rating CBR-10 or better. Borrow material is expected to be obtained within the right-of-way and within free haul distance in most cases. Gravel will be obtained from sources now existing in the area and from newly developed locations to reduce haul distance. These pits are generally negotiated between thecontractor and the land owner. Water for construction may require new wells to supplement those existing in the area.

The stripping of 9 inches deep of ground surface at Y-27 site is required to remove existing vegetation prior to placing embankment material.

The observation station foundations will be constructed of poured-in-place concrete and will be the under-reamed bell type. For most of the observing station foundations bell bottom concrete footings at 15 foot depths will be used. The shaft will be 4 feet in diameter and bell bottom 8 feet in diameter. One footing will be located for each leg position at theobserving stations. Similar foundations will be constructed at the spur intersections for transfer of the antenna from the main branch.

The staging area covers 24,000 square feet. The area will be paved as follows: hardstand area to have 2-1/2 inches asphaltic concrete over 6 inches gravel base on prepared sub-grade; remaining area to have bituminous double surface treatment over 4 inches of gravel base on prepared sub-grade. Material and construction to meet Asphalt Institute Specifications. The access to the staging area from the building complex will be bygravel road. This road will be 5,280 feet long for Y-27. Drainage will be minimal and existing flow delineations will generally be crossed by construction of dips through the washes.

6. Access Road

The entrance road from the main highway to the building complex will have a wearing course of asphaltic concrete on a 6 inch gravel base. The roadway will be 24 feet wide with 2 foot wide shoulders. It is 2 miles long for Y-27. This road is designed for the traffic classification designated "light" and based on the average daily number of equivalent 18,000 lbs. single axle load applications expected. Mix design criteria, specifications and construction methods are MS-2 and SS-1 from the Asphalt Institute.

The access road from the building complex to the airstrip, the staging area and the Wye vary from the entrance road design only in width; design section is the same. Total length of all Y-27 access roads is 4 miles.

7. Airstrip

The airstrip will run approximately southeast-northwest to face the prevailing wind on the site. The landing strip will be 150 feet wide with paved runway 75 feet wide and 5,900 feet long.

A 1,000 foot clear zone precedes the airstrip at each end to provide for a 20:1 glide approach. The length of the runway is determined by the altitude (4,540 feet above sea level) and the mean maximum temperature (100 degrees F.).

A 30 foot wide paved taxiway and 150 foot by 200 foot paved apron are located

at one end of the airstrip. The runway, taxiway and apron are surfaced with bituminous triple surface treatment on granular base. The mix, placing, shaping and consolidation of the paved areas shall be to the Asphalt Institute specifications and modified Proctor of 90%(AASHO - T180-57). The paved areas can accommodate a 15,000 lb. wheel loading which is equivalent to DC3 class aircraft. The airstrip will be equipped with a wind cone and serviced by a paved access road.

8. Water Supply

The source of the water supply is anunderground acquifer which will be tapped by drilling a 10 inch diameter well and casing the well to 8 inches. Delivery of the water will be by an electric, submersible, centrifugal pump in the well. The pumped water is conveyed by pipe to an elevated 65,000 gallon storage tank. This tank will contain a 3-day domestic supply and 50,000 gallons of water for fire delivered at the rate of 400 gallons per minute for a 2-hour duration. Distribution from the storage tank is by gravity through a chlorinator and zeolite filter prior to consumption atthe building complex.

Wells in the Y-27 site area show water to be found from 300 to 530 feet below the ground surface. Analysis of wells in the area indicates that a properly constructed well will produce the quantity and quality of water desired with a well depth of 700 feet. (Chart D)

9. Utilities

West Texas Utilities Company has an existing 12 KV line from Marfa to Valentine which would have to be converted to at least a 69 KV line and 26.5 miles of line would have to be constructed to serve the center of the site. Additionally, the Rio Grande Electric Cooperative, Inc. has a 14.4 KV line which parallels U. S. Highway 90 and this line could be increased to carry the VLA loads. From one of these two companies, both of which are interested in this possible new load, it is reasonable to assume that adequate electric power can be obtained.

The West Texas Utilities Company letter of November 28, 1969, indicates that the establishment of the desired facilities would require a 10-year contract with a non-refundable advance payment of $181,000 and a monthly minimum billing of $7,200. The rate schedule is included inthe letter of November 28, 1969.

A completely automatic 500 KW diesel driven emergency generator set is included in the budget for this site.

The area is served by Southwestern Bell Telephone Company with an office in Marfa, Texas.

10. Real Estate

The proposed site is located in Jeff Davis and Presidio Counties, Texas, approximately 23 miles west of Marfa, Texas, along U. S. Highway 90 and the Texas and New Orleans Railroad right of way. The elevation of this land is approximately 4,750 feet above sea level. The land has a good cover of grass and appears to be excellent cattle ranching country.

Dr. James N. Douglas in the Department of Astronomy of the University of Texas was contacted for information regarding the University of Texas' acquisition for a similar site some miles east of Marfa, Texas. The University of Texas site is in the shape of a "T", being seven miles by seven miles. Dr. Douglas advises that after about a year of negotiations they have finally come to an agreement with the landowner to acquire the site for their facility; however, he stated they had to lease 35,000 acres which is roughly a block of land seven miles by seven miles. This land was leased on the basis of ninety cents (90¢) per acre per year for the first five years and is subject to re-negotiation each five (5) years during the term of the lease. Dr. Douglas stated that they anticipated sub-leasing for grazing purposes the land not required for their facility at approximately fifty cents (50¢) per acre per year which would make the net cost to the University approximately forty cents (40¢) per acre per year for the entire block of land. He said the

owners would not talk about leasing just the right of way needed for the facility but insisted on leasing all of the land affected by the installation. (Chart B).

Investigation reveals that from sixty-five cents (65¢) to seventy-five cents (75¢) per acre per year is being paid for grazing purposes in this area; however, it would appear that the price of ninetycents (90¢) per acre per year as paid by the University of Texas tends to set the minimum limit for the cost of acquisition of the subject site, or $65 per mile with theright of way being approximately 600 feet wide. (Chart G).

All of the subject facility appears to be on privately owned land; therefore, the lease on the entire facility including the Wye, Building Complex, Airstrip, Staging area, roads, etc., would be approximately $2,649.00 per year.

Total: $2,700.00 Lease/Year

I. Y-33, NEVADA SITE

1. General Site Features

The VLA site Y-33 (Exhibit 25) is located in the Steptoe Valley area of Nevada approximately 50 miles southeast of Wells, Nevada. The apex of the array is at latitude 40°28.3'N, longitude 114°28.8'W, elevation 5,600 feet above mean sea level. The branches of the Wye are spaced at120° angles from a common apex with a true azimuth of 7° for the northern branch. (Exhibits 26, 27 and 28).

The coordinates of the apex of Y-33 have been adjusted to effect an improved gradient for the last mile of the southeastern branch.

The Y-33 site is situated in an elongated, northerly trending valley that is surrounded on 3 sides by mountain ranges with peaks that attain elevations of over 8,000 feet. Slopes in the central part of thevalley are very slight, but around the margins of the valley the slopes increase rapidly toward the bases of the adjacent mountains. The terrain on which the site lies is mainly flat to slightly rolling.

There is a low altitude federal airways V269 which crosses the southwestern branch of the Wye (Chart A). The Nevada Northern Railroad (single track) also crosses the southwestern branch at a point approximately eight miles from the apex. A telephone line parallels the railroad through Steptoe Valley. There are no highway crossings on any of the branches.

Radio navigational aids, radar relay stations, and electronic installations are noted on Chart A. There are no satellite communication facilities which would conflict with operations of the facility.

The site lies within fifty miles of the Wendover Bombing and Gunnery Range, (Utah).

The Central Nevada test area of the AEC is located at the approximate coordinates of 38°30'N, 116°10'W in Nevada. Although the test area lies more than 100 miles distant, the AEC indicates that there would be perceptible seismic effects at site Y-33.

This site location is in a remote area where the communities are small, widely scattered and localized at road junctions. The nearest town of any size is Wells, Nevada, which is a long established railhead for three different railroads. It is approximately 75 miles north of the site. The town has a population of 1,100 people with the nearest medical facilities approximately 60 miles away at Elko. The town is served by bus service with connections to Salt Lake City and Reno, Nevada. (Chart C). There are a few motels and restaurants and two gambling casinos in the town.

The nearest towns with a population of 2,000 or more are Ely and Elko. Ely is 104 miles south of the site by State Road 93 and Elko is 106 miles northwest of the site by way of State Road 93 and Interstate Highway 80. Both Elko and Ely have been described under site Y-17. (Charts C and D).

2. Climatology

As at site Y-17, the remoteness and scarcity of weather data necessitated some of the data to be interpolated, analyzed and in some cases estimated.

The average daily maximum temperature for Y-33 is 60.2 degrees and the average daily minimum temperature is 30.2 degrees. The highest recorded temperature was 100 degrees and the lowest temperature recorded was -26 degrees. The average yearly precipitation is 12.89 inches with 18.84 inches as the greatest annual precipitation total on record. The greatest monthly precipitation total was 4.61 inches and the mean yearly snowfall is51.2 inches with a record maximum single snowfall of 28.4 inches. The mean annual relative humidity is 55 percent. The sunshine possible throughout the year is estimated at 70 percent. The number of tornadoes in the state averages one in two years. Dust storms are not severe and hail occurs about 4 times per year. The prevailing wind direction is from the southwest and the estimated average hourly speed for the year is 10.2 miles per hour with a maximum wind expectancy of 75 miles per hour in 50 years. Thunder-

storms occur on the average of 25 times per year. (Chart E). The average solar radiation is 425 Langleys.

3. Geology

The setting of the Y-33 site is the upper part of the Steptoe Valley, which is 10 to 12 miles in width and over 40 miles in length. The site area is bounded on the west by the Pequop Mountains, on the east by the Goshute Mountains and on the south by the Dolly Varden Mountains. The surrounding mountains all have peaks over 8,000 feet in elevation with some areas along the east side attaining elevations of over 9,000 feet. The maximum relief from the bottom of the valley is over 4,000 feet.

The mountains were formed by tilted fault blocks millions of years ago and the only evidence of more recent activityis a fault line along the west side of the Dolly Varden Mountains. This faulting, although more recent probably did not take place during historic time, for it appears that the immature alluvial fans that began to develop after the faulting have been truncated by the Pleistocene age lake beds around the perimeter of the valley. Geologically, the area appears stable at the present time. The closest recorded earthquake epicenter is in the Elko area over 60 miles to the northwest, where in 1901 an earthquake with an intensity of 7 (on an increasing scale from 1 to 12) was felt over an area of 3,500 square miles and caused building damage in Elko. (Chart B).

The branches of the Wye lie entirely on Quaternary deposits of sand, gravel, silt, and clay that were deposited asalluvial fans, lake sediments and beach deposits. The areas between the 5,700 foot elevation and the base of the mountains at about the 6,000 foot elevation are underlain primarily by silty sand and gravel with many areas of well developed shoreline deposits of sand and gravel bars formed at the edge of anancient lake. The lowland areas are underlain by low to medium plasticity clays and silty clays, that are relatively

impermeable. Along the southwestern branch there is an area about 3 miles in length that is mantled by low brush-covered sand dunes.

Sand and gravel deposits for use in construction are abundantly available around the perimeter of the valley wherever the oldshoreline deposits are well developed. The amount of gravel varies considerably, ranging from about 15 percent in the sandier areas to over 60 percent in the gravel bar deposits. Rock for railroad ballast can be obtained by crushing the limestone that crops out in all of the mountains surrounding the valley. There are particularly good exposures of thick-bedded, gray limestone in the southern end of the Goshute Mountains adjacent to the southeastern branch of the Wye.

In areas where the Wye branches cross sandy slopes, the soil should make good embankment material. It is quite likely that considerable hauling of material might be required to obtain satisfactory embankment material for building up the roadbed along the northern branch in the lowland areas of silty and clayey sediments.

The only test pits in the area are old ones along Alternate U. S. Highway 50 south of the end of the southeastern branch of the Wye. The material is a sandy gravel with up to 8 percent silty fines. It has been given an AASHO rating of A-3, indicating that it has quite good bearing capacity.

The bearing capacity of that part of the southwestern branch of the Wye west of the railroad should generally be quite good. Special investigations will be required should observation stations be needed in the immediate vicinity of the Nelson Creek crossing. The remainder of the southwestern branch should have fair to good bearing capacity.

Almost all of the northern branch as well as most of the southeastern branch should be in areas where the bearing capacity will be fair and could even be poor. The silty and clayey deposits of the bottomlands may have moderate compressibility when saturated, and it is possible that expansive clays could occur

below the surface. The end of the northern branch is in an area where the water table could be quite shallow, and this could cause a further complication during construction.

The end of the southeastern branch is in an area of sand and gravel deposits, and the bearing capacity should be good.

Investigation of mineral activity in the area disclosed that one test well was drilled in search of oil in the southeastern corner of Township 30 North, Range 64 East, but it was abandoned and there were no oil indications. (Chart F). Three oil tests have been drilled in the southern part of the Steptoe Valley, also without signs of oil. Chances of future oil activity are slight but cannot be ruled out entirely.

At present the closest large scale mining operation is at Ruth, located approximately 100 miles to the south. The largest adjacent area of potential activity would be the Dolly Varden Mountains, where the Anaconda Company has an inactive Copper-Bismuth mine apparently with substantial remaining reserves. Mining claims, mostly lead-zinc, are located in the White Horse, Spruce, and Pilot Mountains. There is only very minor activity at present, and although the future potential is not known, it is unlikely that any really large mining operations will develop, based on present information.

4. Topography and Drainage

The apex of Y-33 lies at an elevation of approximately 5,600 feet and the Wye branches cover parts of the valley ranging in elevation from about 5,550 feet along the northern branch to 5,900 feet at the end of the southeastern branch.

Slopes are negligible on the northern branch and on most of the other two branches. From Nelson Creek southwesterly the slope increases to about 1 percent. Along the easternmost 6,000 feet of the southeastern branch, the gradient of the Wye averages slightly over 2 percent and short segments may exceed 4 percent. In

this area the excessive gradient can probably be circumvented either by a shift in the array or by curving the railroad tracks to conform to the contour of the hill.

On the alluvial fans and gravel beds around the valley perimeter, there is a covering of sparse grass and scattered clumps of low sage. The low poorly drained areas are covered with moderately dense sagebrush that reaches heights of 2 to 3 feet. In areas of shallow water table such asnear the end of the northern branch, the growth becomes quite dense, except inlocalized areas of ponding, where the vegetation is quite sparse.

The primary drainage at the upper Steptoe Valley is Nelson Creek, which is an ephemeral stream flowing northeasterly parallel to the Nevada Northern Railroad at the southwestern side of the site. Near the Dolly Varden siding, the gradient becomes so slight that the water tendsto pond. Although there are undoubtedly substantial flows in canyons of the mountains bordering the site, few of these drainages extend into the valley for more than a few hundred feet from the base of the mountains, indicating that the soil around the perimeter of the valley is quite permeable. One factor that tends to reduce runoff from the adjacent mountains is that in many areas around the valley, there are well developed shoreline deposits of sand and gravel that are very permeable and would tend to absorb all but the larger flows from the uplands. When large flows do occur or substantial rainfall occurs on the lowland areas, there would be a tendency for sheet flooding to take place in areas of the valley of slight to moderate gradient and for ponding to occur in all of the nearly flat areas underlain by accumulations of impermeable silt and clay. (Chart B).

The southwestern branch is the only one that will need to be constructed with a substantial number of culverts to pass flood waters beneath the roadway. (The drainage structures required for the Wyeare shown on Exhibits 26, 27 and 28). The Nelson Creek crossing is about 500 feet in width as presently oriented and could

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100
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$Q = 1600 M^{.580}$

$Q = CIA$

Q = Run off Volume (c.f.s.)
c = 0.08
I = 2.96"
M = Drainage Area in Square Miles
A = Drainage Area Converted To Square Miles

50 YEAR STORM
RUN-OFF CURVE
SITE, Y-33, NEVADA

0.01 0.10 1.00 10.00 100.00 1000.00

Drainage Area (square miles)

figure 7

be substantially wider if the Wye were shifted farther south. In order to minimize the crossing structure, some dike construction with appropriate riprap protection will be required. The section of the southwestern branch of the Wye from the railroad west is on an alluvial fan with numerous small drainage channels. The number of culvert structures will vary, depending on the amount of protecting dikes and ditches that are built. Because the quantities of water reaching the Wye roadbed would not normally be substantial, it would be practical to do a moderate amount of drainage diversion.

Flowing water during heavy storms will also occur at the end of the southeastern branch and possibly where it crosses the northeastern flank of the Dolly Varden Mountains. (Figure 7).

Embankments of about 2 feet in height are recommended for the southwestern branch west of the railroad, and in the area to theeast embankments should be about 3 feet in the more poorly drained areas and 2 feet in the sand dune and better drained areas. Three foot embankments probably would be advisable along most of the southeastern branch because of the possibility that substantial quantities of water may accumulate in thebottomlands during extremely heavy storms. A 2 foot embankment with adequate culvert structures should fulfill requirements for the end of the southeastern branch. The northern branch is almost entirely on the lowland areas of the valley and consequently embankments of 3 and possibly 4 feet should be considered, particularly in areas that are normal ponding locations. All of the lowland areas will require at least a minimum number of culvert structures in order to prevent the Wye roadway from becoming a dike. The height of the roadway and the number of culvertscan be minimized by constructing drainage courses to channelize the lowland waters and divert them across or away from the roadway.

5. Railway

The railway tracks will consistof 90# relayer rails on untreated hardwood, random cut, industry grade ties. Tieswill be at 28 inch spacing and will be supported by 6 inches of gravel ballast. Tie plates and joint bars will be used material, with other accessories being new. The tracks and ballast section will be constructed by approved methods and procedures to meet AREA specifications. All rails will have terminal stops. The sub-grade shall have a rating CBR-10 or better. Borrow material is expected to be obtained within the right-of-way and within free haul distance in most cases. Gravel will be obtained from sources now existing in the area and from newly developed locations to reduce haul distance. These pits are generally negotiated between the contractor and the land owner. Water for construction may require new wells to supplement those existing in the area.

The stripping of 9 inches deep of ground surface in the Y-33 site is required to remove existing vegetation prior to placing embankment material.

The observation station foundations will be constructed of poured-in-place concrete and will be the under-reamed bell type. For most of the observing station foundations bell bottom concrete footings at 15 feet depths will be used. The shaft will be 4 feet in diameter and bell bottom 8 feet in diameter. One footing will be located for each leg position at the observing stations. Similar foundations will be constructed at the spur intersections for transfer of the antenna from the main branch.

