# ENGINEERS' FIELD BOOK

No. 10-403

## Distances from Center of Roadway for Cross-Sectioning
Roadway 16 feet wide. - Side Slopes 1 on 1.
For Single Track Embankment.

| H | 0 | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | H |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.0 | 8.1 | 8.2 | 8.3 | 8.4 | 8.5 | 8.6 | 8.7 | 8.8 | 8.9 | 0 |
| 1 | 9.0 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 | 9.6 | 9.7 | 9.8 | 9.9 | 1 |
| 2 | 10.0 | 10.1 | 10.2 | 10.3 | 10.4 | 10.5 | 10.6 | 10.7 | 10.8 | 10.9 | 2 |
| 3 | 11.0 | 11.1 | 11.2 | 11.3 | 11.4 | 11.5 | 11.6 | 11.7 | 11.8 | 11.9 | 3 |
| 4 | 12.0 | 12.1 | 12.2 | 12.3 | 12.4 | 12.5 | 12.6 | 12.7 | 12.8 | 12.9 | 4 |
| 5 | 13.0 | 13.1 | 13.2 | 13.3 | 13.4 | 13.5 | 13.6 | 13.7 | 13.8 | 13.9 | 5 |
| 6 | 14.0 | 14.1 | 14.2 | 14.3 | 14.4 | 14.5 | 14.6 | 14.7 | 14.8 | 14.9 | 6 |
| 7 | 15.0 | 15.1 | 15.2 | 15.3 | 15.4 | 15.5 | 15.6 | 15.7 | 15.8 | 15.9 | 7 |
| 8 | 16.0 | 16.1 | 16.2 | 16.3 | 16.4 | 16.5 | 16.6 | 16.7 | 16.8 | 16.9 | 8 |
| 9 | 17.0 | 17.1 | 17.2 | 17.3 | 17.4 | 17.5 | 17.6 | 17.7 | 17.8 | 17.9 | 9 |
| 10 | 18.0 | 18.1 | 18.2 | 18.3 | 18.4 | 18.5 | 18.6 | 18.7 | 18.8 | 18.9 | 10 |
| 11 | 19.0 | 19.1 | 19.2 | 19.3 | 19.4 | 19.5 | 19.6 | 19.7 | 19.8 | 19.9 | 11 |
| 12 | 20.0 | 20.1 | 20.2 | 20.3 | 20.4 | 20.5 | 20.6 | 20.7 | 20.8 | 20.9 | 12 |
| 13 | 21.0 | 21.1 | 21.2 | 21.3 | 21.4 | 21.5 | 21.6 | 21.7 | 21.8 | 21.9 | 13 |
| 14 | 22.0 | 22.1 | 22.2 | 22.3 | 22.4 | 22.5 | 22.6 | 22.7 | 22.8 | 22.9 | 14 |
| 15 | 23.0 | 23.1 | 23.2 | 23.3 | 23.4 | 23.5 | 23.6 | 23.7 | 23.8 | 23.9 | 15 |
| 16 | 24.0 | 24.1 | 24.2 | 24.3 | 24.4 | 24.5 | 24.6 | 24.7 | 24.8 | 24.9 | 16 |
| 17 | 25.0 | 25.1 | 25.2 | 25.3 | 25.4 | 25.5 | 25.6 | 25.7 | 25.8 | 25.9 | 17 |
| 18 | 26.0 | 26.1 | 26.2 | 26.3 | 26.4 | 26.5 | 26.6 | 26.7 | 26.8 | 26.9 | 18 |
| 19 | 27.0 | 27.1 | 27.2 | 27.3 | 27.4 | 27.5 | 27.6 | 27.7 | 27.8 | 27.9 | 19 |
| 20 | 28.0 | 28.1 | 28.2 | 28.3 | 28.4 | 28.5 | 28.6 | 28.7 | 28.8 | 28.9 | 20 |
| 21 | 29.0 | 29.1 | 29.2 | 29.3 | 29.4 | 29.5 | 29.6 | 29.7 | 29.8 | 29.9 | 21 |
| 22 | 30.0 | 30.1 | 30.2 | 30.3 | 30.4 | 30.5 | 30.6 | 30.7 | 30.8 | 30.9 | 22 |
| 23 | 31.0 | 31.1 | 31.2 | 31.3 | 31.4 | 31.5 | 31.6 | 31.7 | 31.8 | 31.9 | 23 |
| 24 | 32.0 | 32.1 | 32.2 | 32.3 | 32.4 | 32.5 | 32.6 | 32.7 | 32.8 | 32.9 | 24 |
| 25 | 33.0 | 33.1 | 33.2 | 33.3 | 33.4 | 33.5 | 33.6 | 33.7 | 33.8 | 33.9 | 25 |
| 26 | 34.0 | 34.1 | 34.2 | 34.3 | 34.4 | 34.5 | 34.6 | 34.7 | 34.8 | 34.9 | 26 |
| 27 | 35.0 | 35.1 | 35.2 | 35.3 | 35.4 | 35.5 | 35.6 | 35.7 | 35.8 | 35.9 | 27 |
| 28 | 36.0 | 36.1 | 36.2 | 36.3 | 36.4 | 36.5 | 36.6 | 36.7 | 36.8 | 36.9 | 28 |
| 29 | 37.0 | 37.1 | 37.2 | 37.3 | 37.4 | 37.5 | 37.6 | 37.7 | 37.8 | 37.9 | 29 |
| 30 | 38.0 | 38.1 | 38.2 | 38.3 | 38.4 | 38.5 | 38.6 | 38.7 | 38.8 | 38.9 | 30 |
| 31 | 39.0 | 39.1 | 39.2 | 39.3 | 39.4 | 39.5 | 39.6 | 39.7 | 39.8 | 39.9 | 31 |
| 32 | 40.0 | 40.1 | 40.2 | 40.3 | 40.4 | 40.5 | 40.6 | 40.7 | 40.8 | 40.9 | 32 |
| 33 | 41.0 | 41.1 | 41.2 | 41.3 | 41.4 | 41.5 | 41.6 | 41.7 | 41.8 | 41.9 | 33 |
| 34 | 42.0 | 42.1 | 42.2 | 42.3 | 42.4 | 42.5 | 42.6 | 42.7 | 42.8 | 42.9 | 34 |
| 35 | 43.0 | 43.1 | 43.2 | 43.3 | 43.4 | 43.5 | 43.6 | 43.7 | 43.8 | 43.9 | 35 |
| 36 | 44.0 | 44.1 | 44.2 | 44.3 | 44.4 | 44.5 | 44.6 | 44.7 | 44.8 | 44.9 | 36 |
| 37 | 45.0 | 45.1 | 45.2 | 45.3 | 45.4 | 45.5 | 45.6 | 45.7 | 45.8 | 45.9 | 37 |
| 38 | 46.0 | 46.1 | 46.2 | 46.3 | 46.4 | 46.5 | 46.6 | 46.7 | 46.8 | 46.9 | 38 |
| 39 | 47.0 | 47.1 | 47.2 | 47.3 | 47.4 | 47.5 | 47.6 | 47.7 | 47.8 | 47.9 | 39 |
| 40 | 48.0 | 48.1 | 48.2 | 48.3 | 48.4 | 48.5 | 48.6 | 48.7 | 48.8 | 48.9 | 40 |

Example—If point is 22.6 ft. above grade, how far should it be from center line to be a slope stake point? Ans. from Table 30.6. For same slopes but other widths of roadbed, correct above figures by one-half difference in width of roadbed; thus in example above, for 20 ft. roadbed distance will be 30.6+(20—16)÷2 or 2 ft. added to 30.6 =32.6. For slopes of 1 on 1½ see inside of back cover.

White Bear Road

from PROJ-23-52

Lambert Ave North

to Connect with

STH No 1 in the City of

White Bear.

Project No 1

Transit Notes

&

H-t. Topog.

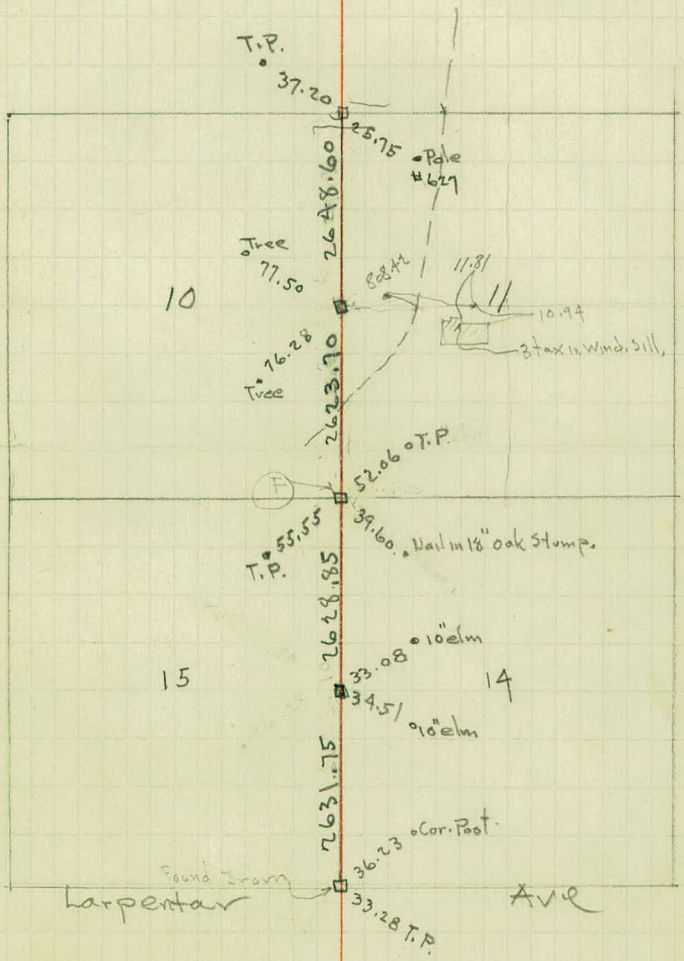
# INDEX

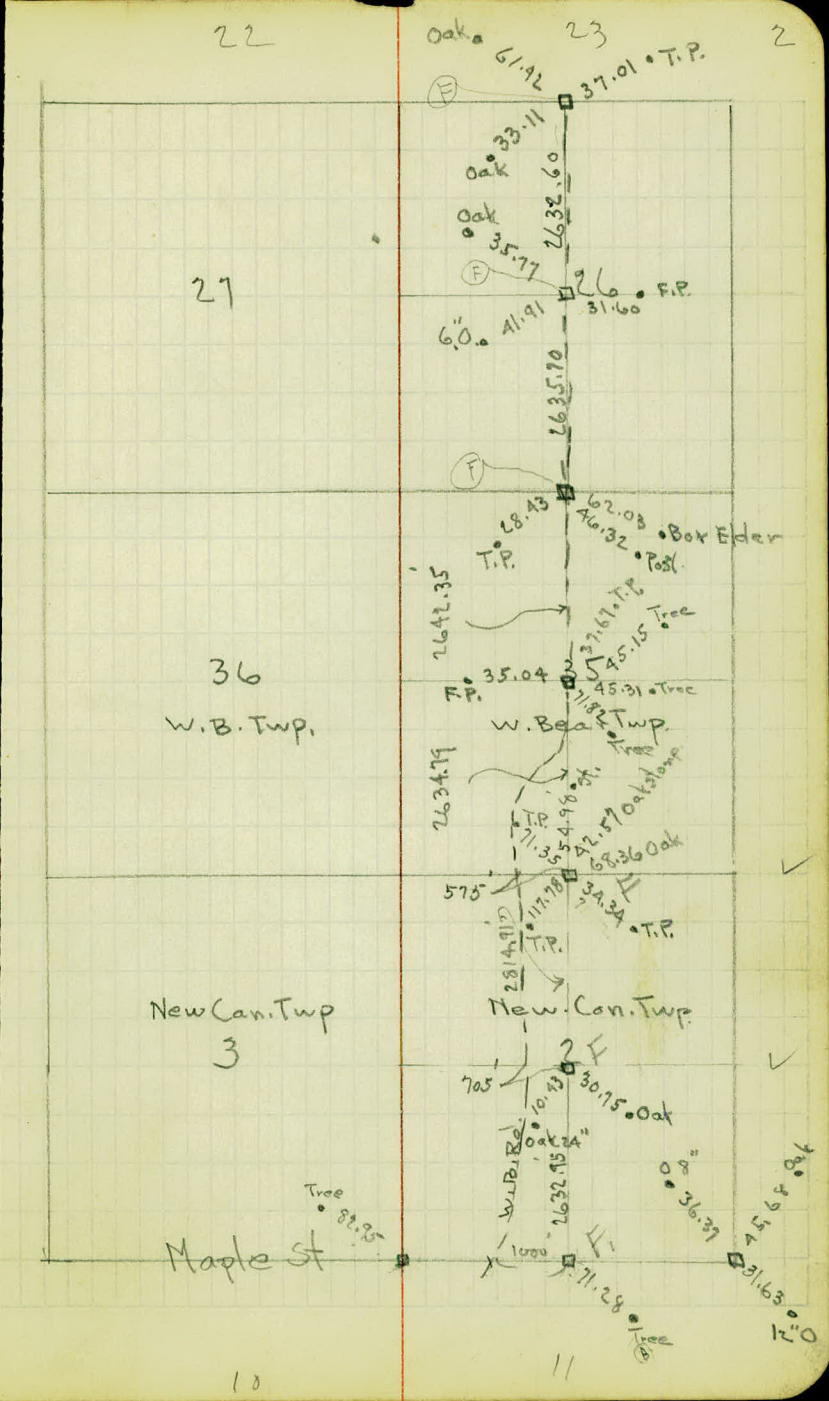
Notes Copied from plats - Page to Page

# INDEX

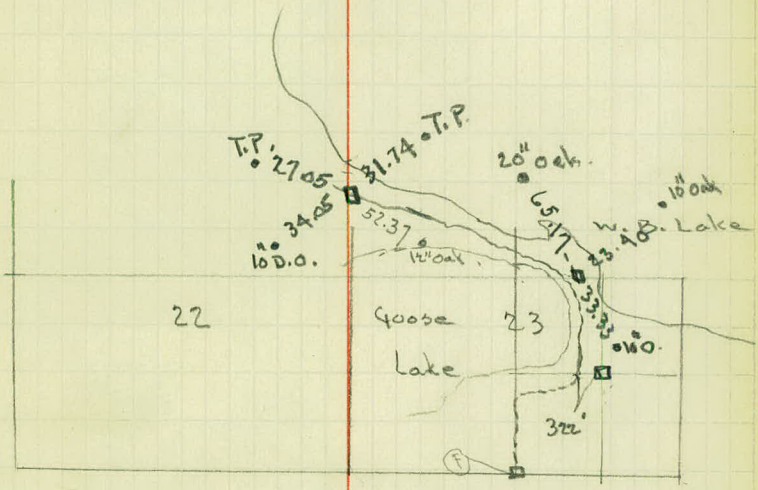
2631.5
2628.9
5260.4

# New Canada Twp

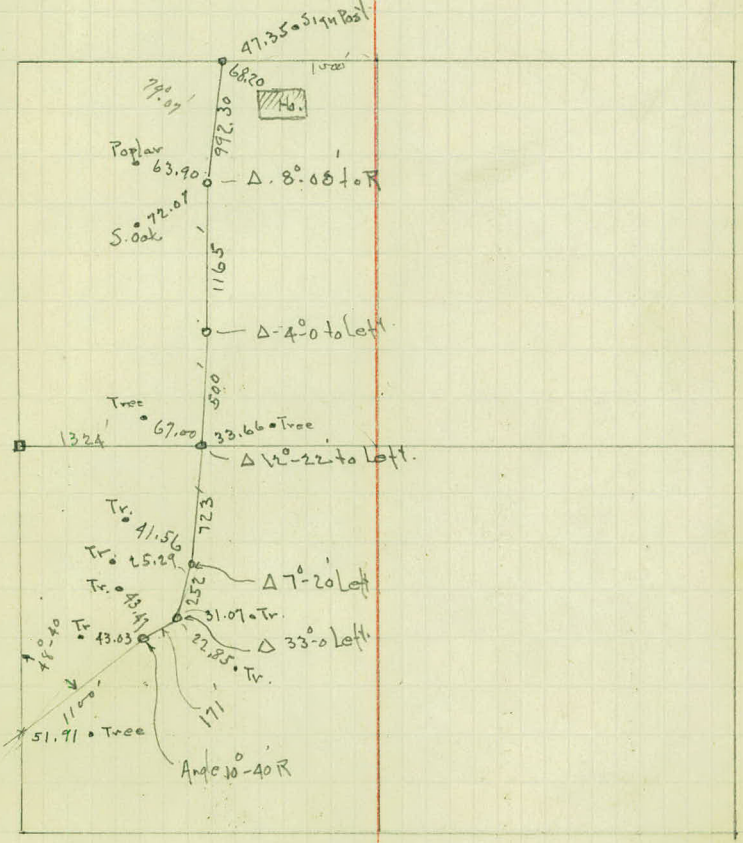



22
23
2
Oak
61.92
37.01 • T.P.
33.11
Oak
Oak
35.77
2632.60
F
F
26
31.60 • F.P.
27
6.0
41.91
2635.10
F
28.43
62.03
46.32 • Box Elder
T.P.
Post
2642.35
37.67 • T.P.
45.15 • Tree
36
W.B. Twp.
F.P.
35.04
45.31 • Tree
W. Bea Twp.
71.82
Tree
2634.79
St.
10 oak stone
T.P.
21.35
54.96
42.51
68.36 Oak
575
117.78
34.34 • T.P.
T.P.
281.41
New Can. Twp
3
New Con. Twp.
705
10.53
30.75 • Oak
Oak 24"
2632.95
Tree
88.95
Maple St
0.8"
36.37
45.69
31.63
71.28
Tree
12"0
18
11

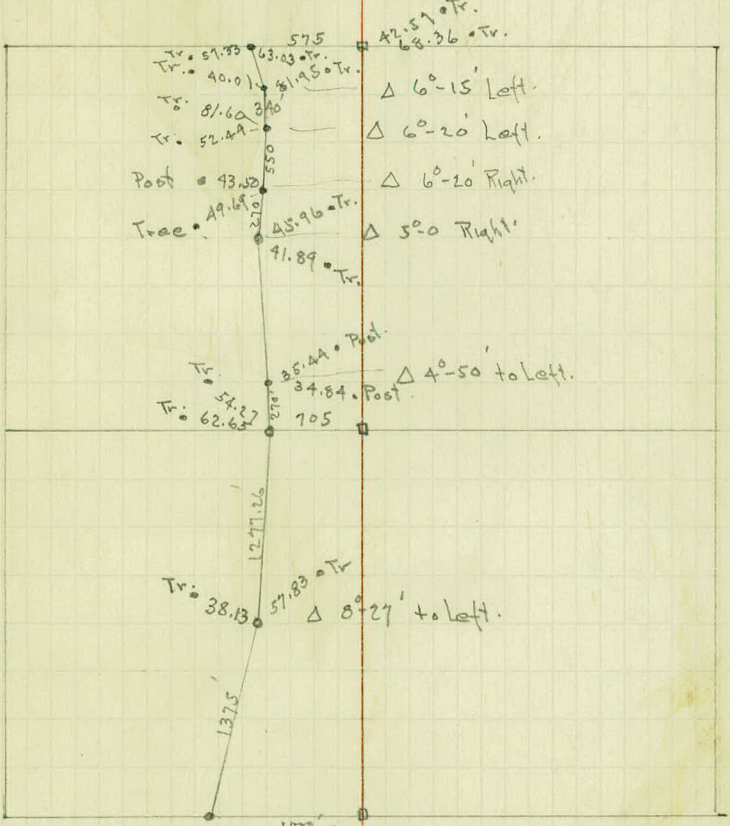
W. Bear Twp


T.P.
27.05
31.74
T.P.
20" oak
10" oak
W. B. Lake
34.05
52.37
10" D.O.
14" oak
23.18
22
Goose
Lake
23
110
322

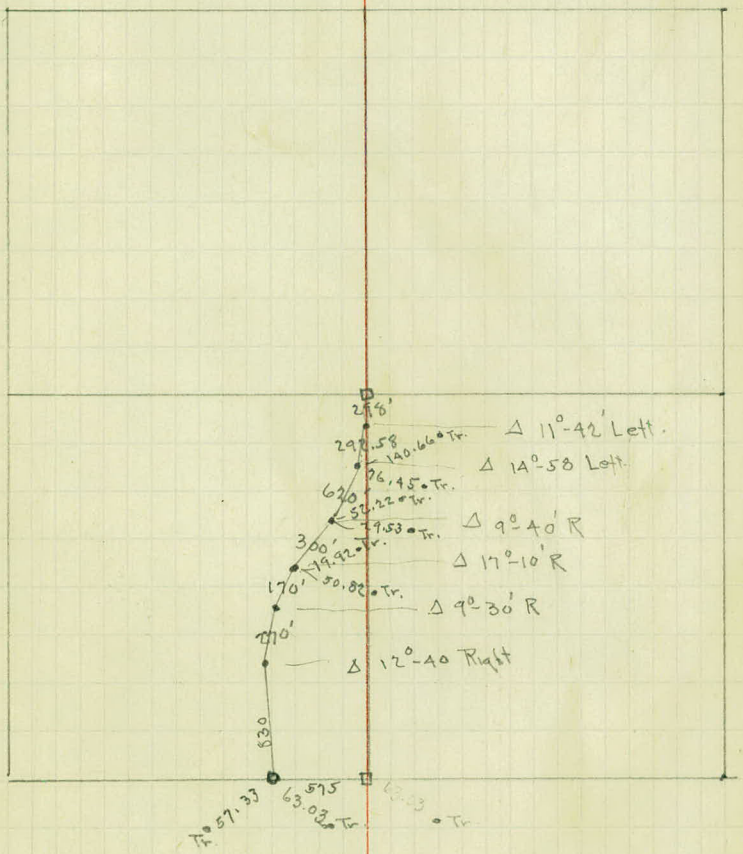
# Alignment from Notes in Plat Book
## Section 11 - New Canada Twp.



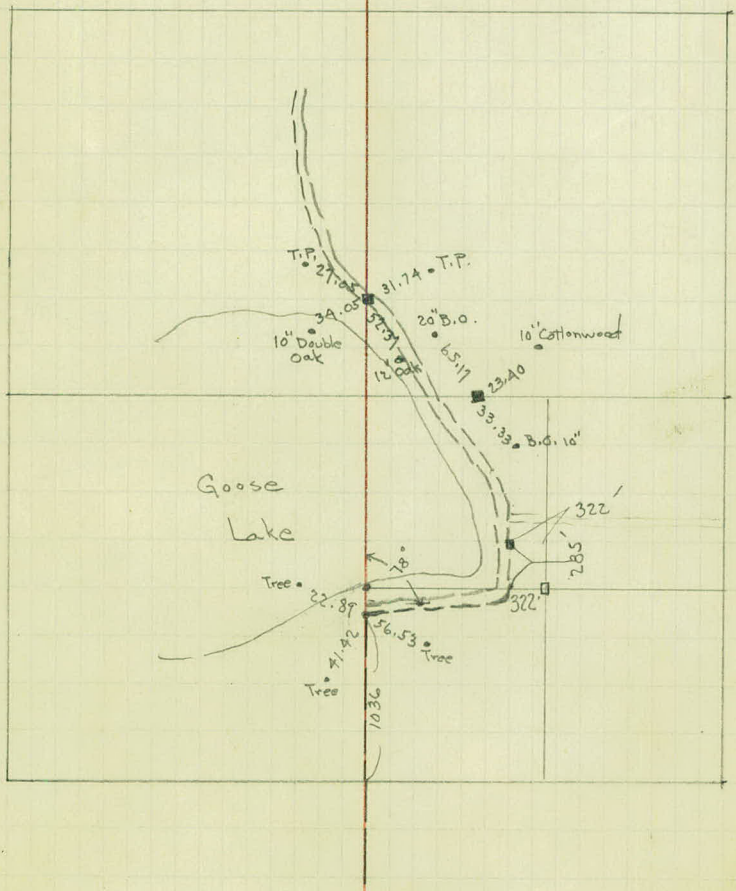
# Section 2 - N. Canada Twp.



# Section 35 - White Bear Twp.



# Section 23
# White Bear Twp.



White Bear Rd. North from City Limits.

| Sta. | Point | L ℄ R. | Calc. Bearing | Mdg. |
|---|---|---|---|---|
| 52+743 = 52+85 | | | | |
| 52+85 | POT | | | |
| | | | N0°-06E | ✓ |
| 26+359 | Δ = | 0°-12' Rt. | | |
| 18+80 ± | POT | | | |
| | | | N. 0°06' W. | |

3/16/23

0+00 Conner, Carr, Galvin, Rempe, Rottenberg, Toenney, Persons) Transit party / Level party.

2-13-23

8

℄

52°
0 TP

TP
0 52.5

Note chaining was checked carefully while taking Art. Topog. Sta 0+00 to Sta 52+85.
Errors appears to be distributed evenly. Equations a follow

blaze

nail

Corner

52+74.3 = 52+85.1

32 65
0 Nail in fence post

25.9

TST & TG
No 338

S.W. Corner Sect. 14
Twp. 29-R 22

41.22
33.80

Top Hyd

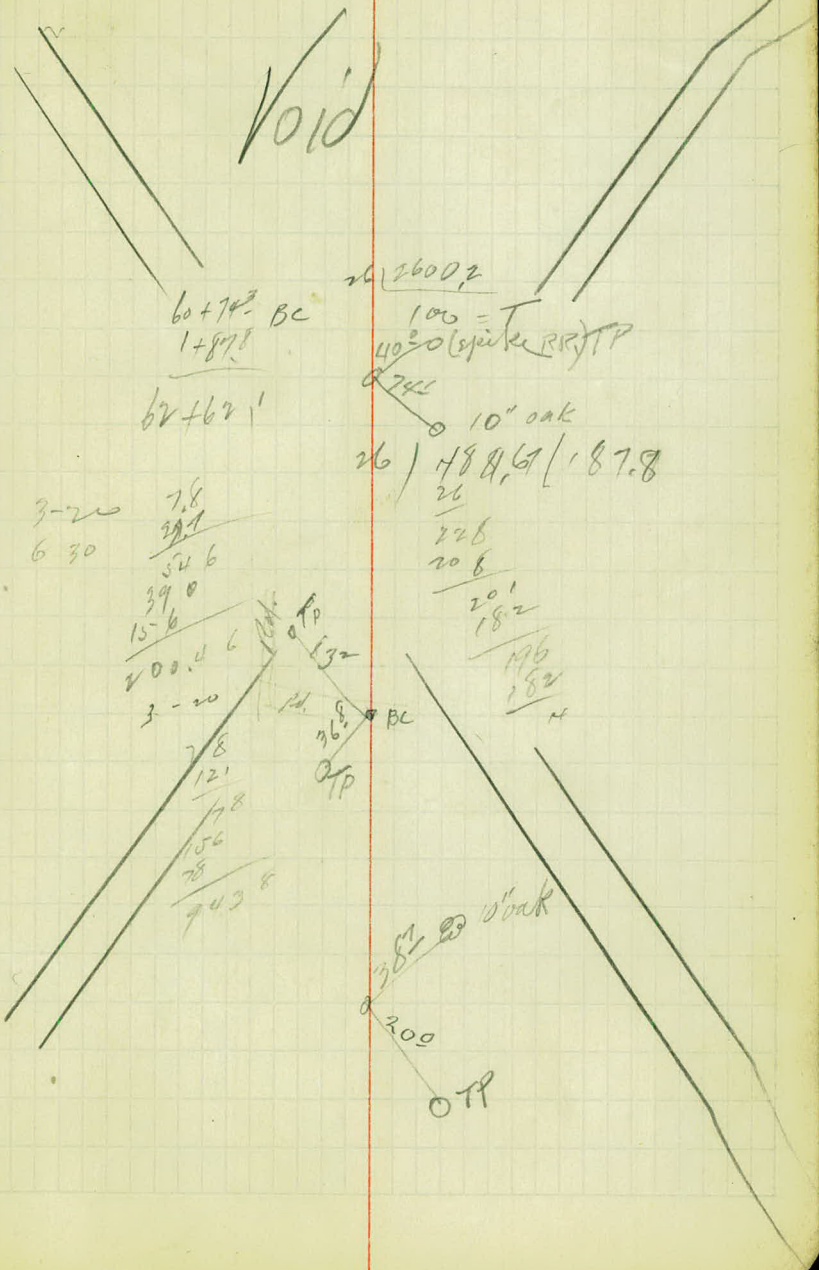
Iron Sight Post

73+00

Void

| | |
|---|---|
| PC 62+62½ | 24°-24½' |
| +50 | 22-50 |
| 62 | 16-20 |
| +50 | 16-20 |
| 61 | 3-20 |
| BC 60+74.3 | 00 |

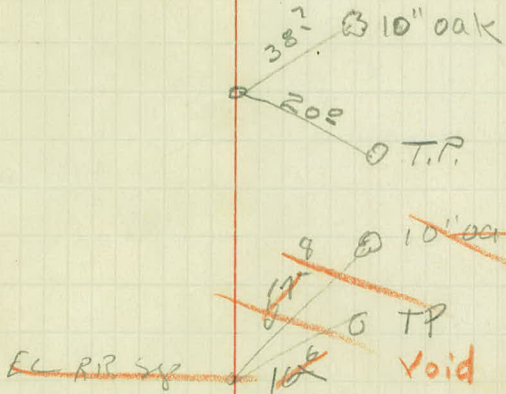
PI 61+74.3 Δ = 48°-49' Rt.

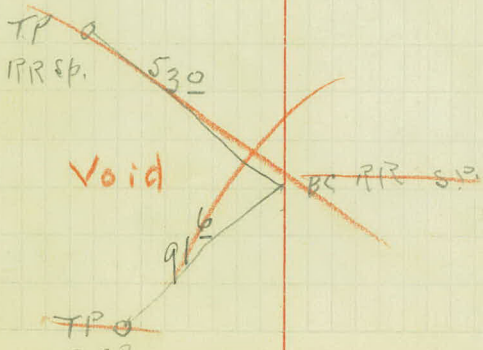

Void
60+74.3 BC
1+87.8
62+62.1
3-20
6 30
7.8
39.1
52.6
39.0
15.6
200.6
3-20
7.8
12.1
7.8
5.6
2.8
94.3
26 | 2600.2
100 = T
40° 0 (spike RR) TP
7.2
10" oak
26 | 48.9.6 | 87.8
26
22.8
20.8
20.1
18.2
4.6
2.8
PC
36.8
PT
38.1
10" oak
20.0
PT

| Sta | Pt. | L | R | Calc Bearing |
|---|---|---|---|---|
| 61+74.3 | PI | | | N48°-55' E |
| bk 87.1 = 62+89 | EC | | 24-24½ | Δ=48°-49' |
| | | | 20°-34 | 20° Curve Rt. T=130° |
| | | | 15-34 | L.C.=344.1 |
| | | | 10-34 | |
| | | | 5°-34 | |
| | | | 0°-34 | |
| 60+44.3 ahead 43.6 | BC | | 00 | |
| 2/17/23 | Conner, Carr, Galvin, Rottenberg, Tierney, Persons | | | transit party, Level. |

Error in Closing 0.1

29-30
2
T.S. 1-62
59-47



| Sta | Point | L | T | Calc. Bear. | Mag. Bear. |
|---|---|---|---|---|---|
| 82+00 | POT | | | | |
| 74+98.0 | PI | | | N19°-05E | |
| 76+43.5 = 74+43.2 | | | | | |
| 43.3 | EC | 14°-55' | | | |
| 76 | | 12-44 | | Δ = 29°-50' | |
| | | | | D = 2°-00' | |
| +50 | | 10-14 | | T = 152.6 | |
| | | | | LC = 298.3 | |
| 75 | | ~~70-14~~ | 7-44 | | |
| +50 | | 5-14 | | | |
| 74 | | 2°-44' | | | |
| +45.7 | | | | | |
| 73+45.1 | BC | 00 | | | |
| | | | | N48-55E | |
| 72+96.3 | POT | | | | |

Curve in clearing 9/4/74

(Transit Notes Continued on page 34) 11

T
1526.3

E
199.82

13+45.4
1526.6

10°C

T = 1526.6
E = 20°

~~66.67~~

2983.33
BC — 13 + 45.4
LC — 2 + 98.3

EC 76 + 43.7

15" oak 336

P1

53.5

T.P. 0

4 4 7
1 3 1.0
1 4 0
2 — 1 1

5 4 6
3
1 6 3.8
1 2 0

~~27.6~~

Void

EC

~~35.2~~

Sign board

~~30°~~ ~~80~~ ~~46.8~~ 12" oak

12" oak
RR Sp.

