154

FIELD BOOK

S 1135

PLEASE RETURN TO
GEAUGA COUNTY ENGINEER
COURT HOUSE
CHARDON, O.
PHONE 250-X

154

Black Brook Ditch 1-43
Troy Cemetery Page 60
Flood channel Black Brook
at Rapids Rd 1951 44-

SHAW'S
PIONEERS
SINCE 1831

Field Book
No. S 1135

MADE IN 88 LEAVES

A Product of Wilson-Jones Co.
Made in U. S. A.

154

Black Brook Ditch

6

5

Sta 4+25.9 Def Rt 75°41' Hub Set

4

N 24°30'E

3

2

1

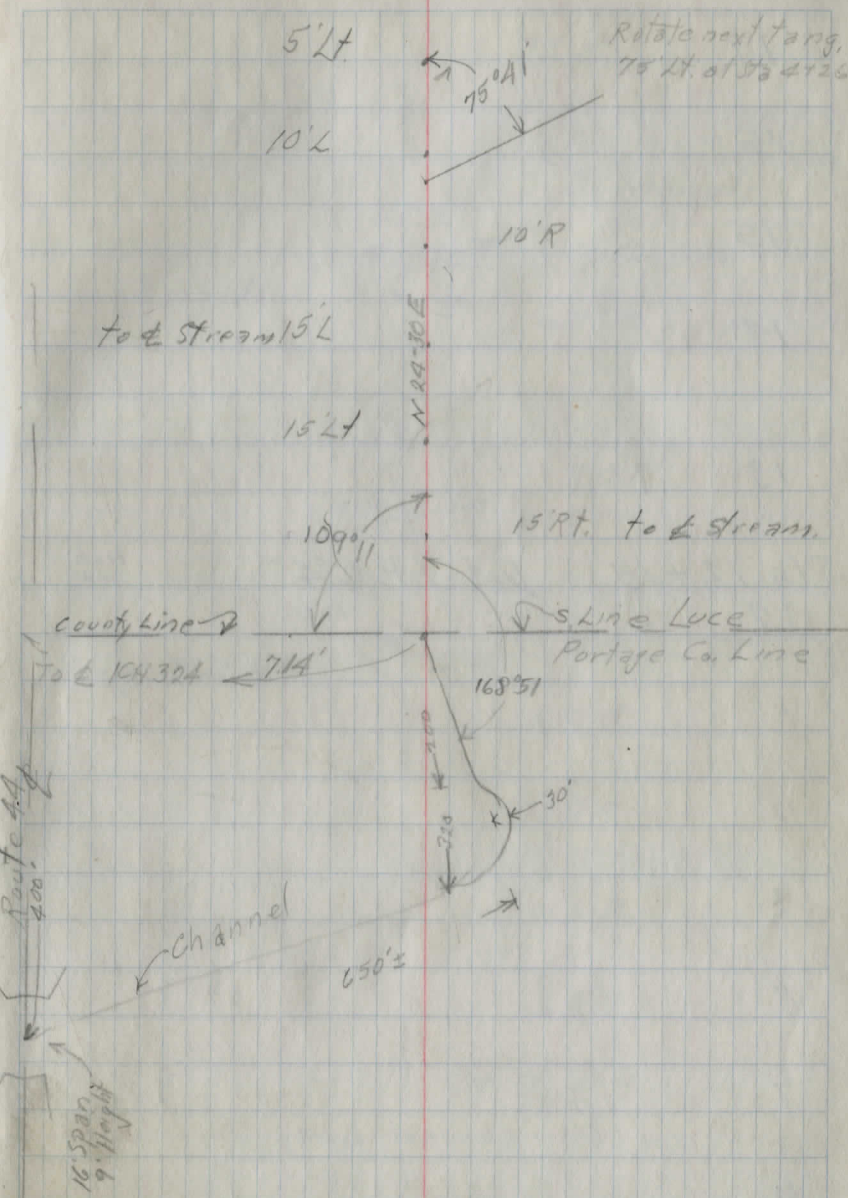
Set 30' Lt.