The staging area covers 24,000 square feet. The area will be paved as follows: hardstand area to have 2-1/2 inches of asphaltic concrete over 6 inches of gravel base on prepared sub-grade; remaining area to have bituminous double surface treatment over 4 inches of gravel base on prepared sub-grade. Material and construction are to meet Asphalt Institute Specifications. The access to the staging area from the building complex will be bygravel road. This road will be 5,800 feet long

for Y-33. Drainage will be minimal and existing flow delineations will generally be crossed by construction of dips through thewashes.

6. Access Road

The entrance road from the main highway to the building complex will have a wearing course of asphaltic concrete on a 6 inch gravel base. The roadway will be 24 feet wide with 2 foot wide shoulders. It is 14 miles long for Y-33. This road is designed for the traffic classification designated "light" and based on the average daily number of equivalent 18,000 lbs. single axle load applications expected. Mix design criteria, specifications and construction methods are MS-2 and SS-1 from the Asphalt Institute.

The access road from the building complex to the airstrip, the staging area and the Wye varies from the entrance road design only in width; design section is the same. Total length of all Y-33 access roads is17 miles.

7. Airstrip

The airstrip will run approximately southwest-northeast to face the prevailing wind on the site. The landing strip will be 150 feet wide with paved runway 75 feet wide and 6,600 feet long.

A 1,000 foot clear zone precedes the airstrip at each end to provide for a 20:1 glide approach. The length of the runway isdetermined by the altitude (5,600 feet above sea level) and the mean maximum temperature (80 degrees F.).

A 30 foot wide paved taxiway and150 foot x 200 foot paved apron are located at one end of the airstrip. The runway, taxiway and apron are surfaced with bituminous triple surface treatment on granular base. The mix, placing, shaping and consolidation of the paved areas shall be to the Asphalt Institute specifications and modified Proctor of 90%(AASHO - T180-57). The paved areas can accommodate a 15,000 lb. wheel loading which is equivalent to DC3 class aircraft. The airstrip will be equipped with a wind cone and serviced bya paved access road.

8. Water Supply

The source of the water supply isan underground acquifer which will be tapped by drilling a 10 inch diameter well and casing the well to 8 inches. Delivery of the water will be by an electric, submersible, centrifugal pump in the well. The pumped water is conveyed by pipe to an elevated 65,000 gallon storage tank. This tank will contain a three-day domestic supply and 50,000 gallons of water for fire delivered at the rate of 400 gallons per minute for a two-hour duration. Distribution from the storage tank is by gravity through a chlorinator and zeolite filter prior to consumption at the building complex.

Information on the availability of water from wells in the site area is very sketchy. There are several stock wells scattered around the upper Steptoe Valley, but they are all quite shallow and no pumping tests have been run. The acquifers are in sandy horizons in the valley fill deposits. According to the U. S. Geological Survey information, the subsurface flow is northerly on both sides of Dolly Varden Mountains at least as far a point midway between the Dolly Varden and Decoy sidings on the Nevada Northern Railroad.

Near the apex the water level is estimated tobe at a depth of about 70 feet and the potential yield based on bailing testsof wells in the general vicinity would be 20 to 30 gallons per minute. (Chart D). There is no information at present about the quality of water, but theU. S. Geological Survey is currently analyzing water samples from the area. Near the end of the northern branch the water table probably is only 40 to 50 feet deep. Based on information from similar acquifers in the southern part of the Steptoe Valley, the water might be expected to have a medium salinity hazard. In that area some of the well water contained a sulphage content of over 250 ppm, the maximum level suggested by the U. S. Health Department. It can be expected that wells drilled along the edges of the valley will yield better quality water than those in the center of the valley.

9. Utilities

At present there is no electric service available in the vicinity of the Y-33 site; however, the Mount Wheeler Power, Inc., would apply for certification from the Nevada Public Service Commission to serve that area. In order to provide service to the site area, it would be necessary to construct 33.2 miles of line, to reconductor about 5.6 miles of line and to increase the capacity of the proposed Steptoe Valley substation. Under regulations of the Nevada Public Service Commission, a contract could be negotiated subject to their approval, and because of their rules an advance of funds for this service would not be required. The estimated billing, however, would be approximately $10,373.00 per month.

The Associated Engineers of 2520 South State Street, Salt Lake City, Utah, sent a letter dated November 18, 1969, concerning the availability of electric power to the site area. This letter indicates that Mount Wheeler Power, Inc., has an application pending for a certificate to serve anarea adjacent to site Y-33. A breakdown of the costs and billing schedule are included with this letter. (Appendix A).

A completely automatic 500 KV diesel emergency driven generator set is included in the budget estimate for this site.

The telephone company serving thisarea is the California-Pacific Utilities Company, which has its business office at 670 Idaho Street, Elko, Nevada.

10. Real Estate

This area is in the Antelope and Steptoe Valleys of Nevada. The Valley is approximately 75 miles southeast of Wells and 104 miles north of Ely. This is ranching country.

All portions of the land to be acquired in this instance belong to the Bureau of Land Management. The Valley floor hasan elevation of approximately 5,600 feet with surrounding mountains extending to elevation of over 8,000 feet.

The soil is typically sandy loam with a predominantly poor quality ground cover including grama grasses and rabbit brush.

The Valley is basically devoid of improvements; however, at the extreme end of the southwestern branch, the taking comes within a quarter mile of a watering facility and crosses the tracks of the Nevada Northern Railroad Company. Damages are considered minimal. (Chart B).

Ranch land in this general area is currently valued at $15 per acre. Since there are no private lands involved, and since damages to the ranching operation are minimal, the value of the entire 3,056 acres is estimated on the basis of $15 per acre. If the property is to be acquired by another government agency from the Bureau of Land Management, then the acquisition could be made without cost for the land, but with a reimbursement to the lessee for damages. The estimated cost of acquisition as reported herein is deemed to be the maximum figure that would have to be paid for this site. (Chart G).

3,056 acres @ $15 =	$45,840
CALLED	$46,000

J. FACILITIES CONSIDERED IDENTICAL FOR ALL SITES

1. Building Complex

The building complex is comprised of three main buildings located in a closely related plot, the axis of which lies on the north leg of the array. The buildings consist of the following:

Laboratory Building		
Control and Electronics Equipment		10,000 SF
Offices and Director's Area		2,500 SF
Electronics Laboratory		3,000 SF
Storage		1,000 SF
	Total	16,500 SF
Supporting Area: toilets, entrances, stairs, air handling equipment rooms.		3,750 SF
	Total of Building	20,250 SF
Shops Building, Garages, and Central Mechanical Plant:		
Shops		9,750 SF
Garages		1,620 SF
Covered Vehicle Storage		2,300 SF
	Total	13,670 SF
Central Mechanical Plant		1,450 SF
	Total	15,120 SF
Dormitory		7,900 SF

a. Architectural

All buildings are single story, except the Dormitory and the Electronics and Control portion of the Laboratory Building, which are two story.

An electrical equipment room is combined with the Shops and Garage Building and supplies electrical distribution to the individual buildings of the Complex as well as housing the 500 kw emergency power unit.

Floors will be of concrete. Slabs on grade will be reinforced and poured over compacted fill. Structurally supported floors for the second floor of the Dormitory and for the second floor of the Electronics Equipment and Control Building will be reinforced concrete slab poured over corrugated steel forms supported upon steel framing members.

Roof construction will be long span steel joints supporting a light aggregate roof deck.

Roofing will be 20-year bonded, built-up roof with colored aggregate surfacing. Roffing will be installed over rigid insulation board.

Windows will generally be of fixed type (non-opening) to control dust and air conditioning. Vents and screens will be strategically located. All windows will be of steel. Glass will be 7/32" crystal.

Interior finishing will be as follows:

Floor covering: Toilet rooms will be ceramic mosaic tile with coved base. Shop building, garages, mechanical rooms, and rough storage areas will have concrete floors. All other floors will receive vinyl-asbestos floor tile and vinyl cove base.

Doors: Exterior doors will be of metal for minimum upkeep. Steel roll-up doors will be used for vehicles. Interior doors will be label type where location requires label to satisfy code requirements. All other interior doors will be solid core wood, book-matched veneers.

Partition Work will be of the movable type in the laboratory sections. Partitions around stairways and vertical chases carry through two stores will be of 2-hour fire-rated construction. Masonry partitions will be plastered and all other partitions are of steel studs, with gypsum board facing.

Ceiling work will be of one-hour-rated construction, and will vary from plaster ceilings in toilet rooms, kitchen and mechanical rooms, to that of lift-out Tee-bar and acoustical board ceilings in offices, in dormitory rooms, and in laboratories where ceilings are required. All other buildings will be exposed structure, painted.

All spaces will be painted.

b. Structural

Structure will be of two types. Skeleton steel frame will be used generally, with reinforced concrete spot footings and grade beam. Wall-bearing construction of brick and tile masonry, and with continuous reinforced concrete foundations will be used for the Dormitory, and for all locations where such is economical. Exterior walls will be of face brick, with structural tile backing reinforced. Where feasible to leave interior wall surfaces of exposed masonry, backing will be of concrete masonry units.

c. Mechanical

Description of Systems

The office laboratory wing of this building will be air conditioned and heated by two multizone air conditioning units. Cooling will be provided by direct expansion cooling coils served by air cooled condensing units on mechanical room roofs. Heating will be provided by electric coils in the units. Humidity control will be provided at the units.

The Control and Electronic Equipment wing of this building will be air conditioned and heated by two single zone air conditioning units, one for each floor.

Cooling will be provided by direct expansion cooling coils served by air cooled condensing units on the roof over the mechanical spaces. Heating will be provided by electric coils in the units. Humidity control will be provided at the units.

Shops and Garage Building

This building will be heated by electric unit heaters in the shop and garage areas. Exhaust ventilation will be provided in those areas requiring it. The office will be air conditioned by a through-the-wall, self-contained unit and heated by electric baseboard.

Dormitory Building

This building will be air conditioned and heated by a single zone air conditioning unit. Cooling will be provided by a direct expansion cooling coil served by an air cooled condensing unit on theroof. Electric zone coils will provide reheat for each zone during the cooling cycle. Heating will be provided by an electric unit pre-heat coil, the zone reheat coils and electric baseboard units in each dormitory room and along the window wall in the lounge and dining room. Exhaust ventilation will be provided for bathrooms and kitchen. Humidity control will be provided at the unit.

Equipment and Material

Condensing units will be air cooled, roof mounted, with low ambient temperature kits, Carrier or equal.

Heating coils will be electric blast coils for duct or unit installation, Indeeco or equal.

Air Conditioning units will be blow-through multizone and draw-through single zone units with direct expansion cooling coils and electric heating coils, Carrier or equal.

Unit heaters will be electric, propellor fan type, horizontal discharge, Electromode or equal.

Baseboard heaters will be electric, Electromode or equal.

Refrigerant piping will be Type ACR copper tubing.

Plumbing fixtures will be American Standard, Crane, or Kohler.

Fire protection for all buildings will be by means of a wet type automatic system with alarm valve and water motor alarm. There will be a separate system for each building. Upright heads will be used in all shops and garages and pendant heads will be used in offices, laboratories, dormitory and other areas with finished ceilings.

d. Electrical

The electrical work will include, but is not limited to, the following principal items:

480/277 volt, 3 Phase, 4 wire power distribution system to the various buildings of building complex.

Systems of power and light foreach building in the building complex.

Parkway, road and floodlighting as required.

Telephone systems for the various buildings.

Grounding system.

The electrical work will comply with all applicable Federal and State building laws, codes, ordinances, and regulations relating to the building and public safety.

Distribution System

Electrical service for the building complex will be supplied by the utility company by overhead lines and from an outdoor transformer. The outdoor transformer shall have the following secondary characteristics: 277/480 volts, 3 Phase, 4 wire, full capacity neutral and frequency of 60 cps. The secondary of the 277/480 volts, 3 Phase, 4 wire transformer will distribute power to the main switchboard and from the main switchboard to power panel or load centers of the various buildings of

building complex. Power distribution through the building complex will be 480/277 volt, 3 Phase, 4 wire. Motors 1/2 h.p. and larger will be served at 440 volts, 3 Phase. Receptacles and small appliances will be served from 480/120/208 volt dry type transformers and panelboards.

Lighting systems will in general be 277 volt flourescent with 120 volt lighting kept to a minimum except in the dormitory building.

The main switchboard will be 480 volt and will be metal-enclosed, free-standing structure with General Electric Type "AK" draw-out air circuit breakers or approved equal.

The 2300 volt main switchgear will be the metal-clad roll out fusible air switch type.

The motor control center will be totally enclosed, free-standing type of modular design with main horizontal bus and individual vertical bus runs. All units shall be plug-in type, full voltage, non-reserving, circuit breaker combination starters. Construction shall be NEMA, Class 1, Type B. Control devices shall be furnished as shown on the drawings.

Panelboards

a. General lighting panelboards shall be GE type NHB with main lugs only or approved equal.

b. General 120/208 volt distribution panels shall be GE type NLAB with main lugs only or approved equal.

Transformers shall be 480-120/208 volts, 3 phase, dry type Class "H" insulation, GE type H or approved equal.

Bus ducts shall be totally metal enclosed, low impedence type.

All wiring shall be copper conductors with 600 V insulation, Type TW for conductor size No. 10 AWG and smaller, and type THW for conductor size No. 8 AWG and larger, THW shall be used in all underground, and damp or wet areas. No

conductor smaller than #12 AWG will be used except in the case of control circuits, where #14 may be used.

Conduits

All wiring shall be installed in rigid metallic conduit (hot dip galvanized after threading). Minimum conduit size shall be 3/4" trade size. Flexible conduit shall be used for the final connection to rotating equipment and to transformers.

All flourescent lighting fixtures shall be furnished with ETL, CMB approved instant start ballast. Ballasts shall be individually fused. All other fixtures types shall be as designated on the Drawings.

The grounding system will be as required by the National Electrical Code or as specified. The grounding conductor shall not be smaller than No. 6 AWG copper nor larger than No. 4 AWG copper.

e. Parking

The roadways and parking areasin the building complex area will be constructed of 1" thick asphaltic concrete surface. The base course will be 6" gravel compacted on prepared sub-grade. All methods, procedures and materials will meet the Asphalt Institute specifications.

f. Landscaping

The landscaping will be simple and of indigenous nature to present the area surrounding the buildings in harmony with the site. Plants and trees native to the area will be used combined with a small sprinklered area of grass. The sidewalks will be of concrete and of 4" thickness laid on prepared gravel bed.

2. Sewage Treatment

Assuming a biochemical oxygen demand (BOD) of 0.20 lb. per day per capita with a 20-day minimum retention period permits a 1/2 acre cell as ample size for the planned capacity of 50 personnel, two cells are designated for operational use and maintenance. Each cell will be 150' x 150' at the 5' level with sides

sloping out at a 4:1 terminating on a compacting berm 5' above the normal ground. The total cell depth will be 8' and operating depth from 3' to 5'. An adjustable outlet pipe is located at the 5' level for overflow.

Only one cell will be used at a time, the second cell accepting effluent when maintenance is required on the first cell. Both cells are to be clay lines and no primary treatment is anticipated. Effluent flow from the building complex is through 5" C.I. pipe, direction controlled by gate valves at the lagoon site. The Lagoon area is to be enclosed by a cyclone fence with a gate and appropriate signs.

3. Underground Cable Trenches

The cables which extend to each observation station on the Wye will be carried in a multiple duct conduit of four 3-1/2" dia. Transite pipes. The top of the duct will be a minimum of 42 inches below ground surface. Manholes to give access to the duct will be 6' x 4' x 6' deep, constructed of prefabricated reinforced concrete with a wood cover which can be locked. These manholes will give sufficient clearance to permit the cables to be fed through the duct.

Both the multiple duct conduit and the manholes will be centered between the railway tracks. A manhole will be located at each spur and conduit will be branched here to supply a vault located at the center of the observation station. This vault will be 6' x 4' x 6' deep. The cover of the vault will be wood and will be secured from access by a lock.

Existing overhead telephone and power lines will be conducted underground in suitable conduits where they cross theWye branches.

K. SITE PREPARATION COST ESTIMATE

The cost estimates for this study have been developed as "budget type" estimates for each site. (Chart G). These cost estimates cover all the physical facilities including land required, but not special laboratory and scientific equipment and apparatus, shop equipment, movable antennae, cables to observation stations, terminal boards, dormitory and office furnishings and similar items. These budget estimates are sufficiently detailed to be used as a basis for determining funds required later for design and construction of the project.

In order to determine the best possible unit cost estimates, the services of the C. L. Noe consulting firm specializing in cost estimating in the southwest were procured for the original estimates onthe Y-15, Y-23 and Y-27 sites. Cost estimates on these sites have been updated. This firm is familiar with cost estimating for government projects having done so in such contracts as AMRAD Facilities, White Sands, New Mexico; Manned Spacecraft Center, Clear Lake, Texas; Air Force Academy Complex, Colorado Springs, Colorado; and many others.

In addition to these services an independent determination of unit prices was made by one of the largest contractors inNew Mexico. While certain of the unit prices had considerable variances between these two sources, the total costs compared favorably. Individual item differences can be discounted because of the normal contractor tendency to unbalance bids. Labor rates for the various labor categories were obtained from the Labor Commissions of the different states.

Cost estimates have been prepared on the following:

1. Air strip including drainage
2. Access roads including drainage
3. Water supply system
4. Sewage treatment system
5. Wye branches and spurs including drainge

6. Cable trenches
7. Foundations
8. Staging area
9. Power supply
10. Telephone system
11. Real estate
12. Buildings

The unit prices used in this report are based on existing material and labor costs in New Mexico, Arizona, Texas, Utah and Nevada as of 1969. It is expected that when the time schedule of request for funds, design, and tentative construction is set, that these figures will require adjustment to reflect costs expected during the construction period.