RR Sp.

Void

2+17

1+64

1+50

1+35

1+17

1+15

0+73

0+49

0+44

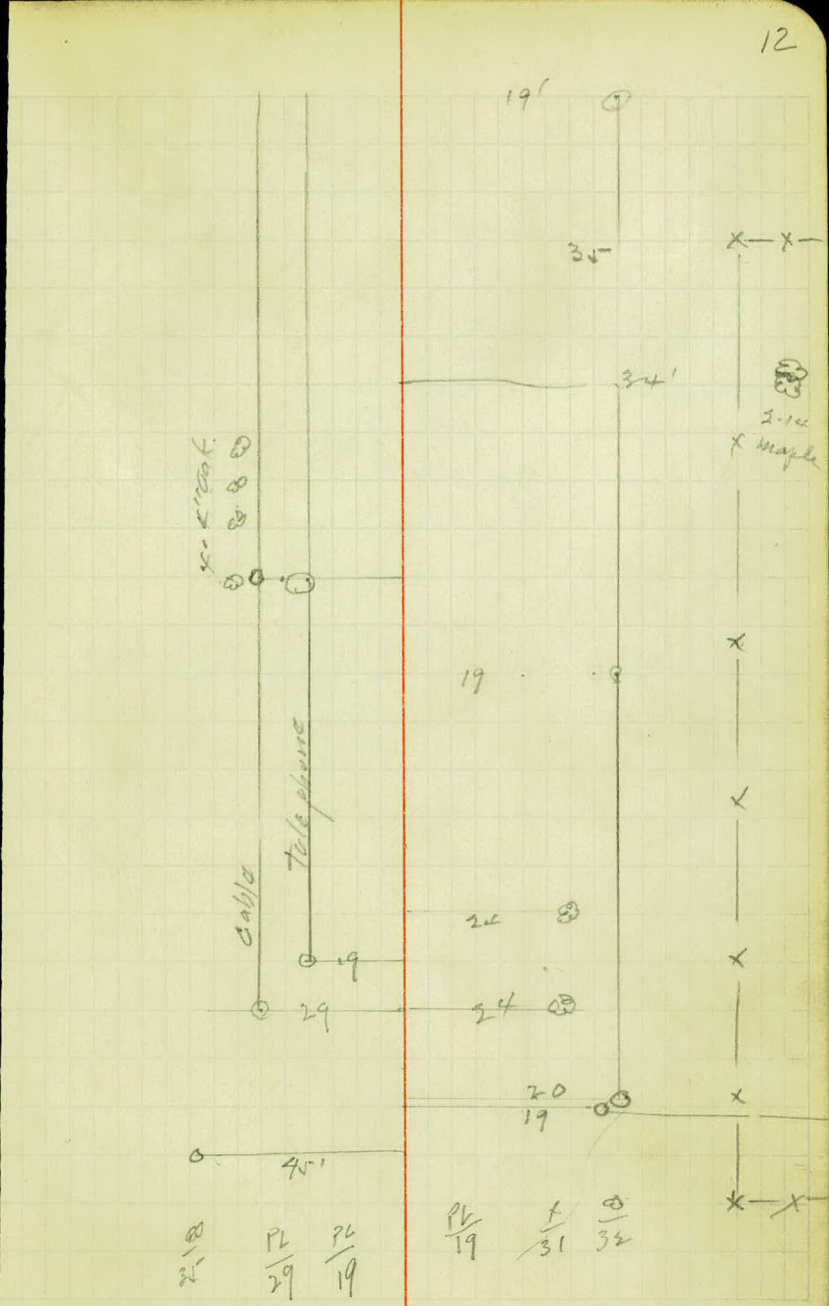
0+31

0+26

0+24

0+00

Am. T. Topog. 2/19/23
Conner - Recorder
Ruttenberg - Chainmen
Kembe


19
3-4'
3-14 Maple
19
Telephone
Cable
29
19
20
19
PL/19
X/31
Ø/32
Ø/25
PL/29
PL/19

+24

37+10

3+00

+87

+73

+69

+66

+59

+45

2+32

2+24

29
22
Small maple 4"
Cable
Telephone
34
12" maple
34'
6" oak

(sta 5+00 marked 0 S 8'
shoulder 0 S 12')

(sta. 4+00 marked 0 S 8'
shoulder ✓ 0 S 12')

4 + 24

+ 21

+ 18

+ 15

+ 07

4 + 00

+ 98

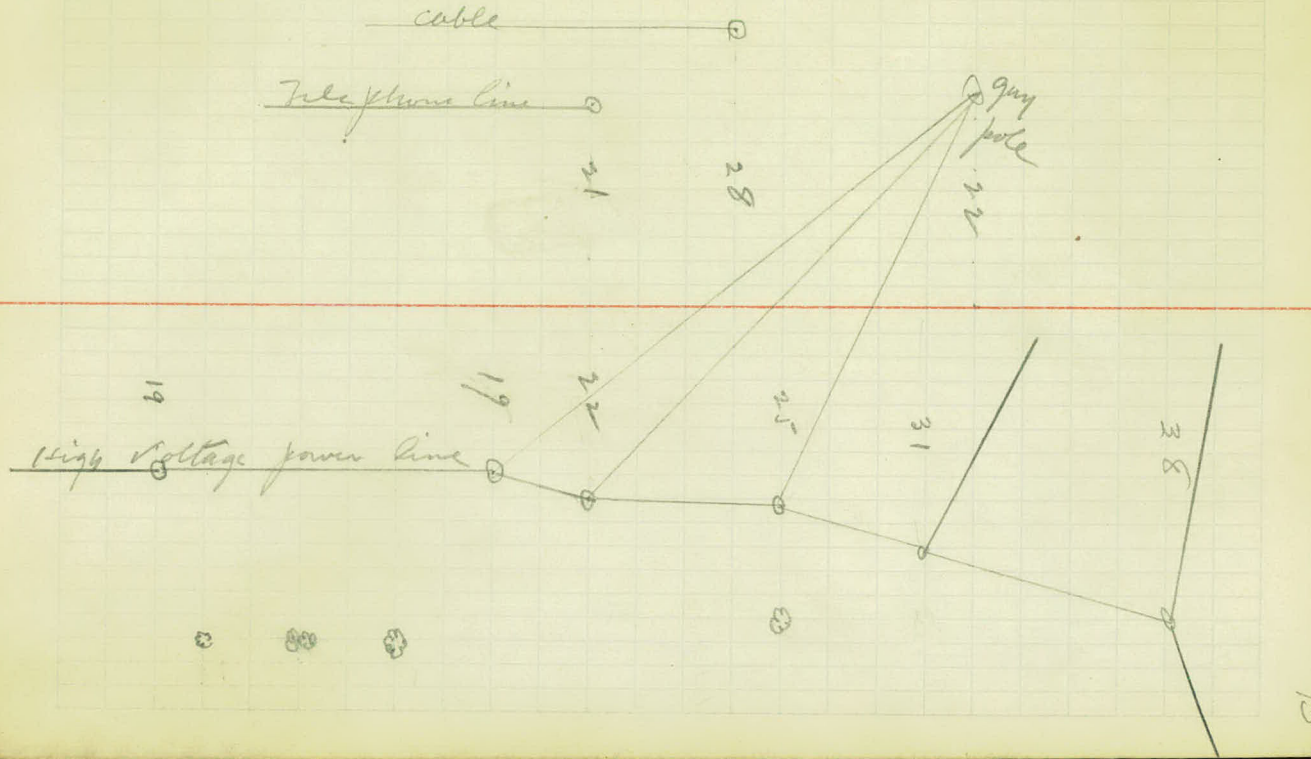
3 + 86

3 + 80

3 + 54

3 + 39

3 + 30


cable
Telephone line
guy pole
31
28
22
19
11
14
High voltage power line
24
31
38

8+18

7+96

7+15

+93

6+59

+58

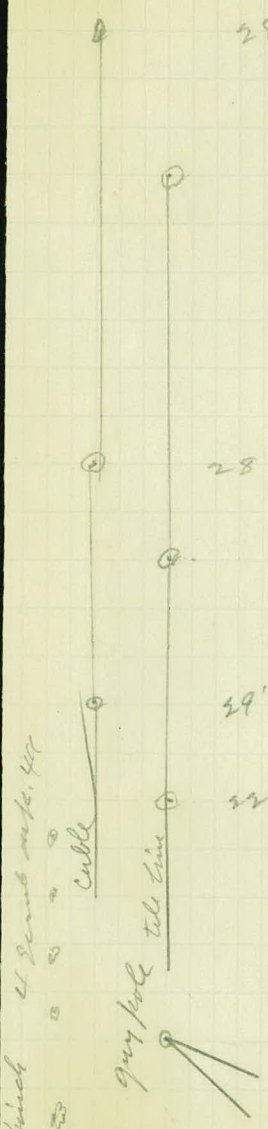
5+34

+75

+65

+62

4+60


28'
22'
28'
21'
29'
22'
guy/bolt
tel line
cable
2-8" birch
4 Stems maple, ash
2-4" oak
small brush
31
maple
31
maple

12+81

12+64

12+57

12+05

+98

+93

+51

11+40

+86

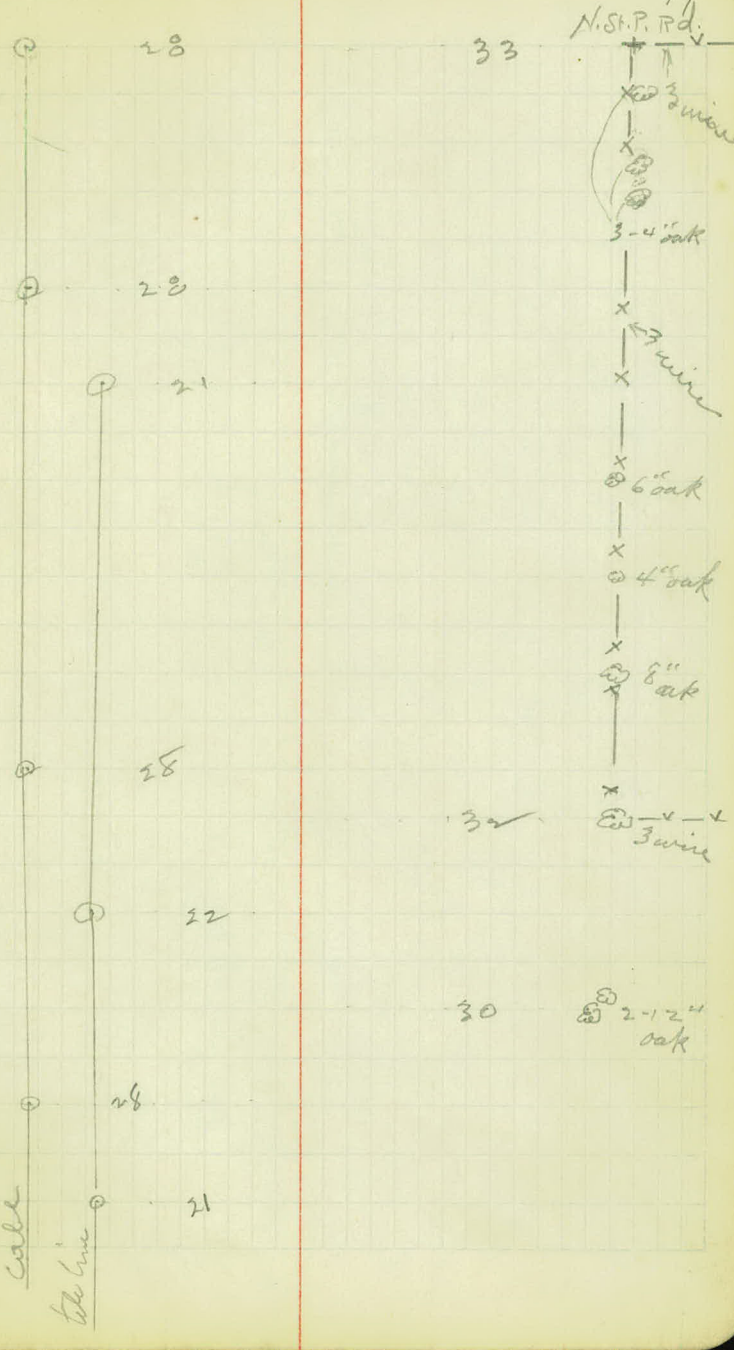
+80

+59

10+06

+56

9+21


N. St. P. Rd.
33
3 wires
3-4" oak
3 wire
6" oak
4" oak
8" oak
3 wire
2-1 2" oak
28
28
21
28
22
28
21
cable
tile line

+26

16+17

+97

+75

+62

+49

14+28

+47

+44

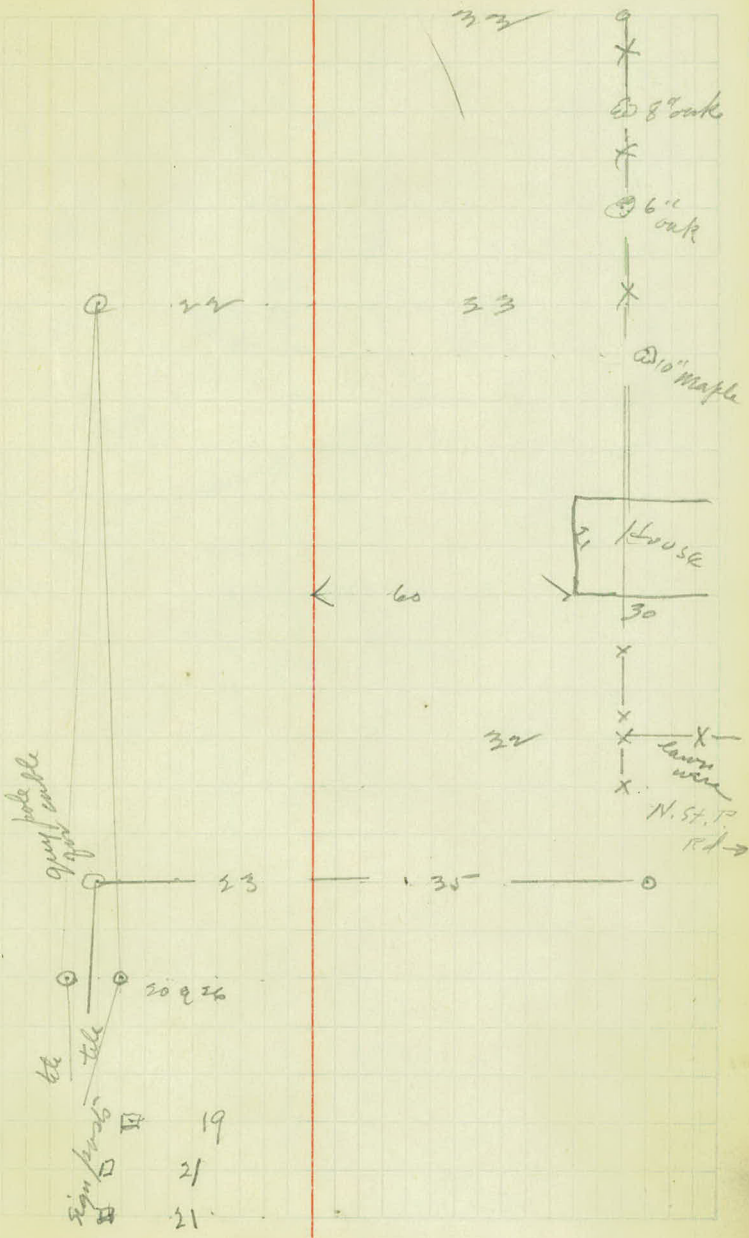
+43

13+29

+26

+22

13+21


33
8" oak
6" oak
22
33
10" Maple
House
60
30
32
Lawn wire
N. 54. P.
R. 1
Open hole
23
35
20 & 24
tel
tele
Signal wire
19
21
21

+92

+73

+64

23+33

23+22

22+50

+36

21+19

+97

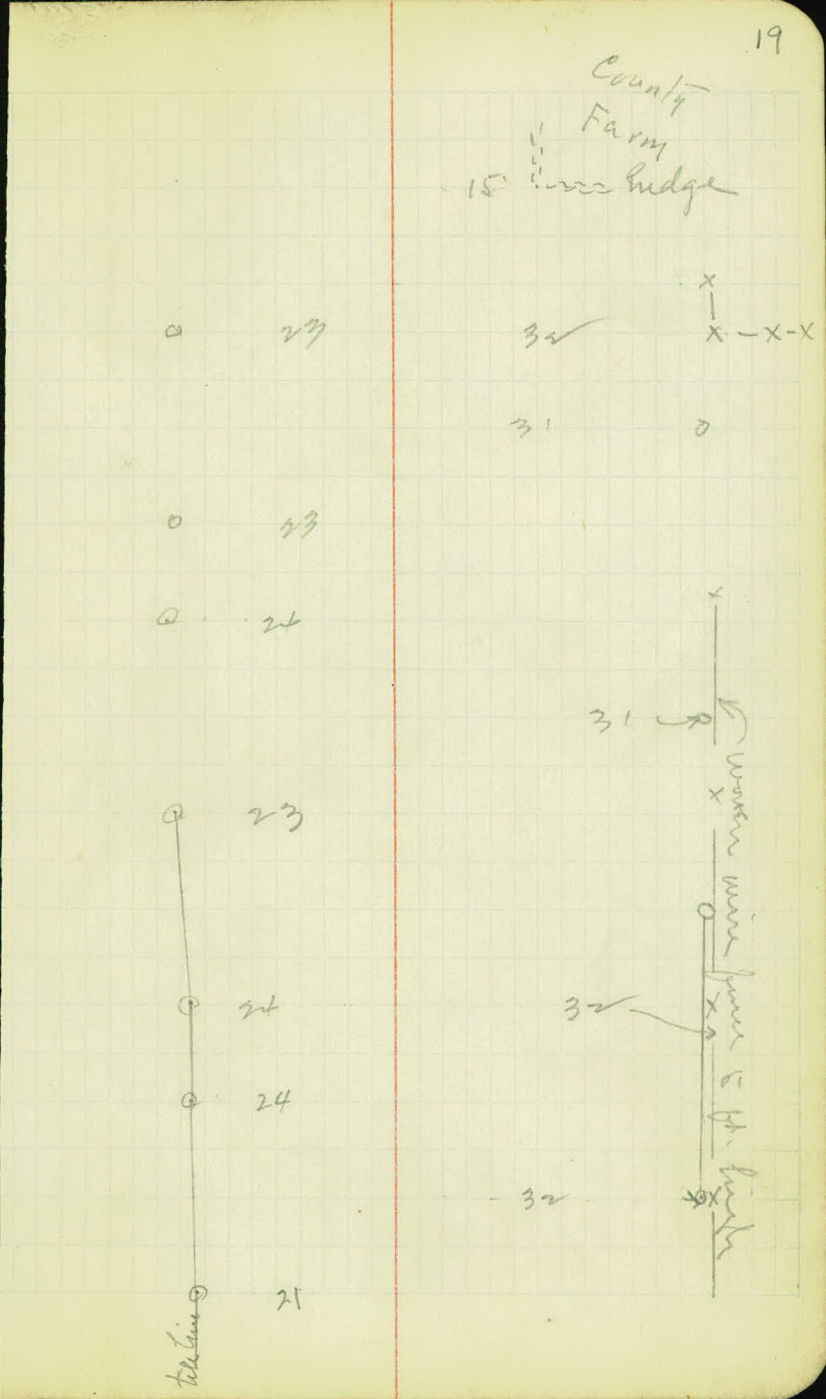
19+24

18+64

+35

17+21

16+03


County Farm
15
Bridge
X
X-X-X
32
31
23
24
21
Wooden mile
32
32
title line

+70

+66

+64

+63 begin hedge E Stone wall Rt.
+61 end of wall

+57

2+49
+46 end of wall
+44 end of hedge Rt.
25+00

+81

+96

+64

+50 beginning wall Rt.
+25

24+02

24+00 Building Line
+92

⊙ 16" elm

⊙ 22

⊙ 31

16' walk

11 ☐ mailbox

⊙ 2" elm

⊙ 24

32 ⊙ P

31 ⊙ 2" elm

31 ⊙ 2" elm

27 ⊙ 2" elm

+80

+76 end of wall

+73

+36

+18

27+00

+90

+80

+77

+60

+49

+42 N. fence county Rd Ft.

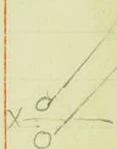
26+~~77~~ R.R. Spike @ ¼ Cor. = Sta. 26+35.9

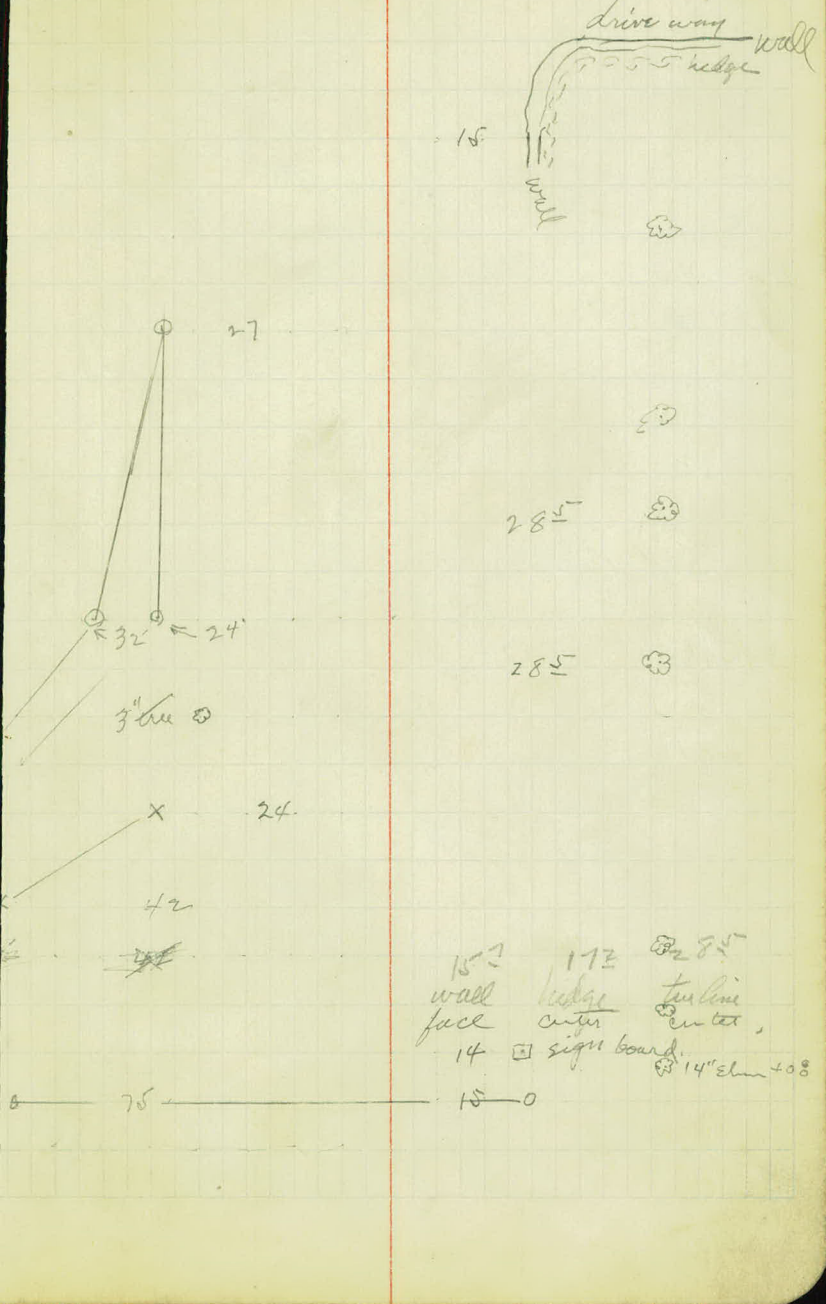
+25

+24

+04

25+93 County Rd Ft.
fence Ft. E & W end 49 Ft.




drive way
wall
hedge
18
wall
27
28±
28±
32
24
3" tree
X
24
42
15±
wall face
17±
hedge center
8±
tree center
14 ☐ sign board
14" Elm
75
15
0

+97

+66

30+24

+88

+72

+54

29+18

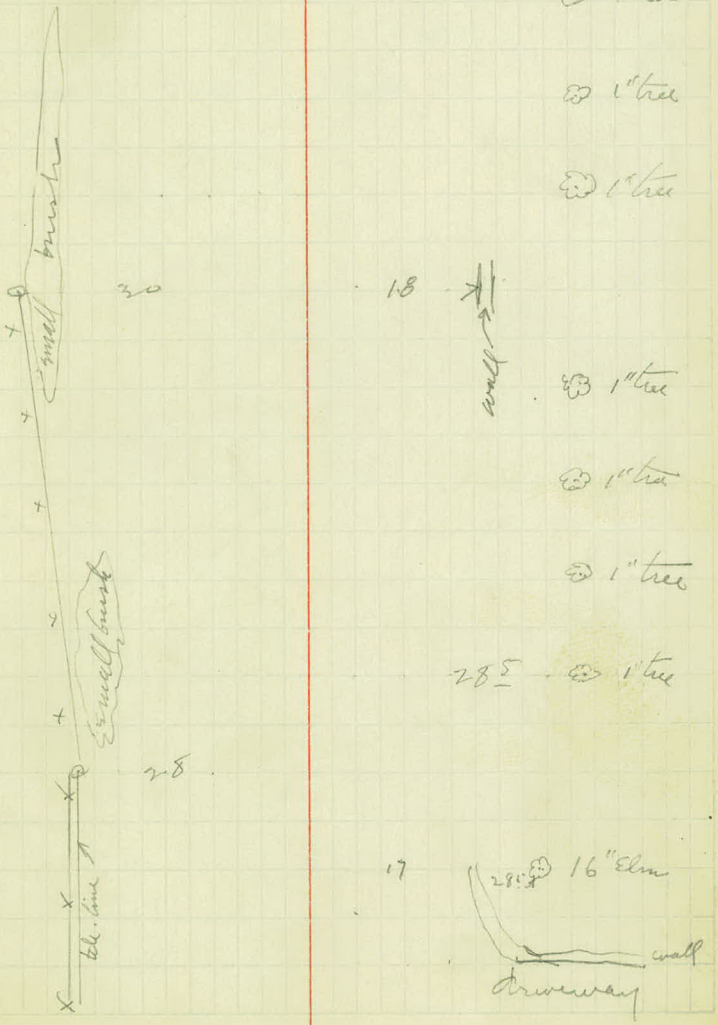
+81

+43

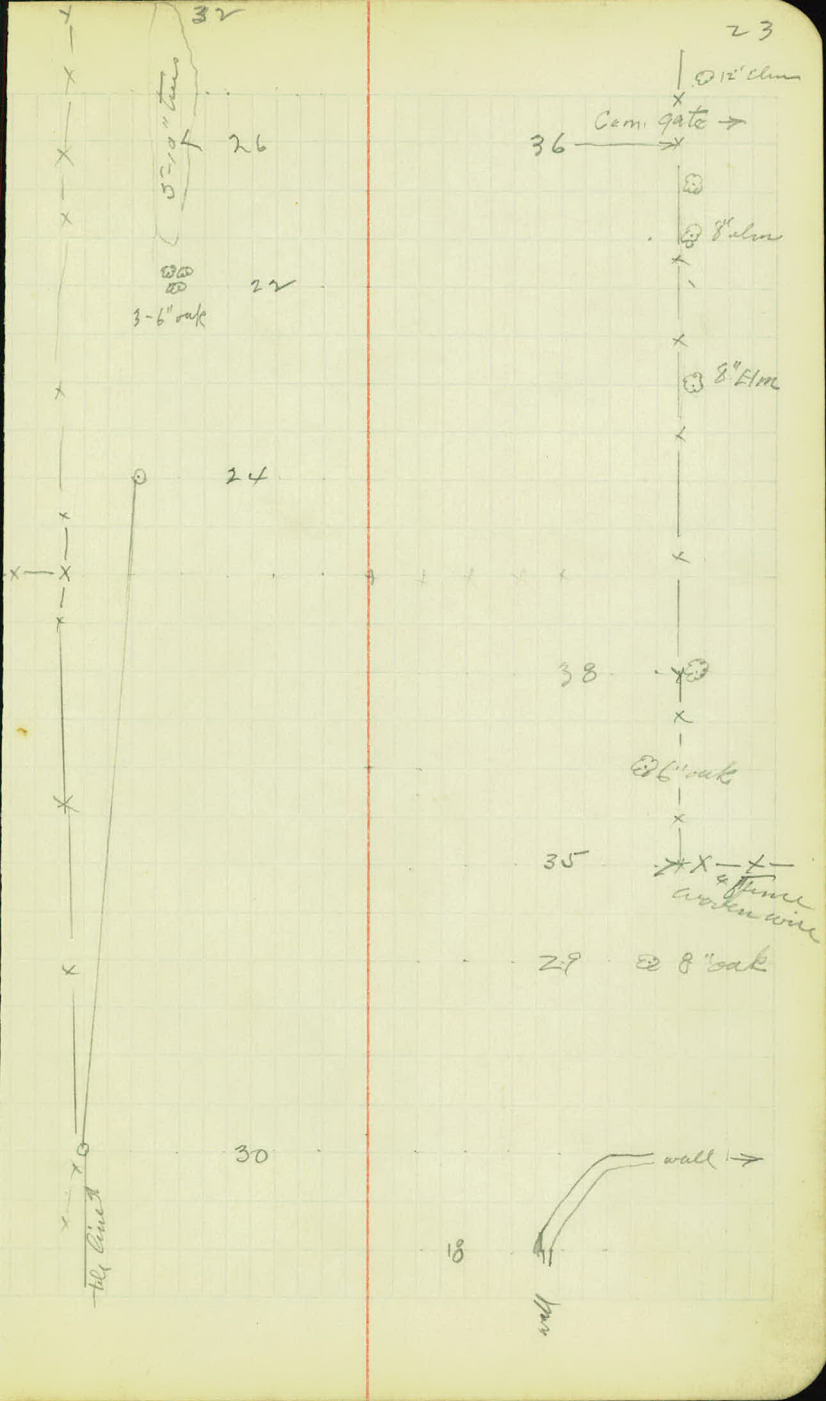
+26

+07

28+04


1" tree
1" tree
1" tree
1" tree
30
18
wall
1" tree
1" tree
1" tree
28.5
1" tree
28
17
16" Elm
wall
driveway

+62
+49
+45
~~+49~~
+33
+29
+12
33+06
+67
+59
+55
+20
32+07
+92
+89 ~~gate Ct.~~
+80 gate Ct.
+11
+09
31+00


32
26
22
24
30
18
36
38
35
29
12" elm
Cem. gate
8" elm
8" Elm
6" oak
8" oak
wall
3-6" oak
5"-8" elm
Hedge
wall