Sidestakes 20' Left

Sta 0+00 Portage Co. Line

2/23/37

Richey
Marks &
Merritt



17

16

15

14

13

Sta 12+15 Def Lt 46°40' Hub Set

12

11

10

9

8

7

cross channel 6+95

6

25' R

10' R.

Bednovich

15+30

14+90

30' R.

14+70

Pipeline

14+50 - 15' Lt.

14+25

Lvce 30 R.

46°30'

30 R.

12+30

70' Lt.

11+75

Bridge 752+11+50

60 R

20' R.

100 R.

60' R

5' R.

Sta 29+00 Def Rt 22°46'

28

27

26

25

24

23

Sta 22+10 Def Lt 50°26 Hub Set

22 any ext.

21

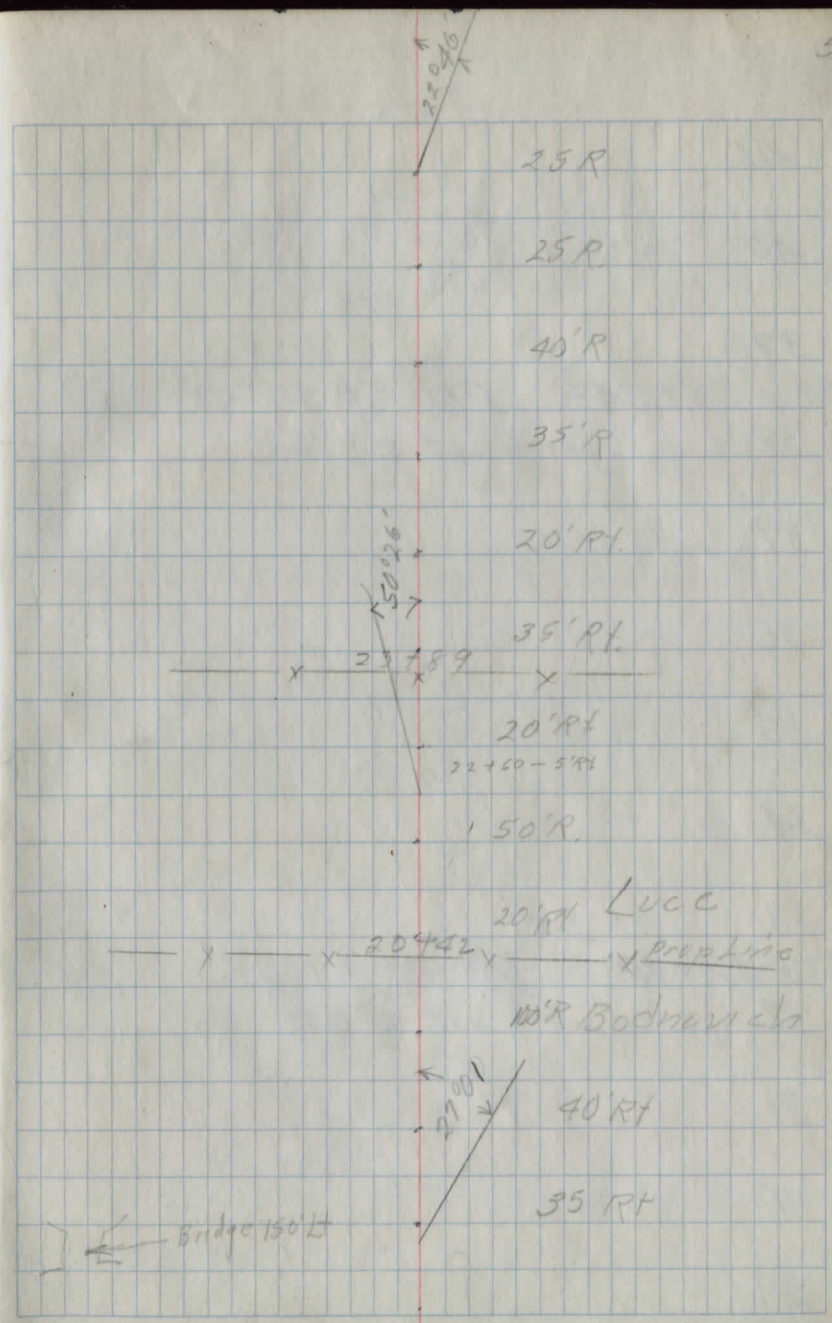
20

19

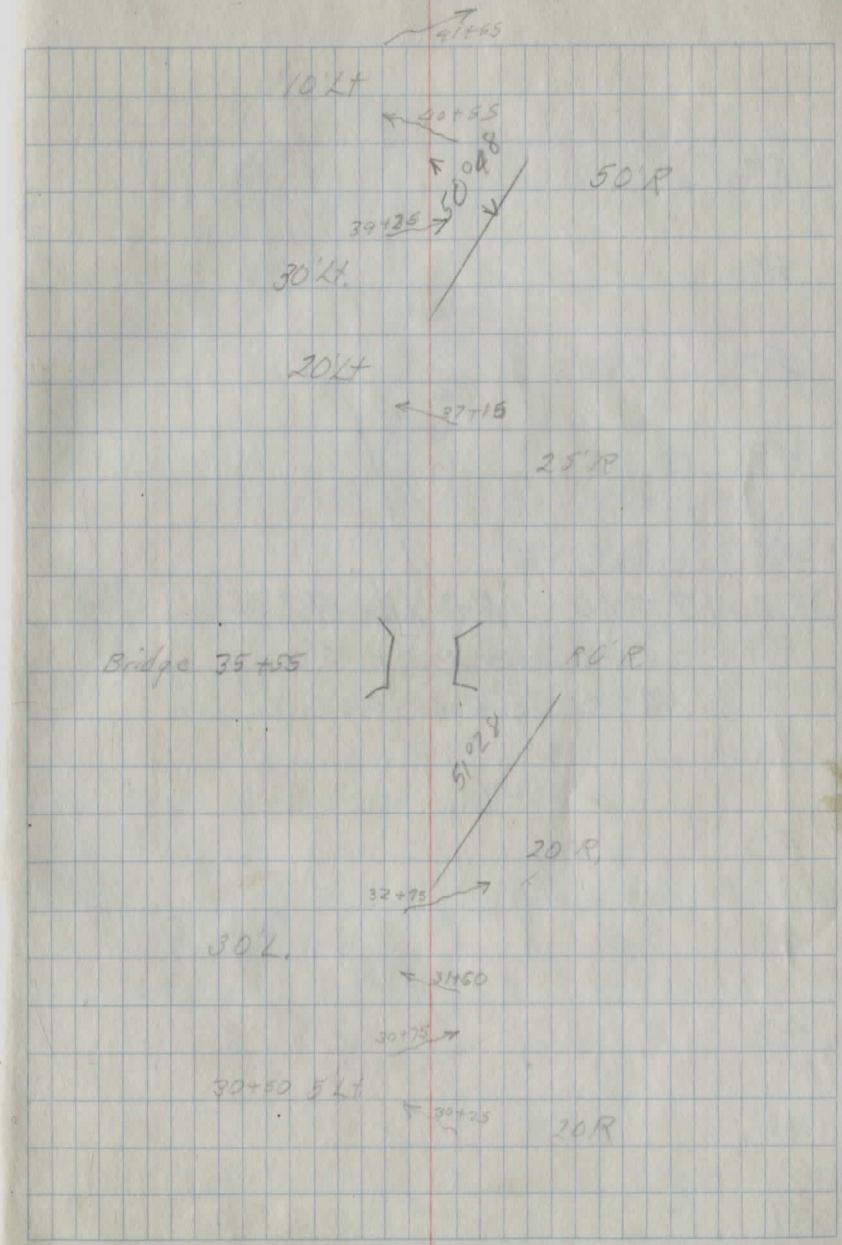
18

Sta 17+26 Def Rt. 27°01' Hub Set

17



41
40
39
Sta 38+34.3 Def Rt 50°48' Hub set
38 make ext 30' any
37
36
35 Obs. S 77° E
34
33
Sta 32+90 Def Rt 51°28' Hub set
32 make ext 30' to 50' any
31
30
29