Y-15 December 23, 1969

Item No.	Item	Cost
1.	Airstrip	134,000
2.	Access Roads	26,742
3.	Water Supply System	63,115
4.	Sewage Treatment Plant	33,725
5.	Wye Branches	
	Earth Work	1,064,007
	Railroad	4,748,332
	Existing Utilities	13,000
6.	Cable Trenches	1,248,100
7.	Foundations	244,845
8.	Staging Area	
	Earth Work	14,570
	Asphaltic Surface	27,931
	Railroad Facilities	9,000
9.	Power Supply	14,000
10.	Telephone System	3,000
11.	Real Estate	77,000
12.	Buildings	
	Laboratory	426,452
	Shops, Garages, and Storage	213,430
	Central Mechanical Plant	24,433
	Dormitory	166,790
	Parking Area and Roads	14,080
	Landscaping and Sidewalks	5,000
	Power Supply	71,400

Y-16 December 23, 1969

Item No.	Item	Cost
1.	Airstrip	109,756
2.	Access Roads	383,283
3.	Water Supply System	70,680
4.	Sewage Treatment Plant	35,125
5.	Wye Branches	
	Earth Work	1,205,056
	Railroads	4,748,332
	Existing Utilities	11,300
6.	Cable Trenches	1,248,100
7.	Foundations	244,845
8.	Staging Area	
	Earth Work	20,300
	Asphaltic Surface	42,181
	Railroad Facilities	9,000
9.	Power Supply	1,160,000
10.	Real Estate	36,000
11.	Buildings	
	Laboratory	426,452
	Shops, Garages and Storage	213,430
	Central Mechanical Plant	24,433
	Dormitory	166,790
	Parking Area and Roads	14,080
	Landscaping and Sidewalks	5,000
	Power Supply	71,400

Y-17 December 23, 1969

Item No.	Item	Cost
1.	Airstrip	133,047
2.	Access Roads	401,247
3.	Water Supply System	70,680
4.	Sewage Treatment Plant	35,125
5.	Wye Branches	
	Earth Work	947,960
	Railroads	4,748,332
	Existing Utilities	11,900
6.	Cable Trenches	1,248,100
7.	Foundations	244,845
8.	Staging Area	
	Earth Work	20,300
	Asphaltic Surface	42,181
	Railroad Facilities	9,000
9.	Power Supply	146,870
10.	Telephone System	5,200
11.	Real Estate	117,800
12.	Buildings	
	Laboratory	426,452
	Shops, Garages and Storage	213,430
	CentralMechanical Plant	24,433
	Dormitory	166,790
	Parking Area and Roads	14,080
	Landscaping and Sidewalks	5,000
	Power Supply	71,400

Y-22 December 23, 1969

Item No.	Item	Cost
1.	Airstrip	104,876
2.	Access Roads	273,253
3.	Water Supply System	70,680
4.	Sewage Treatment Plant	35,125
5.	Wye Branches	
	Earth Work	782,910
	Railroads	4,748,332
	Existing Utilities	21,300
6.	Cable Trenches	1,248,100
7.	Foundations	244,845
8.	Staging Area	
	EarthWork	20,300
	Asphaltic Surface	22,181
	Railroad Facilities	9,000
9.	Power Supply	118,000
10.	Telephone System	4,600
11.	Real Estate	67,000
12.	Buildings	
	Laboratory	426,452
	Shops, Garages and Storage	213,430
	Central Mechanical Plant	24,433
	Dormitory	166,790
	Parking Area and Roads	14,080
	Landscaping and Sidewalks	5,000
	Power Supply	71,400

Y-23 December 23, 1969

Item No.	Item	Cost
1.	Airstrip	175,255
2.	Access Roads	268,130
3.	Water Supply System	70,680
4.	Sewage Treatment Plant	35,125
5.	Wye Branches	
	Earth Work	2,727,750
	Railroads	4,739,513
	Existing Utilities	13,100
6.	Cable Trenches	1,248,100
7.	Foundations	275,452
8.	Staging Area	
	Earth Work	20,300
	Asphaltic Surface	42,181
	Railroad Facilities	9,000
9.	Power Supply	34,000
10.	Telephone System	3,000
11.	Real Estate (Lease & Purchase)	74,000
12.	Buildings	
	Laboratory	426,452
	Shops, Garages, and Storage	213,430
	Central Mechanical Plant	24,433
	Dormitory	166,790
	Parkingarea and Roads	14,080
	Landscaping and Sidewalks	5,000
	Power Supply	71,400

Y-27 December 23, 1969

Item No.	Item	Cost
1.	Airstrip	138,741
2.	Access Roads	455,952
3.	Water Supply System	70,580
4.	Sewage Treatment Plant	35,125
5.	Wye Branches	
	EarthWork	1,334,312
	Railroads	4,748,332
	Existing Utilities	13,000
6.	Cable Trenches	1,248,100
7.	Foundations	275,452
8.	Staging Area	
	EarthWork	20,300
	Asphaltic Surface	34,431
	Railroad Facilities	9,000
9.	Power Supply	181,000
10.	Telephone System	14,500
11.	Real Estate (Lease per year)	2,700
12.	Buildings	
	Laboratory	426,452
	Shops, Garages and Storage	213,430
	Central Mechanical Plant	24,433
	Dormitory	166,790
	Parking Area and Roads	14,080
	Landscaping and Sidewalks	5,000
	Power Supply	71,400

Y-33 December 23, 1969

Item No.	Item	Cost
1.	Airstrip	149,829
2.	Access Roads	1,208,028
3.	Water Supply System	70,680
4.	Sewage Treatment Plant	35,125
5.	Wye Branches	
	Earth Work	1,194,652
	Railroad	4,748,332
	Existing Utilities	12,100
6.	Cable Trenches	1,248,100
7.	Foundations	275,452
8.	Staging Area	
	Earth Work	20,300
	Asphaltic Surface	34,431
	Railroad Facilities	9,000
9.	Power Supply	200,500
10.	Telephone System	12,000
11.	Real Estate	46,000
12.	Buildings	
	Laboratory	426,452
	Shops, Garages and Storage	213,460
	Central Mechanical Plant	24,433
	Dormitory	166,790
	Parking Area and Roads	14,080
	Landscaping and Sidewalks	5,000
	Power Supply	71,400

CHARTS

CONFLICTING ACTIVITIES

ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
AIRWAYS	FEDERAL AIRWAYS NO. V264-V1905	FEDERAL AIRWAYS NO. V21-V257	NONE	SAN SIMEON-DEMING SAN SIMEON-COLUMBUS FEDERAL AIRWAYS NO. V94	FEDERAL AIRWAYS NO. V105 F.A.A. RESTRICTED AREA NO. R-2303A	NONE	FEDERAL AIRWAYS NO. V269
RAILROADS	NONE	UNION PACIFIC RAILROAD	NONE	SOUTHERN PACIFIC RAILROAD	NONE	THE TEXAS AND NEW ORLEANS RAILROAD	NEVADA NORTHERN RAILROAD
MAJOR HIGHWAYS	U.S. HIGHWAY 60	STATE ROAD 257	U.S. HIGHWAY 50	INTERSTATE HWY. 10	STATE ROAD 86	U.S. HIGHWAY 90 STATE ROAD 166	NONE
MILITARY OR DEFENSE ACTIVITIES	WHITE SANDS MISSILE RANGE	NONE	WENDOVER BOMBING AND GUNNERY RANGE	"DEFENSE AREA" ASSOCIATED WITH MEXICO-U.S. BORDER	SOUTHERN BORDER DOMESTIC A.D.I.Z.	SOUTHERN BORDER DOMESTIC A.D.I.Z.	WENDOVER BOMBING AND GUNNERY RANGE
RELAY STATIONS — RADIO NAVIGATIONAL AIDS — RADAR	RML (RADIO MICROWAVE LINK) 34° 10' 48" N 106° 57' 22" W 33° 39' 34" N 107° 04' 13" W 33° 52' 01" N 106° 44' 01" W	RCAG (REMOTE AIR-GROUND) 39° 23' 54" N 112° 30' 06" W VORTAC (RADIO TACTICAL AIR NAVIGATION) 39° 18' 09" N 112° 30' 17" W RML (RADIO MICROWAVE LINK) 39° 33' 32" N 111° 54' 02" W 39° 12' 06" N 112° 09' 59" W	RCAG (REMOTE AIR-GROUND) 48° 24' 11" N 116° 52' 02" W RADAR 40° 24' 11" N 116° 52' 02" W RML (RADIO MICROWAVE LINK) 40° 35' 45' N 116° 30' 24" W	RML (RADIO MICROWAVE LINK) 32° 59' 20" N 108° 57' 40" W 32° 45' 07" N 108° 19' 31" W 32° 25' N 107° 53' W RCAG (REMOTE AIR-GROUND) 31° 56' 10" N 108° 41' 50" W FSS (FLIGHT SERVICE STATION) NO COORDINATES	RADAR 32° 09' 36" N 110° 53' 10" W VORTAC (RADIO TACTICAL AIR NAVIGATION) 32° 53' 09" N 111° 54' 29' W 32° 07' 21" N 110° 49' 12' W TACAN (TACTICAL AIR-NAVIGATION) 32° 09' 36" N 110° 52' 49" W	VOR (VOICE RADIO) 30° 17' 53" N 103° 57' 15" W Mc DONALD OBSERVATORY 30° 30' N 104° 01' W	RML (RADIO MICROWAVE LINK) 41° 03' 08" N 115° 20' 46" W 41° 08' 49" N 114° 58' 58" W 41° 20' 02" N 114° 05' 37' W VORTAC (RADIO TACTICAL AIR NAVIGATION) 40° 45' 35" N 115' 45' 38" W

CHART A (1 OF 2)

CONFLICTING ACTIVITIES

(CONTINUED)

ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
(CONTINUED) RELAY STATIONS — RADIO NAVIGATIONAL AIDS — RADAR		38° 59' 11" N 112° 24' 30" W 38° 48' 33" N 112° 53' 30" W 38° 22' 24" N 112° 57' 06" W			ATC (AIR TRAFFIC CONTROL) 32° 07' 04" N 110° 56' 30" W RAPCON (RADAR APPROACH CONTROL) 32° 10' 12" N 110° 52' 33" W		VOR (VOICE RADIO) 41° 08' 40" N 114° 58' 35" W
UNDERGROUND NUCLEAR TESTING WITHIN 100 MILES	NONE	NONE	CENTRAL NEVADA TEST AREA OF THE A.E.C. 38° 30' N 116° 10' W	NONE	NONE	NONE	CENTRAL NEVADA TEST AREA OF THE A.E.C.
SATELLITE COMMUNICATION FACILITIES	NONE	NONE	NONE	NONE	NONE	NONE	NONE

CHART A (2 OF 2)

PHYSICAL CHARACTERISTICS OF SITE

ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
LAND OWNERSHIPS	827 Ac. PRIVATE 1230 Ac. STATE 872 Ac. BLM & ST. VALUE $77,000	125 Ac. PRIVATE 275 Ac. STATE 2572 Ac. BLM VALUE $36,000	140 Ac. PRIVATE 2820 Ac. BLM VALUE $117,800	820 Ac. PRIVATE 935 Ac. BLM 1170 Ac. STATE VALUE $67,000	301 AC. PRIVATE 28 AC. STATE VALUE $46,000 PLUS 2602 AC. INDIAN LEASE VALUE $28,000	2835 AC. PRIVATE LEASE VALUE $ 2,700/ YEAR	3056 Ac. BLM VALUE $46,000
GEOLOGICAL STABILITY	NO SIGNIFICANT FAULTING HAS BEEN RECORDED IN AREA. EARTHQUAKE ACTIVITY HAS OCCURRED IN RIO GRANDE VALLEY, SINCE 1962 THE STRONGEST TREMOR IN THE SOCORRO AREA WAS 2.9 ON RICHTER SCALE	NEAREST ACTIVE FAULT 50 MILES FROM SITE. ONE EARTH FRACTURE NOTED ON EACH OF NE BRANCH AND SOUTH BRANCH. SINCE 1909-21 EARTHQUAKES HAVE OCCURRED WITH EPICENTERS IN MILLARD COUNTY.	NO ACTIVE FAULTING IN AREA. NUCLEAR TESTING BLASTS PROBABLY WOULD BE FELT IN AREA. SINCE 1852-1940 EARTHQUAKE EPICENTERS HAVE BEEN RECORDED WITHIN A 40 MILE RADIUS OF THE SITE TO MAGNITUDE BETWEEN 5-6 ON RICHTER SCALE.	NO ACTIVE FAULTS ARE FOUND IN SITE AREA. PROBABILITY OF TREMORS SMALL. ONLY A FEW OF THE STRONGEST EARTHQUAKES WITH EPICENTERS IN REMOTE AREAS WOULD BE FELT.	AREA IS SUBJECT TO PERIODIC SMALL INTENSITY EARTH TREMORS.	MAJOR EARTHQUAKE OCCURRED IN AREA 1931. SURFACE DAMAGE ON SCALE NOTED AS 8. IN VALENTINE MINOR CRACKING OF EARTH.	AREA APPEARS STABLE. CLOSEST RECORDED EARTHQUAKE 60 MILES TO NORTHWEST WHERE INTENSITY WAS REGISTERED AS 7 ON RICHTER SCALE.
DRAINAGE	ONLY A MODERATE NUMBER OF STRUCTURES ARE REQUIRED. NO MAJOR STREAMS CROSS ARRAY. A DIVERSION LATERAL END NORTH BRANCH WILL BE REQUIRED IN DRAINAGE CONTROL.	SITE HAS VERY LITTLE DRAINAGE PROBLEM AND HAS HIGH PREMEABILITY. MOST CULVERTS ARE TO KEEP WATER FROM PONDING ON ONE SIDE OF EMBANKMENT HAVE ONE LARGE STRUCTURE OVER BEAVER RIVER ON NORTHWEST LEG.	WOULD REQUIRE SEVERAL LARGE DRAINAGE STRUCTURES DUE TO LARGE DRAINAGE AREAS INVOLVED ON TWO BRANCHES. ONE BRANCH HAS POOR DRAINAGE AND IS AFFECTED BY LOCAL PONDING.	MAIN DRAINAGE ACROSS TWO BRANCHES WITH SEVERAL LARGER SIZED STRUCTURES REQUIRED. THIRD BRANCH HAS PONDING IN 2 MILE LOW AREA	CONSIDERABLE DRAINAGE REQUIRED ON ALL BRANCHES. NORTH BRANCH REQUIRES DIVERSION CHANNELS, DIKES AND EROSION PROTECTION. BOX CULVERTS ARE REQUIRED TO ASSIST PIPE CULVERTS ON ALL BRANCHES. MAJOR FLOODING HAS OCCURRED IN SITE AREA.	ALL BRANCHES SUBJECT TO SHEET FLOODING. ALL BRANCHES REQUIRE A SUBSTANTIAL NUMBER OF DRAINAGE STRUCTURES. THE SOUTHWEST BRANCH IS CROSSED BY 6 MAJOR STREAM CHANNELS	MAIN DRAINAGE FLOW IS IN NELSON CREEK WHICH WOULD REQUIRE A BRIDGE OVER CHANNEL. MUCH PONDING IS PRESENT IN LOW AREA OF SITE COMPRISING HALF OF THE ARRAY.

CHART B

ACCESSIBILITY (SUPPORT)

ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
TRAVEL TIME AND MILEAGE FROM TOWNS W/ 2,000 OR MORE IN POPULATION	SOCORRO, N. MEX., 50 MILES EAST OF SITE, TRAVEL TIME 1 HOUR.	DELTA, UTAH, 35 MILES FROM SITE, TRAVEL TIME 45 MINUTES.	ELY, NEVADA, 105 MILES EAST OF SITE, TRAVEL TIME 2 HOURS. ELKO, NEVADA, 106 MILES FROM SITE, TRAVEL TIME 2 HOURS.	LORDSBURG, N. M., 24 MILES WEST OF SITE, TRAVEL TIME 30 MINUTES. DEMING, N. M., 45 MILES EAST OF SITE, TRAVEL TIME 50 MINUTES.	TUCSON, ARIZ., 40 MILES EAST OF SITE, TRAVEL TIME 45 MINUTES.	MARFA, TEXAS, 23 MILES EAST OF SITE, TRAVEL TIME 30 MINUTES.	ELY, NEVADA, 104 MILES SOUTH OF SITE, TRAVEL TIME 2 HOURS. ELKO, NEVADA, 106 MILES FROM SITE, TRAVEL TIME 2 HOURS.
DISTANCE FROM THE NEAREST CITY WITH AIR SERVICE	ALBUQUERQUE, N.M. 125 MILES, TWA, CONTINENTAL, FRONTIER, AND TEXAS INTER-NATIONAL AIRLINES.	DELTA, UTAH, 35MILES, DIXIE AIRLINES. SALT LAKE CITY, UTAH, 160 MILES, UNITED AIRLINES, FRONTIER AIRLINES, WESTERN AIRLINES, AND AIR WEST.	ELKO, NEVADA, 104 MILES, UNITED AIRLINES, WITH CONNECTIONS IN SALT LAKE CITY, RENO, AND SAN FRANCISCO.	GRANT COUNTY AIRPORT, 70 MILES, FRONTIER AIRLINES WITH CONNECTIONS IN TUCSON AND ALBUQUERQUE.	TUCSON, ARIZONA, 40 MILES, AMERICAN AIRLINES, TWA, CONTINENTAL, APACHE & FRONTIER AIRLINES.	MIDLAND, TEXAS, 150 MILES, CONTINENTAL, TEXAS INTER-NATIONAL AIRLINES.	ELKO, NEVADA, 104 MILES, UNITED AIRLINES WITH CONNECTIONS IN SALT LAKE CITY, RENO, AND SAN FRANCISCO.
AVAILABILITY AND QUALITY OF SCHOOLS	SOCORRO, N. MEX.; 3 ELEMENTARY, 1 PAROCHIAL GRADE SCHOOL, 1 JUNIOR HIGH, 1 SENIOR HIGH; NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY.	PROVO, UTAH; BRIGHAM YOUNG UNIVERSITY. DELTA SCHOOLS UNDER COUNTY SYSTEM; 1 ELEMENTARY, 1 JUNIOR HIGH, 1 SENIOR HIGH.	ELKO, NEVADA; 4 ELEMENTARY, 1 JUNIOR HIGH, 1 SENIOR HIGH, UNIVERSITY OF NEVADA IN RENO. ELY, NEVADA; 3 ELEMENTARY, 1 JUNIOR HIGH, 1 SENIOR HIGH.	DEMING, N. MEX.; HAS MODERN SCHOOL SYSTEM, 5 ELEMENTARY, 1 JUNIOR HIGH, 1 SENIOR HIGH. SILVER CITY, N. MEX.; NEW MEXICO WESTERN UNIVERSITY. (CONTINUED)	TUCSON, ARIZONA; 88 ELEMENTARY AND JUNIOR HIGH, 8 SENIOR HIGH, 20 PAROCHIAL, EPISCOPAL, HEBREW, LUTHERAN, SEVENTH DAY ADVENTIST, ELEMENTARY, (CONTINUED)	MARFA, TEXAS; 1 SENIOR HIGH. ALPINE, TEXAS, SUL ROSS STATE COLLEGE.	ELKO, NEVADA; 4 ELEMENTARY, 1 JUNIOR HIGH, 1 SENIOR HIGH, UNIVERSITY OF NEVADA IN RENO. ELY, NEVADA; 3 ELEMENTARY, 1 JUNIOR HIGH, 1 SENIOR HIGH.