+96

+56

+48

36 +12

+74

+56

+50

+32

35+15

+95

+93

+60

+54

+33

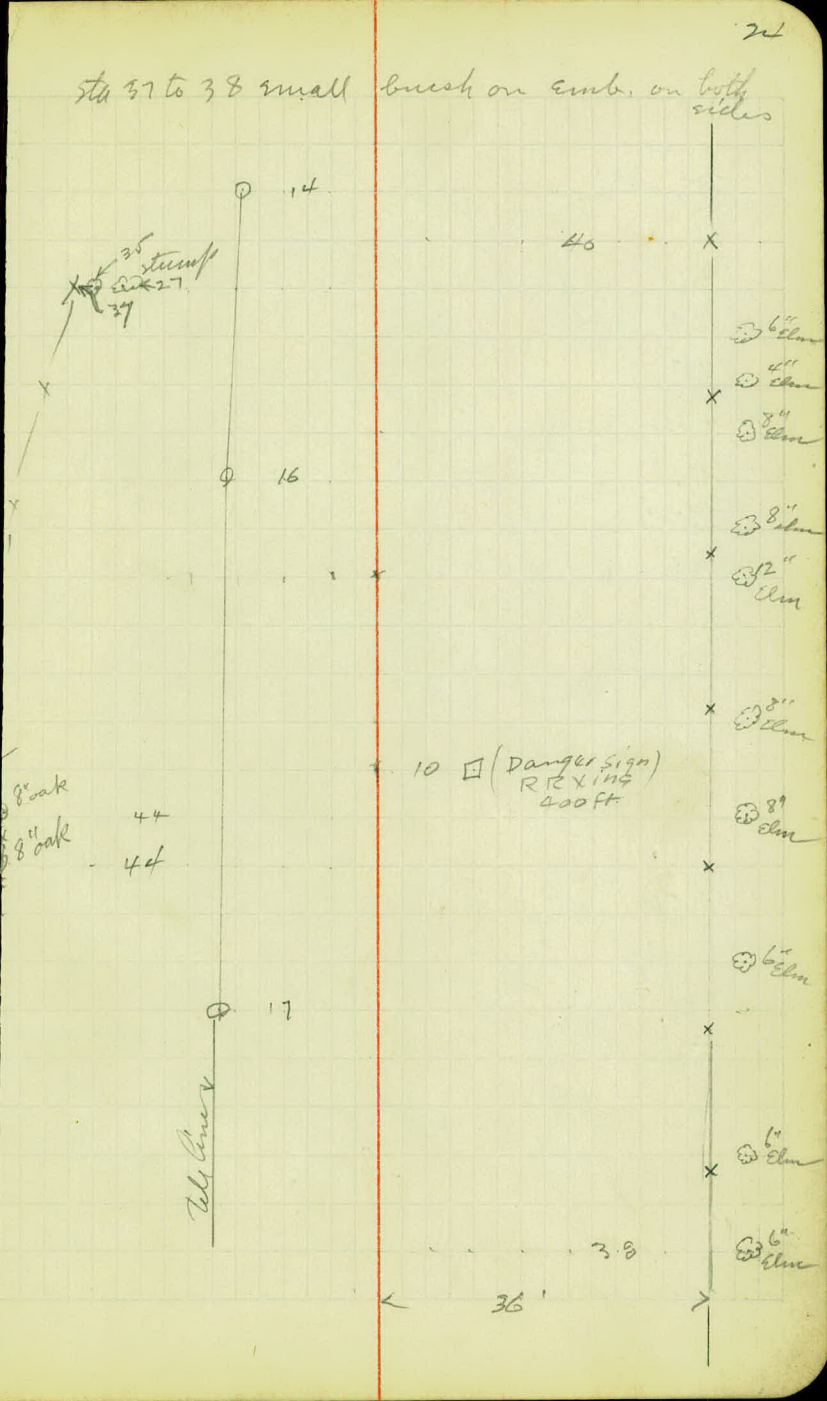
+07

34+00

+92

33+89

Sta 37 to 38 small brush on emb. on both sides



48+42

47+76

46+30

+89

44+72

43+45

42+84

42+78
+48 — possibly curlew. didn't break it. Snow.
42+06

40+63

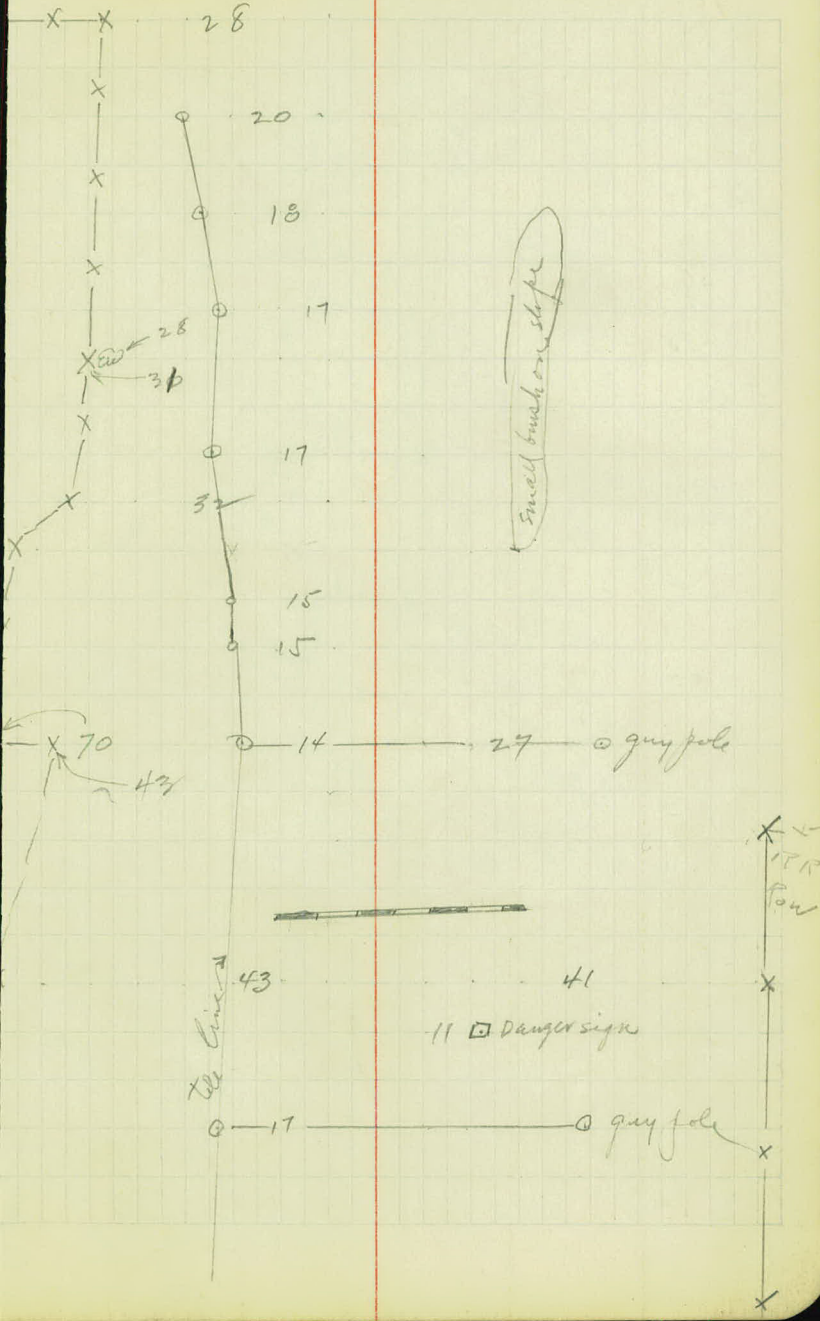
39+10

+90

38+57 & tk
+52

+47

38+17


28
20
18
17
28
36
17
32
15
15
70
14
27
guy pole
43
43
41
11 Danger sign
17
guy pole

+98 barn

+79 shed 30 ft

+63 shed 29 ft

+48 barn

54+35

+85

+85 house

53+63 house

+90

+54

+50

52+21

52+74 = Sta 52+85' see Cor.

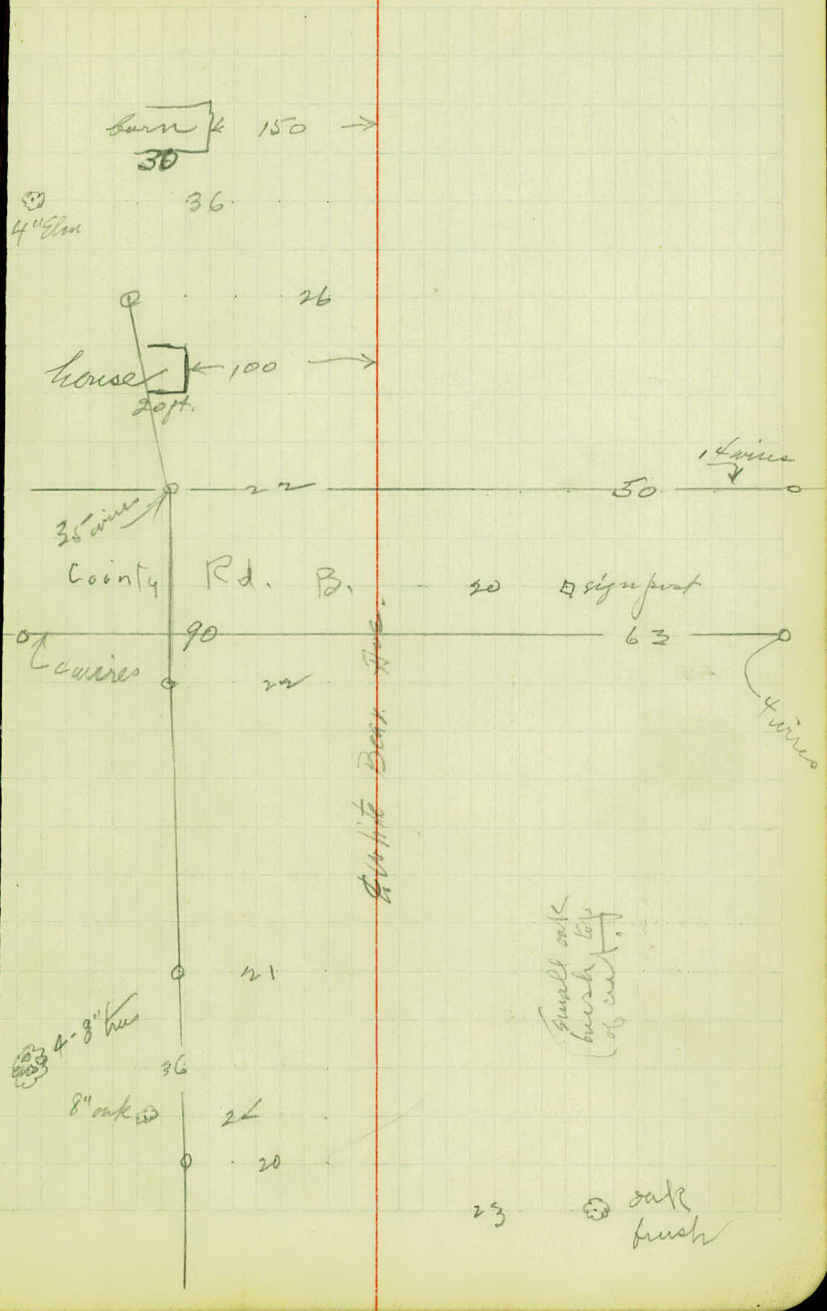
50+68

+77

-57

+20

49+03


barn
30
150
36
4" Elm
26
house
100
20 ft.
1 wire
22
30
35' wire
County Rd. B.
20
sign post
90
63
1 wires
22
4 wires
Gravel Road
21
4-3" trees
36
8" oak
24
20
23
oak
brush
small oak
brush
10 wide

+59

+43

+10

59 +04 house

+85

+80 house

+70

+10

58 +07

57 +39

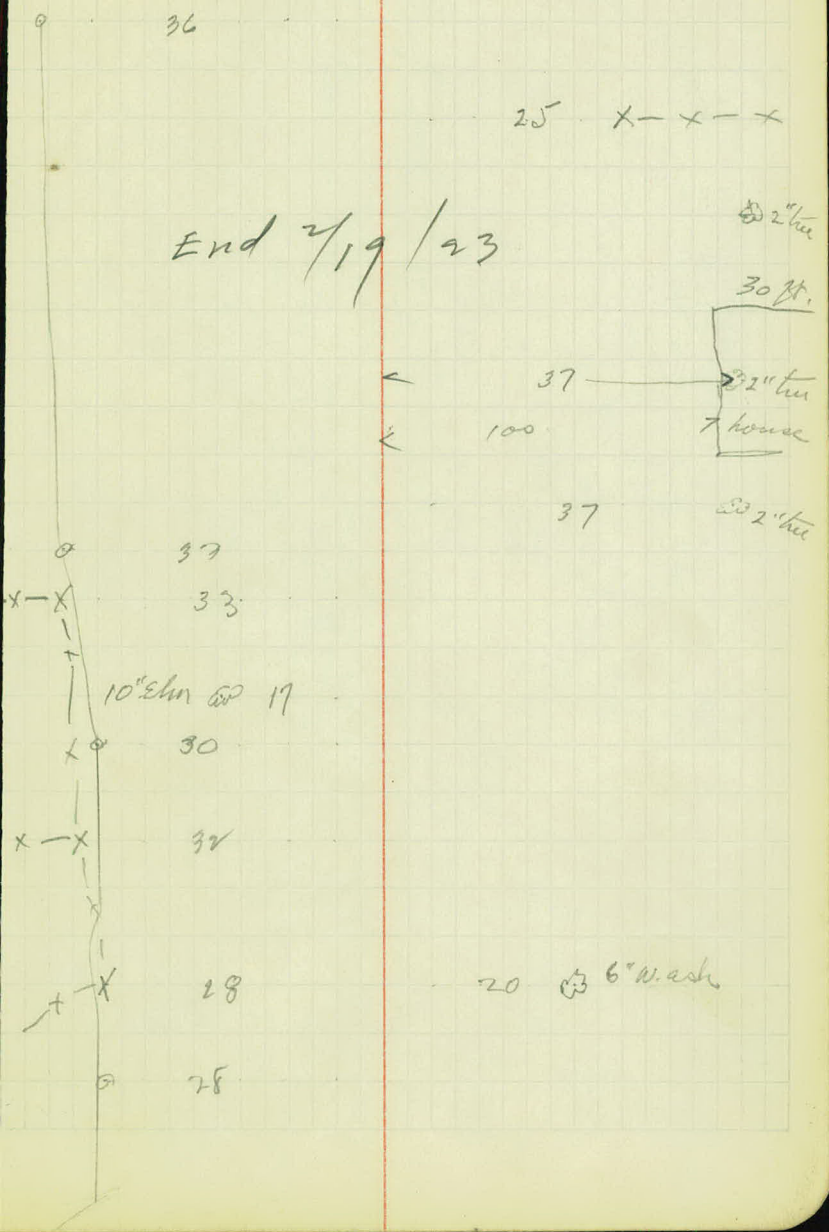
+71

56 +56

+46

55 +30

Rambo
Cattenburg
Conner
7/20/23


36
25
End 7/19/23
2" Elm
30 ft.
37
2" Elm
100
house
37
2" Elm
37
33
10" Elm
17
30
32
28
20
6" Wash
28

+99

+92

+83

+73

+65

+58

64 +43

+34

+25

63 +40

62 +96

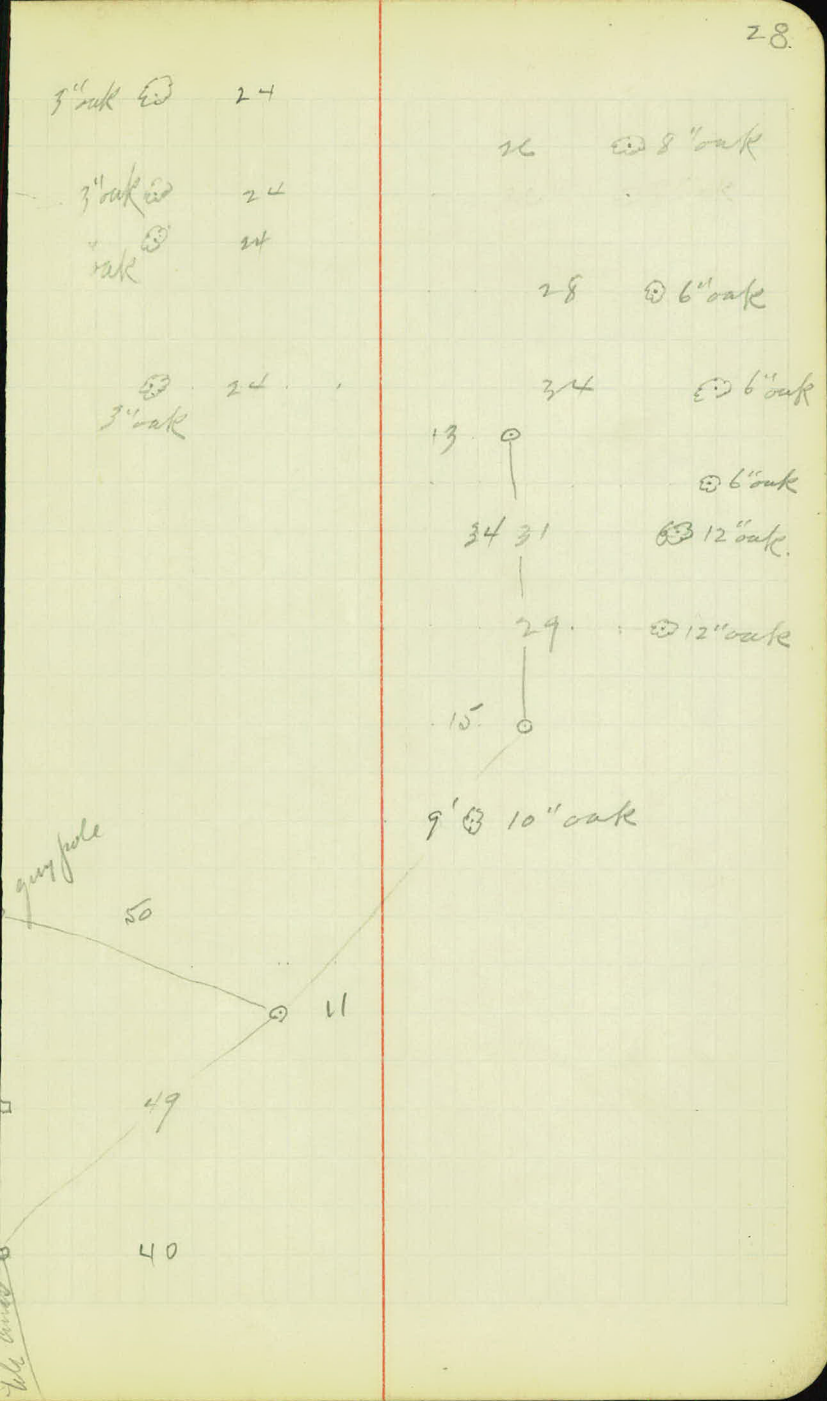
+86

+59

+54

61 +52 St Paul sign

60 +85


3" oak 24
3" oak 24
oak 24
3" oak 24
24 8" oak
28 6" oak
34 6" oak
6" oak
13
34 31 12" oak
29 12" oak
15
9' 10" oak
guy pole
50
11
49
40

+76

+66
+37
+20

67+05

+82
+58
+55
+46
+37
+07
66+02

+94

+90

+73

+60

65+14

12" Elm

30 — 14" oak

14

29 — 12" oak

29 — 12" oak

— 2 wire

29 — 12" oak

end of fence

3" oak 24

4" oak 24

3" oak 24

4" oak 28

5" oak 24

3" oak 25

26 — 4" oak

12

3" oak 24

3" oak 24

3" oak 24

left line

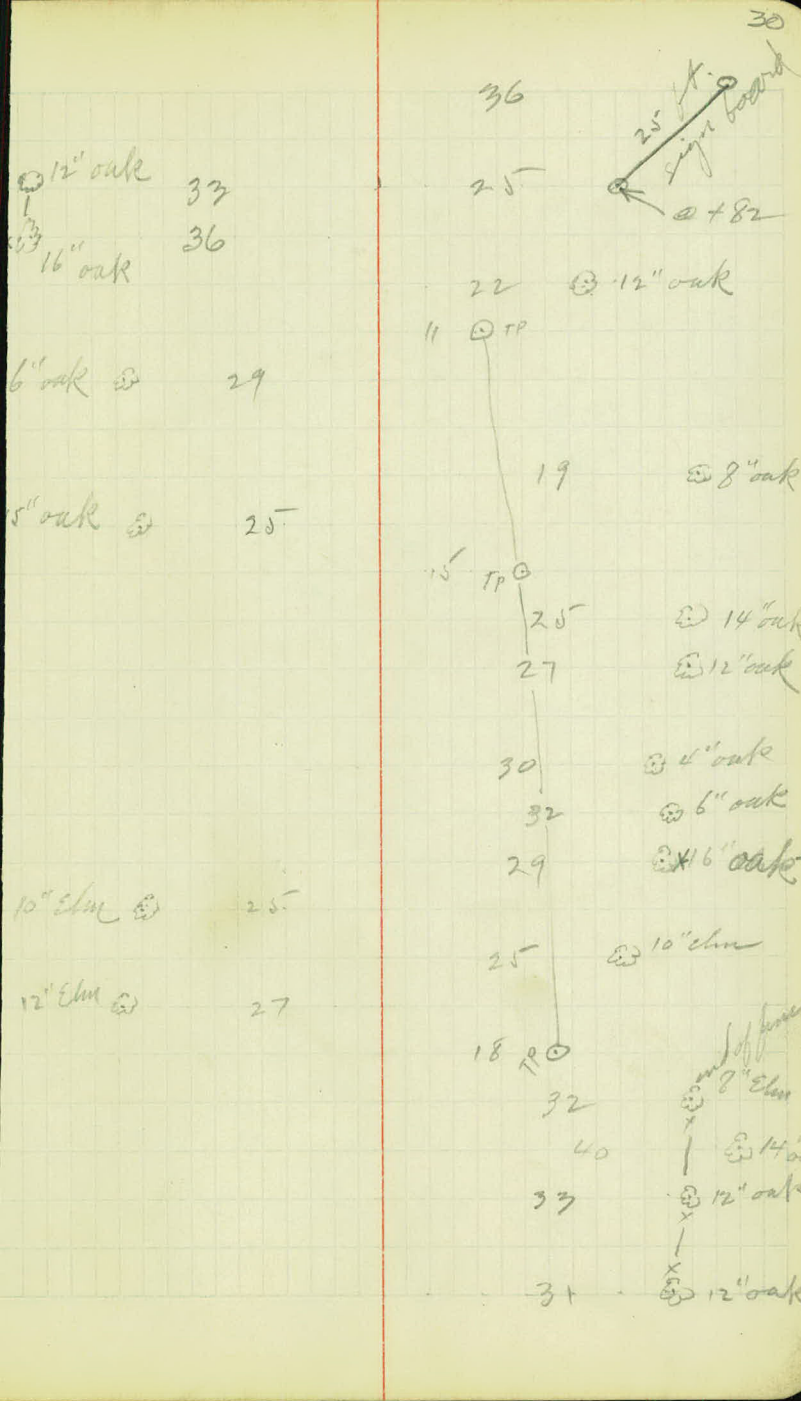
73+05

+89
+87
+79
72+62
+84
71+60

+54
+50
+24
+11
70+01

+82
+76
+71
+51
+44
69+20
+80
+59
+58
+30

68+08


12" oak
33
16" oak
36
6" oak
29
5" oak
25
10" Elm
25
12" Elm
27
36
25
+82
22
12" oak
11
TP
19
8" oak
15
TP
25
14" oak
27
12" oak
30
6" oak
32
6" oak
29
16" oak
25
10" elm
18
TP
32
8" Elm
40
14" oak
33
12" oak
31
12" oak

75 +49
+35
74 +95

+75

+49

+46

+44

+31

+21

+14

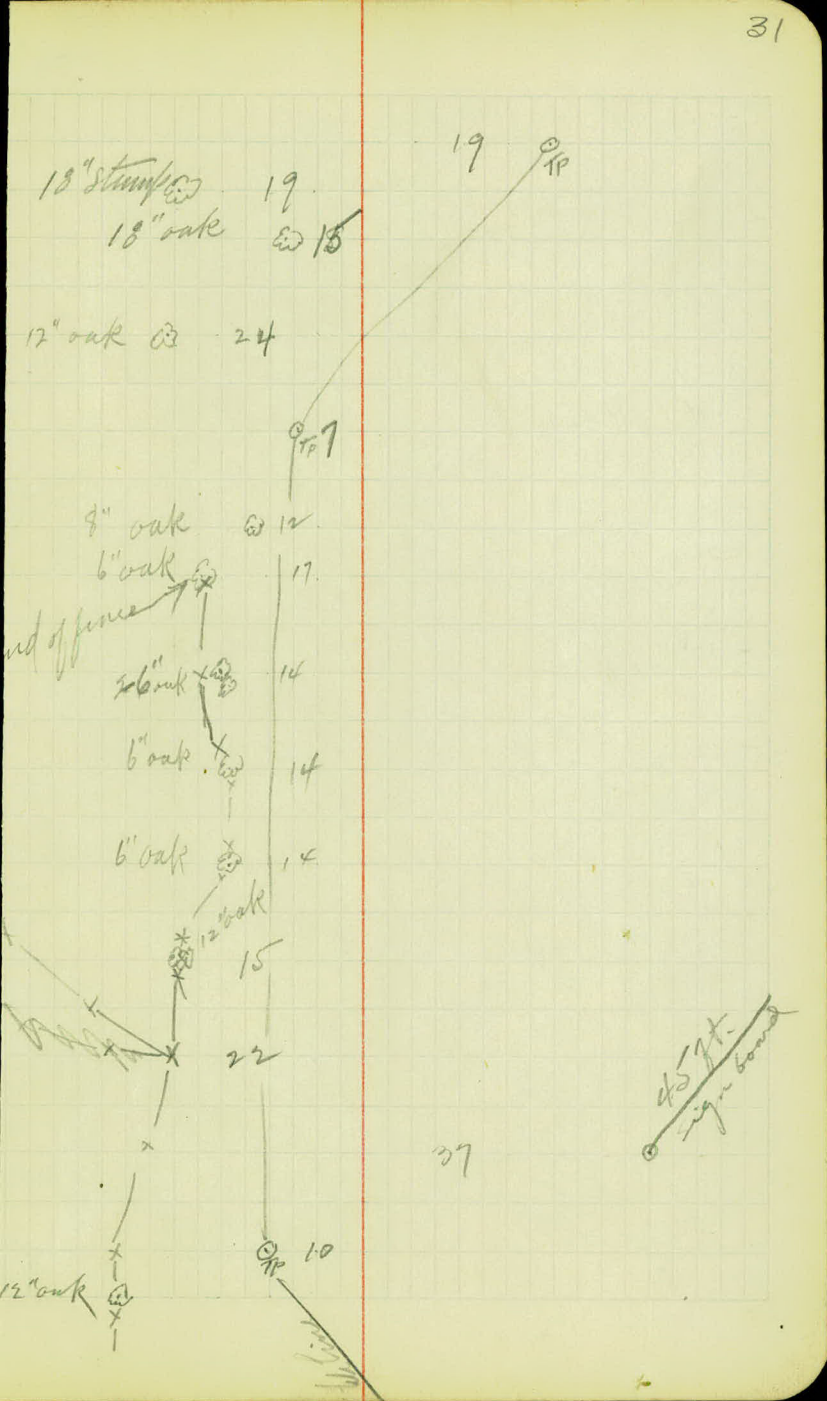
74 +00

+61

+36

+24

73 +15


19
TP
18" Stump
19
18" oak
15
12" oak
24
TP 7
8" oak
12
6" oak
17
end of fence
16" oak
14
6" oak
14
6" oak
14
12" oak
15
22
45 ft. sign board
37
10
12" oak

77+95 house lt

+91

+85

+73

+59

+50 house lt.

+44

+23 mail box

+20

77+15

77+00 to 77+15 driveway lt.

76+80

+78

+76

+70

+68

+62

+56

+44

+42

+33

+27

+23

+07

76+01

ak 36 30
6" ash
" oak 29
oak 33
Maple 30

Maple 30
3 stumps 9
" ash 30
ash 30

23 Trp

3" oaks 29
" oak 20
6" oak 24
" oak 26
" oak 22
" oak 28
oak 28
oak 30
" oak 22
Oak 30
4" oak 17
6" oak 26
" oak 30

(cont on page 42)

End 11/20/23 11:00 A.M.

Note from Sta 64 +50 to 81 small brush appears on both sides of ℄ among trees not indicated in these notes.

+74

+82

+67 fence

+67

+50 barn

+26

+13

80+11

barn +100 ft
50

+88

+49

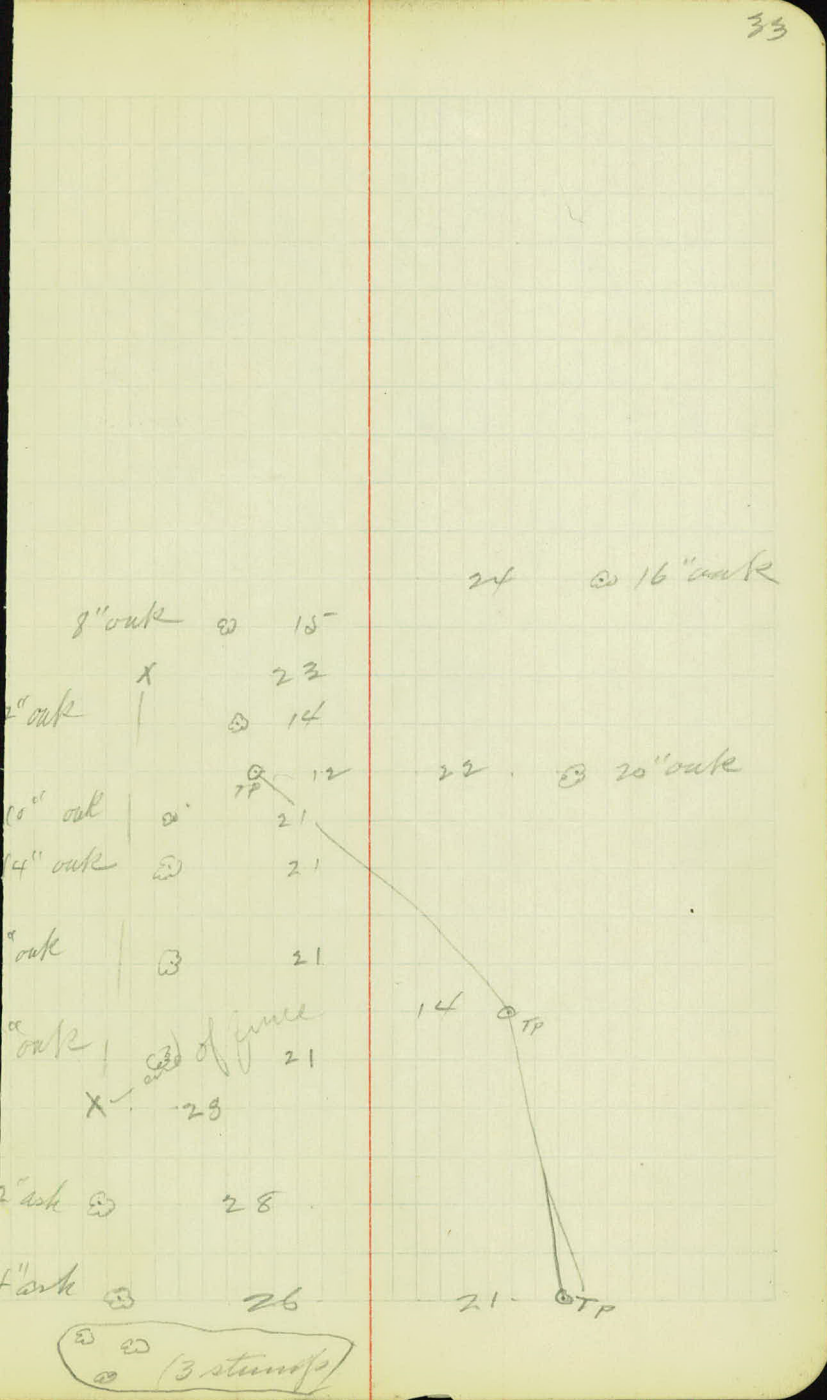
79+20 fence 30 ft. Ct.