53

52

51

50

S 68° 30' E (obs)

49

48

Sta 47+10 Def Lt. 42°06' Hub Set

47

make cut = 35' ±

46+00 = 75' W of fence ℄

46

45

44

43

42

41

53+15

5' Lt

52+40

30' Lt.

50+20

25 R

42°06'

35' R

35' R Bramley

Cross N&S fence 47+40

30' R Lucc

Cross E&W fence 46+00 46+10 - 30' R

+00

30' R.

Cross N&S fence 45+20

40 R

44+10 - 70' R.

40' Lt at 43+60 44+10

43+10

50' R.

65

64

63 Set at +35' All side stakes 30' Rt.

62

61 Sta 60+ All side stakes 30' Rt

Sta 60 + 50± Def Lt. 53°55' Hub Set

30 & 50 ± ft

60

Cross channel 59 + 30

59

58

57 All side stakes 20' Lt.

56

55

54

Sta 53+45 Def. Rt 29°47' Hub Set

53 any set

Plank Bridge 20'Lt± 50'Lt

Sta 64+60

15'Lt.

63+90

20' Rt

53°55'

15' Rt.

61+80

30' Lt.

59+30

10' Lt 58+90 ±

40' R.

30 R.

79 R.

54+50 - 15 R.

15' R.

29°47'

35 R.

35' R.

P.I. in fence E & W

PI is 22.0' west and 150± South of ∠ of woods

77

76

75

74 set at 35'

73

72

Sta 71 +00 Def Lt 22°16
make curve ext. = 60' from book

70

69

68

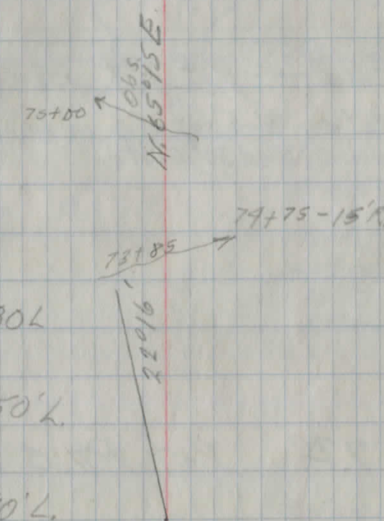
67

66

65

30' Lt

100' Lt



30L

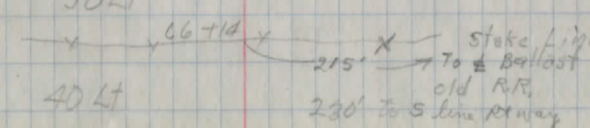
50'L.

60'L.

55'L.

40'L.