CHART C (1 OF 2)

ACCESSIBILITY (SUPPORT)

(CONTINUED)

ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
(CONTINUED) AVAILABILITY AND QUALITY OF SCHOOLS				(CONTINUED) LAS CRUCES, N. MEX; N. MEX. STATE UNIVERSITY. LORDSBURG, N. MEX.; 3 ELEMENTARY, 1 JUNIOR HIGH, 1 SENIOR HIGH.	(CONTINUED) AND JUNIOR HIGH, 4 PAROCHIAL SENIOR HIGHS, UNIVERSITY OF ARIZONA.		
AVAILABILITY OF MEDICAL SERVICE IN THE NEAREST TOWN	SOCORRO, N. MEX.; 4 PHYSICIANS, 3 OSTEOPATHS, 1 DENTIST, 46 BED HOSPITAL.	DELTA, UTAH; 2 PHYSICIANS, 1 DENTIST, 34 BED HOSPITAL. FILLMORE, UTAH; HAS NEW 42 BED HOSPITAL RUN BY L.D.S. CHURCH, 2 DOCTORS, 1 DENTIST.	ELKO, NEVADA; 6 PHYSICIANS, 2 SPECIALISTS, 4 DENTISTS, 80 BED HOSPITAL. ELY, NEVADA; 4 DOCTORS, & 2 DENTISTS IN NEW CLINIC.	LORDSBURG, N. MEX; 2 PHYSICIANS, 1 DENTIST, 25 BED HOSPITAL. DEMING, N. MEX.; 4 PHYSICIANS, 3 DENTISTS, 40 BED HOSPITAL.	TUCSON, ARIZONA; 5 LARGE COMMUNITY HOSPITALS WITH SPECIALISTS IN ALL FIELDS OF MEDICINE.	MARFA, TEXAS; 2 PHYSICIANS, PRIVATE CLINIC. ALPINE, TEXAS; 28 MILES FROM MARFA, 52 BED HOSPITAL.	ELKO, NEVADA; 6 PHYSICIANS, 2 SPECIALISTS, 4 DENTISTS, 24 REGISTERED NURSES, 80 BED HOSPITAL. ELY, NEVADA; 4 DOCTORS, & 2 DENTISTS IN NEW CLINIC.
POPULATION INCREMENT WHICH COULD BE ABSORBED IN THE NEAREST TOWN	SOCORRO, N.M.; 60 FAMILIES.	FILLMORE, UTAH; 20 FAMILIES. DELTA, N.M.; 15 FAMILIES.	ELKO, NEVADA; 30 FAMILIES. ELY, NEVADA; 15 FAMILIES.	LORDSBURG, N.M.; 15 FAMILIES. DEMING, N.M.; 60 FAMILIES	TUCSON, ARIZONA; COULD PROVIDE EXCELLENT ACCOMODATIONS FOR BOTH V.L.A. PERSONNEL AND CONSTRUCTION WORKERS.	MARFA, TEXAS; 25 FAMILIES. ALPINE, TEXAS; 35 FAMILIES.	ELKO, NEVADA; 30 FAMILIES. ELY, NEVADA; 15 FAMILIES.

CHART C (2 OF 2)

INDUSTRIAL SUPPORT

ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
ELECTRICAL POWER	SOCORRO ELECTRIC COOPERATIVE, INC.- REQUIRES 1 MILE OF LINE TO TIE TO EXISTING FACILITY. MONTHLY MINIMUM CHARGE OF $ 2625.00 PLUS GRADUATED ENERGY CHARGE.	UTAH POWER AND LIGHT CO.- REQUIRES 12 MILES NEW LINE. POWER COST BASED ON MONTHLY USAGE IS $5500.00.	MT. WHEELER POWER, INC.- REQUIRES 29.2 MI. OF LINE. MONTHLY MINIMUM $2203.00. BASED ON 541,000 KWH DEMAND CHARGE AND ENERGY CHARGE. RATE WOULD BE $10,373.00 PER MONTH.	COLUMBUS ELECTRIC COOPERATIVE, INC.- REQUIRES 13 MILES OF LINE. MINIMUM MONTHLY CHARGE OF $3000.00 PLUS DEMAND CHARGE.	TRICO ELECTRIC COOPERATIVE, INC.- REQUIRES 2.5 MILES OF POWER LINE. MINIMUM MONTHLY BILLING RATE IS $1125.00. MONTHLY BILLING RATE IS BASED ON DEMAND AND ENERGY CHARGES OF $1.75 PER MONTH PER KW AND $4329.00 ON 541,000 KWH.	WEST TEXAS UTILITIES CO.- REQUIRES 26.5 MI. OF NEW LINE. MINIMUM MONTHLY BILLING RATE IS $7200.00. DEMAND BILLING FOR 1600 KW IS $10,250.00 PER MONTH.	MT. WHEELER POWER, INC.- REQUIRES 33.2 MI. OF NEW LINE. MINIMUM MONTHLY BILLING RATE IS $ 2807.00. BASED ON 541,000 KWH DEMAND CHARGE AND ENERGY CHARGE. RATE WOULD BE $10,373.00 PER MONTH.
AVAILABILITY OF WATER	EXISTING WELLS RANGE FROM 75' TO 250' DEEP FOR POTABLE WATER SUPPLY.	CLEAR LAKE SPRING COULD SERVE AS POTABLE WATER SOURCE. REQUIRES 5 MI. OF PIPELINE. DRILLING DEEP WELLS QUESTIONABLE DUE TO PRESENCE OF HIGH AMOUNT OF DISSOLVED SOLIDS.	WELLS FOR POTABLE WATER APPEAR PRACTICAL FOR DEPTHS TO 100'.	DRILLING WELLS TO 100' SHOULD PRODUCE A POTABLE WATER SUPPLY.	A SUPPLY OF POTABLE WATER REQUIRES DRILLING WELLS 600' TO 800' DEEP.	A POTABLE WATER SUPPLY REQUIRES DRILLING WELLS TO 700' DEEP.	A POTABLE WATER SUPPLY REQUIRES DRILLING WELLS 50' TO 100' DEEP.
AVAILABLE CONST. LABOR FORCE AND AVERAGE WAGE RATE	LOCAL LABOR IS AVAILABLE IN SOCORRO AREA. WAGE RATE $6.35 FOR SKILLED LABORERS PLUS SUBSISTENCE.	VERY LITTLE LOCAL LABOR AVAILABLE. WAGE RATE IS $6.05 FOR CONSTRUCTION WORKERS PLUS SUBSISTENCE.	VERY LIMITED QUANTITY OF LOCAL LABOR AVAILABLE. WOULD HAVE TO COME FROM LARGER CITIES. SKILLED LABOR RATE IS $5.55 PLUS SUBSISTENCE. STATE IS HIGHLY UNIONIZED.	LIMITED QUANTITY OF LOCAL UNSKILLED LABOR AVAILABLE. CONSTRUCTION WORKERS WOULD COME FROM LARGER CITIES. SKILLED LABOR RATE IS $6.35 PLUS SUBSISTENCE	GOOD SUPPLY OF LABOR AVAILABLE IN AREA. CONSTRUCTION WORKERS RATE $5.60 IN TUCSON AREA. PLUS SUBSISTENCE.	WOULD HAVE TO BE DRAWN FROM A VERY WIDE AREA. SKILLED LABOR RATE IS $5.10 PLUS SUBSISTENCE.	LIMITED QUANITY OF UNSKILLED LABOR AVAILABLE. SKILLED CONSTRUCTION LABOR FROM LARGER CITIES. SKILLED LABOR RATE $5.55 PLUS SUBSISTENCE. STATE HIGHLY UNIONIZED

CHART D

CLIMATOLOGY

ITEM		Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
TEMPERATURE-	AVERAGE DAILY MINIMUM-°F	31.0°	38.3°	22.0°	44.6°	58.6°	57.3°	30.2°
	AVERAGE DAILY MAXIMUM-°F	72.0°	73.0°	60.8°	78.3°	81.4°	82.5°	60.2°
	RECORD LOW-°F	-22.0°	-32.0°	-34.0°	- 9.0°	19.0°	- 5.0°	-26.0°
	RECORD HIGH-°F	104.0°	101.0°	98.0°	110.0°	117.0°	111.0°	100.0°
	MONTHLY MEAN-°F	52.5°	54.6°	44.7°	61.5°	70.0°	69.7°	45.2°
PRECIPITATION-	GREATEST ANNUAL-INCHES		11.33	10.57	19.70			18.84
	GREATEST DAILY-INCHES	2.25	2.00		3.08	6.00	4.50	
	AVERAGE ANNUAL TOTAL-INCHES	12.00	8.41	6.32	10.00	12.80	17.83	12.89
	GREATEST MONTHLY-INCHES	4.66	2.88	3.50	6.46	6.30	15.79	4.61
	MEAN YEARLY SNOW-INCHES	25.0	23.1	30.0	4.3	1.5	1.5	51.2
	RECORD MAX.SNOWFALL-INCHES		14.2	37.0	10.0	6.4	4.7	28.4
	THUNDERSTORMS-AVE.PER YEAR	80	35	20	46	35	40	25
WINDS-	STATE TORNADO FREQUENCY/YR.	1 IN 109 YEARS	2 IN 18 YEARS	1 IN 2 YEARS	1 IN 52 YEARS	ALMOST NON-EXISTENT	5 IN 5 YEARS	1 IN 2 YEARS
	50 YR. MAXIMUM WIND-M.P.H.	77	90	70	75	67	67	75
	MEAN HOURLY SPEED FOR YR.-M.P.H.	9.6	10.4	10.0	10.0	7.8	10.4	10.2
	DIRECTION PREVAILING WIND	W	SW	SW	SW	SE	SE	SW
AIR POLLUTION-	DUST DAYS PER YEAR	INFREQUENT	HEAVY	LIGHT	3 SEVERE, 4 MODERATE, 13 LIGHT	LIGHT	FAIRLY SEVERE, SEVERAL PER YEAR	LIGHT
	HAIL DAYS PER YEAR	0 IN 16 YEARS	INFREQUENT	4 PER YEAR	2 PER YEAR	INFREQUENT	FREQUENT-SEVERE	4 PER YEAR
	HEAVY FOG DAYS PER YEAR	2	4	LITTLE FOG	1	1	14	LITTLE FOG
RELATIVE HUMIDITY-	MEAN ANNUAL REL. HUMIDITY	53%	55%	50%	45%	44%	60%	55%
SKY COVER-	ANNUAL AVERAGE CLEAR DAYS		132	123	165	194	132	
	ANNUAL AVE. PTLY. CLOUDY DAYS		104	76	121	91	99	
	ANNUAL AVERAGE CLOUDY DAYS		129	166	79	80	134	
	SUNSHINE POSSIBLE THROUGH YR.	70%	69%	76%	80%	86%	67%	70%
	SOLAR RADIATION (LANGLEYS)	490	421	460	487	513	328	425

CHART E

HEAVY FOG REDUCES VISIBILITY TO 1/4 MILE OR LESS.

PRECIPITATION INCLUDES SNOW REDUCED TO INCHES OF WATER.

ALL TEMPERATURES ARE IN DEGREES FAHRENHEIT.

SKY COVER IS EXPRESSED IN A RANGE OF 0 FOR NO CLOUDS OR OBSCURING PHENOMENA TO 10 FOR COMPLETE SKY COVER. THE NUMBER OF CLEAR DAYS IS BASED ON AVERAGE CLOUDINESS 0-3; PARTLY CLOUDY DAYS 4-7 AND CLOUDY DAYS 8-10 TENTHS.

HIGHEST WIND RECORDED DOES NOT INCLUDE GUSTS WHICH COULD EXCEED HIGHEST WIND.

DEVELOPABLE NATURAL RESOURCES

* Within 40 Miles Of Site Locations

* ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
MINERAL RESOURCES	SOME URANIUM PROSPECTS IN THE REGION — NO ACTIVE MINING	POSSIBLE MINING OF CINDER MATERIAL NEAR PAVANT BUTTE. POSSIBLE POTASH DEPOSITS IN SEVIER LAKE AREA	ZINC MINING 8 MILES FROM APEX. LITTLE CURRENT ACTIVITY IN EUREKA MINING DISTRICT FOR LEAD 25 MILES FROM SITE. MINING CLAIMS HAVE BEEN FILED NEAR BOTH SOUTH-WESTERN AND NORTHERN BRANCHES	LARGE AMOUNT OF OPEN PIT COPPER MINING 28 MILES NORTH OF APEX. SOME COPPER MINING 20 MILES WEST OF SITE	LARGE MINES OPERATING 24 MILES NORTH OF APEX. SEVERAL INACTIVE CLAIMS WITH FUTURE POTENTIAL IN SOUTHERN PART OF SITE	NO ACTIVE MINING	INACTIVE COPPER BISMUTH MINE WITH SUBSTANTIAL RESERVES LOCATED IN DOLLY VARDEN MOUNTAINS.
OIL AND GAS RESOURCES	ONE WELL ON SITE — DRY AND ABANDONED	THERE IS SEISMOGRAPH ACTIVITY IN THE VALLEY AT PRESENT. TWO WELLS IN REGION — DRY AND ABANDONED	NONE	THERE ARE APPROXIMATELY 1,000,000 ACRES UNDER OIL LEASE. ONE WELL NEAR ARRAY PROVED DRY AND ABANDONED	NO ACTIVITY	SEVERAL WELLS IN AREA — ALL DRY AND ABANDONED	ONE WELL ON SITE — DRY AND ABANDONED

CHART F

SITE PREPARATION COSTS

NO. ITEM	Y-15 NEW MEXICO	Y-16 UTAH	Y-17 NEVADA	Y-22 NEW MEXICO	Y-23 ARIZONA	Y-27 TEXAS	Y-33 NEVADA
1. AIRSTRIP	134,000	109,756	133,047	104,876	175,255	138,741	149,829
2. ACCESS ROADS	26,742	383,283	401,247	273,253	268,130	455,952	1,208,028
3. WATER SUPPLY	63,115	70,680	70,680	70,680	70,680	70,680	70,680
4. SEWAGE TREATMENT	33,725	35,125	35,125	35,125	35,125	35,125	35,125
5. WYE	5,825,339	5,964,678	5,708,192	5,552,542	7,480,363	6,095,644	5,955,084
6. CABLE TRENCHES	1,248,100	1,248,100	1,248,100	1,248,100	1,248,100	1,248,100	1,248,100
7. FOUNDATIONS	244,845	244,845	244,845	244,845	275,452	275,452	275,452
8. STAGING AREA	51,501	71,481	71,481	71,481	71,481	71,481	63,731
9. POWER SUPPLY	14,000	160,000	146,870	118,000	34,000	181,000	200,500
10. TELEPHONE	3,000	1,300	5,200	4,600	3,000	14,500	12,000
11. REAL ESTATE	77,000	36,000	117,800	67,000	74,000 **	2,700 *	46,000
12. BUILDING COMPLEX	921,585	921,585	921,585	921,585	921,585	921,585	921,585
SUB-TOTAL CONSTRUCTION COSTS	$ 8,642,952	$ 9,246,833	$ 9,104,172	$ 8,712,087	$10,657,171	$ 9,510,960	$10,186,114
13. CONTINGENCY-15%	1,296,443	1,387,025	1,365,626	1,306,813	1,598,576	1,426,644	1,527,917
ENGINEERING, LEGAL & ADMINISTRATION-10%	864,295	924,683	910,417	871,209	1,065,717	951,096	1,018,611
TOTALS	$10,803,690	$11,558,541	$11,380,215	$10,890,109	$13,321,464	$11,888,700	$12,732,642

CHART G

* YEARLY LEASE REQUIRED
** OF THIS AMOUNT $28,000 PER YEAR IS LEASE OF INDIAN LAND

APPENDICES

Appendix A	Pertinent Correspondence
Appendix B	Consultants
Appendix C	Supplemental Data
Appendix D	Personnel Contacted
Appendix E	Bibliography

APPENDIX A

Pertinent Correspondence

National Radio Astronomy Observatory, C. M. Wade, September 23, 1969

Socorro Electric Cooperative, Inc., Joseph F. Gallagher, Manager, October 30, 1969, September 22, 1966

Utah Power and Light Company, Jay F. Gardner, Manager Sales and Marketing, Telluride Division, November 25, 1969

Associated P & C Engineers, Inc., Clare K. Olsen, November 18, 1969

Columbus Electric Cooperative, Inc., Buford Slover, Jr., Manager, December 22, 1969

Trico Electric Cooperative, Inc., A. O. Bicknell, General Manager, November 14, 1969; Lyle J. McDonald, Office Manager, September 30, 1966

West Texas Utilities Company, T. V. Grayson, Rate Engineer, November 28, 1969

Arizona Railroad Company, C. R. Newman, August 22, 1966

Southern Pacific Company, A. S. McCann, Superintendent, August 12, 1966

The Atchison, Topeka and Santa Fe Railway Company, J. E. Eisemann, Chief Engineer, August 11, 1966

Railroad Maintenance and Construction, Inc., G. C. Wilkins, Jr., President, September 20, 1966

Federal Aviation Agency, Paul E. Cannom, Area Manager, June 15, 1966

United States Department of the Interior, Bureau of Indian Affairs, Calvin N. Brice, Acting Superintendent, November 16, 1966

NATIONAL RADIO ASTRONOMY OBSERVATORY
EDGEMONT ROAD
CHARLOTTESVILLE, VIRGINIA 22901
TELEPHONE 703-296-0211

POST OFFICE BOX 2
GREEN BANK, WEST VIRGINIA 24944
TELEPHONE 304-456-3011
TWX 304-940-2681

September 23, 1969

Mr. J. L. Shields
Chief Engineer
Limbaugh Engineers, Inc.
Albuquerque, New Mexico 87103

Dear Mr. Shields:

I spoke to George Love by telephone, on September 17, regarding further work on sites for the Very Large Array. He has no doubt been in touch with you in the meantime to give you a general picture of what we are after. This letter is intended to give you a specific statement of our needs.

We need specific information on a number of things for eight potential VLA sites. You worked on three of these for us in 1966; however, it is well to be able to show that we have made a careful and unprejudiced study of all of the sites which could reasonably be used. Hence the enlarged scope of the work. I do not anticipate that any of the job will require on-site field work of the kind you did in 1966. Rather, we are asking you to find and compile information from existing sources insofar as possible. Field work should be considered only where it is absolutely necessary, particularly in view of the fact that we would need to have your report by 1 January 1970.