+34

78+19 to +38

+18

78+07


24 16" oak
8" oak 18"
X 23
" oak 14
12
TP
22 20" oak
(6" oak
14" oak
21
21
" oak
21
" oak
21
X 23
14
TP
" ash 28
" ash 26
21
TP
(3 stumps)

| Sta. | PT | Lt | Rt. | Calc. Bearing |
|---|---|---|---|---|
| 87+71.7 | EC | 8-25' | | N02°-05'E |
| +50 | | 8-05½ | | |
| (84+93.2 | P.I. | 16°-50' | | |
| 87 | | 7-20½ | | Δ=16°50' |
| | | | | 3°C Lt. |
| +50 | | 6-35½ | | T=282.6 |
| | | | | LC=561' |
| 86 | | 5-50½ | | |
| +50 | | 5-05½ | | |
| 85 | | 4-20½ | | |
| +50 | | 3-35½ | | |
| 84 | | 2-50½ | | |
| +50 | | 2-05½ | | |
| 83 | | 1-20½ | | |
| +50 | | 0-35½ | | |
| 82+10.6 | BC | 00 | | N19°-05'E |

(cont. from page 11)

Chord Bearing 0.0

16-50
33-40

84+99.2
2+82.6
82+10.6 BC
5+61.1
87+71.7 EC

8493.2
81.3
8412.0

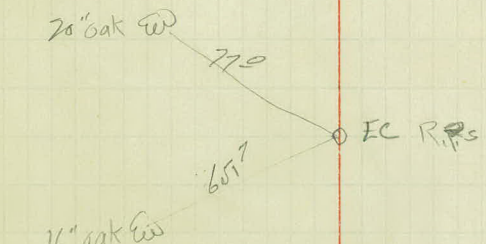
394
9
35.46
217
19
19.73

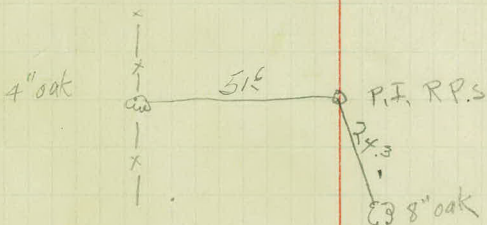
T
3 | 847.78
T = 282.59

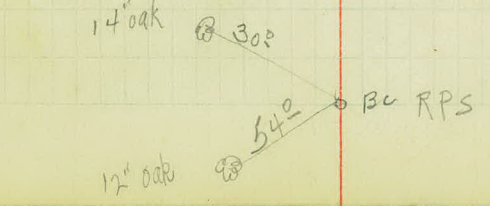
E
3 | 62.38
E = 20.8

3 | 1683.33
∠c = 561.1

Transit # 40258



| Sta | PT | Lt | Rt | Bear. Calc |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | N09° 37' 27" E |
| 110+62 | PI | 0°55 | | |
| | | | | |
| | | | | N10° 32' 22" E |
| | | | | |
| +74 +73 | EC | | 4-08½ | D = 8-17 |
| | | | | Δ° C Rt |
| +50 | | | 3-32 | T = 83.0 |
| | | | | LC = 165.7 |
| 101 | | | 2-17 | PI = 100+91.6 |
| | | | | |
| +50 | | | 1-02 | |
| | | | | |
| 100+08 | BC | | 00 | |
| | | | | |
| | 3/21/23 | | | N.2° 15' E. |

Corner Job malvoney Carr

Rumbe - 1 hr. Teirney Persons ) transit party

EC measured -142

Rd. Δ = 0° - 55' Lt 38-

8° - 7'

100 - 91.6
53
100+08.6
1+65.7
101+73.3

411.4
1.5
2.0.0
6.2.10
2.3.3
1.1.7
35.0

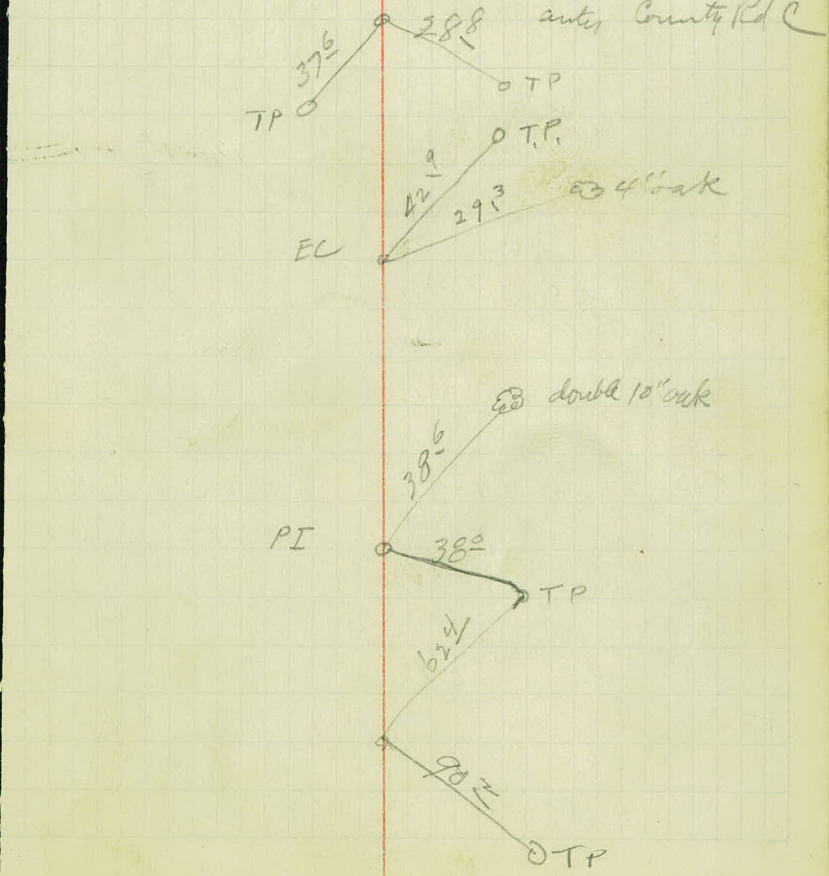
T 414.9 — ~~T = 8298~~ T = 8298

E 15.0 E = 3.0

5°C Rt.

8.2833

~~EC~~ 165.65



| Sta | PT | L | R | |
|---|---|---|---|---|
| | | | | N 01° 07' 17" E |
| +25 | EC | 4-10 | | Δ = 8°-20' |
| | | | | 5°C Lt. |
| 1+25 | | 3-32 | | T = 83.5 |
| | | | | E = 3.0 |
| 4+50 | | 2-17 | | LC = 166.7 |
| | | | | PI = 13+42 |
| Int | | 1-02 | | |
| 12+58.5 | BC | 00 | | |
| | | | | N. 09°37' E. |

8° 20'

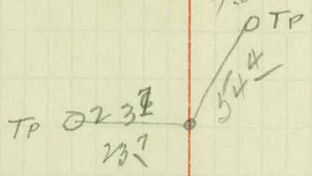
T
5 | 417.41
83.5

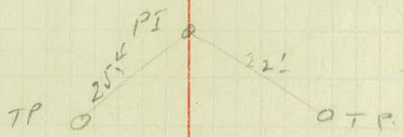
E
5 | 15,8
3

5 | 83.33
16.66

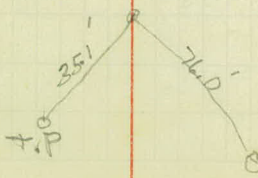
124+42,0
T = 83,5
123+58,5 BC
LC = 1+66
125+25,2 EC

4,5
2,0
6,2
5,2
1,2
7,8




3c



Sta PT L R

I 7/23/23 corner H.L. Wikhosen, Mahoney carr, Galvin } Transit
Jerieny Persons } T-Level

End 7/21/23

9°02'
N8°-52' E

| | | | | |
|---|---|---|---|---|
| 149+ | | | 5-20 | Δ = 16°40' |
| 15 | | | 4-43 | D 2°30' C RT. |
| +65 | | | 4-05½ | T = 214 |
| 151 | | | 3-28 | Lc = 426.7 |
| +55 | | | 2-50½ | PI = 150+36.9 |
| 150 | | | 2-13 | |
| +50 | | | 1-35½ | |
| 149 ~~+50~~ | | | 0-58 | |
| +50 | | | 0-20½ | |
| 148+22.9 | BC | | 00 | |
| | | | | N01°-38'-48" W |
| 141+72.5 | PI | 2°55' | | |
| | | | | N01°-17'-07" E |

Δ = 2-55-37

Δ = 10°-40' Rt.

150+36.9

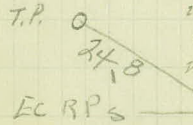
2+14

148+22.9 - BC

4+26.7

152+49.6 EC

| T | E |
|---|---|
| 25) 5349 | 2499 (213.96 |
| 50 | |
| 34 | |
| 25 | |
| 99 | |
| 75 | |
| 240 | |
| 225 | |
| 156 | |




25) 1066.67 (42.67

100

66

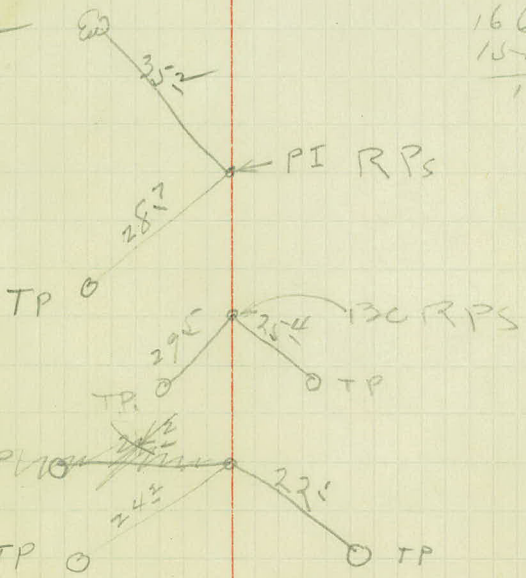
50

166

150

167

6" Elm




Note Sta 148+55 should be 6 ft. Rt.

| Sta. | P.T. | L | ℄ | Calc Bearing |
|---|---|---|---|---|
| 165+31.3 | POT (County Rd D) | | | |
| | | | | TP → 37.2 → ○ → 33.6 → TP |
| | | | | 2°58' |
| | | | | N 3-02 W |
| 165+65.6 | EC | 6-00 | | Δ = 12-00 Lt. |
| +50 | | 5-41 | | T = 150.6 ✓ |
| | | | | E = 7.9 |
| 160 | | 4-41 | | Lc = 300.0 ✓ |
| | | | | PI = 159+16.2 |
| +50 | | 3-41 | | |
| 159 | | 2-41 | | |
| +50 | | 1-41 | | |
| 158 | | 0-41 | | |
| 157+65.6 | BC | 00 | | |
| | | | | N. 9°02' E. |

N 87°-00-W

Sta 160 + 10

Highway Curve D = 12°00' Lt.

152 + 49.6 EC
5 + 18°
157 + 67.6 POT
1 + 48.6
159 + 16.2 PI
1 + 50.6
157 + 65.6 PC
3 + 22
160 + 65.6 EC

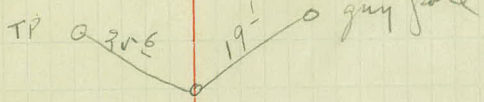
34°
12
41.28

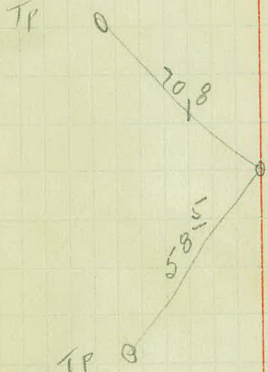
46
12
183

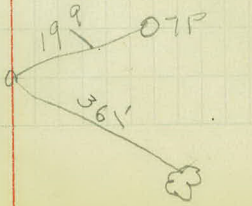
T
L 160 x 12
T = 150.56

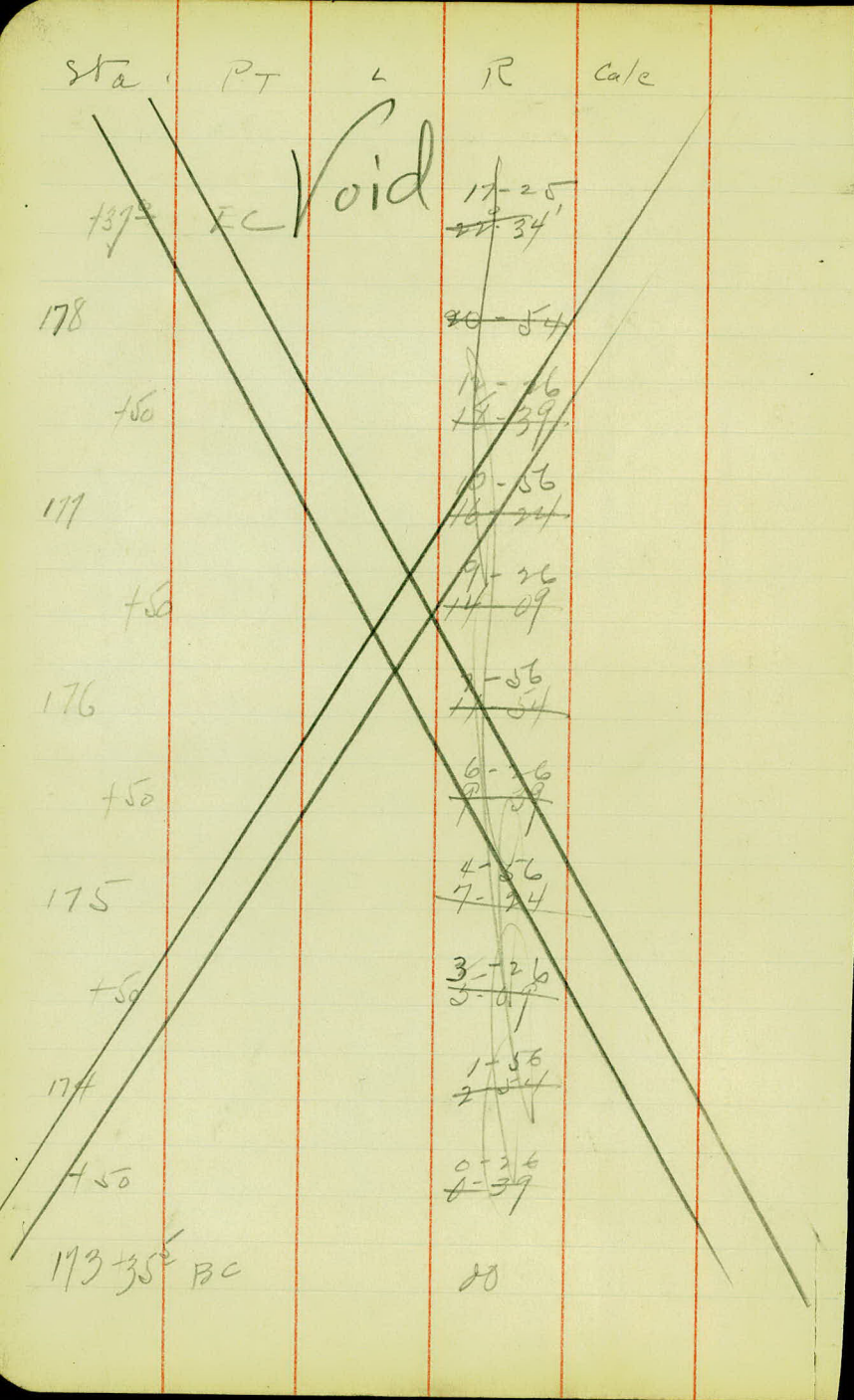
E
31.56
E = 7.89

6 + 66.6
5 + 18
1 + 50.6
1 + 48.6




Sta
PT
L
R
Calc
Void
137+
EC
178
+50
177
+50
176
+50
175
+50
174
+50
173+35
BC

176+00 PI
2645' T
173+35.5 BC
5+01.5 LC
178+37.0 EC

176+00
2+99.6
173+00.4
5+80.5
180+80.9
178+80.9

34°-50'
45°-00'
T
9 | 2380.7
2645

4-30
2.7
14.5
2.7
10.15
290
39.15

L
4749
52.8
9 | 45133.3
501.5
3-39
2-10
3.54
2.15
5:09

6 | 179.4
29.9
6 | 4.0
3:1

6 | 278
46
6 | 45,1333
752.22
134833
580.5

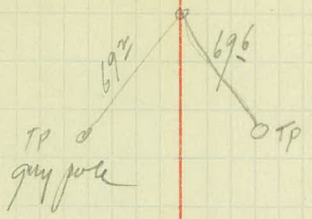
9.8
2.5
3
3.5
3.7
9.2
3
27.6
14.5
1.8
1160
14.5
26.10

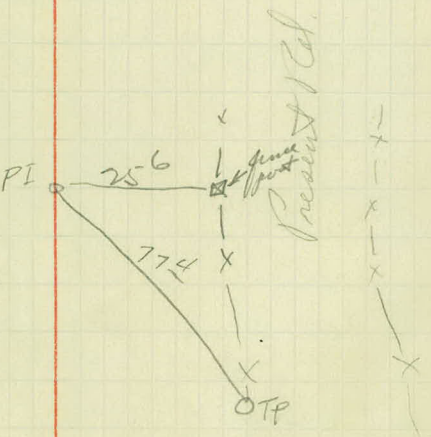
Void

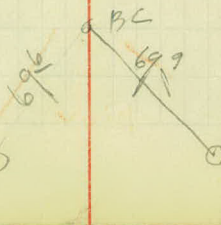
| | | | |
|---|---|---|---|
| +80.9 | EC | 17°25 | Δ = 34°50 |
| | | | 6° C Rt. |
| +50 | | 16-30 | PI-176+00 |
| | | | T = 299.6 ✓ |
| 178 | | 15-00 | LC = 580.5 ✓ |
| +50 | | 13-30 | |
| 177 | | 12-00 | |
| +50 | | 10-30 | |
| 176 | | 9-00 | |
| +50 | | 7-30 | |
| 175 | | 6-00 | |
| +50 | | 4-30 | |
| 174 | | 3-00 | |
| +50 | | 1-30 | |
| 173+00.4 | BC | 00 | |

Ch. chord bearing

N 21°58' W.


69.71
69.96
TP
guy pole
TP


PI
25.6
guy pole
77.14
TP

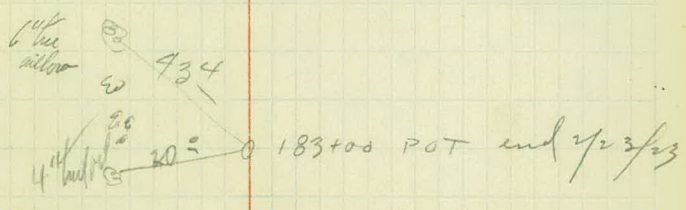

BC
69.96
69.9
T.P.
TP
guy pole

(Cont on page 62)

183+00 POT

End 2/2⅜/2⅓

N. 31° 42' 52" E


6" line
ditch
4" line
20 ±
183+00 POT
end 2/23/23

87

86

85

84

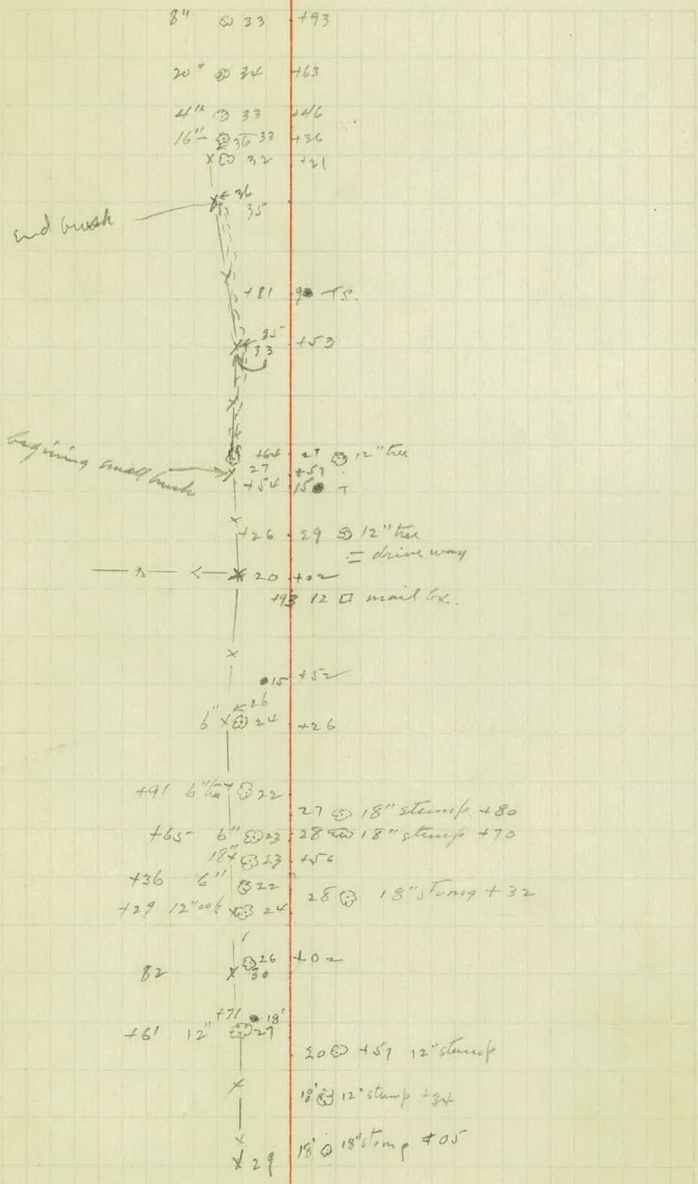
83

82

81

3/24/23
Conner
Wilkinson
Mahoney

Cont from page 33


8" 33 +93
20" 34 +63
4" 33 +46
16" 36 33 +36
32 +21
end brush
36
35
+81 9 TS.
35
33 +53
+66 +27 12" tree
27 +57
+56 15 T
tree showing smaller branches
+26 29 12" tree
= drive way
20 +02
+93 12 mail bx.
15 +52
6" 26 24 +26
+91 6" 22 27 18" stump +80
+65 6" 23 28 18" stump +70
18" 23 +56
+36 6" 22
+29 12" oak 24 28 18" stump +32
82 26 30 +02
+61 12" +71 19' 27
20 +57 12" stump
19' 12" stump +34
19' 18" stump +05
29

93

92

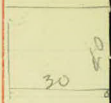
91

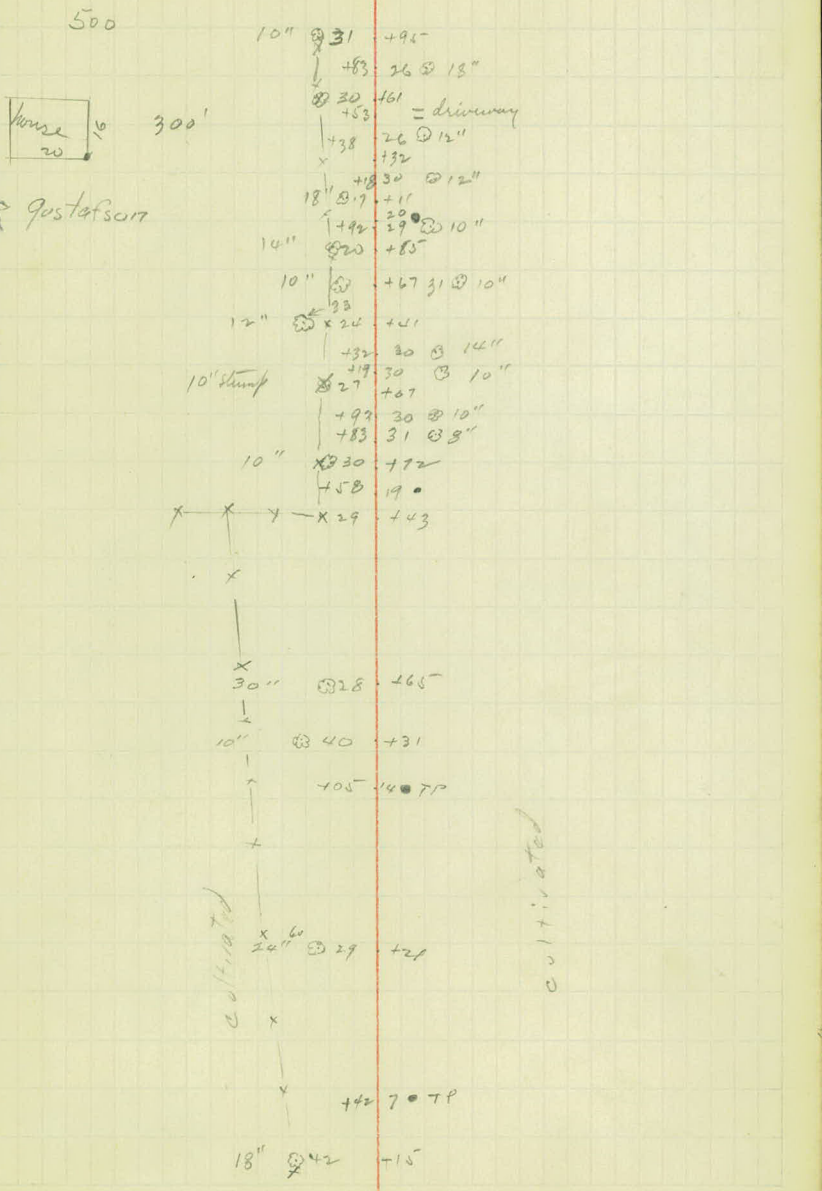
90

89

88

87




500
10" 31 +94
+83 26 18"
30 +61
+53 = driveway
House 20
300'
+38 26 12"
+32
+18 30 12"
18" 17 +11
R Gustafson
+92 29 10"
14" 20 +85
10" +67 31 10"
33
12" 24 +41
+32 30 14"
10" stump 27 +19 30 10"
+67
+92 30 10"
+83 31 8"
10" 30 +72
+58 19
29 +43
30" 28 465
10" 40 +31
405 +40 TP
24" 29 +21
cultivated
cultivated
+42 7 TP
18" 42 +15

98

97

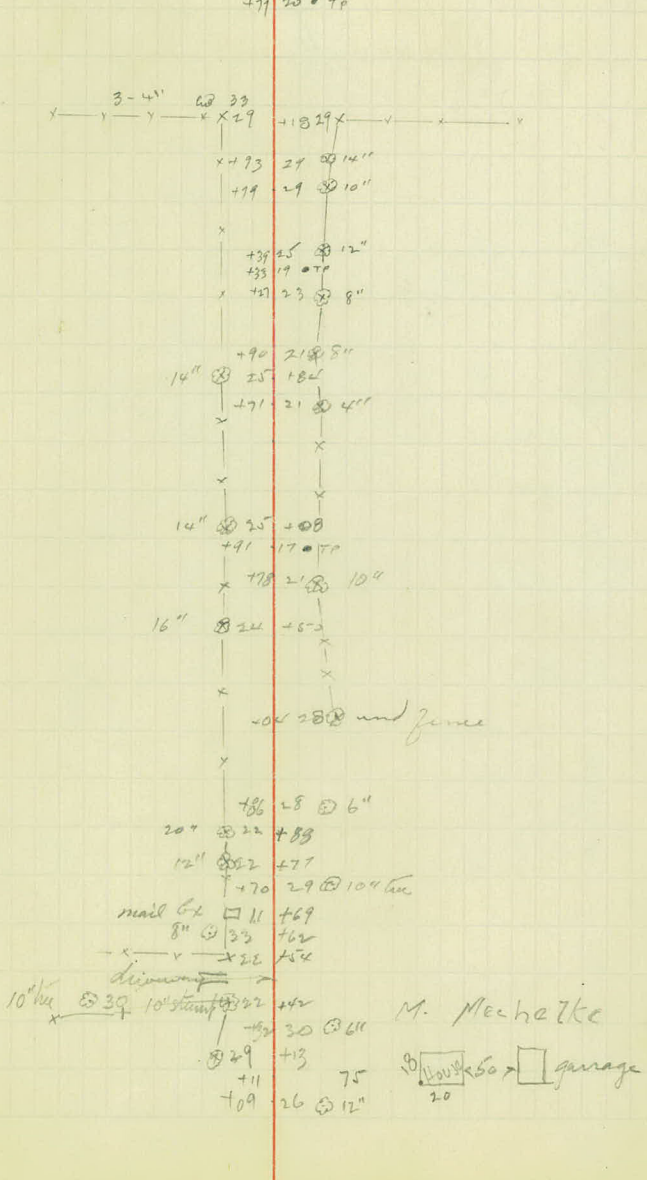
96

95

94

~~93~~

93


+71 20 • TP
3 - 4"
+29
+18 29
+93 27 14"
+99 29 10"
+39 25 12"
+33 19 • TP
+27 23 8"
+90 21 8"
14" 25 +84
+71 21 4"
14" 25 +08
+91 17 • TP
+78 21 10"
16" 24 +6-2
-04 28 mud Jane
+86 28 6"
20" 22 +88
12" 22 +77
+70 29 10" live
mail Bx 11 +69
8" 33 +62
22 +54
driveway
10" live 30 10" stump 22 +42
30 6"
29 +13
+11
+09 26 12"
75
M. Machelke
house
garage
50
20

104

103

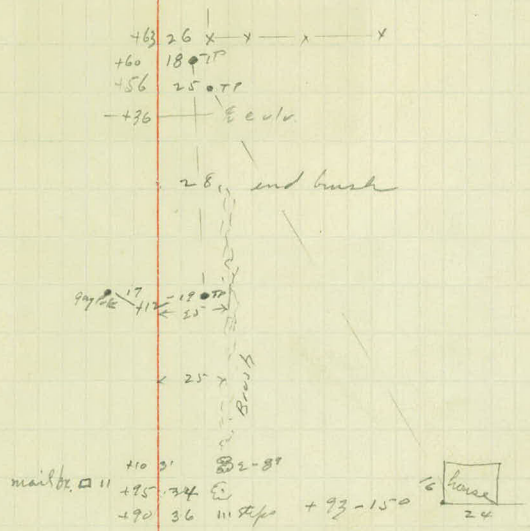
102

101

100

99

98


+63 26 X — X — X — X
+60 18 TP
+56 25 TP
+36 ℄ curb
28 end brush
97 ℄ 17
41 ℄ 19 TP
25
25
Brush
+10 3' 2-8"
mailbox
+95 34 ℄
+90 36 111 steps
+93-15-0
16 house
24
+66 25 TP
+21 23 TP
+65 30 ℄ 6" stump

~~110~~

109

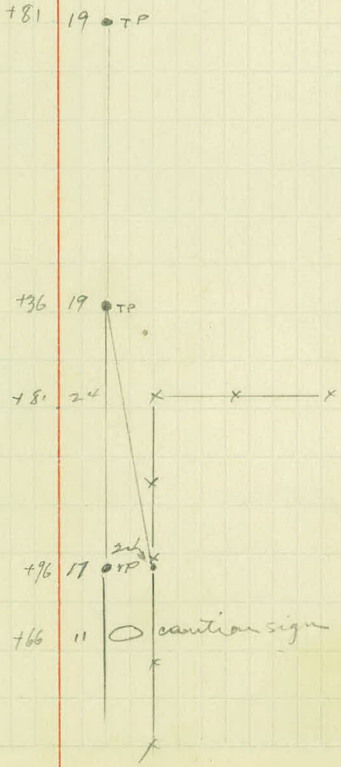
108

107

106

105

104


+81 19 TP
+36 19 TP
+81 24
2nd
+96 17 TP
+66 11
caution sign

115

114

113

112

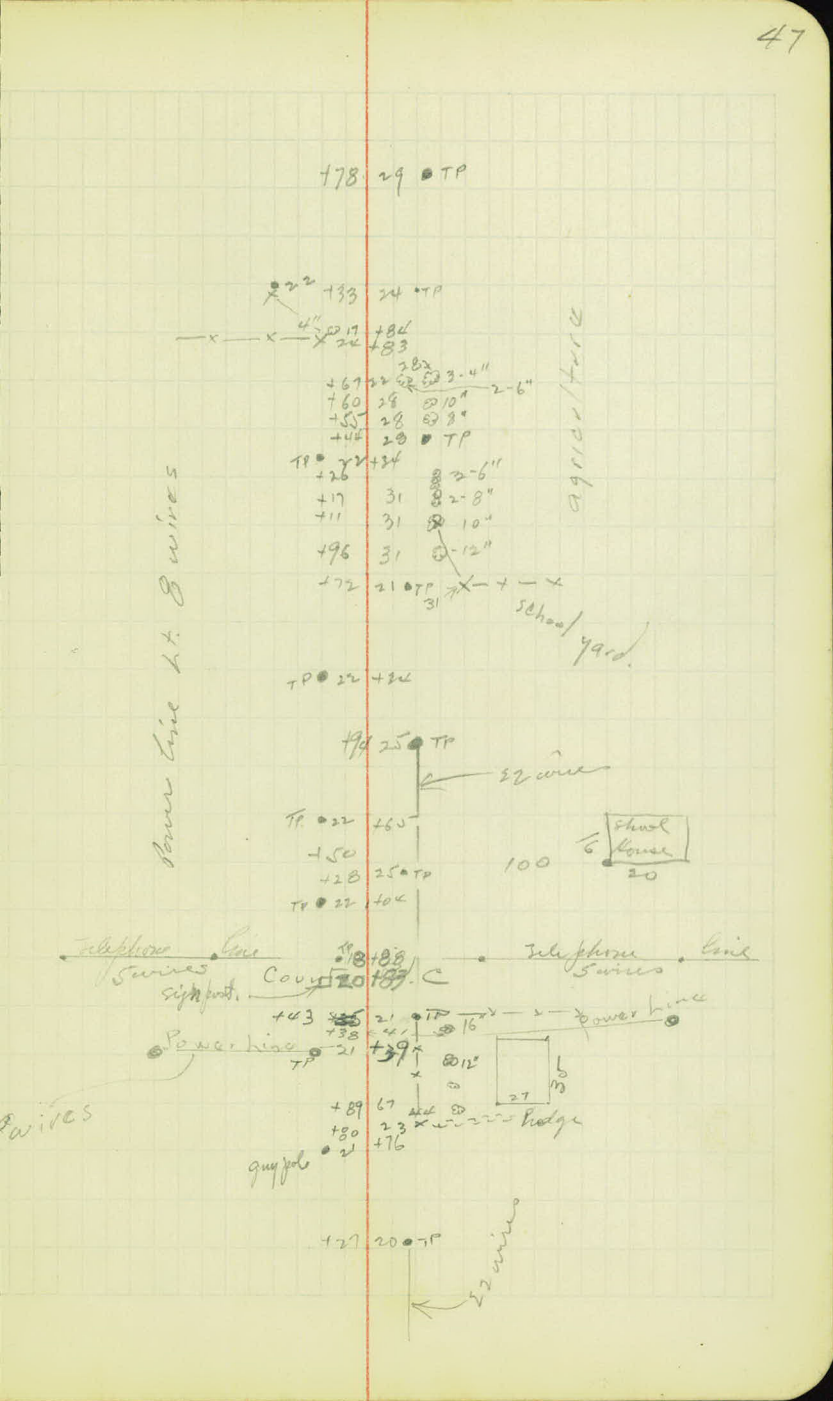
2/26/23
Connor – Recorder
Mik Husen
Mahoney } chairman