30 Lt



40 Lt

89

88

Sta 87+53 Def. Rt 27°07' Hub Set

87 Note: Hub set 3' Lt. in line with N. Railing and 30' South.

86

85

84

Sta 83+37.7 Def. Rt 5°15 Hub Set

83

82

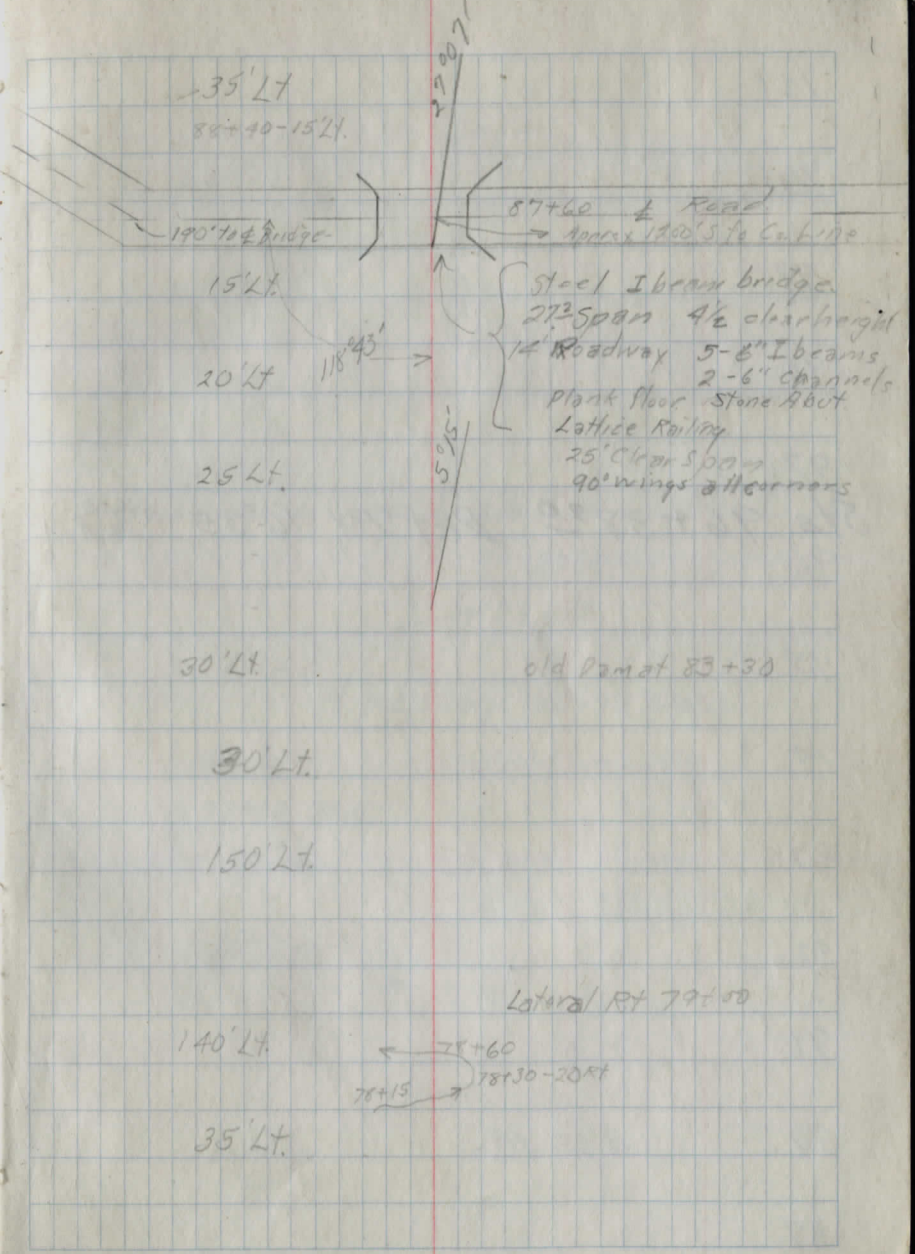
81

80 Side stake 30' Rt.

79

78

77



101

100

99

98

97

Sta 96+38.20 Def Rt 16°35 Hub Set

96

95

94 Stopped 3/4/37

93

92

91

90 Set 35' Rt.

89

15' Lt.

100+40 - 10 Lt.

50' Lt.

100' Lt.

16°35'

40 Lt.

40' Lt.

96+00 - 60' Lt.

96+10

25' Rt.

95+30

10' Lt.

94+50

94+75 on Sta 94+40

60' Lt.

93+30 20' L.

100' Lt.

100' Lt.

91+25

15' R.

92+30

10' L.