The information we desire for each potential site is as follows:

I. Climatic Data: The information required under this heading should be based on work done as near as possible to the specific location, subject to a general similarity of elevation and surrounding terrain. Thus data taken on a mountain top adjacent to a site might not be as valuable as data from a similar flat area 30 or 40 miles away. We need:

   a. Monthly mean and extreme values of temperature, snowfall, and total precipitation.

   b. Wind data, to include the speed and direction of the prevailing wind and annual changes if possible. It is especially important to know the frequency and strength of the high winds (say in excess of 30 mph) which could affect array operation.

c. Frequency and predominant types of cloud cover.

d. Data on the frequency and severity of thunderstorms, dust storms, hail, and very heavy rain.

II. Drainage: This includes the possibility of flooding on any part of a site, and the likelihood of special measures being needed to protect a site from running water damage. Among other things, consideration should be given to the permeability of the soil and the size of the area which drains into or across a site.

III. Land Ownership: We need to know how the land on each site is distributed among Federal, State, private, Indian, etc., ownership. We would like to have some idea of the cost of site acquisition, whether by purchase or by lease. Assume that the array arms will be 200 yards wide. It would be helpful to have a list of the sections crossed by the array.

IV. Geological Stability: This covers the possibility of ground movement due to any cause, including earthquakes, settling because of changes in the level of the water table, and lateral movement on alluvium. It is desirable to know what recent fault lines pass within 50 miles of a site, and what the recent history of fault movements in the vicinity is.

V. Developable Natural Resources: This includes any exploitation which might adversely affect the array environment or its operation. In particular, we would like to know what the mineral and oil resources are within 40 miles of a site, and what development of them is being made or likely to be made.

VI. Conflicting Activities: Any human activity, present or anticipated, which might have an unwelcome effect on the array. Among the things to be considered are: airways, railroads, major highways, military or defense activities (particularly aeronautical and electronic), relay stations, satellite communication facilities, radio navigational aids, radar, mining and drilling, and underground nuclear testing within 100 miles.

VII. "Support": This is something of a catchall. Among the things to consider are:

a. Road distances and driving times to the nearest towns of 2000 or more population and to the nearest large city.

b. Distance to the nearest city with scheduled air service.

c. Availability and quality of schools and medical service in the nearer towns.

d. The size of the population increment which could be absorbed by the nearer towns.

e. Accessibility of the site to existing electric power distribution systems. How much power line would we have to build, and what addition to the capacity of the existing system would be needed? We have reconsidered our electric power requirements, and now feel that we should have available 800 kW continuous and 1600 kW peak demand.

f. Quantity, quality, and depth of water at the site. This assumes that we would supply the on-site water requirements from wells.

g. What is the availability, or nearest source of supply, for the skilled and unskilled labor needed during array construction? Do the wage scales vary significantly over the area we are considering?

The actual sites to be considered are scattered over five states (Texas, New Mexico, Arizona, Utah, and Nevada). One major change in the array design since 1966 is that we now require arms 13 miles long instead of 15. This has permitted an adjustment onto rather better terrain at several of the sites; of the sites you worked on in 1966, only Y27 (near Marfa, Texas) has been altered. Still, much of the data in my 1966 report on the status of the VLA site search (I believe you have a copy) is somewhat obsolete. The enumeration below gives the name of each site, the state in which it is located, the name of the general area, the geographical coordinates of the array center, the approximate elevation at the center, and the true azimuths of the three arms, as seen from the array center. Of these, you worked on Y15, Y23, and Y27 in 1966.

1. Y15; New Mexico; Plains of San Augustine; 34°04!7 N, 107°37!1 W; 6960 ft; 115°-235°-355°.

2. Y16; Utah; Black Rock Desert; 39°02!4 N, 112°40!8 W; 4630 ft; 66°-186°-306°.

3. Y17; Nevada; Monitor Valley; 39°35!1 N, 116°26!5 W; 6180 ft; 114°-234°-354°.

4. Y22; New Mexico; Separ; 32°15!6 N, 108°24!2 W; 4700 ft; 67°-187°-307°.

5. Y23; Arizona; Aguirre Valley; 32°05!0 N; 111°35!3 W; 2800 ft; 115°-235°-355°.

6. Y24; Texas; Pecos; 31°13!1 N, 103°16!9 W; 2700 ft; 54°-174°-294°.

7. Y27; Texas; Lobo Valley; 30°26!4 N, 104°23!4 W; 4540 ft; 116°-236°-356°.

8. Y33; Nevada; Steptoe Valley; 40°28!7 N, 114°27!4 W; 5600 ft; 7°-127°-247°.

It is possible that we will want to substitute one of two other sites for Y16. These are both close to it, but Y16 looks best from the map. We shall look at all three next month, and let you know definitely our preference. The alternatives are:

2a. Y9; Utah; Wah Wah Valley; 38°40!4 N, 113°20!0 W; 4620 ft; 68°-188°-308°.

2b. Y18; Utah; Crater Springs; 39°35!9 N, 112°40!6 W; 4590 ft; 115°-235°-355°.

It is also possible that we will want to drop Y24 after we have seen it.

We expect to visit the Utah and Texas sites sometime next month. On this trip, we could come by Albuquerque to discuss the site study with you. We have not set a date for the trip yet, but we will let you know when we do.

Sincerely,

C. M. Wade

C. M. Wade

CMW:fmc

cc: George Love
H. Hvatum
D. S. Heeschen
J. E. Finks

SOCORRO ELECTRIC COOPERATIVE, INC.
Post Office Box H
SOCORRO, NEW MEXICO 87801

October 30, 1969

Mr. F. W. Edwards, President
Limbaugh Engineers, Inc.
P. O. Box 335
Albuquerque, New Mexico

SUBJECT: Availability of Central Station Electric Power 23.5 Miles West Southwest of Magdalena, New Mexico

Dear Mr. Edwards:

The Socorro Electric Cooperative, Inc. has in being a 14.4/24.9 kv distribution power line in the immediate vicinity of the above mentioned site with available capacity adequate to meet your client's power requirements of 800 to 1600 kw.

Until the exact site location can be identified, I cannot stipulate as to how much line would have to be built, but it is my estimate that it would require less than one mile.

The Socorro Electric Cooperative, Inc. is a public utility and operates under filed rules and regulations approved by the New Mexico Public Service Commission. These regulations govern our extension policies and our rates: -a copy of each is attached for your information.

Using your load projections and applying them to the rate it is my estimate that the monthly usage would be 500,000 kwhs and the cost $7,000.00. The monthly minimum would be the contracted minimum but not less than $1.75 per kva of contracted capacity. Or, if your client desires, we can provide for an annual minimum of twelve times the monthly minimum charge.

Assuming an installed capacity of 1500 kva and a resulting annual minimum of $31,500.00 (1500 kva x $1.75 x 12); if your client will agree to a five year contract no contribution-in-aid of construction would be required.

Because it is important, I would like to add that our system planning calls for a 69 kv line from Magdalena to Datil to be constructed in 1974. Upon completion of which, consumers in this area will be able to receive power and energy from either or both the Magdalena or Datil substations.

As an electric cooperative, loads of this magnitude require the approval of the Rural Electrification Administration. However, it has been my experience that if the terms of an agreement comply with our filed tariffs approval is readily attained.

Very truly yours,

SOCORRO ELECTRIC COOPERATIVE, INC.

Joseph F. Gallagher
Manager

JFG/aa

Enclosures

Socorro Electric Cooperative, Inc. Revised N.M.P.S.C. SHEET NO. #44
Name of Issuing Corporation

Socorro, Valencia & Catron Co. CANCELLING Original N.M.P.S.C. SHEET NO. #26
Community, Town or City

RULE 12
LINE EXTENSIONS TO CONTINUOUS USE FACILITIES

Whenever an extension of the Cooperative's overhead distribution system is necessary to serve an applicant or a group of applicants, the Cooperative will provide the requested service on the following terms under the Applicable Rate

EFFECTIVE BY OPERATION OF LAW SEC. 43 AND G. O. NO. 2, SEC. 18
DATE JAN 10 1969
NEW MEXICO PUBLIC SERVICE COMMISSION

I. RESIDENTIAL SERVICE:

A. Schedule R-Residential Rate

B. Without charge if the applicant or applicants are located within one-half mile of the Cooperative's distribution system and the service requested is single phase; or,

C. By special agreement without charge if the distance exceeds one-half a mile to serve an applicant or the average distance, per applicant, to serve a group of applicants exceeds one-half mile with the applicant agreeing to a ten year contract with a monthly minimum of eight ($8.00) dollars per one-thousand ($1,000.00) dollars of required investment; or,

D. By special agreement with the applicant agreeing to make a consumer advance in aid of construction of costs in excess of one-thousand ($1,000.00) dollars refundable at the rate of fifty (50%) percent of the monthly bill in excess of eight ($8.00).dollars.

II. COMMERCIAL; LARGE COMMERCIAL; LARGE POWER; LARGE INDUSTRIAL; and IRRIGATION.

A. Schedules C; LC; LC-1; LP; LI; and I.

B. By special agreement subject to the approval of the Administrator of the Rural Electrification Administration if more that 350 KVA is required.

C. Without charge provided the required investment does not exceed three times the annual minimum revenues established from the applicable rate schedule and the applicant agrees to a minimum contract period of five years; or,

(CONTINUED)

(To be inserted by utility) Issued by (To be inserted by N.M.P.S.C.)

ADVICE NO. 2 Joseph F. Gallagher DATE FILED DEC 10 1968
Name

ORDER NO. Joseph Gallagher EFFECTIVE JAN 10 1969
Title of Officer

Socorro Electric Cooperative, Inc. Revised N.M.P.S.C. SHEET NO. #44
Name of Issuing Corporation

Socorro, Valencia & Catron Co. CANCELLING Original N.M.P.S.C. SHEET NO. #26
Community, Town or City

EFFECTIVE BY ORDER OF LAW SEC. 43 AND U. C. NO. 2 SEC. 18

DATE JAN 10 1969
NEW MEXICO PUBLIC SERVICE COMMISSION

D. With the applicant making a non-refundable contribution in aid of construction of the required investment in excess of three times the annual minimum revenues established from the applicable rate schedule and agreeing to a minimum contract period of five years; or,

E. Without a contract period, with the applicant making a non-refundable contribution in aid of construction of the required investment.

F. Without charge if the required investment does not exceed five times the guaranteed annual revenues with the applicant agreeing to a minimum contract period of ten years; or,

G. With the applicant making a consumer advance in aid of construction of the required investment in excess of five times the guaranteed annual revenues - refundable at the rate of fifty (50%) percent of the monthly bill in excess of one-twelfth of the guaranteed annual revenues - and agreeing to a minimum contract period of ten years.

III. SECURITY LIGHTS:

A. Without charge if only the light and service drop is required and the applicant signs a 3 year contract; or,

B. With the applicant making a contribution in aid of construction of all costs in excess of of cost of the light and service drop and agreeing to a three year contract.

IV. EXTENSION CHARGE ADJUSTMENT:

A. There will be no adjustment to excess charges due to the extension of lines when there is an extension of the extension.

B. When an extension is tapped to serve a new consumer, excess charges will be ajusted so that all parties share a fair portion of the required excess charges.

(CONTINUED)

(To be inserted by utility) Issued by (To be inserted by N.M.P.S.C.)

ADVICE NO. 2 Joseph F. Gallagher DATE FILED DEC 10 1968
Name

ORDER NO. Joseph F. Gallagher Pub. Manager EFFECTIVE JAN 10 1969

SOCORRO ELECTRIC COOPERATIVE, INC.

Schedule LC

LARGE COMMERCIAL SERVICE

Availability:	Available in areas contiguous to the electric distribution system of the Cooperative to customers contracting for not less than 45 kva or more than 1,499 kva of capacity.
Applicability:	Power, Lighting and General Use.
Characher of Service:	Service shall be furnished from the available transmission or distribution voltage of 12,500 volts or higher with delivery at the desired utilization voltage or voltages.
Rate Per Month:	Demand charge of $1.75 per kw of demand. Energy charge of: 2.0¢ per kwh for the first 100 kwh per kw of demand 1.5¢ per kwh for the next 100 kwh per kw of demand 1.0¢ per kwh for the next 100 kwh per kw of demand 0.8¢ per kwh all over 300 kwh per kw of demand
Determination of Demand:	The monthly billing demand shall be determined by measurement and shall be the highest 15 minute kw demand as measured by standard metering equipment.
Minimum Charge:	The contracted minimum with a monthly minimum of not less than $1.75 per kva of contracted capacity or an annual minimum of not less than 12 times the monthly minimum of $1.75 per kva of contracted capacity.
Power Factor Adjustment:	If the consumer's power factor at maximum demand is less than 80% there will be added to the bill $2.50 per kva by which the actual kva demand exceeds the demand at 80% power factor.
Metering Voltage:	Metering shall normally be at the secondary voltage, however, if metered at the primary, the billing kwh shall be metered kwh times 95% to compensate for losses.

SOCORRO ELECTRIC COOPERATIVE, INC.
POST OFFICE BOX H
SOCORRO, NEW MEXICO 87801

September 22, 1966

RECEIVED
LIMBAUGH ENGINEERS
SEP 23 1966

Please Initial and Date
✓FWE_____ MEE_____
✓GCL 9/23 RAJ_____
JVW_____ JLS JLS
_____ WJH_____
File 2.316

Geroge C. Love, Vice-President
Limbaugh Engineers, Inc.
P. O. Box 335
Albuquerque, New Mexico

Dear Mr. Love:

This letter is in reply to your letter of September 16, 1966, and in answer to questions raised during our telephone conversation of this date.

We have a total system capacity of approximately twenty-thousand KW and our existing distribution system in the area of concern is capable of supplying up to an additional eight-hundred kilowatts without excessive voltage drop. Therefore, we can meet your operating requirements of four-hundred kilowatts and possible surge requirements of eight-hundred kilowatts from the existing facilities.

Our Large Power Rate Schedule, on file with the New Mexico Public Service Commission, is designed to cover the cost of service to facilities to be located contiguous to our existing distribution system. This rate will fully support all costs incurred by this utility to serve your client from the existing system.

Should your client deem it essential to have service through means of a 69 KV transmission line with a 1500 KVA allocation of capacity, at a delivery voltage to be established, a contribution in aid of construction will be necessary.

Our projections indicate that revenues from a four-hundred kilowatt load, having ninety percent load factor and billed under our Large Power Rate Schedule, would support an investment in new facilities of approximately one-hundred thousand dollars or approximately one-half of the required amount. A Contribution in aid of construction would be required of the investment requirement in excess of $100,000.00.

Should your client prefer to accept delivery, on an interim basis, over existing facilities, but provide guarantees at this time conuerning an alternate capability, we are willing to make this commitment based on the above revenue and investment projections.

Simply stated, if your client will agree to a monthly minimum usage of $3,500.00 per month for ten years, we will invest $100,000.00, subject to approval by R. E. A., towards the cost of the required construction.

Further, should the monthly usage exceed $3,500.00, we will refund 25% of such amount in excess, in the form of a credit applied against the contribution.

For your client's information, we are enclosing copies of our standard contract and the applicable rate structure.

Very truly yours,

SOCORRO ELECTRIC COOPERATIVE, INC.

Joseph F. Gallagher
Manager

JFG/aa

Enclosure

- S. E. C.-

SOCORRO ELECTRIC COOPERATIVE, INC.

Schedule P

Large Commercial Service

AVAILABILITY:	Available to consumers located contiguous to the electric distribution system of the Cooperative.
APPLICABILITY:	General power and lighting uses with demands in excess of 45 kw.
CHARACTER OF SERVICE:	Alternating current; 60 cycles; single phase 120/240 volts; three phase 120/208 volts; 240 volts; 480 volts; 2400 volts.
DEMAND CHARGE:	$1.75 per kw of demand
ENERGY CHARGE:	2.0¢ per kwh for the first 100 kwh of demand 1.5¢ per kwh for the next 100 kwh of demand 1.0¢ per kwh for the next 100 kwh of demand 0.8¢ all over
MINIMUM BILL:	The demand charge but not less than $1.00 per kva of installed capacity.
METERING:	Primary or Secondary
POWER FACTOR ADJUSTMENT:	If the consumer's power factor at maximum demand is less than 80% there will be added to the bill $2.50 per kva by which the actual kva demand exceeds the demand at 80% power factor.
DELAYED PAYMENT:	Six percent added after 30 days.
DEPOSIT REQUIREMENT:	An amount equal twice the monthly billing.
TEMPORARY SERVICE:	Available subject to special agreement.
TAX ADJUSTMENT:	Billings under this schedule may be increased by an amount equal to the sum of the taxes payable under the New Mexico Emergency School Tax Act and of all other taxes, fees, or charges, (exclusive of ad valorem, state and federal income taxes) payable by the utility and levied or assessed by any governmental authority on the public utility service rendered, or on the right or privilege of rendering the service, or on any subject or event incidental to the rendition of the service.

UTAH POWER & LIGHT COMPANY

Richfield, Utah 84701
November 25, 1969

Mr. F. W. Richards, Pres.
Limbaugh Engineers Inc.
P. O. Box 335
3125 Carlisle Blvd. N.E.
Albuquerque, New Mexico 87103

Dear Mr. Richards:

Thank you for your inquiry concerning electric power in our service area southwest of Delta, Utah. I will answer the questions in the sequence of your letter of November 3rd, and telephone conversation of November 20th.

1. Your requirements of 800 kilowatts continuous with a 1600 kilowatt peak demand can be furnished.

2. From the location listed in your letter we have estimated approximately 12 miles of 46 KV line would have to be built, which would cost approximately $160,000.

3. There will be no increase in our existing system needed to carry your client's load.

4. Your client could expect a power bill of approximately $5500 monthly and for this guaranteed revenue annually for 5 years there would be no cost to your client to furnish the electric facilities mentioned. Copy of our Extension Policy No. 14 enclosed.

5. As you will note, the minimum charge on Company's schedule 9 is $160.

Enclosed also is a pre-calculated billing schedule for various loads and load factors. I estimated from the information supplied that there would be 1,000 kilowatts with 80% load factor or a monthly bill of $5,429, which is.93¢ per kilowatt-hour.

If we can be of any assistance to you in negotiating with your client we would be most happy. Thanks again for your inquiry.

Sincerely,

Jay F. Gardner
Manager Sales & Marketing
Telluride Division

JFG:dk
Encl.