111

End 12:30 PM 2/24/23

110

109


478 29 TP
+33 24 TP
4"
+84
+83
3-4"
2-6"
+67
+60
+55
+46
TP
+26
+24
2-6"
+17
+11
2-8"
10"
+96
12"
+72
21 TP
31
Gravel Drive
Power Line 4 Wires
Shed
+TP 22 +24
+94 25 TP
22 wire
TP 22 +60
+50
+28 25 TP
100
Shed
Power House
20
TP 22 +40
Telephone Line 5 wires
Telephone Line 5 wires
Court
+63
21 TP
16
Power line
Power line
TP 21
+39
12"
27
Bridge
+89 67
+80 23
+76
guy pole
21
Wires
+27 20 TP
22 wire

121

120

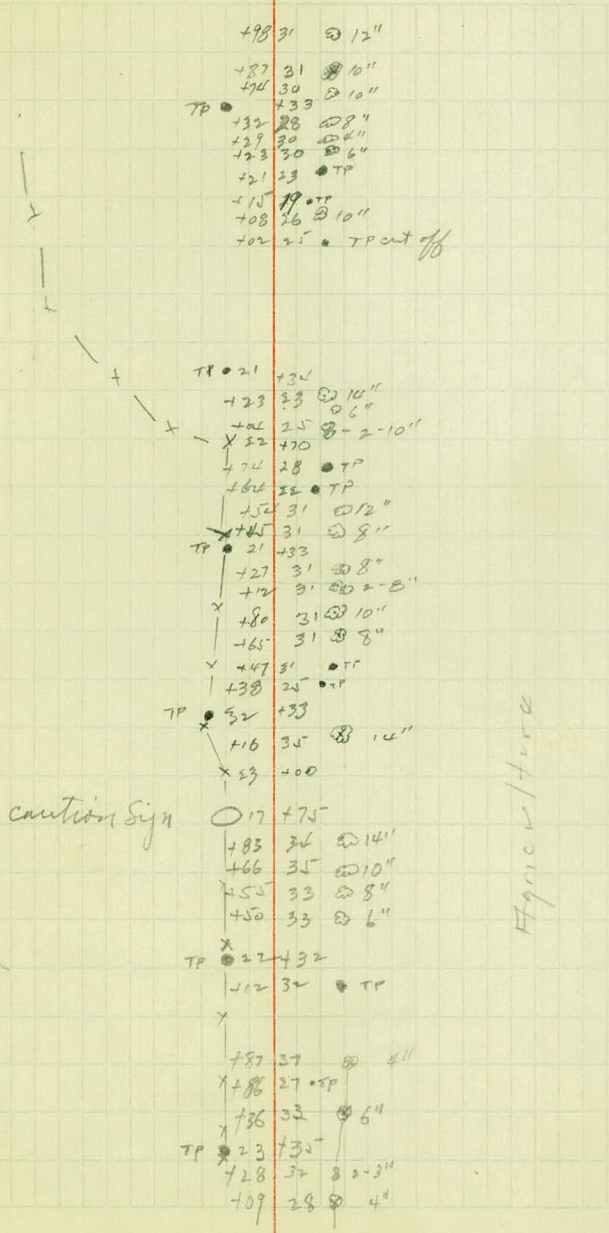
119

118

117

116

115


+98 31 12"
+87 31 10"
+76 30 10"
TP
+33
+32 28 8"
+29 30 6"
+23 30 6"
+21 23 TP
+15 19 TP
+08 26 10"
+02 25 TP cut
TP 21 +34
+23 33 10"
6"
+02 25 2-10"
22 +10
+04 28 TP
+64 32 TP
+52 31 12"
+45 31 8"
TP 21 +33
+27 31 8"
+12 31 2-8"
+80 31 10"
+65 31 8"
+47 31 TP
+38 25 TP
TP 32 +33
+16 35 10"
23 +00
caution Sign
17 +75
+83 36 14"
+66 35 10"
+55 33 8"
+50 33 6"
TP 22 +32
+12 32 TP
+87 27 4"
+86 27 TP
+36 32 6"
TP 23 +35
+28 32 8 2-3"
+09 28 4"
Hanch Here
Hanch Here

127

126

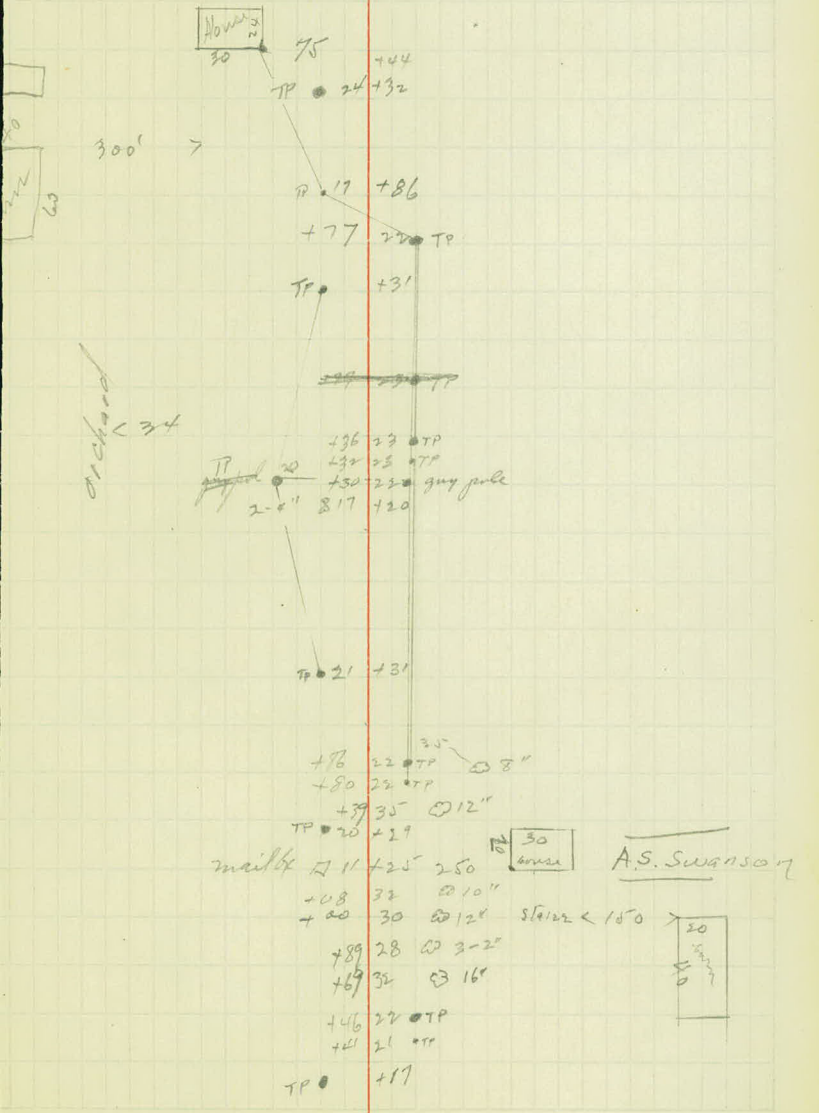
125

124

123

122

121


House
30
75
+44
TP 24 +32
300'
TP 17 +86
+77 22 TP
TP +31
orchard
+36 23 TP
+32 25 TP
TP 20 +30 23 guy pole
2-6" 817 +20
TP 21 +31
35'
+76 22 TP 8"
+80 22 TP
+39 35' 12"
TP 20 +29
mailbox 11 +25' 250
30 corner
A.S. Swanson
+08 32 10"
+20 30 12"
Stairs < 15'0
20
+89 28 3-2"
+69 32 16"
+46 22 TP
+41 21 TP
TP +17

133

132

131

130

129

128

127

TP ● 24 +31

+07 37 ● TP

TP ● 24 +31

+63 33 ● TP

TP ● 24 +33

+45 34 ● TP

TP ● 24 +32

TP ● 24 +34

+46 28 ● TP

TP ● 24 +33

Collected 8 min

Tower Line Lt

Tele Phone Line Refl. 17 min

Cultivated

139 ℄ Rd 5 ft. Rt.

138 ↘

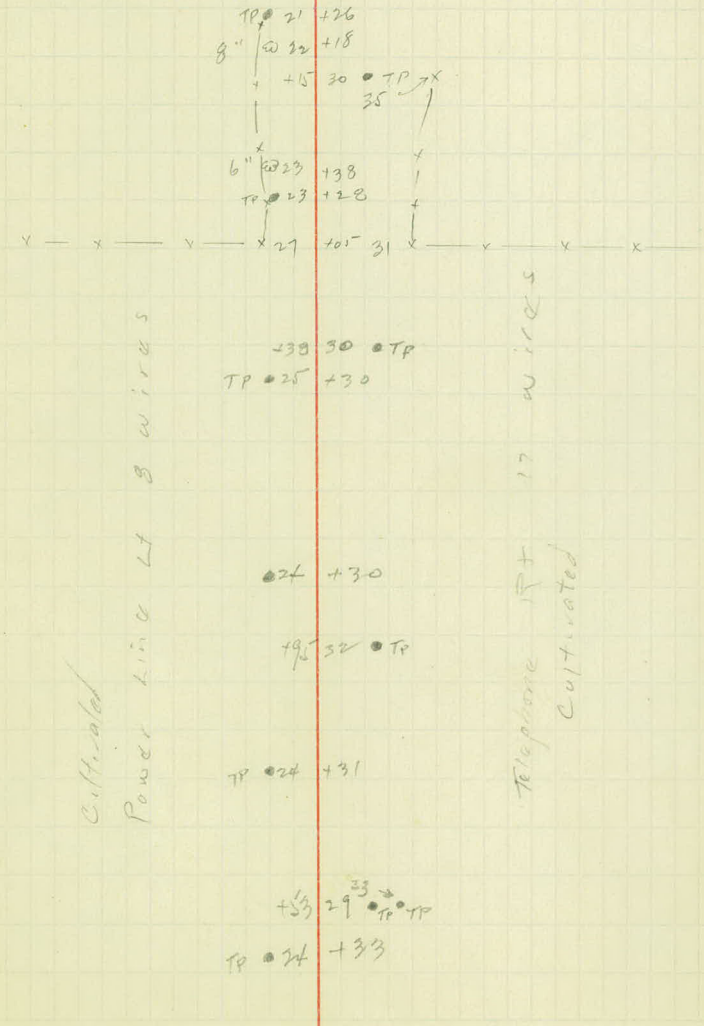
137

136 ℄ Rd Rt 2°

135

134 Note ℄ OK to Sta 34+00

133


TP 21 +26
8" ω 22 +18
+ +15 30 TP
35
6" ω 23 +38
TP 23 +28
27 +01 31
+39 30 TP
TP 25 +30
24 +30
+95 32 TP
TP 24 +31
+53 29 33 TP TP
TP 24 +33
Telephone 17 wires
Cultivated
Cultivated
Power line 4 wires

144

143

(143 to 0.K. on Rd.)

142

141

140

139

√3

8" ⊗ 26 +88
+89 16 ● TP 31 →X
8" ⊗ 23 +70
10" ⊗ SW +60
12" ⊗ SW +41
TP ● 23 +30
10" ⊗ SW +22
12" ⊗ 24 +16

6" ⊗ 25 +00
6" ⊗ 24 +91
10" ⊗ 21 +87
8" ⊗ 21 +84
6" ⊗ 21 +77
8" ⊗ SW 24 +76
10" ⊗ 21 +71
6" ⊗ 22 +57
+57 30 ⊗ 18"
+38 28 ⊗ 10"
+41 16 ● TP
18" ⊗ 23 +45
TP ● 24 +39
6" ⊗ 21 +25
10" ⊗ 22 +08
8" ⊗ 20 +06

8" ⊗ 23 +99
6" ⊗ 21 +92
12" ⊗ 21 +84 (142+00 33 →X)
10" ⊗ 19 +80
12" ⊗ 22 +61
8" ⊗ 19 +56
2-10" ⊗ 20 +47
10" ⊗ 21 +39
2-10" ⊗ 17 +27
TP ● 23 +21
+09 18 ● TP.

2-6" ⊗ 22 19 +98
8" ⊗ 16 +67
12" ⊗ 19 +46 (140+23 47 →X)
8" ⊗ 10 +35
TP ● 19 +27
10" ⊗ 10 +06
8" ⊗ 11 +89
8" ⊗ 15 +85
TP ● 16 +74
+70 27 ● guy pole
+60 25 ● TP
8" ⊗ 15 +45
TP ● 17 +29
12" ⊗ 14 19 +15

Power line 4# 8 wires Cultivated
Road pole
Telephone line Rt. 17 wires Cultivated

150

149

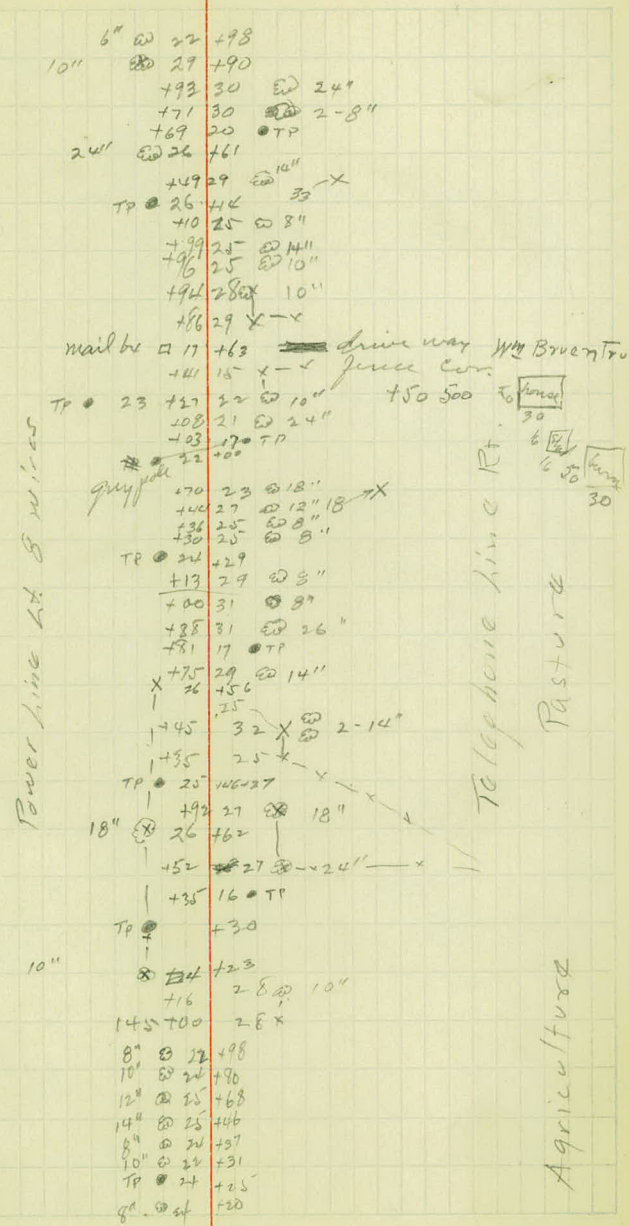
148

147

146

145

144


6" 22 +98
10" 29 +90
+93 30 24"
+71 30 2-8"
+69 20 TP
24" 26 +61
+49 29 14"
TP 26 +K
+10 25 8"
+99 25 14"
+96 25 10"
+94 28 10"
+86 29
mail bx 17 +63 drive way Wm Bruentrup
+41 15 fence cor.
TP 23 +27 22 10" +50 500
+08 21 24"
+03 17 TP
+00
gray pole
+70 23 18"
+46 27 12" 18
+36 25 8"
+30 25 8"
TP 24 +29
+13 29 5"
+00 31 8"
+88 31 26"
+81 17 TP
+75 29 14"
26 +56
+45 32 2-14"
+35 25
TP 25 +K
+92 27 18"
18" 26 +62
+52 27 24"
+35 16 TP
TP +30
10" +23
28 10"
+16
145 +00 28
8" 32 +98
10" 24 +90
12" 25 +68
14" 25 +46
8" 32 +37
10" 24 +31
TP 24 +25
8" 24 +20
Agriculture
Power line 47 ft wide
Telephone line 12 ft.
Pasture
Agriculture
30
30

156

155

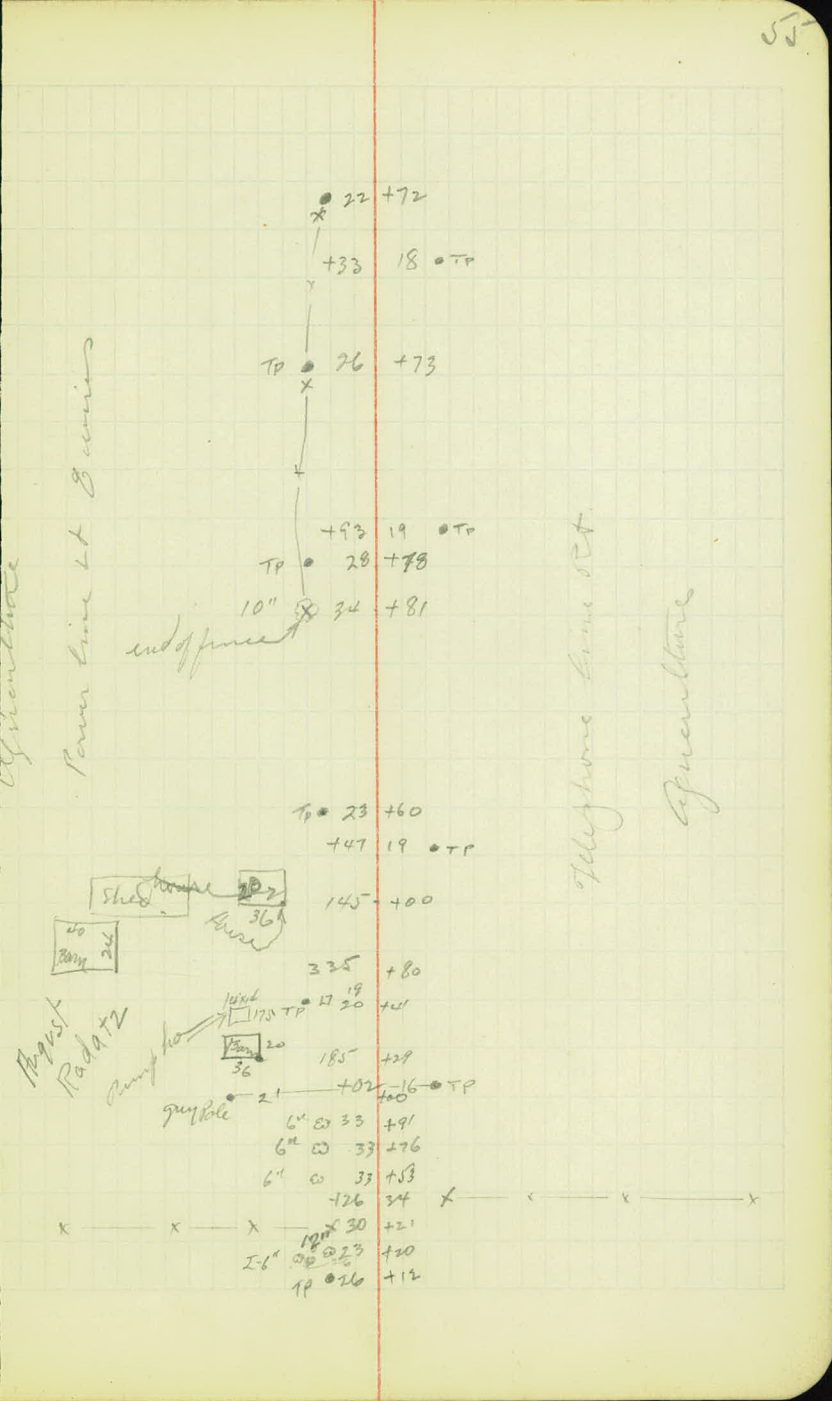
154

153

152

151

150


22 +72
+33 18 TP
TP 26 +73
+93 19 TP
TP 28 +78
10" 34 +81
end of fence
Power line to Barns
Telephone line to Barns
TP 23 +60
+47 19 TP
Shed
36
145 +00
40
Barn
34
335 +80
Joint
175 TP 17 19 20 +41
Corn Crib
20
36
185 +29
Privy
Radio
21 +02 -16 TP +00
guy pole
6" Ø 33 +91
6" Ø 33 +76
6" Ø 33 +53
+26 34
30 +21
12" Ø 23 +20
I-6" Ø 26 +12
1P

162

161

160

159

158

157

156

Test taken 2/26/23
Snow flurries working in this cut.

+87 28 ⌀ 4"
+75 20 ⌀ 6"
TP ● 22 +64
+57 30 ⌀ 14"
+37 29 ⌀ 8"
+21 21 ● TP
X23
<22
Brush

+83 30 X— <—
TP ● 28 +70 1
+71 19 ● guy pole
+69 27 ⌀ 12"
+65 25 ⌀ 4"
+62 27 ⌀ 10"
+43 28 ⌀ 14"
+09 27 ⌀ 4"
+02 29 ⌀ 6"
+82 25 ⌀ 8"
+79 17 ● TP
TP ● 24 +71
+70 20 ● guy pole
+44 35 ⌀ 18"
+29 29 ⌀ 6"

168

167

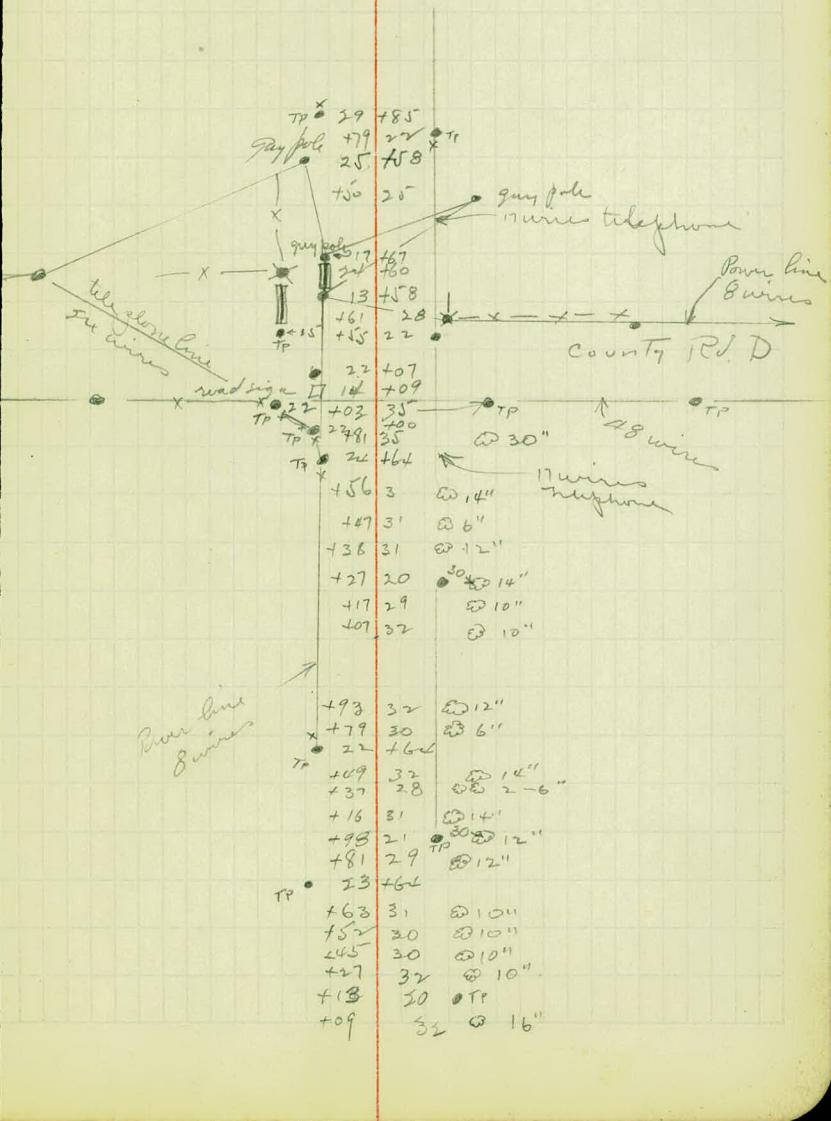
166

165

164

163

162


guy pole
17 wires telephone
Power line
8 wires
telephone line
54 wires
County Rd. D
road sign
48 wires
30"
17 wires
telephone
Power line
8 wires

174

173

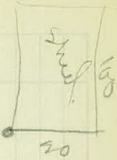
172

171

170

169

168




+77 31 TP


TP 33 +17
+82 100
4-4" 29 +73
4" 28 +67
+50 34 X — X
TP 26 +33 19 TP
guy pole
TP 31 +50
X 23
+92 20 X TP
TP 30 +97
+51 23 X TP
2 wire fence
X 21
TP 29 +44
+11 X TP

180

End 2/26/23

179

(178+50 End shaft on Rt.)

178

177

176

175

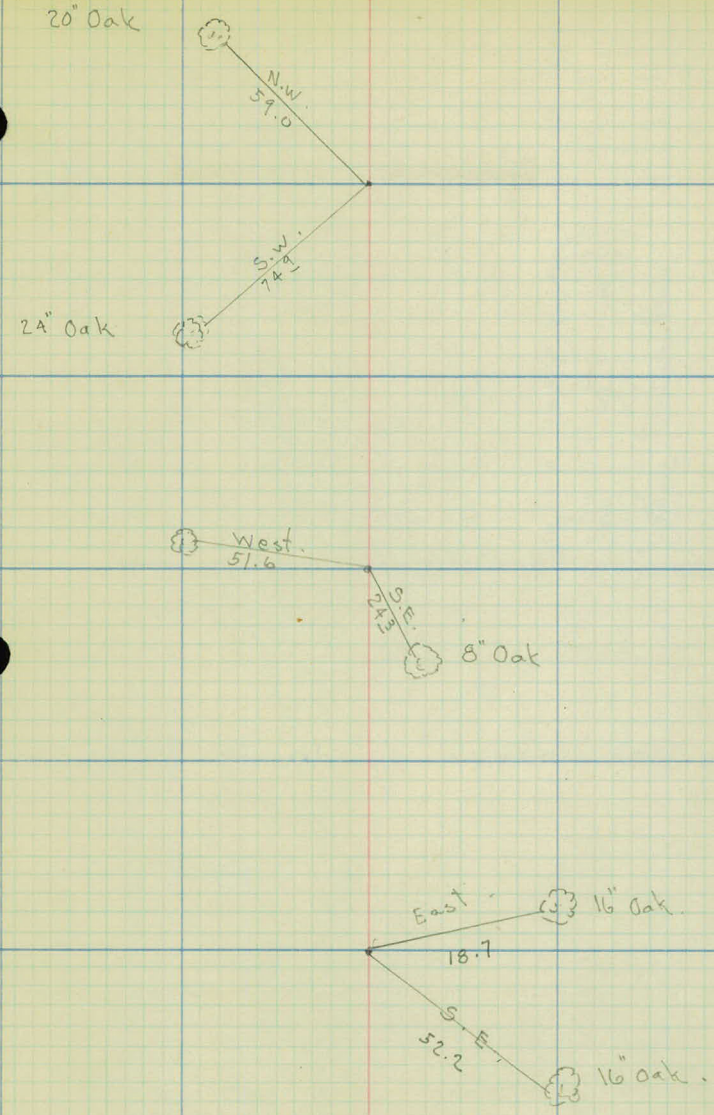
174

Proj. 23-52

4-27-23

# White Bear Rd.

| Station | Point | Left. | Right | |
|---|---|---|---|---|
| 89+11 ℄ | P.T. | | | |
| 89 | | 8°-25' | | |
| 88 | | 8°-18' | | |
| 87 | | 7°-18' | | |
| 86 | | 6°-18' | | |
| 85 | | 5°-18' | | Δ 16°-50' |
| 84+93.2 | P.I. | | | C 2°-0 |
| 84 | | 4°-18' | | S.T. 423.9 |
| | | | | L.C. 841.7 |
| 83 | | 3°-18' | | |
| 82 | | 2°-18' | | |
| 81 | | 1°-18' | | |
| 80+69.3 | P.C. | 0-18' | | |


20" Oak
N.W.
59.0
S.W.
74.9
24" Oak
West.
51.6
S.E.
24.1
8" Oak
East.
18.7
16" Oak.
S.E.
52.2
16" Oak.

+54 29 TP

X 21 +60

+49 15 X 28 ∈ 15"

+03 19 ∈ 8"

+98 13 ∈ 4"

+66 14 X

guy pole 23 +14

+12 24 TP

+69 27 X

X 25

+64 25 TP

X

X

+86 38 X — X — X

+24 28 TP TP

guy pole 14 +18

+95 32 ∈ 8"

TP 22 +84

+79 35 ∈ 6"

+58 85

+66 31 ∈ 6"

House

36

2 wire TP

A.1

X Sect. Ck Levels 7/27/23

2+00

12+00

2 2

3 2

4 2

5 2

6 2

7 2

8 2

9 2

10 2

11 2

12 2

Conner-Wikhausen - Mahoney-Galvin

| | | | | |
|---|---|---|---|---|
| 00 | -1.2 | -2.5 | -0.9 | +0.3 |
| 34 | 26 | 23 | 13 | 9 |
| | +1.2 | -0.1 | 00 | +0.8 | 00 |
| | 33 | 29 | 19 | 13 | 8 |
| .6 | -1.0 | -1.5 | -0.3 | +0.8 | +0.2 |
| 4 | 25 | 21 | 13 | 8 | 4 |
| | +1.8 | -0.9 | -1.9 | -0.3 |
| | 32 | 22 | 16 | 6 |
| | | -6.8 | -4.1 | 00 |
| | | 32 | 19 | 12 |
| | -0.3 | -0.8 | -0.9 | 00 |
| | 25 | 31 | 21 | 7 |
| | | -3.0 | -2.5 | 00 |
| | | 33 | 28 | 17 |
| | | -7.3 | -4.2 | -0.2 |
| | | 33 | 25 | 17 |
| | +1.8 | +2.0 | -1.1 | 00 |
| | 33 | 23 | 18 | 12 |
| | +0.3 | +0.2 | -0.9 | -0.5 |
| | 33 | 19 | 13 | 11 |
| | | -7.5 | -4.8 | -3.1 | -0.2 |
| | | 35 | 25 | 14 | 6 |
| 0.5 | +1.5 | -1.0 | -1.4 | -0.5 |
| 33 | 28 | 22 | 16 | 11 |
| | -3.1 | -2.7 | -1.9 | -0.2 |
| | 33 | 24 | 20 | 9 |

| | | | | |
|---|---|---|---|---|
| -0.1 | -1.1 | -1.3 | -3.5 | -1.1 |
| 12 | 19 | 29 | 30 | 34 |
| -0.3 | -2.1 | -3.2 | -3.3 |
| 12 | 20 | 26 | 32 |
| -0.4 | -2.8 | -4.2 | -4.4 |
| 9 | 14 | 21 | 31 |
| -0.2 | -1.4 | -1.2 | +0.9 |
| 10 | 16 | 24 | 31 |
| -0.6 | -0.6 | -7.6 | -8.0 |
| 9 | 19 | 26 | 36 |
| 00 | -1.0 | -0.5 | +0.8 | +2.0 |
| 4 | 14 | 22 | 28 | 32 |
| 00 | -1.9 | -2.4 | -3.9 |
| 4 | 11 | 24 | 33 |
| 00 | -4.4 | -4.8 | bottom up |
| 4 | 20 | 30 |
| -0.1 | -1.0 | -2.5 | -2.0 |
| 6 | 14 | 21 | 33 |
| -0.5 | -1.6 | -0.6 | -0.7 |
| 9 | 16 | 20 | 33 |
| -0.1 | -0.9 | -2.0 | +2.5 |
| 13 | 16 | 24 | 33 |
| -0.0 | -0.2 | +0.3 | +2.2 | +3.3 |
| 8 | 12 | 23 | 26 | 33 |
| -0.2 | -1.2 | -0.9 |
| 11 | 21 | 29 |

Equation in hand levels.