113 Set 35' Rt.

112

111

110

109

108

107

106

Sta 105 +00 Def. Lt. 39°12'

104

103

102

101

10' Lt.

102+95

100' Lt.

100' Lt.

109+50 - 100' Lt.

45' Lt.

108+80 Lateral Rt 108+00

60' Rt

39°12'

10' Lt

108+70

60' Lt

250' Lt

300' Lt

200' Lt

102+50 - 60' Lt - 150' Lt

Troy Twp.

30' Lt.

101+35

Auburn Twp.

Approx Twp Line

198.5 State Line

South to NW ¼ Nelson

101+35

125

124 set 40' Rt.

123 Set 25' Rt.

Sta 122+00 Def Rt 37°51'

121

120

119

118

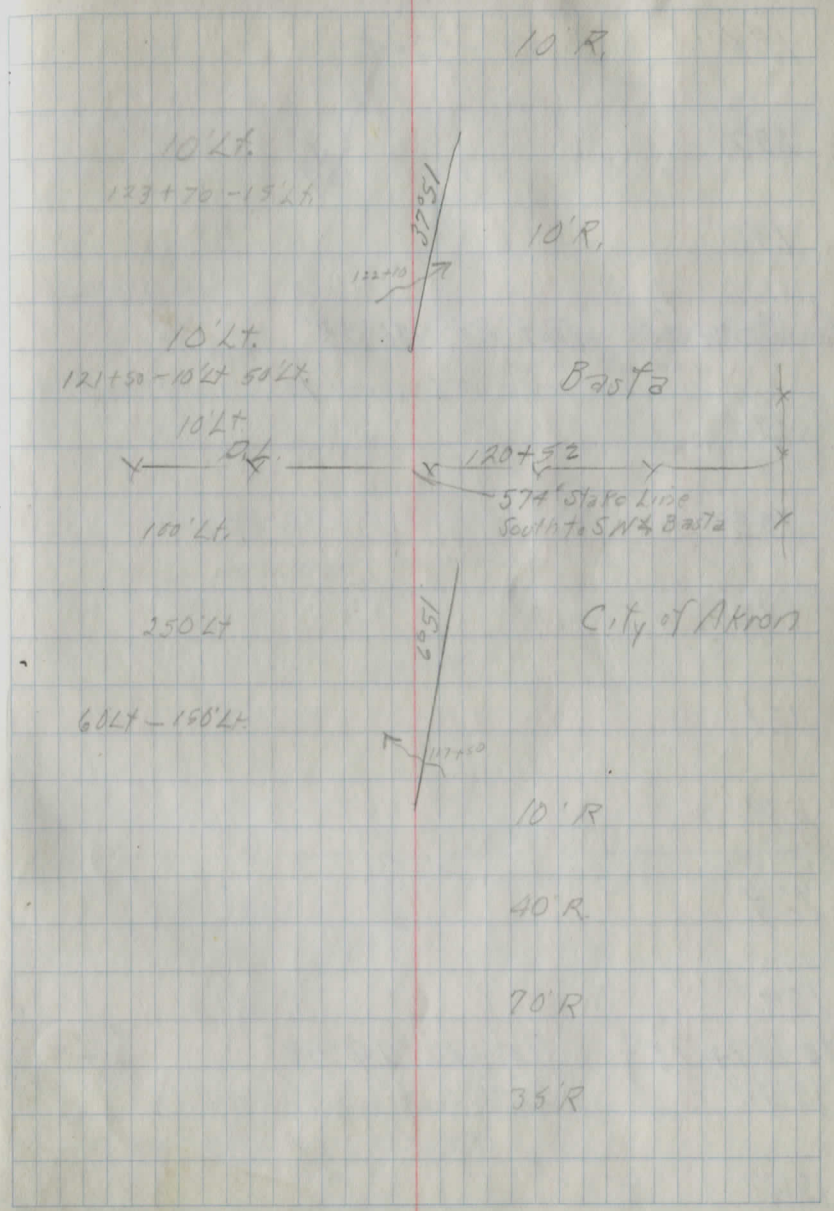
Sta 117+74.6 Def Rt 6°51 Hub Set

116

115

114

113



138

137

136

Sta 135+00 Def Rt 46°58'

← move PI ahead 16'± & shift next tang.