UTAH POWER & LIGHT COMPANY P. S. C. U. No. 8

ELECTRIC SERVICE

SCHEDULE NO. 14

STATE OF UTAH

EXTENSIONS

AVAILABILITY: In all territory served by the Company.

APPLICATION: Applicable to all classes of electric service.

EXTENSIONS: An extension is any continuation of or branch from, the nearest available existing line of the Company, including any increase of capacity of an existing line or facilities or the supply of three phase service to meet the Customer's requirements.

The Company will make the extension at its own expense when the estimated cost thereof is $400 or less per customer and the service to be supplied is of a continuous permanent nature.

Extensions for residential service costing more than $400 per customer will be made in accordance with the following conditions:

1. The Company will make the extension at its own expense when the guaranteed minimum total bills for service thereon for an initial period of five years are not less than the estimated cost of the extension.

2. The Company will make the extension when the guaranteed five year minimum total bills for service are less than the estimated cost thereof, upon receipt of an advance from the Customer of the difference between such guaranteed minimum bills and the estimated cost of the extension, and an agreement to take service for a term of not less than five years.

Extensions for commercial or industrial service costing more than $400 per customer will be made in accordance with the following provisions:

1. The Company will make the extension at its own expense when the guaranteed annual minimum bills for service thereon for an initial period of five years are not less than ⅓ of the estimated cost of the extension.

2. The Company will make the extension when the guaranteed annual minimum bills for service are less than ⅓ of the estimated cost thereof, upon receipt of an advance from the Customer of the difference between three times such guaranteed annual minimum bills and the estimated cost of making the extension and an agreement to take service for a term of not less than five years.

The Company will credit any Customer having made an advance as above provided with ⅓ of his monthly bill, from the date of beginning of service until, but not after: (1) the expiration of five years from the beginning of service; or, (2) the amount of such credits is equal to the Customer's advance without interest.

When additional Customers other than the original users desire service during the first 60 months after completion of an extension constructed with the aid of Customers' cash advances, the Company will supply such service when an equitable settlement or agreement (financial or otherwise) has been reached by the additional Customers with the original Customers, assisted by the Company when requested, or when notified to make the connection by the Public Service Commission, provided that: (1) the original Customers shall have notified the Company in writing of the proposed connection of the additional Customers, (2) the amount of the refunds or credits made hereunder shall not exceed the advances made by the original Customers, and (3) the contracts of the original Customers shall not have been terminated.

The requirement for guaranteed minimum bills may be waived when the Company's estimate of revenue from the extension justifies the cost of the extension.

The Customer will pay the estimated cost to the Company of making an extension for service to a venture of speculative permanency, or an enterprise of a temporary nature requiring service for a period of less than one year, or for a period exceeding one year if it be known at the time of making the extension that service will be temporary and the facilities will be dismantled. The Company will receive such estimated cost from the Customer before beginning work on the extension. Adjustments, taking into consideration cost of removal and credit for salvage value of material recovered, will be made with the Customer, at the option of the Company, initially or after termination of service.

The Company will own, operate and maintain all extensions made under this Schedule.

Issued on not less than one day's notice to the Commission and the public by authority Public Service Commission of Utah Order in Case No. 5129 dated December 27, 1962.

ISSUED JANUARY 21, 1963 EFFECTIVE JANUARY 23, 1963

UTAH POWER & LIGHT COMPANY

P. S. C. U. No. 8

ELECTRIC SERVICE

SCHEDULE NO. 9

STATE OF UTAH

GENERAL INDUSTRIAL SERVICE — HIGH VOLTAGE

AVAILABILITY: At any point on the Company's interconnected system where there are facilities of adequate capacity.

APPLICATION: This Schedule is for alternating current, three phase electric service supplied at approximately 44,000 volts or higher through a single point of delivery for all service required on the Customer's premises for manufacturing or other industrial purposes by industrial customers contracting for not less than 80 kw. Seasonal service will be available only under other appropriate schedules.

MONTHLY BILL:

Rate:

$2.00 per kw first 100 kw of Demand
$1.90 per kw next 200 kw of Demand
$1.63 per kw all additional kw of Demand

0.635c per kwh first 1,000,000 kwh
0.530c per kwh all additional kwh

Power Factor:

This rate is based on the Customer maintaining at the time of maximum use a power factor of 85% lagging, or higher, as determined by measurement. If the power factor is found to be less than 85% lagging, the Demand as recorded by the Company's meter will be increased by ¾ of 1% for every 1% that the power factor is less than 85%.

Minimum:

The monthly Demand charge, but not less than $160.00

DEMAND: The kw as shown by or computed from the readings of the Company's Demand meter for the 15 minute period of Customer's greatest use during the month, adjusted for power factor as specified, determined to the nearest kw, but not less than 80 kw.

CONTRACT PERIOD: One year or longer.

ELECTRIC SERVICE REGULATIONS: Service under this Schedule will be in accordance with the terms of the Electric Service Agreement between the Customer and the Company. The Electric Service Regulations of the Company on file with and approved by the Public Service Commission of the State of Utah, including future applicable amendments, will be considered as forming a part of and incorporated in said Agreement.

Issued on not less than one day's notice to the Commission and the public by authority Public Service Commission of Utah Order in Case No. 5129 dated December 27, 1962.

ISSUED JANUARY 21, 1963

EFFECTIVE JANUARY 23, 1963

UTAH POWER & LIGHT COMPANY
STATE OF UTAH
MONTHLY BILLINGS FOR HIGH VOLTAGE SERVICE UNDER INDUSTRIAL SCH. NO. 9 AND RESALE SCH. NO. 16
FOR VARIOUS DEMANDS AND LOAD FACTORS

LCP:lf
2-25-63

Demand	20% Load Factor			30% Load Factor			40% Load Factor			50% Load Factor		
Kw	Kwh	Billing	¢/Kwh	Kwh	Billing	¢/Kwh	Kwh	Billing	¢/Kwh	Kwh	Billing	¢/Kwh
100	14,600	$ 292.71	2.00	21,900	$ 339.07	1.55	29,200	$ 385.42	1.32	36,500	$ 431.78	1.18
200	29,200	575.42	1.97	43,800	668.13	1.53	58,400	760.84	1.30	73,000	853.55	1.17
300	43,800	858.13	1.96	65,700	997.20	1.52	87,600	1,136.26	1.30	109,500	1,275.33	1.16
400	58,400	1,113.84	1.91	87,600	1,299.26	1.48	116,800	1,484.68	1.27	146,000	1,670.10	1.14
500	73,000	1,369.55	1.88	109,500	1,601.33	1.46	146,000	1,833.10	1.26	182,500	2,064.88	1.13
750	109,500	2,008.83	1.83	164,250	2,356.49	1.43	219,000	2,704.15	1.23	273,750	3,051.81	1.11
1,000	146,000	2,648.10	1.81	219,000	3,111.65	1.42	292,000	3,575.20	1.22	365,000	4,038.75	1.11
2,000	292,000	5,205.20	1.78	438,000	6,132.30	1.40	584,000	7,059.40	1.21	730,000	7,986.50	1.09
3,000	438,000	7,762.30	1.77	657,000	9,152.95	1.39	876,000	10,543.60	1.20	1,095,000	11,834.50	1.08
4,000	584,000	10,319.40	1.77	876,000	12,173.60	1.39	1,168,000	13,851.40	1.19	1,460,000	15,399.00	1.05
5,000	730,000	12,876.50	1.76	1,095,000	15,094.50	1.38	1,460,000	17,029.00	1.17	1,825,000	18,963.50	1.04
7,500	1,095,000	19,169.50	1.75	1,642,500	22,071.25	1.38	2,190,000	24,973.00	1.14	2,737,500	27,874.75	1.02
10,000	1,460,000	25,179.00	1.72	2,190,000	29,048.00	1.33	2,920,000	32,917.00	1.13	3,650,000	36,786.00	1.01
15,000	2,190,000	37,198.00	1.70	3,285,000	43,001.50	1.31	4,380,000	48,805.00	1.11	5,475,000	54,608.50	1.00
20,000	2,920,000	49,217.00	1.69	4,380,000	56,955.00	1.30	5,840,000	64,693.00	1.11	7,300,000	72,431.00	0.99
30,000	4,380,000	73,255.00	1.67	6,570,000	84,862.00	1.29	8,760,000	96,469.00	1.10	10,950,000	108,076.00	0.99
40,000	5,840,000	97,293.00	1.67	8,760,000	112,769.00	1.29	11,680,000	128,245.00	1.10	14,600,000	143,721.00	0.98
50,000	7,300,000	121,331.00	1.66	10,950,000	140,676.00	1.28	14,600,000	160,021.00	1.10	18,250,000	179,366.00	0.98

Demand	60% Load Factor			70% Load Factor			80% Load Factor			90% Load Factor		
Kw	Kwh	Billing	¢/Kwh	Kwh	Billing	¢/Kwh	Kwh	Billing	¢/Kwh	Kwh	Billing	¢/Kwh
100	43,800	$ 478.13	1.09	51,100	$ 524.49	1.03	58,400	$ 570.84	0.97	65,700	$ 617.20	0.94
200	87,600	946.26	1.08	102,200	1,038.97	1.02	116,800	1,131.68	0.97	131,400	1,224.39	0.93
300	131,400	1,414.39	1.08	153,300	1,553.46	1.01	175,200	1,692.52	0.97	197,100	1,831.59	0.93
400	175,200	1,855.52	1.06	204,400	2,040.94	1.00	233,600	2,226.36	0.95	262,800	2,411.78	0.92
500	219,000	2,296.65	1.05	255,500	2,528.43	0.99	292,000	2,760.20	0.95	328,500	2,991.98	0.91
750	328,500	3,399.48	1.03	383,250	3,747.14	0.98	438,000	4,094.80	0.93	492,750	4,442.46	0.90
1,000	438,000	4,502.30	1.03	511,000	4,965.85	0.97	584,000	5,429.40	0.93	657,000	5,892.95	0.90
2,000	876,000	8,913.60	1.02	1,022,000	9,817.60	0.96	1,168,000	10,591.40	0.91	1,314,000	11,365.20	0.86
3,000	1,314,000	12,995.20	0.99	1,533,000	14,155.90	0.92	1,752,000	15,316.60	0.87	1,971,000	16,477.30	0.84
4,000	1,752,000	16,946.60	0.97	2,044,000	18,494.20	0.90	2,336,000	20,041.80	0.86	2,628,000	21,589.40	0.82
5,000	2,190,000	20,898.00	0.95	2,555,000	22,832.50	0.89	2,920,000	24,767.00	0.85	3,285,000	26,701.50	0.81
7,500	3,285,000	30,776.50	0.94	3,832,500	33,678.25	0.88	4,380,000	36,580.00	0.84	4,927,500	39,481.75	0.80
10,000	4,380,000	40,655.00	0.93	5,110,000	44,524.00	0.87	5,840,000	48,393.00	0.83	6,570,000	52,262.00	0.80
15,000	6,570,000	60,412.00	0.92	7,665,000	66,215.50	0.86	8,760,000	72,019.00	0.82	9,855,000	77,822.50	0.79
20,000	8,760,000	80,169.00	0.92	10,220,000	87,907.00	0.86	11,680,000	95,645.00	0.82	13,140,000	103,383.00	0.79
30,000	13,140,000	119,683.00	0.91	15,330,000	131,290.00	0.86	17,520,000	142,897.00	0.82	19,710,000	154,504.00	0.78
40,000	17,520,000	159,197.00	0.91	20,440,000	174,673.00	0.85	23,360,000	190,149.00	0.81	26,280,000	205,625.00	0.78
50,000	21,900,000	198,711.00	0.91	25,550,000	218,056.00	0.85	29,200,000	237,401.00	0.81	23,850,000	256,746.00	0.78

Kwh based on 730 hour month.

ASSOCIATED P & C
ENGINEERS Inc. *CONSULTING ENGINEERS*

PHONE 801-487-7222 • 2520 SOUTH STATE STREET • SALT LAKE CITY, UTAH 84115

November 18, 1969

Mr. J. L. Shields, Chief Engineer
Limbaugh Engineers, Inc.
P. O. Box 335
3125 Carlisle Blvd., N.E.
Albuquerque, New Mexico 87103

Subject: Mt. Wheeler Power, Inc.

Dear Mr. Shields:

I have been authorized by Mr. Wayne Gonder, President of Mt. Wheeler Power, Inc. to reply to your letter regarding potential projects for a Federal Agency that requires power in the State of Nevada. Mt. Wheeler has made application for a Certificate to serve the area and we anticipate approval by December 15, 1969.

I am enclosing some maps and data which will help to answer the questions you raise in your letter. From Mt. Wheeler's point of interest, Site Y17 holds the most promise since it is closer to one of their proposed distribution substations, (29.2 miles) and it is within the area for which Certification has been applied for. In order for Mt. Wheeler to serve Site Y33, it would be necessary to obtain an extension of the Certificated area from the Nevada PSC. In addition to this, Site Y33 would require a greater investment.

Referring to the questions which you raise in your letter, the answers are as follows:

1. Mt. Wheeler can furnish 800 kW and 1600 kW if they are Certificated by the Nevada PSC. Since no lines are presently constructed in the area, service could not begin until April, 1971.

2. The amount of power line that would have to be built to serve Site Y17 is approximately 29.2 miles at a cost of $146,870. In order to serve Site Y33, it would require an investment of $200,500 with 33.2 miles of line. A detailed breakdown of these costs is shown on the attached sheet.

3. To serve Site Y17 it would be necessary to increase the conductor size of about 13.2 miles of line from the proposed Diamond Valley Substation. Substation capacity in the Diamond Valley Substation will be adequate.

   To serve Site Y33, it would be necessary to reconductor about 5.6 miles of line and increase the capacity of the proposed Steptoe Valley Substation.

4. Since the load will be of permanent nature, we anticipate that it will qualify under Mt. Wheeler's proposed Extension Rule #9. And that furthermore, the load is in excess of 350 kW, so a Contract may be negotiated subject to the approval of the Nevada PSC. Under these rules, the Customer would not be required to advance any funds.

5. The minimum monthly charge for service would be subject to Extension Rule No. 9 which is 1.5 per cent per month of the investment. Or for Site Y17 it would be $2,203.00.

   The average monthly charge is determined by the Demand Charge and the Energy Charge. This would be in accordance with rate Schedule B, Commercial and Industrial Lighting and Power Service. A copy of the Rate Schedule is enclosed. However, in connection with the last block of energy rate, we propose to add two additional steps since the load is in excess of 350 kW Billing Demand. Under the assumed consumption, the Customer would pay approximately $10,373.00 per month.

Mt. Wheeler Power would be very pleased to serve such an electrical load for your Client. If we can be of further service to you, or you have additional questions, please call us. We shall be pleased to work with you in any way to make this potential load become a reality. Since the facility is a Radio Telescope there may be some requirements for undergrounding of distribution lines in the area. If extensive underground facilities are required, the Customer would have the pay for the additional investment.

Very truly yours,

Clare K. Olsen

Clare K. Olsen

CKO:dp

Enclosures:

RECEIVED
LIMBAUGH ENGINEERS
NOV 24 1969

Date When Read

	FWE			EE	
	GCL			WJH	
	RAJ			WB	
	JLS				
	ALP				

File 2915

ASSOCIATED P & C
ENGINEERS Inc. CONSULTING ENGINEERS

PHONE 801-487-7222 • 2520 SOUTH STATE STREET • SALT LAKE CITY, UTAH 84115

COST ESTIMATES

Construction Costs	Site Y17 Monitor Valley	Site Y33 Antelope Valley
Distribution Line 14.4/24.9 KV		
Reconductor 13.2 miles from #4 to 4/0 ACSR @ 2630/mi	34,716	
5.6 miles		14,728
New Line 4/0 ACSR 16 mi @ 4830	77,280	
27.6 mi @ 4830		133,308
Increase Substation KVA	No Cost	13,600
Transformer Bank, Meter and Service 1500 kVA 14.4/24.9 kV to 2.4/4.16 kV	24,000	24,000
Engineering and Overhead @ 8%	10,874	14,864
Total Cost	$146,870	$200,500
Extension Rule #9		
Minimum Bill @ 1½% / month	2,203	2,807
Monthly Rate Charges		
Assume 800 kW @ 90% LF = 800 x 730 x 9 = 525,000 KWH		
1600 kW @ 10 hrs = 1600 x 10 = 16,000 KWH		
Total = 541,000 KWH		
Demand Charge		
1580 KW @ 2.00/KW	3,160	
Energy @		
First 50 KWH @ 12¢	6	
Next 50 " @ 7¢	3½	
" 900 " @ 4½¢	40½	
" 4000 " @ 3½¢	140	
" 5000 " @ 2¢	100	
" 10000 " @ 1½¢	150	
All Over, 521,000 @ 1.3¢	6,773	
Total Monthly Bill	$10,373.00 per month	

MT. WHEELER POWER, INC. Original Sheet P.S.C.N. No. 7

SCHEDULE B

COMMERCIAL AND INDUSTRIAL LIGHTING AND POWER SERVICE

APPLICABILITY

Applicable to consumers for commercial, industrial and three-phase farm service for all uses, including lighting, heating, and power, subject to the established rules of the Utility.

TYPE OF SERVICE

Single-phase, and three-phase, 60 cycles, at available secondary voltages.

RATE PER MONTH

Demand Charge

First 20 kilowatts of billing demand per month, no demand charge.

Excess above 20 kilowatts of billing demand per month at $2.00 per kilowatt.

Plus Energy Charge

First	50 kwh per month	@	12 ¢ per kwh	6.00		
Next	50 kwh per month	@	7 ¢ per kwh	3.50	9.50	
Next	900 kwh per month	@	4.5¢ per kwh	40.50		
Next	4000 kwh per month	@	3.5¢ per kwh			
Over	5000 kwh per month	@	2.0¢ per kwh			

Except that if the consumer is using more than 150 kwh per kW per month, all kwh in excess of 5000 kwh shall be billed at the rate of 1.7¢ per kwh

ISSUED BY:
MT. WHEELER POWER, INC.

President

ISSUED: June 2, 1969

SCHEDULE B

COMMERCIAL AND INDUSTRIATL LIGHTING AND POWER SERVICE
(Continued)

DETERMINATION OF BILLING DEMAND

The billing demand shall be the maximum kilowatt demand established by the consumer for any period of fifteen consecutive minutes during the month for which the bill is rendered, as indicated or recorded by a demand meter, but not less than the following minimum monthly charge.