Ramsey Co. — + 0.2

Conners — + 0.3

Error in levels for 30 ft = 0.1 ft

132

142

| | | | | | |
|---|---|---|---|---|---|
| -1.3 | -1.8 | -0.8 | -0.4 | -1.0 | -0.6 |
| 30 | 34 | 11 | 11 | 16 | 27 |
| -0.9 | -2.7 | 0.0 | -0.3 | -2.8 | -4.7 |
| 23 | 16 | 9 | 11 | 19 | 27 |

| Sta. | PT. | ∠ | R | Calc. Bearing |
|---|---|---|---|---|
| 190 | | 13-02½ | | |
| +50 | | 11-55 | | |
| 189 | | 10-47½ | | |
| +50 | | 9-40 | | PI = 187+83? |
| | | | | Δ = 31°-50' Lt |
| 188 | | 8-32½ | | 4° 30' C |
| | | | | T = 363 ± ✓ |
| +50 | | 7-25 | | E = 51.? |
| | | | | LC = 787.4 ✓ |
| 187 | | 6-17½ | | |
| +50 | | 5-10 | | |
| 186 | | 4-02½ | | |
| | | | | N 31°52' E. ✓ |
| +50 | | 2-55 | | |
| | | | | 3/27/23 - P.M. |
| 185 | | 1-47½ | Party - | Conner |
| | | | | Wikhusen |
| +50 | | 0-40 | | Mahoney |
| | | | | Carr |
| 184+20 | BC ✓ | | | Galvin |

Cont from page 41

$\Delta = 31-50$ Lt. $\alpha = 30'$ C.Lt. 62

PI = 187+83.7
3+63 ∠
BC = 184+20.6
∠C = 3+07.4
EC 191+28.0

45) 16339 (363 ∠ 52)
135
283
270
139
135
40

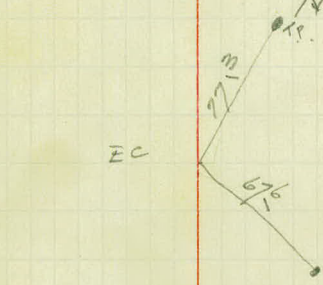
E
2284 (45
206
204

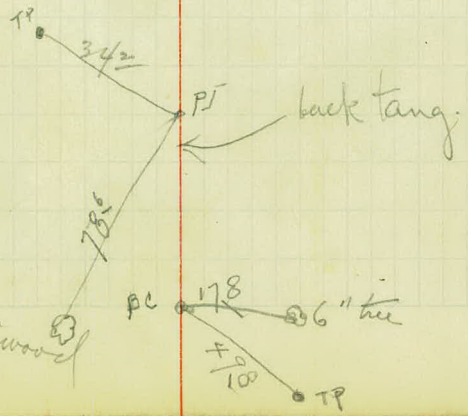
45) 2284 (50.7
220
84
52
320

45) 3183333 (707.4
315
333
315
183
180
1-07½
1080
270
3780

30-150
1-15
135
284
5460
121 5
270
39690

N31-42E
31-50
N80-08'W

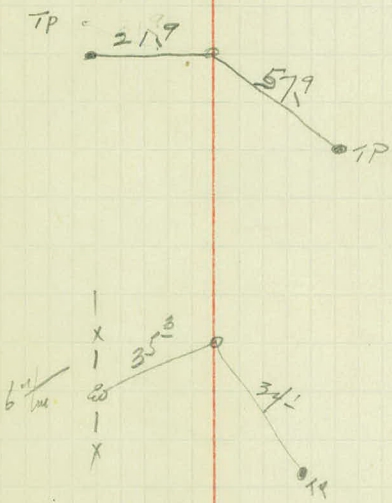


| Sta | Pt. | L | R | Calc Bearing |
|---|---|---|---|---|
| 219+54.8 | | | | |
| | | | | N.00°03'E. |
| 213+50 | POT | | | |
| 205+00 | POT | | | |
| | | | | N.00°03'E. |
| | | | | N00-08'W |
| +28.0 | EC | 15-55 | | |
| 191 | | 15-17½ | | |
| +50 | | 14-10 | | |

Ck. clear error 0.27 ft.

1/4 Cor bet Sec 26 & 35 County Rd E



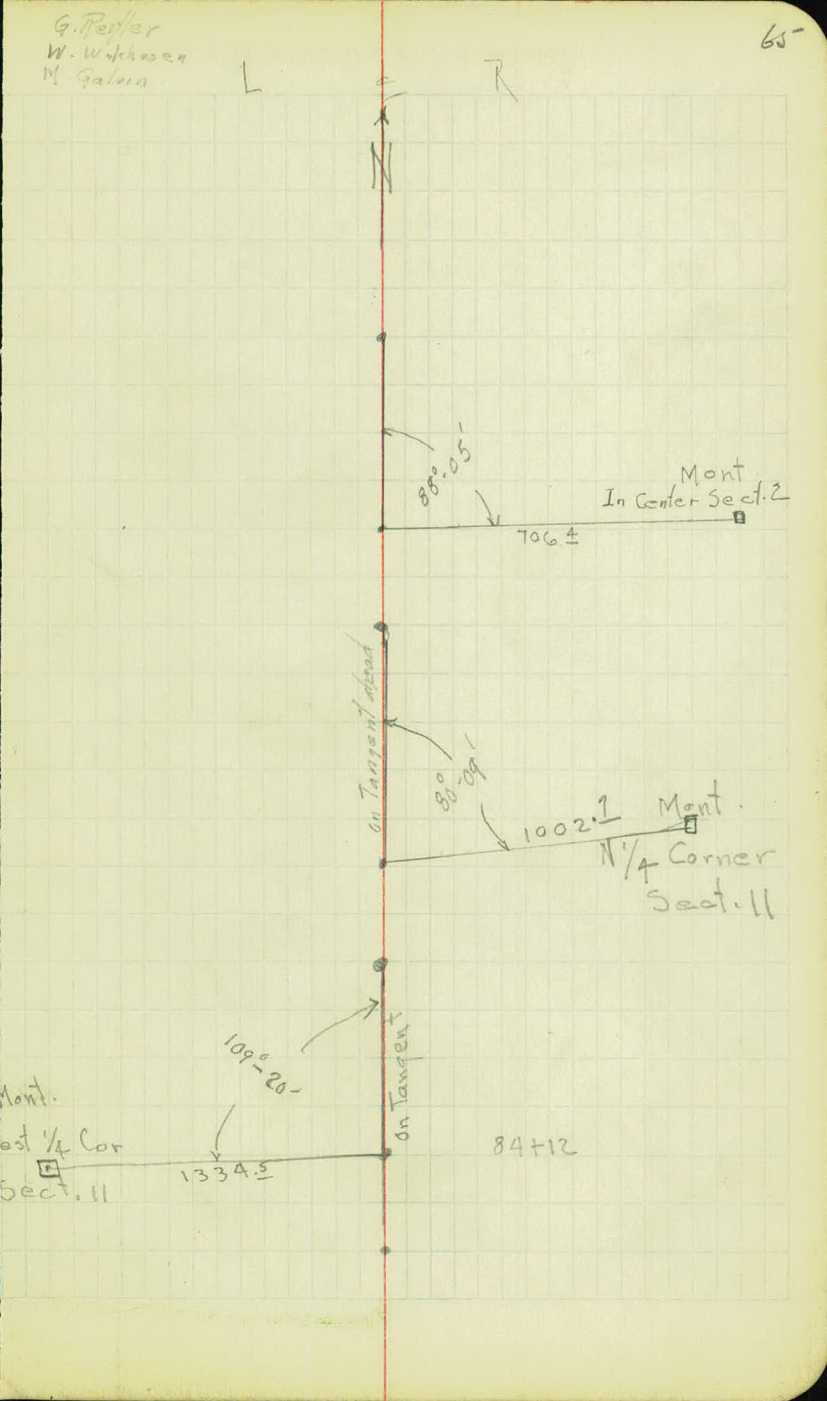
| Sta | Pt. | L | R | Calc Bearing |
| --- | --- | --- | --- | --- |

3-19-23

# Mont. Ties & Angles

| | | |
|---|---|---|
| 138+00 | P.O.T. | |
| 137+04.2 | Sect. line | ⌅ |
| 123+58.2 | B.C. | |
| 110+62.1 | P.I. | ⌅ |
| 84+93.2 | P.I. | |
| Station | 84+12 | ⌅ |

G. Perler
W. Wilkinson
M. Galvin



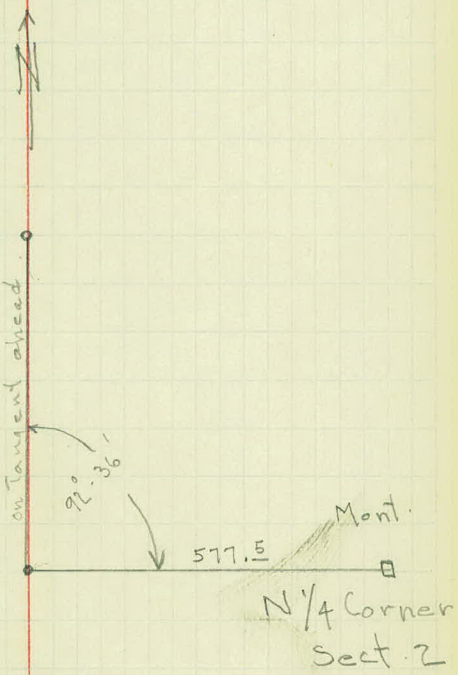
Ties to Mont.

176+00 P.I

165+31.3 P.O.T.

3-19-23

G. Reiffer Inst.
W. Wikhusen - H.Ch.
M. Galvin - R.Ch.



Copy of Align. Notes

| Sta. | Pt. | ∠ | ℄ | Calc Bearing |
|---|---|---|---|---|
| 0+00 | | | | |
| 18+80.2 | POT | | | N00°-06' W |
| 26+27.5 | | | 0°-12' | |
| (52+74.3 = 52+85.1) | POT | 5 1/2° Sta. | | N00°-06' E ✓ |
| 60+44.3 | BC | < 20°00 Rt. > | | |
| 61+74.3 | PI | | 48°49' | |
| 62+88.4 | EC | < | | N48°-55' E ✓ |
| 73+45.4 | BC | | < 10°00 Lt > | |
| 74+98.0 | PI | 29°-50' | | |
| 76+43.7 | EC | | < | N19°-05 E ✓ |
| 82+10.6 | BC | | | |
| 84+93.2 | PI | 16°-50' | < 3°00 Lt > | |
| 87+71.7 | EC | | < | N02°-05' 15" E |

| Sta. | Pt. | Lt. △ | Rt. | Calc. Bear. |
|---|---|---|---|---|
| 100+08.6 | BC | | | |
| 100+91.6 | PI | < 5°-00' Rt. > | 08°-17' | |
| 101+73.3 | EC | | | N10°-32'-E |
| 110+62.1 | PI | 0°-55' | | N.09°-37'-E |
| 123+58.5 | B.C. | | | |
| 124+42.0 | PI | 8°-20' | < 5°-00' Lt. > | |
| 125+25.2 | EC | | | N01°-07'-E |
| 141+17.5 | PI | 2°-55' | | N01°-48'-W |
| 148+22.9 | BC | | | |
| 150+86.9 | PI | < 2°-30' Rt. > | 10°-40' | |
| 152+49.6 | EC | | | N08°-52'-E |
| 157+65.6 | BC | | | |
| 159+16.2 | PI | 12°-00' | < 4°-00' Lt. > | |
| 161+65.6 | EC | | | N3°-08'-W. |

| Sta. | Pt. | Lt. △ | Rt. | Calc. Bearing |
|---|---|---|---|---|
| 173+00.4 | BC | | | N 03°-08' W<br>02° 58' |
| 176+00 | PI | 6° Rt. | 34°-50 | |
| 178+80.9 | EC | | | N. 31° 42' 52" E |
| 184+20.6 | BC | | | |
| 187+83.7 | PI | 31°-50' | 47°-30' Lt. | |
| 191+28.2 | EC | | | N. 00° 02' E.<br>N. 00-08' W. |
| N 191+54.8 | | | | |

# KEITH'S RAILROAD CURVE TABLES.

Published by KEUFFEL & ESSER CO., New York.

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## HOW TO USE KEITH'S TABLES.

### EXAMPLE.

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P.=23° 20′ to the R. at Station 542+72.

Ext. in Tab. IV opposite 23° 20′=120.87
120.87÷12=10.07. Say a 10° Curve.

Tan. in Tab. IV opp. 23° 20′=1183.1
1183.1÷10=118.31.

Tab. V. correction for A. 23° 20′ for a 10° Cur.=0.16
118.31+0.16=118.47=corrected Tangent.

(If corrected Ext. is required find in same way)
Ang. 23° 20′=23.33°÷10=2.3333=L. C.

| | | | |
|---|---|---|---|
| 2° 19½′=def. for sta. | 542 | I. P =sta. | 542+72 |
| 4° 49½′= " " " | +50 | Tan.= | 1.18.47 |
| 7° 19½′= " " " | 543 | B. C.=sta. | 541+53.53 |
| 9° 49½′= " " " | +50 | L. C.= | 2.33.33 |
| 11° 40′= " " " | 543+ | E. C.=sta. | 543+86.86 |
| | 86.86 | | |

100—53.53=46.47×3′(def. for 1 ft. of 10° Cur.)=139.41′=
2° 19½′ =def. for sta. 542.

Def. for 50 ft.=2° 30′ for a 10° Curve.

Def. for 36.86 ft.=1° 50½′ for a 10° Curve

(These tables are published in Field Books of KEUFFEL & ESSER Co., New York, N. Y.)

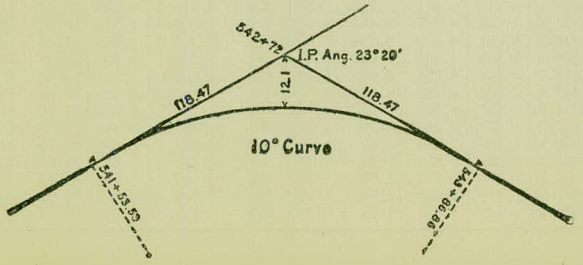


TABLE I. — Minutes in Decimals of a Degree.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1′ | .0167 | 11′ | .1833 | 21′ | .3500 | 31′ | .5167 | 41′ | .6833 | 51′ | .8500 |
| 2 | .0333 | 12 | .2000 | 22 | .3667 | 32 | .5333 | 42 | .7000 | 52 | .8667 |
| 3 | .0500 | 13 | .2167 | 23 | .3833 | 33 | .5500 | 43 | .7167 | 53 | .8833 |
| 4 | .0667 | 14 | .2333 | 24 | .4000 | 34 | .5667 | 44 | .7333 | 54 | .9000 |
| 5 | .0833 | 15 | .2500 | 25 | .4167 | 35 | .5833 | 45 | .7500 | 55 | .9167 |
| 6 | .1000 | 16 | .2667 | 26 | .4333 | 36 | .6000 | 46 | .7667 | 56 | .9333 |
| 7 | .1167 | 17 | .2833 | 27 | .4500 | 37 | .6167 | 47 | .7833 | 57 | .9500 |
| 8 | .1333 | 18 | .3000 | 28 | .4667 | 38 | .6333 | 48 | .8000 | 58 | .9667 |
| 9 | .1500 | 19 | .3167 | 29 | .4833 | 39 | .6500 | 49 | .8167 | 59 | .9833 |
| 10 | .1667 | 20 | .3333 | 30 | .5000 | 40 | .6667 | 50 | .8333 | 60 | 1.0000 |

TABLE II. — Inches in Decimals of a Foot.

| 1-16 | 3-32 | 1/8 | 3-16 | 1/4 | 5-16 | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 |
|---|---|---|---|---|---|---|---|---|---|---|
| .0052 | .0078 | .0104 | .0156 | .0208 | .0260 | .0313 | .0417 | .0521 | .0625 | .0729 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| .0833 | .1667 | .2500 | .3333 | .4167 | .5000 | .5833 | .6667 | .7500 | .8333 | .9167 |

TABLE III. — Radii, Ordinates and Deflections.

| Deg. | Radius | Mid. Ord. | Tan. Def. | Chd. Def. | Def. for 1 Foot | Deg. | Radius | Mid. Ord. | Tan. Def. | Chd. Def. | Def. for 1 Foot |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0° 10′ | 34377. | .036 | .145 | .291 | 0.05′ | 7° | 819.0 | 1.528 | 6.105 | 12.21 | 2.10′ |
| 20 | 17189. | .073 | .291 | .582 | 0.10 | 20′ | 781.8 | 1.600 | 6.395 | 12.79 | 2.20 |
| 30 | 11459. | .109 | .436 | .873 | 0.15 | 30 | 764.5 | 1.637 | 6.540 | 13.08 | 2.25 |
| 40 | 8594.4 | .145 | .582 | 1.164 | 0.20 | 40 | 747.9 | 1.673 | 6.685 | 13.37 | 2.30 |
| 50 | 6875.5 | .182 | .727 | 1.454 | 0.25 | 8 | 716.8 | 1.746 | 6.976 | 13.95 | 2.40 |
| 1 | 5729.6 | .218 | .873 | 1.745 | 0.30 | 20 | 688.2 | 1.819 | 7.266 | 14.53 | 2.50 |
| 10 | 4911.2 | .255 | 1.018 | 2.036 | 0.35 | 30 | 674.7 | 1.855 | 7.411 | 14.82 | 2.55 |
| 20 | 4297.3 | .291 | 1.164 | 2.327 | 0.40 | 40 | 661.7 | 1.892 | 7.556 | 15.11 | 2.60 |
| 30 | 3819.8 | .327 | 1.309 | 2.618 | 0.45 | 9 | 637.3 | 1.965 | 7.846 | 15.69 | 2.70 |
| 40 | 3437.9 | .364 | 1.454 | 2.909 | 0.50 | 20 | 614.6 | 2.037 | 8.136 | 16.27 | 2.80 |
| 50 | 3125.4 | .400 | 1.600 | 3.200 | 0.55 | 30 | 603.8 | 2.074 | 8.281 | 16.56 | 2.85 |
| 2 | 2864.9 | .436 | 1.745 | 3.490 | 0.60 | 40 | 593.4 | 2.110 | 8.426 | 16.85 | 2.90 |
| 10 | 2644.6 | .473 | 1.891 | 3.781 | 0.65 | 10 | 573.7 | 2.183 | 8.716 | 17.43 | 3.00 |
| 20 | 2455.7 | .509 | 2.036 | 4.072 | 0.70 | 30 | 546.4 | 2.292 | 9.150 | 18.30 | 3.15 |
| 30 | 2292.0 | .545 | 2.181 | 4.363 | 0.75 | 11 | 521.7 | 2.402 | 9.585 | 19.16 | 3.30 |
| 40 | 2148.8 | .582 | 2.327 | 4.654 | 0.80 | 30 | 499.1 | 2.511 | 10.02 | 20.04 | 3.45 |
| 50 | 2022.4 | .618 | 2.472 | 4.945 | 0.85 | 12 | 478.3 | 2.620 | 10.45 | 20.91 | 3.60 |
| 3 | 1910.1 | .655 | 2.618 | 5.235 | 0.90 | 30 | 459.3 | 2.730 | 10.89 | 21.77 | 3.75 |
| 10 | 1809.6 | .691 | 2.763 | 5.526 | 0.95 | 13 | 441.7 | 2.839 | 11.32 | 22.64 | 3.90 |
| 20 | 1719.1 | .727 | 2.908 | 5.817 | 1.00 | | 425.4 | 2.949 | 11.75 | 23.51 | 4.05 |
| 30 | 1637.3 | .764 | 3.054 | 6.108 | 1.05 | 14 | 410.3 | 3.058 | 12.18 | 24.37 | 4.20 |
| 40 | 1562.9 | .800 | 3.199 | 6.398 | 1.10 | 30 | 396.2 | 3.168 | 12.62 | 25.24 | 4.35 |
| 50 | 1495.0 | .836 | 3.345 | 6.689 | 1.15 | 15 | 383.1 | 3.277 | 13.05 | 26.11 | 4.50 |
| 4 | 1432.7 | .873 | 3.490 | 6.980 | 1.20 | 30 | 370.8 | 3.387 | 13.49 | 26.97 | 4.65 |
| 10 | 1375.4 | .909 | 3.635 | 7.271 | 1.25 | 16 | 359.3 | 3.496 | 13.92 | 27.84 | 4.80 |
| 20 | 1322.5 | .945 | 3.718 | 7.561 | 1.30 | 30 | 348.5 | 3.606 | 14.35 | 28.70 | 4.95 |
| 30 | 1273.6 | .982 | 3.926 | 7.852 | 1.35 | 17 | 338.3 | 3.716 | 14.78 | 29.56 | 5.10 |
| 40 | 1228.1 | 1.018 | 4.071 | 8.143 | 1.40 | 18 | 319.6 | 3.935 | 15.64 | 31.29 | 5.40 |
| 50 | 1185.8 | 1.055 | 4.217 | 8.433 | 1.45 | 19 | 302.9 | 4.155 | 16.51 | 33.01 | 5.70 |
| 5 | 1146.3 | 1.091 | 4.362 | 8.724 | 1.50 | 20 | 287.9 | 4.374 | 17.37 | 34.73 | 6.00 |
| 10 | 1109.3 | 1.127 | 4.507 | 9.014 | 1.55 | 21 | 274.4 | 4.594 | 18.22 | 36.44 | 6.30 |
| 20 | 1074.7 | 1.164 | 4.653 | 9.305 | 1.60 | 22 | 262.0 | 4.814 | 19.08 | 38.16 | 6.60 |
| 30 | 1042.1 | 1.200 | 4.798 | 9.596 | 1.65 | 23 | 250.8 | 5.035 | 19.94 | 39.87 | 6.90 |
| 40 | 1011.5 | 1.237 | 4.943 | 9.886 | 1.70 | 24 | 240.5 | 5.255 | 20.79 | 41.58 | 7.20 |
| 50 | 982.6 | 1.273 | 5.088 | 10.18 | 1.75 | 25 | 231.0 | 5.476 | 21.64 | 43.28 | 7.50 |
| 6 | 955.4 | 1.309 | 5.234 | 10.47 | 1.80 | 26 | 222.3 | 5.697 | 22.50 | 44.99 | 7.80 |
| 10 | 929.6 | 1.346 | 5.379 | 10.76 | 1.85 | 27 | 214.2 | 5.918 | 23.35 | 46.69 | 8.10 |
| 20 | 905.1 | 1.382 | 5.524 | 11.05 | 1.90 | 28 | 206.7 | 6.139 | 24.19 | 48.38 | 8.40 |
| 30 | 881.9 | 1.418 | 5.669 | 11.34 | 1.95 | 29 | 199.7 | 6.360 | 25.04 | 50.07 | 8.70 |
| 40 | 859.9 | 1.455 | 5.814 | 11.63 | 2.00 | 30 | 193.2 | 6.583 | 25.88 | 51.76 | 9.00 |

## TABLE IV. — Tangents and Externals to a 1° Curve.

| Angle | Tangent | External | Angle | Tangent | External | Angle | Tangent | External |
|---|---|---|---|---|---|---|---|---|
| **1°** | 50.00 | .22 | **11°** | 551 70 | 26.50 | **21°** | 1061.9 | 97.57 |
| 10′ | 58.34 | .30 | 10′ | 560 11 | 27.31 | 10′ | 1070.6 | 99.16 |
| 20 | 66.67 | .39 | 20 | 568 53 | 28.14 | 20 | 1079.2 | 100.75 |
| 30 | 75.01 | .49 | 30 | 576.95 | 28.97 | 30 | 1087.8 | 102.35 |
| 40 | 83.34 | .61 | 40 | 585.36 | 29.82 | 40 | 1096.4 | 103.97 |
| 50 | 91.68 | .73 | 50 | 593.79 | 30.68 | 50 | 1105.1 | 105.60 |
| **2** | 100.01 | .87 | **12** | 602.21 | 31.56 | **22** | 1113.7 | 107.24 |
| 10 | 108.35 | 1.02 | 10 | 610.64 | 32.45 | 10 | 1122.4 | 108.90 |
| 20 | 116.68 | 1.19 | 20 | 619.07 | 33.35 | 20 | 1131.0 | 110.57 |
| 30 | 125.02 | 1.36 | 30 | 627.50 | 34.26 | 30 | 1139.7 | 112.25 |
| 40 | 133.36 | 1.55 | 40 | 635.93 | 35.18 | 40 | 1148.4 | 113.95 |
| 50 | 141.70 | 1.75 | 50 | 644.37 | 36.12 | 50 | 1157.0 | 115.66 |
| **3** | 150.04 | 1.96 | **13** | 652.81 | 37.07 | **23** | 1165.7 | 117.38 |
| 10 | 158.38 | 2.19 | 10 | 661.25 | 38.03 | 10 | 1174.4 | 119.12 |
| 20 | 166.72 | 2.43 | 20 | 669.70 | 39.01 | 20 | 1183.1 | 120.87 |
| 30 | 175.06 | 2.67 | 30 | 678.15 | 39.99 | 30 | 1191.8 | 122.63 |
| 40 | 183.40 | 2.93 | 40 | 686.60 | 40.99 | 40 | 1200.5 | 124.41 |
| 50 | 191.74 | 3.21 | 50 | 695.06 | 42.00 | 50 | 1209.2 | 126.20 |
| **4** | 200.08 | 3.49 | **14** | 703.51 | 43.03 | **24** | 1217.9 | 128.00 |
| 10 | 208.43 | 3.79 | 10 | 711.97 | 44.07 | 10 | 1226.6 | 129.82 |
| 20 | 216.77 | 4.10 | 20 | 720.44 | 45.12 | 20 | 1235.3 | 131.65 |
| 30 | 225.12 | 4.42 | 30 | 728.90 | 46.18 | 30 | 1244.0 | 133.50 |
| 40 | 233.47 | 4.76 | 40 | 737.37 | 47.25 | 40 | 1252.8 | 135.35 |
| 50 | 241.81 | 5.10 | 50 | 745.85 | 48.34 | 50 | 1261.5 | 137.23 |
| **5** | 250.16 | 5.46 | **15** | 754.32 | 49.44 | **25** | 1270.2 | 139.11 |
| 10 | 258.51 | 5.83 | 10 | 762.80 | 50.55 | 10 | 1279.0 | 141.01 |
| 20 | 266.86 | 6.21 | 20 | 771.29 | 51.68 | 20 | 1287.7 | 142.93 |
| 30 | 275.21 | 6.61 | 30 | 779.77 | 52.89 | 30 | 1296.5 | 144.85 |
| 40 | 283.57 | 7.01 | 40 | 788.26 | 53.97 | 40 | 1305.3 | 146.79 |
| 50 | 291.92 | 7.43 | 50 | 796.75 | 55.13 | 50 | 1314.0 | 148.75 |
| **6** | 300.28 | 7.86 | **16** | 805.25 | 56.31 | **26** | 1322.8 | 150.71 |
| 10 | 308.64 | 8.31 | 10 | 813.75 | 57.50 | 10 | 1331.6 | 152.69 |
| 20 | 316.99 | 8.76 | 20 | 822.25 | 58.70 | 20 | 1340.4 | 154.69 |
| 30 | 325.35 | 9.23 | 30 | 830.76 | 59.91 | 30 | 1349.2 | 156.70 |
| 40 | 333.71 | 9.71 | 40 | 839.27 | 61.14 | 40 | 1358.0 | 158.72 |
| 50 | 342.08 | 10.20 | 50 | 847.78 | 62.38 | 50 | 1366.8 | 160.76 |
| **7** | 350.44 | 10.71 | **17** | 856.30 | 63.63 | **27** | 1375.6 | 162.81 |
| 10 | 358.81 | 11.22 | 10 | 864.82 | 64.90 | 10 | 1384.4 | 164.86 |
| 20 | 367.17 | 11.75 | 20 | 873.35 | 66.18 | 20 | 1393.2 | 166.95 |
| 30 | 375.54 | 12.29 | 30 | 881.88 | 67.47 | 30 | 1402.0 | 169.04 |
| 40 | 383.91 | 12.85 | 40 | 890.41 | 68.77 | 40 | 1410.9 | 171.15 |
| 50 | 392.28 | 13.41 | 50 | 898.95 | 70.09 | 50 | 1419.7 | 173.27 |
| **8** | 400.66 | 13.99 | **18** | 907.49 | 71.42 | **28** | 1428.6 | 175.41 |
| 10 | 409.03 | 14.58 | 10 | 916.03 | 72.76 | 10 | 1437.4 | 177.55 |
| 20 | 417.41 | 15.18 | 20 | 924.58 | 74.12 | 20 | 1446.3 | 179.72 |
| 30 | 425.79 | 15.80 | 30 | 933.13 | 75.49 | 30 | 1455.1 | 181.89 |
| 40 | 434.17 | 16.43 | 40 | 941.69 | 76.86 | 40 | 1464.0 | 184.08 |
| 50 | 442.55 | 17.07 | 50 | 950.25 | 78.26 | 50 | 1472.9 | 186.29 |
| **9** | 450.93 | 17.72 | **19** | 958.81 | 79.67 | **29** | 1481.8 | 188.51 |
| 10 | 459.32 | 18.38 | 10 | 967.38 | 81.09 | 10 | 1490.7 | 190.74 |
| 20 | 467.71 | 19.06 | 20 | 975.96 | 82.53 | 20 | 1499.6 | 192.99 |
| 30 | 476.10 | 19.75 | 30 | 984.53 | 83.97 | 30 | 1508.5 | 195.25 |
| 40 | 484.49 | 20.45 | 40 | 993.12 | 85.43 | 40 | 1517.4 | 197.53 |
| 50 | 492.88 | 21.16 | 50 | 1001.7 | 86.90 | 50 | 1526.3 | 199.82 |
| **10** | 501.28 | 21.89 | **20** | 1010.3 | 88.39 | **30** | 1535.3 | 202.12 |
| 10 | 509.68 | 22.62 | 10 | 1018.9 | 89.89 | 10 | 1544.2 | 204.44 |
| 20 | 518.06 | 23.38 | 20 | 1027.5 | 91.40 | 20 | 1553.1 | 206.77 |
| 30 | 526.48 | 24.14 | 30 | 1036.1 | 92.92 | 30 | 1562.1 | 209.12 |
| 40 | 534.89 | 24.91 | 40 | 1044.7 | 94.46 | 40 | 1571.0 | 211.48 |
| 50 | 543.29 | 25.70 | 50 | 1053.3 | 96.01 | 50 | 1580.0 | 213.86 |