MINIMUM MONTHLY CHARGE

The minimum monthly charge under the above rate shall be $6.00 where 5 kVA or less transformer capacity is required. For consumers requiring more than 5 kVA transformer capacity the minimum monthly charge shall be increased at the rate of 75¢ for each additional kVA or fraction thereof required. Where it is necessary to extend or re-enforce existing distribution facilities, the minimum monthly charge may be increased to assure adequate compensation for the added facilities. Where the minimum charge is increased in accordance with the terms of this section, additional energy and demand shall be included in accordance with the foregoing rate schedule.

MINIMUM ANNUAL CHARGE FOR SEASONAL SERVICE

Consumers requiring service only during certain seasons not exceeding 9 months per year may guarantee a minimum annual charge, in which case there shall be no minimum monthly charge. The minimum annual charge shall be sufficient to assure adequate compensation for the facilities installed to serve the consumer, and in no event shall it be less than twelve times the minimum monthly charge determined in accordance with the foregoing paragraph.

ISSUED BY:
MT. WHEELER POWER, INC.

President

ISSUED: June 2, 1969

RULE NO. 9

LINE EXTENSION
(Continued)

G. Extensions for Continuous Permanent Service

1. The Utility will construct entirely at its own expense, extensions of its electric system to serve new customers, where the Customers make guarantees to Utility in writing to pay monthly revenue of not less than 1½% monthly of the investment required but not less than the regular minimum of the filed rate schedule.

2. Under existing minimums as specified in the schedules hereafter set out the Utility will build:

   a. 200 feet of extension plus service drop for service under Rate Schedule A.

   b. 200 feet of extension plus service drop for service under Rate Schedule A-5.

   c. 200 feet of extension plus service drop for service under Rate Schedule B.

   d. 200 feet of extension plus service drop for service under all Rate Schedules EL & P.

ISSUED BY:
MT. WHEELER POWER, INC.
Eugene D. Goodell
President

ISSUED: June 2, 1969

RULE NO. 10

CONTRACTS
(Continued)

6. All contracts for sale of power for re-sale, (except pursuant to Rule 18C) and all large power service in excess of 350KW of billing demand shall be pursuant to negotiated contract, which contracts shall be subject to the approval of the Public Service Commission.

B. Each contract for electric service will contain the following provision:

This contract shall at all times, be subject to such changes or modifications by the Public Service Commission as said Commission may from time to time direct in the exercise of its jurisdiction.

ISSUED BY:
MT. WHEELER POWER, INC.
Wayne D. Goudelock
President

ISSUED: June 2, 1969

BUFORD SLOVER, JR.
Manager

ELECTRIC POWER
Telephone 546-8838
or 546-8839

Columbus Electric Cooperative Inc.
P. O. Box 631
DEMING, N. M. 88030

December 22, 1969

Limbaugh Engineers, Inc.
3125 Carlisle Blvd. N. E.
Albuquerque, New Mexico

Attention: Mr. Earl Hoffman

Dear Sir:

With reference to your inquiry as to the availability of electric service to a point approximately 5 miles North of Separ, New Mexico, and with further reference to our recent telephone conversation, we find the Columbus Electric Cooperative, Inc. can not furnish power from the existing 13.8KV satisfactory ~~service~~ to the location mentioned, therefore we have made an estimate of the cost to furnish you service by installing a 1500 KVA substation near our 69 KV transmission line approximately eight miles South of Separ, and extending a 14.4/24.9 line to the location, with a step down station to the required service voltage.

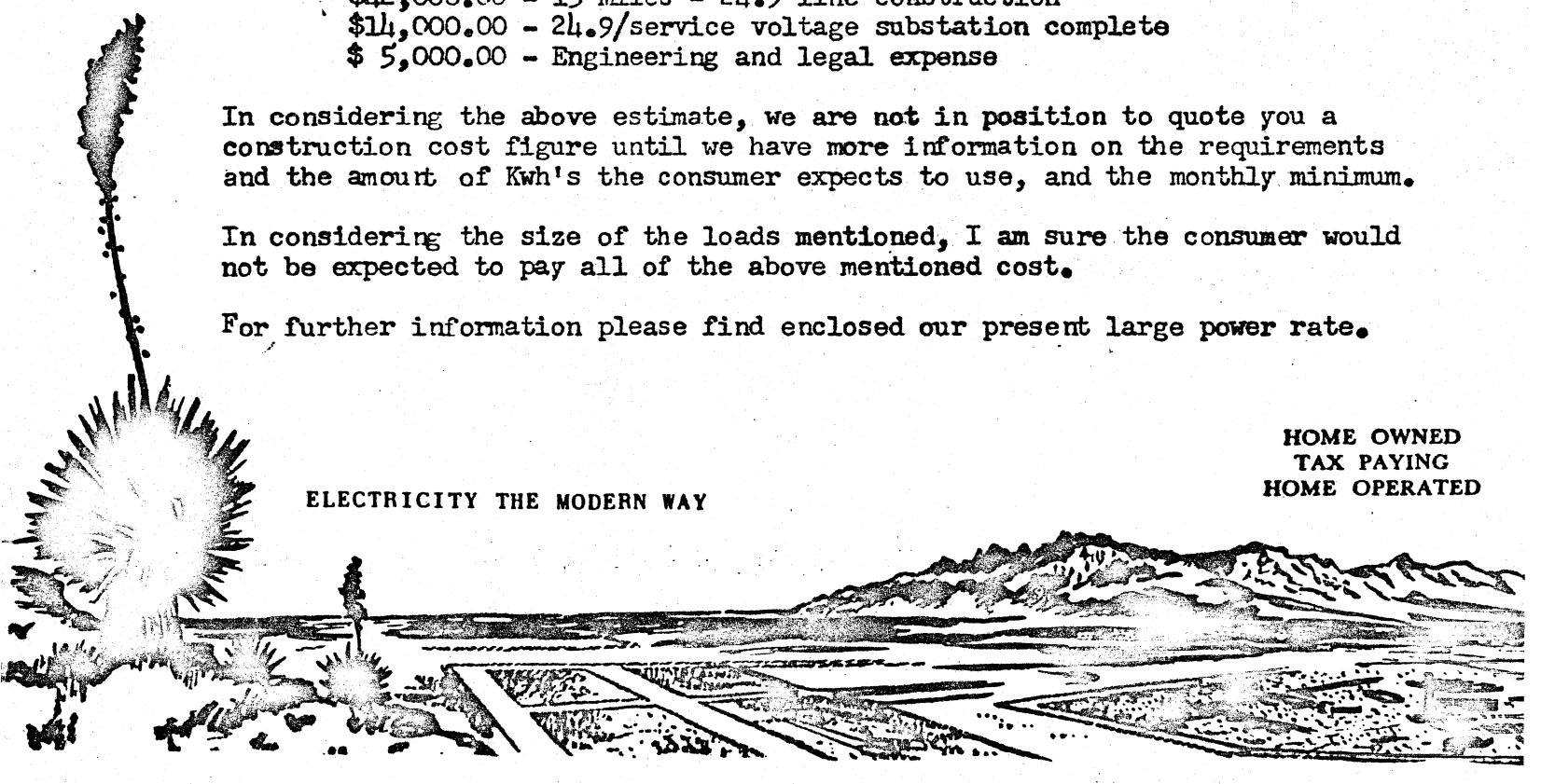
The estimated cost of installing the above is approximately $118,000.00 broken down as follows:

$47,000.00 - 69/24.9 Substation equipment
$10,000.00 - 69/24.9 substation installation
$42,000.00 - 13 miles - 24.9 line construction
$14,000.00 - 24.9/service voltage substation complete
$ 5,000.00 - Engineering and legal expense

In considering the above estimate, we are not in position to quote you a construction cost figure until we have more information on the requirements and the amount of Kwh's the consumer expects to use, and the monthly minimum.

In considering the size of the loads mentioned, I am sure the consumer would not be expected to pay all of the above mentioned cost.

For further information please find enclosed our present large power rate.



Please let me hear from you concerning this service, for, as you may know equipment of this type is very scarce at this time.

Awaiting your reply.

Sincerely,

COLUMBUS ELECTRIC COOPERATIVE, INC.

Buford Slover Jr.

Buford Slover, Jr., Manager

BS,Jr./sgg

Encl. - 1 Rate

SCHEDULE LP
LARGE POWER SERVICE

AVAILABILITY

Available to consumer located on or near Seller's three-phase lines for all types of usage, subject to the established rules and regulations of Seller.

TYPE OF SERVICE

Three-phase, 60 cycles, at Seller's standard voltages.

RATE

Demand Charges

$ 2.00 per month per KW of billing demand.

Plus energy Charges

3.0 ¢ per KWH for the first 50 KWH used per month per KW of billing demand.

2.0 ¢ per KWH for the next 100 KW used per month per KW of billing demand.

1.5 ¢ per KWH for all remaining KWH used per month.

DETERMINATION OF BILLING DEMAND

The billing demand shall be the maximum kilowatt demand established by the consumer for any period of fifteen consecutive minutes during the month adjusted for power factor as provided below.

POWER FACTOR ADJUSTMENT

The consumer agrees to maintain unity power factor as nearly as practicable. Demand charges will be adjusted for consumers with 50 KW or more of measured demand to correct for average power factors lower than 90% and may be so adjusted for other consumers if and when the Seller deems necessary. Such adjustments will be made by increasing the measured demand 1% for each 1% by which the average power is less than 90% lagging.

FUEL COST ADJUSTMENT CHARGE

In case the rate under which Seller purchases power at Wholesale is adjusted in accordance with a fuel cost adjustment provision in Seller's wholesale power contract, the foregoing energy charges shall be adjusted each month by the same amount per KWH as the fuel cost adjustment per KWH in Seller's wholesale power bill for the next preceding month.

MINIMUM MONTHLY CHARGE

The minimum monthly charge shall be the highest one of the following charges as determined for the consumer in question.

(1) The minimum monthly charge specified in the contract for service.

(2) A charge of $0.75 per KVA of installed transformer capacity.
(3) A charge of $25.00.

MINIMUM ANNUAL CHARGE FOR SEASONAL SERVICE:

Consumers requiring service only during certain seasons not exceeding 9 months per year may guarantee a minimum annual charge, in which case there shall be no minimum monthly charge. The minimum annual charge shall be sufficient to assure adequate compensation for the facilities installed to serve the Consumer, and in no event shall it be less than $9.00 per KVa of installed transformer capacity, or $300.00 whichever is greater.

SERVICE PROVISIONS

1. Delivery Point. If service is furnished at secondary voltage the delivery point shall be the metering point unless otherwise specified in the contract for service. All wiring, pole lines and other electric equipment on the load side of the delivery point shall be owned and maintained by the Consumer.

If service is furnished at Seller's primary line voltage the delivery point shall be the point of attachment of Seller's primary line to Consumer's transformer structure unless otherwise specified in the contract for service. All wiring, pole lines and other electric equipment (except metering equipment) on the load side of the delivery point shall be owned and maintained by the Consumer.

2. Lighting. Both power and lighting shall be billed at the foregoing rate. If a separate meter is required for the lighting circuit, the registrations of the two watt-hour meters shall be added to obtain total kilowatt-hours used and the registrations of the two demand meters shall be added to obtain the total kilowatt demand for billing purposes.

3. Primary Service. If service is furnished at primary distribution voltage, a discount of seven per cent (7%) shall apply to the demand and energy charges, and if the minimum charge is based on transformer capacity, a discount of seven per cent (7%) shall also apply to the minimum charge. However, the Seller shall have the option of metering at secondary voltage and adding the estimated transformer losses to the metered kilowatt-hours and kilowatt demand.

TERMS OF PAYMENT

The above rates are net, the gross rates being 10 % higher on the first $25.00 and two per cent(2%) on the remainder of the bill. In the event the current monthly bill is not paid within fifteen days from the date of the bill, the gross rates shall apply.

ELECTRIC COOPERATIVE, INC.
TRICO
People — Power — Progress

November 14, 1969

Limbaugh Engineers, Inc.
3125 Carlisle Blvd., N.E.
Post Office Box 335
Albuquerque, New Mexico 87103
Attn: Mr. Earl Huffman

SUBJECT: Electrical Power Supply

Dear Mr. Huffman:

In response to your letter of October 28th, we are pleased to submit the following to supply 800 kilowatts continuous and 1600 kilowatt peak demand at a proposed site.

1)	Trico to construct approximately 2.5 miles of overhead, three-phase, 60-cycle, 4-wire power lines with overhead neutral at 14,400/24,900 primary voltage	$10,200.00
2)	Install a three-phase oil circuit reclosure at the take-off point of the above line from our main feeder circuit	2,400.00
3)	Install a complete metering set consisting of a watthour meter, demand meter, current and potential transformers	1,800.00
4)	Install one three-phase, 1500 KVH transformer and sub-station with secondary voltage to meet your requirements at 240/480, 277/480, 2300/4160 or any other standard voltage you may require	19,600.00
	Total:	$34,000.00

We note on a drawing previously submitted to us that a landing strip is planned near the building complex. Due to this, you might want to consider placing the substation south of this, take the power at this point and bury the lines from this point to the complex to keep the landing strip area clear of poles. Our cost estimates do not reflect this idea of construction.

The rate for this service will be in accordance with our Arizona Corporation Commission rate schedule L.P. attached hereto.

We propose that your client pay to Trico at the time of execution of the contract a sum of $34,000.00, which sum would be refunded to your client at the rate of 15 percent of the monthly billing until the total of $34,000.00 has been refunded.

We are enclosing a map depicting Trico's power system with the proposed line to the complex colored in red thereon. The map also shows in green the additional circuit under plans to be built within the next year. We will construct this line at 115,000 volts but energize it at 25 KV for the first two or three years. Your complex and Kitt Peak could be served from this line directly out of the Three Points substation.

We also submit additional information concerning the Tucson area that could be extremely important to your client.

Already recognized as the astronomy center of the world, Tucson's stature as a scientific research center is rapidly growing.

When a new scientific or technical facility locates here, they have the advantages of the scientific brains and know-how as well as the technical skills and manpower of an area that already serves Kitt Peak National Astronomical Observatory, the University of Arizona Lunar and Planetary Lab, the University's Steward Observatory, the National Radio Observatory, the Smithsonian Astrophysical Observatory, and the world's newest and finest Optical Science Center at the University of Arizona.

Add to this the attached list of companies that presently have operations in the area and you will find that Tucson is a hub of activity in the world of astronomy and communications.

It makes readily available a source of trained scientists, knowledgeable technicians and skilled workers. It provides a pooling of some of the finest scientific brains in the country and it makes service facilities for the manufacture, repair, servicing and maintenance of intricate equipment close at hand. It gives a quick source for needed parts and auxiliary equipment.

And...Tucson is a great place to live and raise a family!

If you have any questions concerning this proposal, or need additional information, please do not hesitate to call upon us.

Very truly yours,

A. O. Bicknell, General Manager
Trico Electric Cooperative, Inc.

mj

Enclosures

TRICO ELECTRIC COOPERATIVE INC.
7144 WEST MIRACLE MILE
TUCSON, ARIZONA 85705

SCHEDULE LP

LARGE POWER SERVICE

AVAILABILITY

Available to consumers located on or near Seller's three-phase lines for all types of usage, subject to the established rules and regulations of Seller.

TYPE OF SERVICE

Three-phase, 60 cycles, at Seller's standard voltages.

RATE

Demand Charges
$ 1.75 per month per KW of billing demands.

Plus Energy Charges
2.0 ¢ per KWH for the first 50 KWH used per month per KW of billing demand.
1.5 ¢ per KWH for the next 100 KWH used per month per KW of billing demand.
0.8 ¢ per KWH for all remaining KWH used per month.

DETERMINATION OF BILLING DEMAND

The billing demand shall be the maximum kilowatt demand established by the consumer for any period of fifteen consecutive minutes during the month for which the bill is rendered, as indicated or recorded by a demand meter and adjusted for power factor as provided below.

MINIMUM MONTHLY CHARGE

The minimum monthly charge shall be the highest one of the following charges as determined for the consumer in question.

(1) The minimum monthly charge specified in the contract for service.
(2) A charge of $0.75 per KVA of installed transformer capacity.

Partial listing of electronic or scientifically-oriented organizations presently operating or preparing facilities in the Tucson area:

Headquarters for STRATCOM - United States Army Strategic Communications Command

Control Data - Autocon Division: Electronic Controls

Control Data - Manufacturing Division: Digital Terminals

Erie Technological Products, Inc.: Semi-Conductors

Motorola, Incorporated: Semi-Conductors

Lear-Jet: Eight-Track Stereos

Northrup-Page: Electronic Communication Systems

Kaman Sciences Co.: Weaponry Systems - Communications Engineers

I.O.T.A. Engineers: Optical Electronic Testing

Volt-Tech Corporation: Aircraft Instruments

Monsanto: Electronics Division - Testing Equipment Manufacturer

Sprague of Tucson: Amplifier Manufacturers

Transistor Electronics Co.: Digital Readouts/Research

T.S.N. Optical Company, Inc.: Lens Design

Electronetics: Resistor Manufacturer

Fairchild Camera Co.: Semi-Conductors

Imperial Camera Co.: Camera Assembly

ARCO Spear Co.: Electronic Resistors

Philco-Ford, Incorporated: Communications Systems Center

####

ELECTRIC COOPERATIVE, INC.
TRICO
+ 1144 W. Miracle Mile • Tucson, Arizona +

RECEIVED
LIMBAUGH ENGINEERS
OCT 6 1966

Please Initial and Date
① FWE 10/5/66 MEE
GCL Come 10/6 RAJ
JVW JLS
WJH
File 2016 - Utilities

September 30, 1966

Limbaugh Engineers, Inc.
P. O. Box 335
3125 Carlisle Blvd., N.E.
Albuquerque, New Mexico 87103

Attn: Mr. George C. Love,
Vice President

Dear Mr. Love:

Thank you for your letter giving us additional information relative to the power load at a tentative site near Three Points, Arizona. The map will be kept confidential and it's contents have been revealed only to those staff members of Trico, necessary to supply the information requested in your letter of September 14, 1966.

Not that it's of any consequence at this time, but we believe the location of the proposed site is Section1, T16S, Range 7E, and not Township 15 South as shown on the map sent to us. You may want to note this if you are using this same map for other purposes.