## TABLE IV. — Tangents and Externals to a 1° Curve.

| Angle | Tangent | External | Angle | Tangent | External | Angle | Tangent | External |
|---|---|---|---|---|---|---|---|---|
| **31°** | 1589.0 | 216.3 | **41°** | 2142.2 | 387.4 | **51°** | 2732.9 | 618.4 |
| 10′ | 1598.0 | 218.7 | 10′ | 2151.7 | 390.7 | 10′ | 2743.1 | 622.8 |
| 20 | 1606.9 | 221.1 | 20 | 2161.2 | 394.1 | 20 | 2753.4 | 627.2 |
| 30 | 1615.9 | 223.5 | 30 | 2170.8 | 397.4 | 30 | 2763.7 | 631.7 |
| 40 | 1624.9 | 226.0 | 40 | 2180.3 | 400.8 | 40 | 2773.9 | 636.2 |
| 50 | 1633.9 | 228.4 | 50 | 2189.9 | 404.2 | 50 | 2784.2 | 640.7 |
| **32** | 1643.0 | 230.9 | **42** | 2199.4 | 407.6 | **52** | 2794.5 | 645.2 |
| 10 | 1652.0 | 233.4 | 10 | 2209.0 | 411.1 | 10 | 2804.9 | 649.7 |
| 20 | 1661.0 | 235.9 | 20 | 2218.6 | 414.5 | 20 | 2815.2 | 654.3 |
| 30 | 1670.0 | 238.4 | 30 | 2228.1 | 418.0 | 30 | 2825.6 | 658.8 |
| 40 | 1679.1 | 241.0 | 40 | 2237.7 | 421.4 | 40 | 2835.9 | 663.4 |
| 50 | 1688.1 | 243.5 | 50 | 2247.3 | 425.0 | 50 | 2846.3 | 668.0 |
| **33** | 1697.2 | 246.1 | **43** | 2257.0 | 428.5 | **53** | 2856.7 | 672.7 |
| 10 | 1706.3 | 248.7 | 10 | 2266.6 | 432.0 | 10 | 2867.1 | 677.3 |
| 20 | 1715.3 | 251.3 | 20 | 2276 2 | 435.6 | 20 | 2877.5 | 682.0 |
| 30 | 1724.4 | 253.9 | 30 | 2285.9 | 439.2 | 30 | 2888.0 | 686.7 |
| 40 | 1733.5 | 256.5 | 40 | 2295.6 | 442.8 | 40 | 2898.4 | 691.4 |
| 50 | 1742.6 | 259.1 | 50 | 2305.2 | 446.4 | 50 | 2908.9 | 696.1 |
| **34** | 1751.7 | 261.8 | **44** | 2314.9 | 450.0 | **54** | 2919.4 | 700.9 |
| 10 | 1760.8 | 264.5 | 10 | 2324.6 | 453.6 | 10 | 2929.9 | 705.7 |
| 20 | 1770.0 | 267.2 | 20 | 2334.3 | 457.3 | 20 | 2940.4 | 710.5 |
| 30 | 1779.1 | 269.9 | 30 | 2344.1 | 461.0 | 30 | 2951.0 | 715.3 |
| 40 | 1788.2 | 272.6 | 40 | 2353.8 | 464.6 | 40 | 2961.5 | 720.1 |
| 50 | 1797.4 | 275.3 | 50 | 2363.5 | 468.4 | 50 | 2972.1 | 725.0 |
| **35** | 1806.6 | 278.1 | **45** | 2373.3 | 472.1 | **55** | 2982.7 | 729.9 |
| 10 | 1815.7 | 280.8 | 10 | 2383.1 | 475.8 | 10 | 2993.3 | 734.8 |
| 20 | 1824.9 | 283.6 | 20 | 2392.8 | 479.6 | 20 | 3003.9 | 739.7 |
| 30 | 1834.1 | 286.4 | 30 | 2402.6 | 483.8 | 30 | 3014.5 | 744.6 |
| 40 | 1843.3 | 289.2 | 40 | 2412.4 | 487.2 | 40 | 3025.2 | 749.6 |
| 50 | 1852.5 | 292.0 | 50 | 2422.3 | 491.0 | 50 | 3035.8 | 754.6 |
| **36** | 1861.7 | 294.9 | **46** | 2432.1 | 494.8 | **56** | 3046.5 | 759.6 |
| 10 | 1870.9 | 297.7 | 10 | 2441.9 | 498.7 | 10 | 3057.2 | 764.6 |
| 20 | 1880.1 | 300.6 | 20 | 2451.8 | 502.5 | 20 | 3067.9 | 769.7 |
| 30 | 1889.4 | 303.5 | 30 | 2461.7 | 506.4 | 30 | 3078.7 | 774.7 |
| 40 | 1898.6 | 306.4 | 40 | 2471.5 | 510.3 | 40 | 3089.4 | 779.8 |
| 50 | 1907.9 | 309.3 | 50 | 2481.4 | 514.3 | 50 | 3100.2 | 784.9 |
| **37** | 1917.1 | 312.2 | **47** | 2491.3 | 518.2 | **57** | 3110.9 | 790.1 |
| 10 | 1926.4 | 315.2 | 10 | 2501.2 | 522.2 | 10 | 3121.7 | 795.2 |
| 20 | 1935.7 | 318.1 | 20 | 2511.2 | 526.1 | 20 | 3132.6 | 800.4 |
| 30 | 1945.0 | 321.1 | 30 | 2521.1 | 530.1 | 30 | 3143.4 | 805.6 |
| 40 | 1954.3 | 324.1 | 40 | 2531.1 | 534.2 | 40 | 3154.2 | 810.9 |
| 50 | 1963.6 | 327.1 | 50 | 2541.0 | 538.2 | 50 | 3165.1 | 816.1 |
| **38** | 1972.9 | 330.2 | **48** | 2551.0 | 542.2 | **58** | 3176.0 | 821.4 |
| 10 | 1982.2 | 333.2 | 10 | 2561.0 | 546.3 | 10 | 3186.9 | 826.7 |
| 20 | 1991.5 | 336.3 | 20 | 2571.0 | 550.4 | 20 | 3197.8 | 832.0 |
| 30 | 2000.9 | 339.3 | 30 | 2581.0 | 554.5 | 30 | 3208.8 | 837.3 |
| 40 | 2010.2 | 342.4 | 40 | 2591.0 | 558.6 | 40 | 3219.7 | 842.7 |
| 50 | 2019.6 | 345.5 | 50 | 2601.1 | 562.8 | 50 | 3230.7 | 848.1 |
| **39** | 2029.0 | 348.6 | **49** | 2611.2 | 566.9 | **59** | 3241.7 | 853.5 |
| 10 | 2038.4 | 351.8 | 10 | 2621.2 | 571.1 | 10 | 3252.7 | 858.9 |
| 20 | 2047.8 | 354.9 | 20 | 2631.3 | 575.3 | 20 | 3263.7 | 864.3 |
| 30 | 2057.2 | 358.1 | 30 | 2641.4 | 579.5 | 30 | 3274.8 | 869.8 |
| 40 | 2066.6 | 361.3 | 40 | 2651.5 | 583.8 | 40 | 3285.8 | 875.3 |
| 50 | 2076.0 | 364.5 | 50 | 2661.6 | 588.0 | 50 | 3296.9 | 880.8 |
| **40** | 2085.4 | 367.7 | **50** | 2671.8 | 592.3 | **60** | 3308.0 | 886.4 |
| 10 | 2094.9 | 371.0 | 10 | 2681.9 | 596.6 | 10 | 3319.1 | 892.0 |
| 20 | 2104.3 | 374.2 | 20 | 2692.1 | 600.9 | 20 | 3330.3 | 897.5 |
| 30 | 2113.8 | 377.5 | 30 | 2702.3 | 605.3 | 30 | 3341.4 | 903.2 |
| 40 | 2123.3 | 380 8 | 40 | 2712.5 | 609.6 | 40 | 3352.6 | 908.8 |
| 50 | 2132 7 | 384.1 | 50 | 2722.7 | 614.0 | 50 | 3363.8 | 914.5 |

TABLE IV. — Tangents and Externals to a 1° Curve.

| Angle | Tangent | External | Angle | Tangent | External | Angle | Tangent | External |
|---|---|---|---|---|---|---|---|---|
| **61°** | 3375.0 | 920.2 | **71°** | 4086.9 | 1308.2 | **81°** | 4893.6 | 1805.3 |
| 10′ | 3386.3 | 925.9 | 10′ | 4099.5 | 1315.6 | 10′ | 4908.0 | 1814.7 |
| 20 | 3397.5 | 931.6 | 20 | 4112.1 | 1322.9 | 20 | 4922.5 | 1824.1 |
| 30 | 3408.8 | 937.3 | 30 | 4124.8 | 1330.3 | 30 | 4937.0 | 1833.6 |
| 40 | 3420.1 | 943.1 | 40 | 4137.4 | 1337.7 | 40 | 4951.5 | 1843.1 |
| 50 | 3431.4 | 948.9 | 50 | 4150.1 | 1345.1 | 50 | 4966.1 | 1852.6 |
| **62** | 3442.7 | 954.8 | **72** | 4162.8 | 1352.6 | **82** | 4980.7 | 1862.2 |
| 10 | 3454.1 | 960.6 | 10 | 4175.6 | 1360.1 | 10 | 4995.4 | 1871.8 |
| 20 | 3465.4 | 966.5 | 20 | 4188.5 | 1367.6 | 20 | 5010.0 | 1881.5 |
| 30 | 3476.8 | 972.4 | 30 | 4201.2 | 1375.2 | 30 | 5024.8 | 1891.2 |
| 40 | 3488.3 | 978.3 | 40 | 4214.0 | 1382.8 | 40 | 5039.5 | 1900.9 |
| 50 | 3499.7 | 984.3 | 50 | 4226.8 | 1390.4 | 50 | 5054.3 | 1910.7 |
| **63** | 3511.1 | 990.2 | **73** | 4239.7 | 1398.0 | **83** | 5069.2 | 1920.5 |
| 10 | 3522.6 | 996.2 | 10 | 4252.6 | 1405.7 | 10 | 5084.0 | 1930.4 |
| 20 | 3534.1 | 1002.3 | 20 | 4265.6 | 1413.5 | 20 | 5099.0 | 1940.3 |
| 30 | 3545.6 | 1008.3 | 30 | 4278.5 | 1421.2 | 30 | 5113.9 | 1950.3 |
| 40 | 3557.2 | 1014.4 | 40 | 4291.5 | 1429.0 | 40 | 5128.9 | 1960.2 |
| 50 | 3568.7 | 1020.5 | 50 | 4304.6 | 1436.8 | 50 | 5143.9 | 1970.3 |
| **64** | 3580.3 | 1026.6 | **74** | 4317.6 | 1444.6 | **84** | 5159.0 | 1980.4 |
| 10 | 3591.9 | 1032.8 | 10 | 4330.7 | 1452.5 | 10 | 5174.1 | 1990.5 |
| 20 | 3603.5 | 1039.0 | 20 | 4343.8 | 1460.4 | 20 | 5189.3 | 2000.6 |
| 30 | 3615.1 | 1045.2 | 30 | 4356.9 | 1468.4 | 30 | 5204.4 | 2010.8 |
| 40 | 3626.8 | 1051.4 | 40 | 4370.1 | 1476.4 | 40 | 5219.7 | 2021.1 |
| 50 | 3638.5 | 1057.7 | 50 | 4383.3 | 1484.4 | 50 | 5234.9 | 2031.4 |
| **65** | 3650.2 | 1063.9 | **75** | 4396.5 | 1492.4 | **85** | 5250.3 | 2041.7 |
| 10 | 3661.9 | 1070.2 | 10 | 4409.8 | 1500.5 | 10 | 5265.6 | 2052.1 |
| 20 | 3673.7 | 1076.6 | 20 | 4423.1 | 1508.6 | 20 | 5281.0 | 2062.5 |
| 30 | 3685.4 | 1082.9 | 30 | 4436.4 | 1516.7 | 30 | 5296 4 | 2073.0 |
| 40 | 3697.2 | 1089.3 | 40 | 4449.7 | 1524.9 | 40 | 5311.9 | 2083.5 |
| 50 | 3709.0 | 1095.7 | 50 | 4463.1 | 1533.1 | 50 | 5327.4 | 2094.1 |
| **66** | 3720.9 | 1102.2 | **76** | 4476.5 | 1541.4 | **86** | 5343.0 | 2104.7 |
| 10 | 3732.7 | 1108.6 | 10 | 4489.9 | 1549.7 | 10 | 5358.6 | 2115.3 |
| 20 | 3744.6 | 1115.1 | 20 | 4503.4 | 1558.0 | 20 | 5374.2 | 2126.0 |
| 30 | 3756.5 | 1121.7 | 30 | 4516.9 | 1566.3 | 30 | 5389.9 | 2136.7 |
| 40 | 3768.5 | 1128.2 | 40 | 4530.4 | 1574.7 | 40 | 5405.6 | 2147.5 |
| 50 | 3780.4 | 1134.8 | 50 | 4544.0 | 1583.1 | 50 | 5421.4 | 2158.4 |
| **67** | 3792.4 | 1141.4 | **77** | 4557.6 | 1591.6 | **87** | 5437.2 | 2169.2 |
| 10 | 3804.4 | 1148.0 | 10 | 4571.2 | 1600.1 | 10 | 5453.1 | 2180.2 |
| 20 | 3816.4 | 1154.7 | 20 | 4584.8 | 1608.6 | 20 | 5469.0 | 2191.1 |
| 30 | 3828.4 | 1161.3 | 30 | 4598.5 | 1617.1 | 30 | 5484.9 | 2202.2 |
| 40 | 3840.5 | 1168.1 | 40 | 4612.2 | 1625.7 | 40 | 5500.9 | 2213.2 |
| 50 | 3852.6 | 1174.8 | 50 | 4626.0 | 1634.4 | 50 | 5517.0 | 2224.3 |
| **68** | 3864.7 | 1181.6 | **78** | 4639.8 | 1643.0 | **88** | 5533.1 | 2235.5 |
| 10 | 3876.8 | 1188.4 | 10 | 4653.6 | 1651.7 | 10 | 5549.2 | 2246.7 |
| 20 | 3889.0 | 1195.2 | 20 | 4667.4 | 1660.5 | 20 | 5565.4 | 2258.0 |
| 30 | 3901.2 | 1202.0 | 30 | 4681.3 | 1669.2 | 30 | 5581.6 | 2269.3 |
| 40 | 3913.4 | 1208.9 | 40 | 4695.2 | 1678.1 | 40 | 5597.8 | 2280.6 |
| 50 | 3925.6 | 1215.8 | 50 | 4709.2 | 1686.9 | 50 | 5614.2 | 2292.0 |
| **69** | 3937.9 | 1222.7 | **79** | 4723.2 | 1695.8 | **89** | 5630.5 | 2303.5 |
| 10 | 3950.2 | 1229.7 | 10 | 4737.2 | 1704.7 | 10 | 5646.9 | 2315.0 |
| 20 | 3962.5 | 1236.7 | 20 | 4751.2 | 1713.7 | 20 | 5663.4 | 2326.6 |
| 30 | 3974.8 | 1243.7 | 30 | 4765.3 | 1722.7 | 30 | 5679.9 | 2338.2 |
| 40 | 3987.2 | 1250.8 | 40 | 4779.4 | 1731.7 | 40 | 5696.4 | 2349.8 |
| 50 | 3999.5 | 1257.9 | 50 | 4793.6 | 1740.8 | 50 | 5713.0 | 2361.5 |
| **70** | 4011.9 | 1265.0 | **80** | 4807.7 | 1749.9 | **90** | 5729.7 | 2373.3 |
| 10 | 4024.4 | 1272.1 | 10 | 4822.0 | 1759.0 | 10 | 5746.3 | 2385.1 |
| 20 | 4036.8 | 1279.3 | 20 | 4836.2 | 1768.2 | 20 | 5763.1 | 2397.0 |
| 30 | 4049.3 | 1286.5 | 30 | 4850.5 | 1777.4 | 30 | 5779.9 | 2408.9 |
| 40 | 4061.8 | 1293.6 | 40 | 4864.8 | 1786.7 | 40 | 5796.7 | 2420.9 |
| 50 | 4074.4 | 1300.9 | 50 | 4879.2 | 1796.0 | 50 | 5813.6 | 2432.9 |

## TABLE IV. — Tangents and Externals to a 1° Curve.

| Angle | Tangent | External | Angle | Tangent | External | Angle | Tangent | External |
|---|---|---|---|---|---|---|---|---|
| **91°** | 5830.5 | 2444.9 | **101°** | 6950.6 | 3278.1 | **111°** | 8336.7 | 4386.1 |
| 10′ | 5847.5 | 2457.1 | 10′ | 6971.3 | 3294.1 | 10′ | 8362.7 | 4407.6 |
| 20 | 5864.6 | 2469.3 | 20 | 6992.0 | 3310.1 | 20 | 8388.9 | 4429.2 |
| 30 | 5881.7 | 2481.5 | 30 | 7012.7 | 3326.1 | 30 | 8415.1 | 4450.9 |
| 40 | 5898.8 | 2493.8 | 40 | 7033.6 | 3342.3 | 40 | 8441.5 | 4472.7 |
| 50 | 5916.0 | 2506.1 | 50 | 7054.5 | 3358.5 | 50 | 8468.0 | 4494.6 |
| **92** | 5933.2 | 2518.5 | **102** | 7075.5 | 3374.9 | **112** | 8494.6 | 4516.6 |
| 10 | 5950.5 | 2531.0 | 10 | 7096.6 | 3391.2 | 10 | 8521.3 | 4538.8 |
| 20 | 5967.9 | 2543.5 | 20 | 7117.8 | 3407.7 | 20 | 8548.1 | 4561.1 |
| 30 | 5985.3 | 2556.0 | 30 | 7139.0 | 3424.3 | 30 | 8575.0 | 4583.4 |
| 40 | 6002.7 | 2568.6 | 40 | 7160.3 | 3440.9 | 40 | 8602.1 | 4606.0 |
| 50 | 6020.2 | 2581.3 | 50 | 7181.7 | 3457.6 | 50 | 8629.3 | 4628.6 |
| **93** | 6037.8 | 2594.0 | **103** | 7203.2 | 3474.4 | **113** | 8656.6 | 4651.3 |
| 10 | 6055.4 | 2606.8 | 10 | 7224.7 | 3491.3 | 10 | 8684.0 | 4674.2 |
| 20 | 6073.1 | 2619.7 | 20 | 7246.3 | 3508.2 | 20 | 8711.5 | 4697.2 |
| 30 | 6090.8 | 2632.6 | 30 | 7268.0 | 3525.2 | 30 | 8739.2 | 4720.3 |
| 40 | 6108.6 | 2645.5 | 40 | 7289.8 | 3542.4 | 40 | 8767.0 | 4743.6 |
| 50 | 6126.4 | 2658.5 | 50 | 7311.7 | 3559.6 | 50 | 8794.9 | 4766.9 |
| **94** | 6144.3 | 2671.6 | **104** | 7333.6 | 3576.8 | **114** | 8822.9 | 4790.4 |
| 10 | 6162.6 | 2684.7 | 10 | 7355.6 | 3594.2 | 10 | 8851.0 | 4814.1 |
| 20 | 6180.2 | 2697.9 | 20 | 7377.8 | 3611.7 | 20 | 8879.3 | 4837.8 |
| 30 | 6198.3 | 2711.2 | 30 | 7399.9 | 3629.2 | 30 | 8907.7 | 4861.7 |
| 40 | 6216.4 | 2724.5 | 40 | 7422.2 | 3646.8 | 40 | 8936.3 | 4885.7 |
| 50 | 6234.6 | 2737.9 | 50 | 7444.6 | 3664.5 | 50 | 8965.0 | 4909.9 |
| **95** | 6252.8 | 2751.3 | **105** | 7467.0 | 3682.3 | **115** | 8993.8 | 4934.1 |
| 10 | 6271.1 | 2764.8 | 10 | 7489.6 | 3700.2 | 10 | 9022.7 | 4958.6 |
| 20 | 6289.4 | 2778.3 | 20 | 7512.2 | 3718.2 | 20 | 9051.7 | 4983.1 |
| 30 | 6307.9 | 2792.0 | 30 | 7534.9 | 3736.2 | 30 | 9080.9 | 5007.8 |
| 40 | 6326.3 | 2805.6 | 40 | 7557.7 | 3754.4 | 40 | 9110.3 | 5032.6 |
| 50 | 6344.8 | 2819.4 | 50 | 7580.5 | 3772.6 | 50 | 9139.8 | 5057.6 |
| **96** | 6363.4 | 2833.2 | **106** | 7603.5 | 3791.0 | **116** | 9169.4 | 5082.7 |
| 10 | 6382.1 | 2847.0 | 10 | 7626.6 | 3809.4 | 10 | 9199.1 | 5107.9 |
| 20 | 6400.8 | 2861.0 | 20 | 7649.7 | 3827.9 | 20 | 9229.0 | 5133.3 |
| 30 | 6419.5 | 2875.0 | 30 | 7672.9 | 3846.5 | 30 | 9259.0 | 5158.8 |
| 40 | 6438.4 | 2889.0 | 40 | 7696.3 | 3865.2 | 40 | 9289.2 | 5184.5 |
| 50 | 6457.3 | 2903.1 | 50 | 7719.7 | 3884.0 | 50 | 9319.5 | 5210.3 |
| **97** | 6476.2 | 2917.3 | **107** | 7743.2 | 3902.9 | **117** | 9349.9 | 5236.2 |
| 10 | 6495.2 | 2931.6 | 10 | 7766.8 | 3921.9 | 10 | 9380.5 | 5262.3 |
| 20 | 6514.3 | 2945.9 | 20 | 7790.5 | 3940.9 | 20 | 9411.3 | 5288.6 |
| 30 | 6533.4 | 2960.3 | 30 | 7814.3 | 3960.1 | 30 | 9442.2 | 5315.0 |
| 40 | 6552.6 | 2974.7 | 40 | 7838.1 | 3979.4 | 40 | 9473.2 | 5341.5 |
| 50 | 6571.9 | 2989.2 | 50 | 7862.1 | 3998.7 | 50 | 9504.4 | 5368.2 |
| **98** | 6591.2 | 3003.8 | **108** | 7886.2 | 4018.2 | **118** | 9535.7 | 5395.1 |
| 10 | 6610.6 | 3018.4 | 10 | 7910.4 | 4037.8 | 10 | 9567.2 | 5422.1 |
| 20 | 6630.1 | 3033.1 | 20 | 7934.6 | 4057.4 | 20 | 9598.9 | 5449.2 |
| 30 | 6649.6 | 3047.9 | 30 | 7959.0 | 4077.2 | 30 | 9630.7 | 5476.5 |
| 40 | 6669.2 | 3062.8 | 40 | 7983.5 | 4097.1 | 40 | 9662.6 | 5504.0 |
| 50 | 6688.8 | 3077.7 | 50 | 8008.0 | 4117.0 | 50 | 9694.7 | 5531.7 |
| **99** | 6708.6 | 3092.7 | **109** | 8032.7 | 4137.1 | **119** | 9727.0 | 5559.4 |
| 10 | 6728.4 | 3107.7 | 10 | 8057.4 | 4157.3 | 10 | 9759.4 | 5587.4 |
| 20 | 6748.2 | 3122.9 | 20 | 8082.3 | 4177.5 | 20 | 9792.0 | 5615.5 |
| 30 | 6768.1 | 3138.1 | 30 | 8107.3 | 4197.9 | 30 | 9824.8 | 5643.8 |
| 40 | 6788.1 | 3153.3 | 40 | 8132.3 | 4218.4 | 40 | 9857.7 | 5672.3 |
| 50 | 6808.2 | 3168.7 | 50 | 8157.5 | 4239.0 | 50 | 9890.8 | 5700.9 |
| **100** | 6828.3 | 3184.1 | **110** | 8182.8 | 4259.7 | **120** | 9924.0 | 5729.7 |
| 10 | 6848.5 | 3199.6 | 10 | 8208.2 | 4280.5 | 10 | 9957.5 | 5758.6 |
| 20 | 6868.8 | 3215.1 | 20 | 8233.7 | 4301.4 | 20 | 9991.0 | 5787.7 |
| 30 | 6889.2 | 3230.8 | 30 | 8259.3 | 4322.4 | 30 | 10025.0 | 5817.0 |
| 40 | 6909.6 | 3246.5 | 40 | 8285.0 | 4343.6 | 40 | 10059.0 | 5846.5 |
| 50 | 6930.1 | 3262.3 | 50 | 8310.8 | 4364.8 | 50 | 10093.0 | 5876.1 |

# Table V. Corrections for use with table IV,



## For Tangents Add

| Δ ANGLE / CURVE | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | 60° | 65° | 70° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10° | .03 | .06 | .09 | .13 | .16 | .19 | .22 | .25 | .28 | .31 | .34 | .38 | .42 | .46 |
| 15° | .04 | .10 | .14 | .19 | .24 | .29 | .34 | .39 | .45 | .51 | .53 | .58 | .63 | .68 |
| 20° | .06 | .13 | .19 | .26 | .32 | .39 | .45 | .51 | .58 | .65 | .72 | .79 | .84 | .90 |
| 25° | .08 | .16 | .24 | .33 | .40 | .49 | .58 | .67 | .75 | .83 | .90 | .99 | 1.06 | 1.14 |
| 30° | .10 | .19 | .29 | .39 | .49 | .59 | .69 | .79 | .89 | .99 | 1.09 | 1.20 | 1.29 | 1.39 |
| 35° | .11 | .22 | .34 | .47 | .58 | .69 | .70 | .81 | .92 | 1.04 | 1.29 | 1.42 | 1.54 | 1.66 |
| 40° | .13 | .26 | .40 | .53 | .67 | .80 | .93 | 1.06 | 1.20 | 1.34 | 1.49 | 1.64 | 1.79 | 1.94 |
| 45° | .15 | .30 | .44 | .60 | .76 | .91 | 1.06 | 1.21 | 1.37 | 1.52 | 1.70 | 1 87 | 2.04 | 2.21 |
| 50° | .17 | .34 | .51 | .68 | .85 | 1.02 | 1.19 | 1.36 | 1.54 | 1.72 | 1.91 | 2.10 | 2.29 | 2.48 |
| 55° | .19 | .38 | .57 | .76 | .95 | 1.14 | 1.32 | 1.52 | 1.72 | 1.92 | 2.14 | 2.35 | 2.56 | 2.77 |
| 60° | .21 | .42 | .63 | .84 | 1.05 | 1.27 | 1.49 | 1.71 | 1.94 | 2.17 | 2.38 | 2.60 | 2.83 | 3.07 |
| 65° | .23 | .46 | .69 | .93 | 1.16 | 1.40 | 1.64 | 1.88 | 2.13 | 2.38 | 2.63 | 2.88 | 3.13 | 3.39 |
| 70° | .25 | .51 | .76 | 1.02 | 1.28 | 1.54 | 1.80 | 2.06 | 2.33 | 2.60 | 2.88 | 3,16 | 3.44 | 3.72 |
| 75° | .27 | .56 | .83 | 1.12 | 1.40 | 1.69 | 1.98 | 2.27 | 2.57 | 2.87 | 3.16 | 3.47 | 3.78 | 4.09 |
| 80° | .30 | .61 | .91 | 1.22 | 1.53 | 1.84 | 2.15 | 2.46 | 2.78 | 3.10 | 3.44 | 3.78 | 4.12 | 4.46 |
| 85° | .33 | .66 | 1.00 | 1.33 | 1.68 | 2.02 | 2.36 | 2.70 | 3.05 | 3.40 | 3.77 | 4.14 | 4.55 | 4.89 |
| 90° | .36 | .72 | 1.09 | 1.45 | 1.83 | 2.20 | 2.57 | 2.94 | 3.32 | 3.70 | 4.10 | 4.50 | 4.91 | 5.32 |
| 95° | .39 | .79 | 1.19 | 1.55 | 2.00 | 2.40 | 2.80 | 3.20 | 3.61 | 4.02 | 4.40 | 4.98 | 5.38 | 5.83 |
| 100° | .43 | .86 | 1.30 | 1.74 | 2.18 | 2.62 | 3.06 | 3 50 | 3.95 | 4.40 | 4.88 | 5.37 | 5.85 | 6.34 |

## For Externals Add

| ANGLE / CURVE | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | 60° | 65° | 70° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10° | .001 | .003 | .004 | .006 | .007 | .008 | .009 | .011 | .012 | .014 | .015 | .017 | .018 | .020 |
| 15° | .003 | .007 | .010 | .014 | .018 | .023 | .027 | .029 | .032 | .035 | .039 | .043 | .047 | .051 |
| 20° | .006 | .011 | .017 | .022 | .028 | .034 | 038 | .045 | .051 | .057 | .063 | .070 | .076 | .083 |
| 25° | .009 | .018 | .027 | .036 | .046 | .056 | .065 | .074 | .083 | .093 | 106 | .120 | .127 | .135 |
| 30° | .013 | .025 | .038 | .051 | .065 | .078 | .090 | .103 | .116 | .129 | .149 | .170 | .179 | .188 |
| 35° | .018 | .035 | .054 | .072 | .086 | .109 | .131 | .153 | .175 | .197 | .213 | .230 | .247 | .264 |
| 40° | .023 | .045 | .070 | .093 | .117 | .141 | .172 | .203 | .234 | .265 | .277 | .290 | .315 | .341 |
| 45° | .030 | .060 | .093 | .119 | 153 | .184 | .216 | .254 | .289 | .325 | .351 | .378 | .411 | .445 |
| 50° | .037 | .075 | .116 | .151 | .189 | .227 | .266 | .305 | .345 | .384 | .425 | .467 | .508 | .550 |
| 55° | .046 | .093 | .142 | .188 | .236 | .283 | .332 | .381 | .420 | .479 | .530 | .582 | .641 | .700 |
| 60° | .056 | .112 | .168 | .225 | .283 | .340 | .398 | .457 | .516 | .575 | .636 | .697 | .774 | .851 |
| 65° | .067 | .135 | .204 | .273 | .343 | .412 | .483 | .554 | .625 | .697 | .711 | .845 | 922 | 1.01 |
| 70° | .080 | .159 | .240 | .321 | .403 | .485 | .568 | .652 | .735 | .819 | .906 | .994 | 1.08 | 1.17 |
| 75° | .095 | .182 | .286 | .383 | .480 | .578 | .678 | .777 | .877 | .977 | 1.07 | 1.18 | 1.29 | 1.39 |
| 80° | .110 | .220 | .332 | .445 | .558 | .671 | .787 | .903 | 1.02 | 1.13 | 1 25 | 1.38 | 1 50 | 1.62 |
| 85° | .128 | .259 | .391 | .524 | .657 | .790 | .926 | 1.06 | 1.20 | 1.34 | 1.47 | 1 62 | 1.76 | 1.91 |
| 90° | .149 | .299 | .450 | .603 | .756 | .910 | 1.07 | 1.22 | 1.38 | 1.54 | 1.70 | 1.87 | 2.03 | 2.20 |
| 95° | .174 | .350 | .522 | .706 | .985 | 1.06 | 1.25 | 1.43 | 1.62 | 1.80 | 1 99 | 2.18 | 2 38 | 2.58 |
| 100° | .200 | .401 | .604 | .809 | 1.01 | 1.22 | 1.43 | 1.64 | 1.85 | 2.06 | 2.28 | 2.50 | 2.73 | 2.96 |

## Table VI. Deflections for Sub Chords for Short Radius Curves.

| Degree of Curve | Radius 50 / sin. def. ang. | ½ sub chord / R = sin of def. angle | | | | Length of arc for 100 ft. |
|---|---|---|---|---|---|---|
| | | 12.5 Ft. | 15 Ft. | 20 Ft | 25 Ft. | |
| 30° | 193.18 | 1° 51′ | 2° 17′ | 2° 58′ | 3° 43′ | 101.15 |
| 32° | 181.39 | 1° 59′ | 2° 25′ | 3° 10′ | 3° 58′ | 101.33 |
| 34° | 171.01 | 2° 06′ | 2° 33′ | 3° 21′ | 4° 12′ | 101.48 |
| 36° | 161.80 | 2° 13′ | 2° 41′ | 3° 33′ | 4° 26′ | 101 66 |
| 38° | 153 58 | 2° 20′ | 2° 49′ | 3° 44′ | 4° 40′ | 101.85 |
| 40° | 146.19 | 2° 27′ | 2° 57′ | 3° 55′ | 4° 54′ | 102.06 |
| 42° | 139.52 | 2° 34′ | 3° 05′ | 4° 07′ | 5° 08′ | 102.29 |
| 44° | 133 47 | 2° 41′ | 3° 13′ | 4° 18′ | 5° 22′ | 102.53 |
| 46° | 127.97 | 2° 48′ | 3° 21′ | 4° 29′ | 5° 36′ | 102.76 |
| 48° | 122 92 | 2° 55′ | 3° 29′ | 4° 40′ | 5° 50′ | 103.00 |
| 50° | 118 31 | 3° 02′ | 3° 38′ | 4° 51′ | 6° 04′ | 103 24 |
| 52° | 114 06 | 3° 09′ | 3° 46′ | 5° 02′ | 6° 17′ | 103 54 |
| 54° | 110.11 | 3° 16′ | 3° 54′ | 5° 13′ | 6° 31′ | 103 84 |
| 56° | 106.50 | 3° 22′ | 4° 02′ | 5° 23′ | 6° 44′ | 104.14 |
| 58° | 103.14 | 3° 29′ | 4° 10 | 5° 34′ | 6° 57′ | 104 43 |
| 60° | 100.00 | 3° 35′ | 4° 18′ | 5° 44′ | 7° 11′ | 104.72 |

## CURVE FORMULAS.

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan. \frac{1}{2} I}{\text{Sin. D}}$

$\text{Sin. D} = \frac{50}{R}$

$\text{Sin. D} = \frac{50 \tan. \frac{1}{2} I}{T}$

$R = T \cot. \frac{1}{2} I$

$R = \frac{50}{\text{Sin. D}}$

$E = R \text{ ex. sec. } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

$\text{Chord def.} = \frac{\text{chord}^2}{R}$

$\text{No. chords} = \frac{\frac{1}{2} I}{D}$

$\text{Tan. def.} = \frac{1}{2} \text{ chord def.}$

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

Table IV. contains Tangents and Externals to a 1° curve. Tan. and Ext. to any other radius may be found nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Ext. opposite the given Central Angle by the given External.

To find. Nat. Tan. and Nat. Ex. Sec. for any angle by Table IV.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat Tan. or Nat. Ex. Sec.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.), and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance. Multiply the angle by .01745, and the product by the distance.

Right Angle Triangles. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt 10 $10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. 25. $25^2 \div 200 = 3.125$. $100 - 3.125 = 96.875 =$ Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

## Natural Sines

| DEG. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | DEG. | DEG. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | DEG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0000 | 0029 | 0058 | 0087 | 0116 | 0145 | 89 | 40 | 6428 | 6450 | 6472 | 6494 | 6517 | 6539 | 49 |
| 1 | 0175 | 0204 | 0233 | 0262 | 0291 | 0320 | 88 | 41 | 6561 | 6583 | 6604 | 6626 | 6648 | 6670 | 48 |
| 2 | 0349 | 0378 | 0407 | 0436 | 0465 | 0494 | 87 | 42 | 6691 | 6713 | 6734 | 6756 | 6777 | 6799 | 47 |
| 3 | 0523 | 0552 | 0581 | 0610 | 0640 | 0669 | 86 | 43 | 6820 | 6841 | 6862 | 6884 | 6905 | 6926 | 46 |
| 4 | 0698 | 0727 | 0756 | 0785 | 0814 | 0843 | 85 | 44 | 6947 | 6967 | 6988 | 7009 | 7030 | 7050 | 45 |
| 5 | 0872 | 0901 | 0929 | 0958 | 0987 | 1016 | 84 | 45 | 7071 | 7092 | 7112 | 7133 | 7153 | 7173 | 44 |
| 6 | 1045 | 1074 | 1103 | 1132 | 1161 | 1190 | 83 | 46 | 7193 | 7214 | 7234 | 7254 | 7274 | 7294 | 43 |
| 7 | 1219 | 1248 | 1279 | 1305 | 1334 | 1363 | 82 | 47 | 7314 | 7333 | 7353 | 7373 | 7392 | 7412 | 42 |
| 8 | 1392 | 1421 | 1449 | 1478 | 1507 | 1536 | 81 | 48 | 7431 | 7451 | 7470 | 7490 | 7509 | 7528 | 41 |
| 9 | 1564 | 1593 | 1622 | 1650 | 1679 | 1708 | 80 | 49 | 7547 | 7566 | 7585 | 7604 | 7623 | 7642 | 40 |
| 10 | 1736 | 1765 | 1794 | 1822 | 1851 | 1880 | 79 | 50 | 7660 | 7679 | 7698 | 7716 | 7735 | 7753 | 39 |
| 11 | 1908 | 1937 | 1965 | 1994 | 2022 | 2051 | 78 | 51 | 7771 | 7790 | 7808 | 7826 | 7844 | 7862 | 38 |
| 12 | 2079 | 2108 | 2136 | 2164 | 2193 | 2221 | 77 | 52 | 7880 | 7898 | 7916 | 7934 | 7951 | 7969 | 37 |
| 13 | 2250 | 2278 | 2306 | 2334 | 2363 | 2391 | 76 | 53 | 7986 | 8004 | 8021 | 8039 | 8056 | 8073 | 36 |
| 14 | 2419 | 2447 | 2476 | 2504 | 2532 | 2560 | 75 | 54 | 8090 | 8107 | 8124 | 8141 | 8158 | 8175 | 35 |
| 15 | 2588 | 2616 | 2644 | 2672 | 2700 | 2728 | 74 | 55 | 8192 | 8208 | 8225 | 8241 | 8258 | 8274 | 34 |
| 16 | 2756 | 2784 | 2812 | 2840 | 2868 | 2896 | 73 | 56 | 8290 | 8307 | 8323 | 8339 | 8355 | 8371 | 33 |
| 17 | 2924 | 2952 | 2979 | 3007 | 3035 | 3062 | 72 | 57 | 8387 | 8403 | 8418 | 8434 | 8450 | 8465 | 32 |
| 18 | 3090 | 3118 | 3145 | 3173 | 3201 | 3228 | 71 | 58 | 8480 | 8496 | 8511 | 8526 | 8542 | 8557 | 31 |
| 19 | 3256 | 3283 | 3311 | 3338 | 3365 | 3393 | 70 | 59 | 8572 | 8587 | 8601 | 8616 | 8631 | 8646 | 30 |
| 20 | 3420 | 3448 | 3475 | 3502 | 3529 | 3557 | 69 | 60 | 8660 | 8675 | 8689 | 8704 | 8718 | 8732 | 29 |
| 21 | 3584 | 3611 | 3638 | 3665 | 3692 | 3719 | 68 | 61 | 8746 | 8760 | 8774 | 8788 | 8802 | 8816 | 28 |
| 22 | 3746 | 3773 | 3800 | 3827 | 3854 | 3881 | 67 | 62 | 8829 | 8843 | 8857 | 8870 | 8884 | 8897 | 27 |
| 23 | 3907 | 3934 | 3961 | 3987 | 4014 | 4041 | 66 | 63 | 8910 | 8923 | 8936 | 8949 | 8962 | 8975 | 26 |
| 24 | 4067 | 4094 | 4120 | 4147 | 4173 | 4200 | 65 | 64 | 8988 | 9001 | 9013 | 9026 | 9038 | 9051 | 25 |
| 25 | 4226 | 4253 | 4279 | 4305 | 4331 | 4358 | 64 | 65 | 9063 | 9075 | 9088 | 9100 | 9112 | 9124 | 24 |
| 26 | 4384 | 4410 | 4436 | 4462 | 4488 | 4514 | 63 | 66 | 9135 | 9147 | 9159 | 9171 | 9182 | 9194 | 23 |
| 27 | 4540 | 4566 | 4592 | 4617 | 4643 | 4669 | 62 | 67 | 9205 | 9216 | 9228 | 9239 | 9250 | 9261 | 22 |
| 28 | 4695 | 4720 | 4746 | 4772 | 4797 | 4823 | 61 | 68 | 9272 | 9283 | 9293 | 9304 | 9315 | 9325 | 21 |
| 29 | 4848 | 4874 | 4899 | 4924 | 4950 | 4975 | 60 | 69 | 9336 | 9346 | 9356 | 9367 | 9377 | 9387 | 20 |
| 30 | 5000 | 5025 | 5050 | 5075 | 5100 | 5125 | 59 | 70 | 9397 | 9407 | 9417 | 9426 | 9436 | 9446 | 19 |
| 31 | 5150 | 5175 | 5200 | 5225 | 5250 | 5275 | 58 | 71 | 9455 | 9465 | 9474 | 9483 | 9492 | 9502 | 18 |
| 32 | 5299 | 5324 | 5348 | 5373 | 5398 | 5422 | 57 | 72 | 9511 | 9520 | 9528 | 9537 | 9546 | 9555 | 17 |
| 33 | 5446 | 5471 | 5495 | 5519 | 5544 | 5568 | 56 | 73 | 9563 | 9572 | 9580 | 9588 | 9596 | 9605 | 16 |
| 34 | 5592 | 5616 | 5640 | 5664 | 5688 | 5712 | 55 | 74 | 9613 | 9621 | 9628 | 9636 | 9644 | 9652 | 15 |
| 35 | 5736 | 5760 | 5783 | 5807 | 5831 | 5854 | 54 | 75 | 9659 | 9667 | 9674 | 9681 | 9689 | 9696 | 14 |
| 36 | 5878 | 5901 | 5925 | 5948 | 5972 | 5995 | 53 | 76 | 9703 | 9710 | 9717 | 9724 | 9730 | 9737 | 13 |
| 37 | 6018 | 6041 | 6065 | 6088 | 6111 | 6134 | 52 | 77 | 9744 | 9750 | 9757 | 9763 | 9769 | 9775 | 12 |
| 38 | 6157 | 6180 | 6202 | 6225 | 6248 | 6271 | 51 | 78 | 9781 | 9787 | 9793 | 9799 | 9805 | 9811 | 11 |
| 39 | 6293 | 6316 | 6338 | 6361 | 6383 | 6406 | 50 | 79 | 9816 | 9822 | 9827 | 9833 | 9838 | 9843 | 10 |
| DEG. | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | DEG. | DEG. | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | DEG. |

| DEG. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | DEG. |
|---|---|---|---|---|---|---|---|
| 80 | 9848 | 9853 | 9858 | 9863 | 9868 | 9872 | 9 |
| 81 | 9877 | 9881 | 9886 | 9890 | 9894 | 9899 | 8 |
| 82 | 9903 | 9907 | 9911 | 9914 | 9918 | 9922 | 7 |
| 83 | 9925 | 9929 | 9932 | 9936 | 9939 | 9942 | 6 |
| 84 | 9945 | 9948 | 9951 | 9954 | 9957 | 9959 | 5 |
| 85 | 9962 | 9964 | 9967 | 9969 | 9971 | 9974 | 4 |
| 86 | 9976 | 9978 | 9980 | 9981 | 9983 | 9985 | 3 |
| 87 | 9986 | 9988 | 9989 | 9990 | 9992 | 9993 | 2 |
| 88 | 9994 | 9995 | 9996 | 9997 | 9997 | 9998 | 1 |
| 89 | 9998 | 9999 | 9999 | 9999 | 1.0000 | 1.0000 | 0 |
| DEG. | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | DEG. |

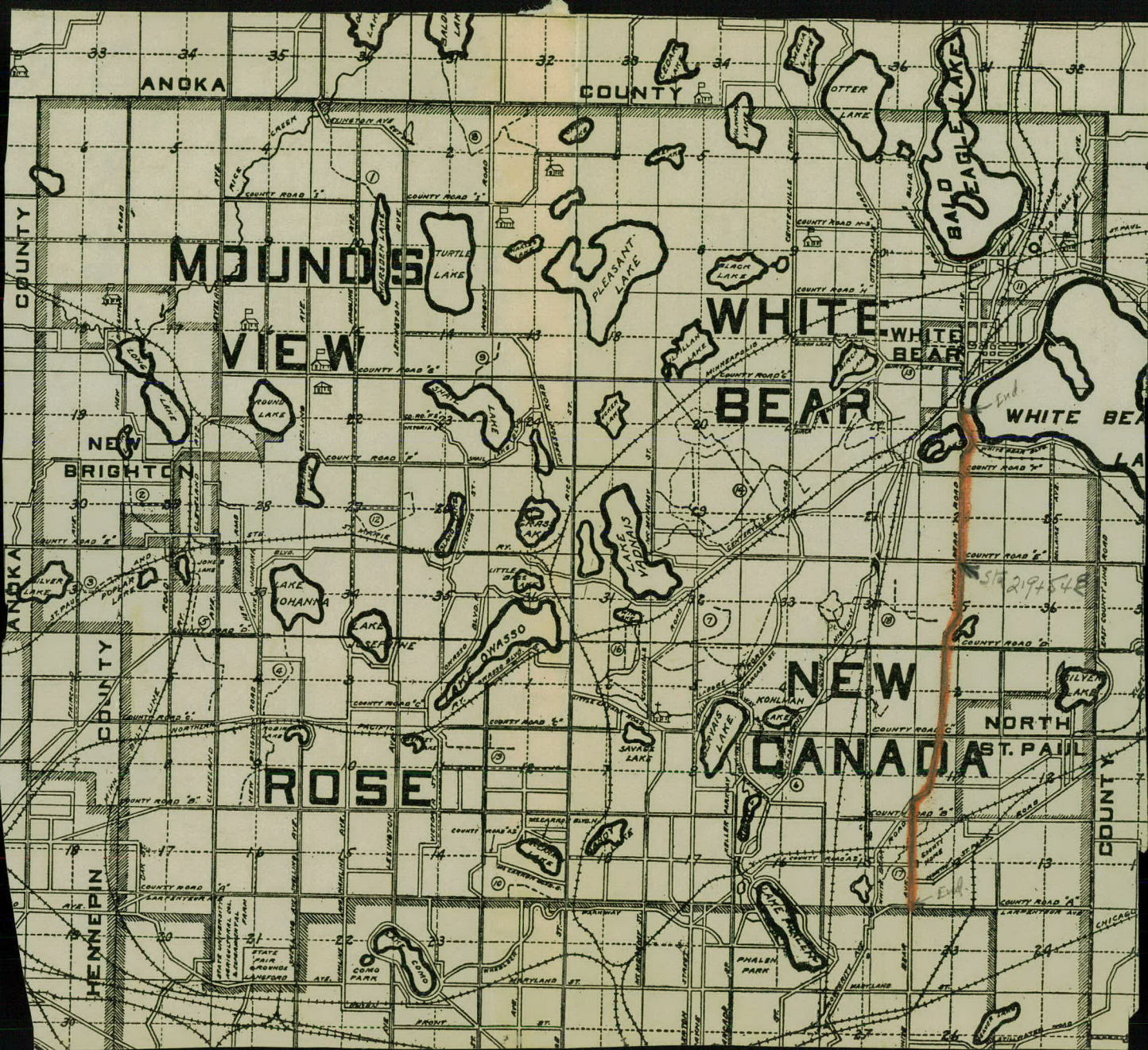
## Natural Cosines

## Natural Tangents

| deg. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | deg. | deg. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | deg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0000 | 0029 | 0058 | 0087 | 0116 | 0145 | 89 | 40 | 8391 | 8441 | 8491 | 8541 | 8591 | 8642 | 49 |
| 1 | 0175 | 0204 | 0233 | 0262 | 0291 | 0320 | 88 | 41 | 8693 | 8744 | 8796 | 8847 | 8899 | 8952 | 48 |
| 2 | 0349 | 0378 | 0407 | 0437 | 0466 | 0495 | 87 | 42 | 9004 | 9057 | 9110 | 9163 | 9217 | 9271 | 47 |
| 3 | 0524 | 0553 | 0582 | 0612 | 0641 | 0670 | 86 | 43 | 9325 | 9380 | 9435 | 9490 | 9545 | 9601 | 46 |
| 4 | 0699 | 0729 | 0758 | 0787 | 0816 | 0846 | 85 | 44 | 9657 | 9713 | 9770 | 9827 | 9884 | 9942 | 45 |
| 5 | 0875 | 0904 | 0934 | 0963 | 0992 | 1022 | 84 | 45 | 1.0000 | 1.0058 | 1.0117 | 1.0176 | 1.0235 | 1.0295 | 44 |
| 6 | 1051 | 1080 | 1110 | 1139 | 1169 | 1198 | 83 | 46 | 1.0355 | 1.0416 | 1.0477 | 1.0533 | 1.0599 | 1.0661 | 43 |
| 7 | 1228 | 1257 | 1287 | 1317 | 1346 | 1376 | 82 | 47 | 1.0724 | 1.0786 | 1.0850 | 1.0913 | 1.0977 | 1.1041 | 42 |
| 8 | 1405 | 1435 | 1465 | 1495 | 1524 | 1554 | 81 | 48 | 1.1106 | 1.1171 | 1.1237 | 1.1303 | 1.1369 | 1.1436 | 41 |
| 9 | 1584 | 1614 | 1644 | 1673 | 1703 | 1733 | 80 | 49 | 1.1504 | 1.1571 | 1.1640 | 1.1708 | 1.1778 | 1.1847 | 40 |
| 10 | 1763 | 1793 | 1823 | 1853 | 1883 | 1914 | 79 | 50 | 1.1918 | 1.1988 | 1.2059 | 1.2131 | 1.2203 | 1.2276 | 39 |
| 11 | 1944 | 1974 | 2004 | 2035 | 2065 | 2095 | 78 | 51 | 1.2349 | 1.2423 | 1.2497 | 1.2572 | 1.2647 | 1.2723 | 38 |
| 12 | 2126 | 2156 | 2186 | 2217 | 2247 | 2278 | 77 | 52 | 1.2799 | 1.2876 | 1.2954 | 1.3032 | 1.3111 | 1.3190 | 37 |
| 13 | 2309 | 2339 | 2370 | 2401 | 2432 | 2462 | 76 | 53 | 1.3270 | 1.3351 | 1.3432 | 1.3514 | 1.3597 | 1.3680 | 36 |
| 14 | 2493 | 2524 | 2555 | 2586 | 2617 | 2648 | 75 | 54 | 1.3764 | 1.3848 | 1.3934 | 1.4019 | 1.4106 | 1.4193 | 35 |
| 15 | 2679 | 2711 | 2742 | 2773 | 2805 | 2836 | 74 | 55 | 1.4281 | 1.4370 | 1.4460 | 1.4550 | 1.4641 | 1.4735 | 34 |
| 16 | 2867 | 2899 | 2931 | 2962 | 2994 | 3026 | 73 | 56 | 1.4826 | 1.4919 | 1.5013 | 1.5108 | 1.5204 | 1.5301 | 33 |
| 17 | 3057 | 3089 | 3121 | 3153 | 3185 | 3217 | 72 | 57 | 1.5399 | 1.5497 | 1.5597 | 1 5697 | 1 5798 | 1.5900 | 32 |
| 18 | 3249 | 3281 | 3314 | 3346 | 3378 | 3411 | 71 | 58 | 1.6003 | 1.6107 | 1.6212 | 1.6319 | 1.6426 | 1.6534 | 31 |
| 19 | 3443 | 3476 | 3508 | 3541 | 3574 | 3607 | 70 | 59 | 1.6643 | 1 6753 | 1.6864 | 1.6977 | 1.7090 | 1 7205 | 30 |
| 20 | 3640 | 3673 | 3706 | 3739 | 3772 | 3805 | 69 | 60 | 1.7321 | 1.7437 | 1.7556 | 1.7675 | 1.7797 | 1.7917 | 29 |
| 21 | 3839 | 3872 | 3906 | 3939 | 3973 | 4006 | 68 | 61 | 1.8040 | 1.8165 | 1.8291 | 1.8418 | 1.8546 | 1.8676 | 28 |
| 22 | 4040 | 4074 | 4108 | 4142 | 4176 | 4210 | 67 | 62 | 1.8807 | 1.8940 | 1.9074 | 1.9210 | 1.9347 | 1.9486 | 27 |
| 23 | 4245 | 4279 | 4314 | 4348 | 4383 | 4417 | 66 | 63 | 1.9626 | 1.9768 | 1.9912 | 2.0057 | 2.0204 | 2.0353 | 26 |
| 24 | 4452 | 4487 | 4522 | 4557 | 4592 | 4628 | 65 | 64 | 2.0503 | 2.0655 | 2.0809 | 2.0965 | 2.1123 | 2.1283 | 25 |
| 25 | 4663 | 4699 | 4734 | 4770 | 4806 | 4841 | 64 | 65 | 2.1445 | 2.1609 | 2.1775 | 2 1943 | 2.2113 | 2.2286 | 24 |
| 26 | 4877 | 4913 | 4950 | 4986 | 5022 | 5059 | 63 | 66 | 2.2460 | 2.2637 | 2.2817 | 2.2998 | 2.3183 | 2.3369 | 23 |
| 27 | 5095 | 5132 | 5169 | 5206 | 5243 | 5280 | 62 | 67 | 2.3559 | 2.3750 | 2.3945 | 2.4142 | 2.4342 | 2.4545 | 22 |
| 28 | 5317 | 5354 | 5392 | 5430 | 5467 | 5505 | 61 | 68 | 2.4751 | 2.4960 | 2.5172 | 2.5386 | 2.5605 | 2.5826 | 21 |
| 29 | 5543 | 5581 | 5619 | 5658 | 5696 | 5735 | 60 | 69 | 2.6051 | 2 6279 | 2.6511 | 2.6746 | 2.6985 | 2.7228 | 20 |
| 30 | 5774 | 5812 | 5851 | 5890 | 5930 | 5969 | 59 | 70 | 2.7475 | 2.7725 | 2 7980 | 2.8239 | 2.8502 | 2.8770 | 19 |
| 31 | 6009 | 6048 | 6088 | 6128 | 6168 | 6208 | 58 | 71 | 2.9042 | 2.9319 | 2 9600 | 2.9887 | 3.0178 | 3.0475 | 18 |
| 32 | 6249 | 6289 | 6330 | 6371 | 6412 | 6453 | 57 | 72 | 3.0777 | 3 1084 | 3.1397 | 3.1716 | 3.2041 | 3.2371 | 17 |
| 33 | 6494 | 6536 | 6577 | 6619 | 6661 | 6703 | 56 | 73 | 3.2709 | 3.3052 | 3.3402 | 3.3759 | 3.4124 | 3.4495 | 16 |
| 34 | 6745 | 6787 | 6830 | 6873 | 6916 | 6959 | 55 | 74 | 3.4874 | 3.5261 | 3 5656 | 3.6059 | 3.6470 | 3.6891 | 15 |
| 35 | 7002 | 7046 | 7089 | 7133 | 7177 | 7221 | 54 | 75 | 3.7321 | 3.7760 | 3.8208 | 3.8657 | 3.9136 | 3.9617 | 14 |
| 36 | 7265 | 7310 | 7355 | 7400 | 7445 | 7490 | 53 | 76 | 4.0108 | 4.0611 | 4.1126 | 4.1653 | 4.2193 | 4.2747 | 13 |
| 37 | 7536 | 7581 | 7627 | 7673 | 7720 | 7766 | 52 | 77 | 4 3315 | 4.3897 | 4.4494 | 4.5107 | 4.5736 | 4.6382 | 12 |
| 38 | 7813 | 7860 | 7907 | 7954 | 8002 | 8050 | 51 | 78 | 4 7046 | 4.7729 | 4.8430 | 4.9152 | 4.9894 | 5.0658 | 11 |
| 39 | 8098 | 8146 | 8195 | 8243 | 8292 | 8342 | 50 | 79 | 5.1446 | 5.2257 | 5,3093 | 5.3955 | 5.4845 | 5.5764 | 10 |
| deg. | 60′ | 50′ | 40′ | 30 | 20′ | 10′ | deg. | deg. | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | deg. |

| deg. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | deg. |
|---|---|---|---|---|---|---|---|
| 80 | 5.6713 | 5 7694 | 5.8708 | 5 9758 | 6 0844 | 6.1970 | 9 |
| 81 | 6.3138 | 6.4348 | 6.5606 | 6.6912 | 6.8269 | 6,9682 | 8 |
| 82 | 7.1154 | 7.2687 | 7.4287 | 7.5958 | 7.7704 | 7.9530 | 7 |
| 83 | 8.1443 | 8 3450 | 8.5555 | 8.7769 | 9.0098 | 9.2553 | 6 |
| 84 | 9.5144 | 9.7882 | 10.078 | 10.385 | 10.711 | 11.059 | 5 |
| 85 | 11.430 | 11.826 | 12.250 | 12.706 | 13.197 | 13.727 | 4 |
| 86 | 14.300 | 14.924 | 15.605 | 16.350 | 17.169 | 18.075 | 3 |
| 87 | 19.081 | 20.206 | 21.470 | 22.903 | 24.542 | 26,432 | 2 |
| 88 | 28.636 | 31.242 | 34.368 | 38.189 | 42.964 | 49.104 | 1 |
| 89 | 57.290 | 68.750 | 85.940 | 114.588 | 171.885 | 343.770 | 0 |
| deg. | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | deg. |

## Natural Cotangents


ANOKA COUNTY
MOUNDS VIEW
NEW BRIGHTON
ROSE
WHITE BEAR
NEW CANADA
NORTH ST. PAUL
HENNEPIN COUNTY
ANOKA COUNTY
TURTLE LAKE
PLEASANT LAKE
BALD EAGLE LAKE
OTTER LAKE
BLACK LAKE
ROUND LAKE
LAKE JOHANNA
LAKE OWASSO
LAKE VADNAIS
SILVER LAKE
POPLAR LAKE
SAVAGE LAKE
KOHLMAN LAKE
PHALEN LAKE
COMO PARK
PHALEN PARK
STATE FAIR GROUNDS
COUNTY ROAD B
COUNTY ROAD C
COUNTY ROAD D
COUNTY ROAD E
COUNTY ROAD F
COUNTY ROAD H
LEXINGTON AVE.
HAMLINE AVE.
SNELLING AVE.
CLEVELAND AVE.
LARPENTEUR AVE.
MARYLAND ST.
LITTLE CANADA ROAD
MAPLEWOOD ROAD
WHITE BEAR AVE.
MINNEAPOLIS ST. PAUL & SAULT STE. MARIE R.R.
CHICAGO GREAT WESTERN R.R.
NORTHERN PACIFIC R.R.
CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC R.R.
CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA R.R.
STP 219+54E
End
Beg

# DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

Roadway 16 feet wide. Side Slopes 1 on 1½.

For Single Track Embankment.

| H | 0 | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | H |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.0 | 8.2 | 8.3 | 8.5 | 8.6 | 8.8 | 8.9 | 9.1 | 9.2 | 9.4 | 0 |
| 1 | 9.5 | 9.7 | 9.8 | 10.0 | 10.1 | 10.3 | 10.4 | 10.6 | 10.7 | 10.9 | 1 |
| 2 | 11.0 | 11.2 | 11.3 | 11.5 | 11.6 | 11.8 | 11.9 | 12.1 | 12.2 | 12.4 | 2 |
| 3 | 12.5 | 12.7 | 12.8 | 13.0 | 13.1 | 13.3 | 13.4 | 13.6 | 13.7 | 13.9 | 3 |
| 4 | 14.0 | 14.2 | 14.3 | 14.5 | 14.6 | 14.8 | 14.9 | 15.1 | 15.2 | 15.4 | 4 |
| 5 | 15.5 | 15.7 | 15.8 | 16.0 | 16.1 | 16.3 | 16.4 | 16.6 | 16.7 | 16.9 | 5 |
| 6 | 17.0 | 17.2 | 17.3 | 17.5 | 17.6 | 17.8 | 17.9 | 18.1 | 18.2 | 18.4 | 6 |
| 7 | 18.5 | 18.7 | 18.8 | 19.0 | 19.1 | 19.3 | 19.4 | 19.6 | 19.7 | 19.9 | 7 |
| 8 | 20.0 | 20.2 | 20.3 | 20.5 | 20.6 | 20.8 | 20.9 | 21.1 | 21.2 | 21.4 | 8 |
| 9 | 21.5 | 21.7 | 21.8 | 22.0 | 22.1 | 22.3 | 22.4 | 22.6 | 22.7 | 22.9 | 9 |
| 10 | 23.0 | 23.2 | 23.3 | 23.5 | 23.6 | 23.8 | 23.9 | 24.1 | 24.2 | 24.4 | 10 |
| 11 | 24.5 | 24.7 | 24.8 | 25.0 | 25.1 | 25.3 | 25.4 | 25.6 | 25.7 | 25.9 | 11 |
| 12 | 26.0 | 25.2 | 26.3 | 26.5 | 26.6 | 26.8 | 26.9 | 27.1 | 27.2 | 27.4 | 12 |
| 13 | 27.5 | 27.7 | 27.8 | 28.0 | 28.1 | 28.3 | 28.4 | 28.6 | 28.7 | 28.9 | 13 |
| 14 | 29.0 | 29.2 | 29.3 | 29.5 | 29.6 | 29.8 | 29.9 | 30.1 | 30.2 | 30.4 | 14 |
| 15 | 30.5 | 30.7 | 30.8 | 31.0 | 31.1 | 31.3 | 31.4 | 31.6 | 31.7 | 31.9 | 15 |
| 16 | 32.0 | 32.2 | 32.3 | 32.5 | 32.6 | 32.8 | 32.9 | 33.1 | 33.2 | 33.4 | 16 |
| 17 | 33.5 | 33.7 | 33.8 | 34.0 | 34.1 | 34.3 | 34.4 | 34.6 | 34.7 | 34.9 | 17 |
| 18 | 35.0 | 35.2 | 35.3 | 35.5 | 35.6 | 35.8 | 35.9 | 36.1 | 36.2 | 36.4 | 18 |
| 19 | 36.5 | 36.7 | 36.8 | 37.0 | 37.1 | 37.3 | 37.4 | 37.6 | 37.7 | 37.9 | 19 |
| 20 | 38.0 | 38.2 | 38.3 | 38.5 | 38.6 | 38.8 | 38.9 | 39.1 | 39.2 | 39.4 | 20 |
| 21 | 39.5 | 39.7 | 39.8 | 40.0 | 40.1 | 40.3 | 40.4 | 40.6 | 40.7 | 40.9 | 21 |
| 22 | 41.0 | 41.2 | 41.3 | 41.5 | 41.6 | 41.8 | 41.9 | 42.1 | 42.2 | 42.4 | 22 |
| 23 | 42.5 | 42.7 | 42.8 | 43.0 | 43.1 | 43.3 | 43.4 | 43.6 | 43.7 | 43.9 | 23 |
| 24 | 44.0 | 44.2 | 44.3 | 44.5 | 44.6 | 44.8 | 44.9 | 45.1 | 45.2 | 45.4 | 24 |
| 25 | 45.5 | 45.7 | 45.8 | 46.0 | 46.1 | 46.3 | 46.4 | 46.6 | 46.7 | 46.9 | 25 |
| 26 | 47.0 | 47.2 | 47.3 | 47.5 | 47.6 | 47.8 | 47.9 | 48.1 | 48.2 | 48.4 | 26 |
| 27 | 48.5 | 48.7 | 48.8 | 49.0 | 49.1 | 49.3 | 49.4 | 49.6 | 49.7 | 49.9 | 27 |
| 28 | 50.0 | 50.2 | 50.3 | 50.5 | 50.6 | 50.8 | 50.9 | 51.1 | 51.2 | 51.4 | 28 |
| 29 | 51.5 | 51.7 | 51.8 | 52.0 | 52.1 | 52.3 | 52.4 | 52.6 | 52.7 | 52.9 | 29 |
| 30 | 53.0 | 53.2 | 53.3 | 53.5 | 53.6 | 53.8 | 53.9 | 54.1 | 54.2 | 54.4 | 30 |
| 31 | 54.5 | 54.7 | 54.8 | 55.0 | 55.1 | 55.3 | 55.4 | 55.6 | 55.7 | 55.9 | 31 |
| 32 | 56.0 | 56.2 | 56.3 | 56.5 | 56.6 | 56.8 | 56.9 | 57.1 | 57.2 | 57.4 | 32 |
| 33 | 57.5 | 57.7 | 57.8 | 58.0 | 58.1 | 58.3 | 58.4 | 58.6 | 58.7 | 58.9 | 33 |
| 34 | 59.0 | 59.2 | 59.3 | 59.5 | 59.6 | 59.8 | 59.9 | 60.1 | 60.2 | 60.4 | 34 |
| 35 | 60.5 | 60.7 | 60.8 | 61.0 | 61.1 | 61.3 | 61.4 | 61.6 | 61.7 | 61.9 | 35 |
| 36 | 62.0 | 62.2 | 62.3 | 62.5 | 62.6 | 62.8 | 62.9 | 63.1 | 63.2 | 63.4 | 36 |
| 37 | 63.5 | 63.7 | 63.8 | 64.0 | 64.1 | 64.3 | 64.4 | 64.6 | 64.7 | 64.9 | 37 |
| 38 | 65.0 | 65.2 | 65.3 | 65.5 | 65.6 | 65.8 | 65.9 | 66.1 | 66.2 | 66.4 | 38 |
| 39 | 66.5 | 66.7 | 66.8 | 67.0 | 67.1 | 67.3 | 67.4 | 67.6 | 67.7 | 67.9 | 39 |
| 40 | 68.0 | 68.2 | 68.3 | 68.5 | 68.6 | 68.8 | 68.9 | 69.1 | 69.2 | 69.4 | 40 |

**Example**—If point is 22.6 ft. above grade, how far should it be from center line to be a slope stake point? Ans. from Table 41.9. For same slopes but other widths of roadbed correct above figures by one-half difference in width of roadbed; thus in example above for 20 ft. roadbed distance will be 41.9+(20—16)÷2 or 2 ft. added to 41.9 =43.9. For slopes of 1 on 1 see inside of front cover.

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