Discrepancy Corrected Dues Corrected 10/7

Upon investigation, we estimate the cost of extending electric service to this tentative site to be as follows:

2.5 miles of 14.4/24.9 KV, three phase power line, 60 cycle, 4 wire, pole construction with overhead static wire for lightning protection, conductor to be 1/0 ACSR.	$10,250.00
3, automatic oil reclosures at take-off point of our existing 3 phase line, electrically interlocked.	2,000.00
1, metering set at secondary voltage.	1,000.00
1, 500 KVA substation, consisting of 3-167 KVA transformers, 14.4/24.9 KV, with secondary voltage as required but not to exceed 2400 volts.	8,000.00
Engineering, Supervision and overhead.	4,000.00
Total Cost	$25,250.00

We propose that your client pay to Trico prior to commencement to construction and at the time of execution of a contract to purchase power, the sum of $25,250.00 as a refundable connection charge. This amount will be refunded to your client at a rate of 10% of each monthly bill on the amount each monthly bill exceeds the monthly minimum.

The monthly minimum will be based upon 75¢ per KVA of installed transformer capacity.

We used 500 KVA of substation capacity to cover your estimated peak deamad of 400 KW. If by any chance, it would be more, or 1500 KW, then the substation size may be increased accordingly and the price of the substation would change according to the change in the transformer price. Also the transformer could be one three phase machine if desired by you. In any event, the transformer or transfomers would be ground mounted on a concrete slab and protected by a chain link fence. The structure would be wood with overhead busses, switches, lightning arrestors, etc.

Information submitted herein is flexible and prices are estimated.

The facilities described would be owned, operated and maintained by Trico, unless other arrangements would be more satisfactory to your client.

The large power rate as described in our letter of July 1, 1966, will apply to this size service.

We hope this information will be helpful to your client. If there is any thing else we can do to aid you, please call upon us.

Very truly yours,

TRICO ELECTRIC COOPERATIVE, INC.

Lyle J. McDonald

Lyle J. McDonald, Office Manager

LJMcD/jb

WEST TEXAS UTILITIES COMPANY

GENERAL OFFICE: P. O. BOX 841
ABILENE, TEXAS 79604

November 28, 1969

Mr. E. G. Huffman, P.E.
Limbaugh Engineers, Inc.
P. O. Box 335
Albuquerque, New Mexico 87103

Dear Mr. Huffman:

In order to provide electric service for a 1600 KW load located approximately 30°-26.4' North and 104°-23.4' West, it will be necessary for us to construct approximately 26.5 miles of 69 KV transmission line, oil circuit breakers and related equipment and a 2500 KVA 69/12 KV substation with regulators and related equipment.

We can establish these facilities on a basis of a 10-year contract with a non-refundable advance payment by the customer in the amount of $181,000, and a monthly minimum billing of $7,200.

If the customer elects to take service at 69 KV, thereby relieving us of the 2500 KVA 69/12 KV substation investment, the non-refundable advance payment would be reduced by $70,000 to $111,000.

The customer will have the option of terminating this contract at any time prior to the expiration of the 10-year term by paying a cancellation charge of $2,000 per month for each month the customer fails to take service for the initial 120 months (10-year contract term).

Rate Schedule LPL-3 would be the applicable tariff and based on a demand of 1600 kilowatts and 1,000,000 KWH, the monthly billing would be $10,250 per the attached calculation.

We are enclosing a map of our system and if there is any further information we can supply, please call on us.

Yours very truly,

WEST TEXAS UTILITIES COMPANY

T. V. Grayson
RATE ENGINEER

TVG/sl

Encl.

WEST TEXAS UTILITIES COMPANY

May 8, 1936 RATE SCHEDULE LPL-3
Revised: INDEX NUMBER
1-18-54, 4-1-59, 7-20-62 8
8-16-62, 7-31-64 6
62

LARGE WHOLESALE POWER SERVICE

AVAILABILITY

Available, where individual cost analysis of load, investment and service conditions justify, and the Customer contracts for a guaranteed minimum monthly billing, only for the operation of large pipe line pump stations, railway repair shops, furnace type carbon black plants, state eleemosynary institutions, federal government main air force bases, and oil field loads with a metered demand of not less than 200 kilowatts where service is taken through one point of delivery.

RATE

$2.00	per month per kilowatt of maximum demand for the first 50 kilowatts of maximum demand in any month
$1.50	per month per kilowatt of maximum demand in excess of first 50 kilowatts of maximum demand in any month
.03	per kilowatt-hour for the first 1,000 kilowatt-hours used per month
.02	per kilowatt-hour for the next 2,000 kilowatt-hours used per month
.015	per kilowatt-hour for the next 12,000 kilowatt-hours used per month
.01	per kilowatt-hour for the next 45,000 kilowatt-hours used per month
.008	per kilowatt-hour for the next 50,000 kilowatt-hours used per month
.006	per kilowatt-hour for all energy used per month in excess of the first 110,000 kilowatt-hours.

FUEL CLAUSE - (a)

The net energy charge per kilowatt-hour delivered hereunder will be increased or decreased $.000132 for each 1¢, and proportionally for fractional part thereof, by which the average delivered cost of fuel to the Company, during the immediately preceding month, exceeds 10¼¢ or is less than 8¢ for that quantity of fuel containing 1,000,000 B.t.u.'s.

DETERMINATION OF MAXIMUM DEMAND

The Customer's maximum demand shall be the average number of kilowatts consumed during the thirty (30) minute period of maximum use during current month, but not less than the contracted minimum.

CONTRACT MONTHLY MINIMUM CHARGE

In consideration that Company must maintain adequate facilities and have ready at all times sufficient power plant capacity to carry a contract load of _____ for Customer, the monthly minimum charge for service supplied hereunder shall be $

WEST TEXAS UTILITIES COMPANY

_____, TEXAS



TO

ELECTRIC SERVICE FURNISHED FROM _____ TO _____ 19 ____

RATE SCHEDULE LPL-3

1600 TOTAL KILOWATT DEMAND

50 KILOWATTS OF MAXIMUM DEMAND . . @ $ 2.00 PER KILOWATT . . . $ 100.00 (A)

1,550 KILOWATTS OF MAXIMUM DEMAND . . @ $ 1.50 PER KILOWATT . . . $ 2325.00 (B)

_____ KILOWATTS OF MAXIMUM DEMAND . . @ $ _____ PER KILOWATT . . . $ _____

TOTAL KILOWATT-HOUR CONSUMPTION 1,000,000 KWH

_____ KWH INCLUDED IN ( )

DEMAND METER READINGS

METER NO.	MAXIMUM READING	MULTIPLIER

KWH METER READINGS

METER NO.	PRESENT	PREVIOUS	NET	MULTI-PLIER

1,000	KWH @	.03	$ 30.00
2,000	KWH @	.02	$ 40.00
12,000	KWH @	.015	$ 180.00
45,000	KWH @	.01	$ 450.00
50,000	KWH @	.008	$ 400.00
890,000	KWH @	.006	$ 5340.00
_____	KWH @	. . .	$ _____

$ _____

$ _____

$ _____

PLUS FUEL CLAUSE ADJUSTMENT $ 1385.00

Per month TOTAL $ 10,250.00

SALES TAX $ _____

X12 Year AMOUNT TO PAY $ 123,000

PAYABLE ON OR BEFORE _____

PAID

ARIZONA RAILROAD COMPANY

TRACK CONSTRUCTION AND MAINTENANCE

P. O. BOX 10271
PHOENIX, ARIZONA 85016
AM 5-0407

RECEIVED
LIMBAUGH ENGINEERS
AUG 26 1966

August 22, 1966

Please Initial and Date

FWE_____ MEE_____
GCL_____ RAJ_____
JVW_____ JLS 8/26
_____ WJH_____

File 2316-

Mr. James L. Shields
Limbaugh Engineers, Inc.
P. O. Box 335
Albuquerque, New Mexico

Dear Sir:

In regard to our telephone conversation Friday, August 19, 1966, it is my pleasure to submit to you this proposal for the construction of approximately 90 miles of railroad trackage.

This trackage being composed of used 90# rail and trim with 4" ballast under untreated ties.

As I mentioned, the cost of such a project would be approximately $8.00 per linear foot not including the preparation of the trackbed. Five dollars and fifty cents of this price (per foot) would be going for the purchasing of materials, the remaining for the cost of labor.

Thank you for calling us and if you should desire any further information please do not hesitate to contact us.

Yours truly,

C R Newman

C. R. Newman

ARIZONA RAILROAD COMPANY

CRN:bl

2-64 S-2660

Southern Pacific Company

400 EAST TOOLE AVENUE, TUCSON, ARIZONA 85701 IN REPLY PLEASE REFER TO

A. S. McCANN
SUPERINTENDENT

August 12, 1966 349-1

RECEIVED
LIMBAUGH ENGINEERS
AUG 15 1966

Please Initial and Date
FWE 8/15/66 MEE
GCL RAJ
JVW JLS 8/15
WJH

File 2316 - Railroad

Limbaugh Engineers Inc.
Box 335
Albuquerque, New Mexico

Attention - Mr. James L. Shields

Gentlemen:

Please refer to your telephone call to my office concerning the cost to build railroad track for a proposed military installation west of Tucson, requiring two tracks to be built radially in three directions, 15-miles long.

Industry tracks, which vary in length from a few hundred feet to 6 or 7 miles long, have been built in the Tucson Area by private contractor at a cost of about $12.00 per foot. This figure would include S/H 112# industrial rail on new ties on a 4" ballast section on a 20-ft. subgrade 1-ft. high. To this you would have to add the cost of drainage structures and additional embankment where necessary.

The above figures cannot be considered as a commitment by the Railroad to perform any of this work or furnish material, but are merely averages of the cost in this area.

Attached also is a list of private rail contractors.

We hope this information will be useful.

Yours very truly,
A S McCann

The Atchison, Topeka and Santa Fe Railway Company

OFFICE OF CHIEF ENGINEER—WESTERN LINES

H. P. WEIDMAN,
Office Engineer

G. R. VANDERPOOL,
Bridge Engineer

E. M. KENDALL,
W. S. & Heating Engineer

Amarillo, Texas 79101

Tele. 806-376-5131

J. E. EISEMANN,
Chief Engineer

G. W. CORRELL,
Valuation Engineer

T. E. REYMAN,
Architect

H. C. MUNN,
Right of Way Agent

August 11, 1966
File A-144000

RECEIVED
LIMBAUGH ENGINEERS
AUG 15 1966

Please Initial and Date

FWE	8/15/66	MEE	
GCL	8/18/66	RAJ	
JVW		JLS	8/15
		WJH	

File 2316 - Railroad

Limbaugh Engineers
P O Box 335
Albuquerque, New Mexico

Attention: Mr. James Shields

Gentlemen:

Your phone request concerning cost of track placed by contractor.

On assumption material will be available near site, it is believed the contractor's bid will be around $11.00 to $12.00 per foot of ballasted track. This is based on using 90-lb. rail and new ties.

Yours truly,

J. E. Eisemann

RAILROAD MAINTENANCE & CONSTRUCTION, INC.
ENGINEERING • MAINTENANCE • CONSTRUCTION
P. O. BOX 1133 IRVING, TEXAS BLACKBURN 4-4177

September 20, 1966

RECEIVED
LIMBAUGH ENGINEERS
SEP 22 1966
Please Initial and Date
FWE _____ MEE _____
✓GCL [initials] RAJ _____
JVW _____ JLS [initials]
_____ WJH _____
File 2316 Roadway design

Mr. James L. Shields
Limbaugh Engineers, Inc.
Box 335
Albuquerque, New Mexico

Dear Mr. Shields:

In response to your inquiry regarding the construction of approximately 90 miles of track some time in the future, we have looked at the various costs as much as can be determined at this time, and feel that this track would probably cost:

$14.50/track foot

This would include the furnishing of all necessary material, except as excluded, required to construct this track upon a subgrade completed by others.

In the preparation of this proposal, we have assumed the following generalities as far as materials and specifications are concerned:

1. Rail would be minimum 90-lb. rail, with a cost of approximately $115.00 per ton delivered to the job site. The rail would be trimmed out with matching relay joint bars and relay tie plates, however, all fastenings would be new with four spikes being employed per tie and four bolts per joint bar.

2. Cross ties would be new, 6" x 8" x 8' creosote treated and would be spaced at approximately 22" center to center.

3. Ballast would be locally produced, crushed rock ballast, made available at $2.00 per ton with sufficient being utilized to provide for 6" of ballast beneath the ties.

All construction, of course, would comply with best modern railroad practices.

If we can be of any further assistance regarding this work, please feel free to call.

Yours very truly,

RAILROAD MAINTENANCE &
CONSTRUCTION, INC.

(For) G. C. Wilkins, Jr.
President

GCWjr:ja

FEDERAL AVIATION AGENCY
ALBUQUERQUE AREA OFFICE
5301 Central Avenue NE.
P. O. Box 8502
Albuquerque, New Mexico 87108

June 15, 1966

IN REPLY REFER TO ABQ-610

George C. Love, Vice President
Limbaugh Engineers Inc.
P. O. Box 335
3125 Carlisle Blvd., NE.
Albuquerque, New Mexico 87103

Dear Mr. Love:

This is in reference to your letter of June 2, 1966, requesting information concerning runway lengths to accommodate DC-3 operations. Following is the recommended runway lengths for the specific locations included in your letter.

1. Between Magdalena and Datil, New Mexico, elevation 6900 m.s.l., the runway length will be 5200' at maximum take-off weight with a runway gradient of .5%. The mean maximum temperature at this location is 85°F.

2. West of Tucson, Arizona, elevation 2900 m.s.l., the runway length will be 4200' at maximum take-off weight with a runway gradient of .5%. The mean maximum temperature was estimated to be 100°F. at this location.

3. West of Marfa, Texas, elevation 4600 m.s.l., the runway length will be 4700' at maximum take-off weight with a runway gradient of .5%. The mean maximum temperature at this location is 91°F.

The following information is not restricted to specific locations but can be used at any location.

1. Glide angles - A 40:1 approach surface is desirable and recommended for this and larger category aircraft. However, a 20:1 approach surface is recommended for basic utility category airports.

This surface begins 200' beyond the paved runway end or 100' beyond the end of a turf landing strip. The first portion of this surface is referred to as a clear zone; and it extends for 2000' for a 40:1 approach surface and 1000' for a 20:1 approach surface. It is desirable to own fee title to this land; however, an aviation easement is sufficient.

2. The runways width will be 75', and the associated taxiways width will be 30'. Taxiway turnarounds are desirable if a considerable amount of activity is anticipated. The landing strip width should be 150', and the length is 100' longer than the paved runway at each end.

3. Apron - It is recommended that a 150' x 200' apron be constructed to accommodate two DC-3 type aircraft at one time or several small aircraft.

4. Clearances - It is recommended that the distance from the center line of the runway to the property line away from the building and parking area be a minimum distance of 250'. The distance to the apron and building line is 275' from the center line of the runway. A minimum of 300' is needed from the ends of the runway to the property line.

5. Surface requirements - It is recommended that a 1½" asphalt concrete surface be placed upon the base; however, a triple bituminous surface treatment is used considerably at utility category airports with the majority of the activity being from light aircraft. The DC-3 type aircraft will loosen the chips on this type of surface; therefore, we would recommend an asphalt concrete surface. The pavement should be designed to withstand a gross load of 30000# or 15000# single wheel load.

6. Lighting - Low intensity lighting would be recommended at a location with a low amount of activity and based aircraft. A lighted wind cone, segmented circle, and a Jr. Beacon should be included as a part of the lighting system.

The above recommendations are not contained in any one publication, but are an accumulation of information from different resources.

If we can be of any further assistance please let us know.

Sincerely yours,

Allen L. Riegel

for Paul E. Cannom
Area Manager

IN REPLY REFER TO:

327-Papago

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
Papago Indian Agency
Sells, Arizona 85634

NOV 16 1966

Mr. George Love
Limbaugh Engineers, Inc.
P.O. Box 335
Albuquerque, New Mexico 87103

Dear Mr. Love:

In reply to your request for a real estate apprasial for the leasing of approximately 4,200 acres within the Papago Reservation for a radio-telescope facility, we regret we have not yet received the formal report from our Phoenix Apprasial office.

However, based on comparable apprasials made in the area of consideration it is our opinion that the annual rental would be approximately $20.00 per acre per year for a total annual rental of $84,000.

As you are aware a lease of a longer duration than 50 years will require Congressional action similar to that of P.L. 85-816, Act of August 28, 1958 (72 Stat 981) which permitted a lease of unlimited to tenure to Kitt Peak National Observatory.

Sincerely,

Calvin N Bruce
Acting Superintendent

RECEIVED
LIMBAUGH ENGINEERS
NOV 18 1966

Please Initial and Date

FWE	MEE
GCL	RAJ
JVW	JLS
	WJH

File 2316

APPENDIX B

Consultants

Architectural	Ferguson, Stevens Mallory & Pearl 115 Amherst Drive S.E. Albuquerque, New Mexico
Estimates	C. L. Noe, P.E. 2101 Coal Avenue S.E. Albuquerque, New Mexico
Real Estate	Herman Harton, Real Estate Appraiser 312 North Union Roswell, New Mexico
Real Estate	D. A. Lomax, Real Estate Appraiser 211 12th N.W. Albuquerque, New Mexico

APPENDIX C

Supplemental Data

Run-off and Drainage Information For Item 4 - General Discussion.

The Talbot formula, $a = C\ ^{4}A^{3}$, (a is area in square feet, C is the coefficient depending upon the type of terrain, A is the drainage area in acres) is one of the oldest and one of the most popular formulas for determining culvert sizes, but it does not include some pertinent factors such as theintensity of rainfall, the velocity of flor, culvert slope and roughness. The advantage of this formula is that it is quick and easy to use giving thedrainage structure area directly, whereas most other formulas produce therunoff quantity and must utilize an additional formula such as Mannings to obtain thedrainage structure area. While it is not possible to express all of the factors affecting runoff in one simple formula for all water sheds, consideration of such variables is desirable. For small drainage areas the rational method, $Q = ciA$, (Qis discharge in cubic feet per second, c is the coefficient representing the ratio of runoff to rainfall, i is the intensity of rainfall in inches per hour for a duration equal to the time of concentration, and A is the area in acres) can be applied satisfactorily. Using this formula with proper weight given to the factors involved, a curve has been plotted for each site giving volume of runoff to area. In developing this curve for larger drainage areas use was made of runoff curves developed by the U. S. Geological Survey. These runoff curves combined with the frequency chart effect a continuation with the rational formula curves and have been used to determine predicted volume of runoff for a 50-year storm for each of the seven sites.

The culvert pipe sizes were developed using Manning's formula, $Q = \frac{1.486}{n} Ar^{2/3} s^{1/2}$ (n = roughness coefficient of the pipe, A = cross section of the pipe in square feet, r = mean hydraulic radius, s = slope of pipeline in feet per foot). Culvert pipe areas were computed on the basis of n = 0.0235 and s = 0.010 for all sites.

APPENDIX D

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APPENDIX E

Bibliography

Airports

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