134

133

132

131

130

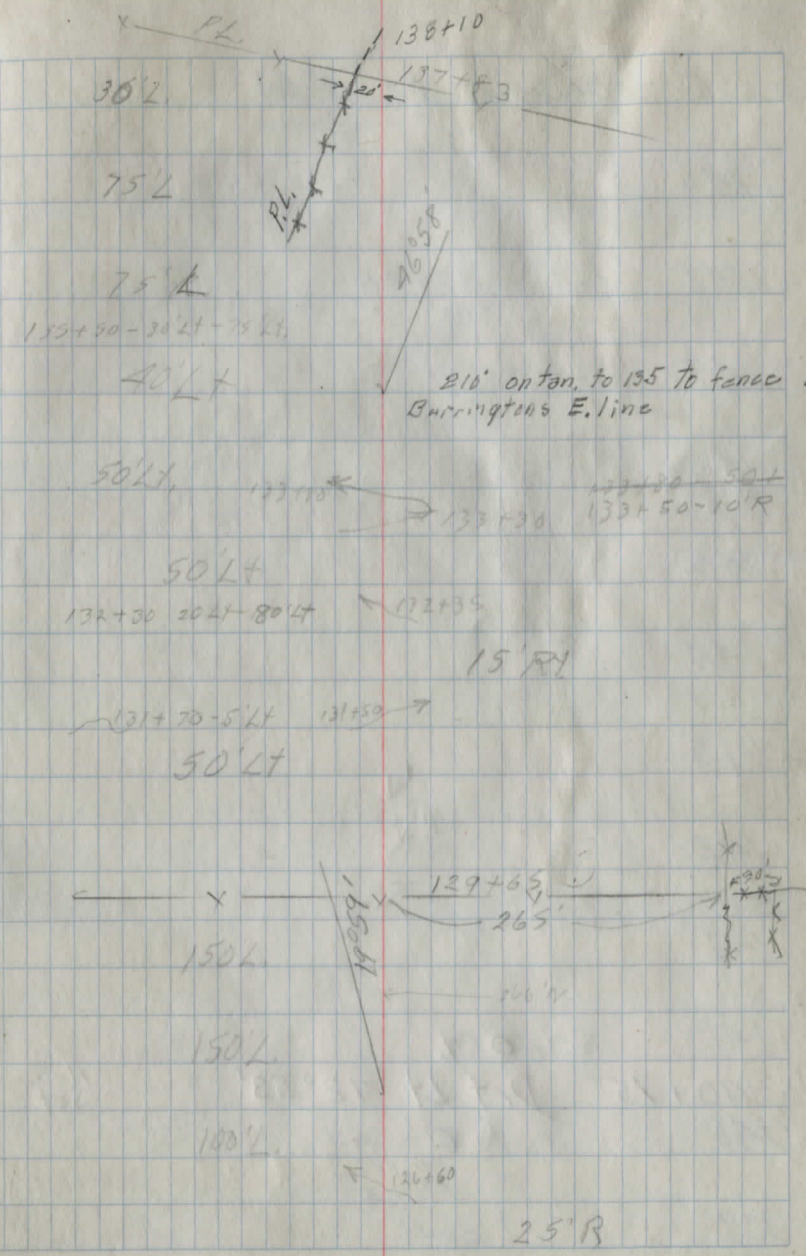
129

128

Sta 127+78 Def Lt 19°59' Hub Set

127 Rotate last tangent to 75' Lt.

126



Sta 150 + 00   Def. Lt. 4°01'

149

148   set at 47+90

147   set 35' Rt

146

145

144

143

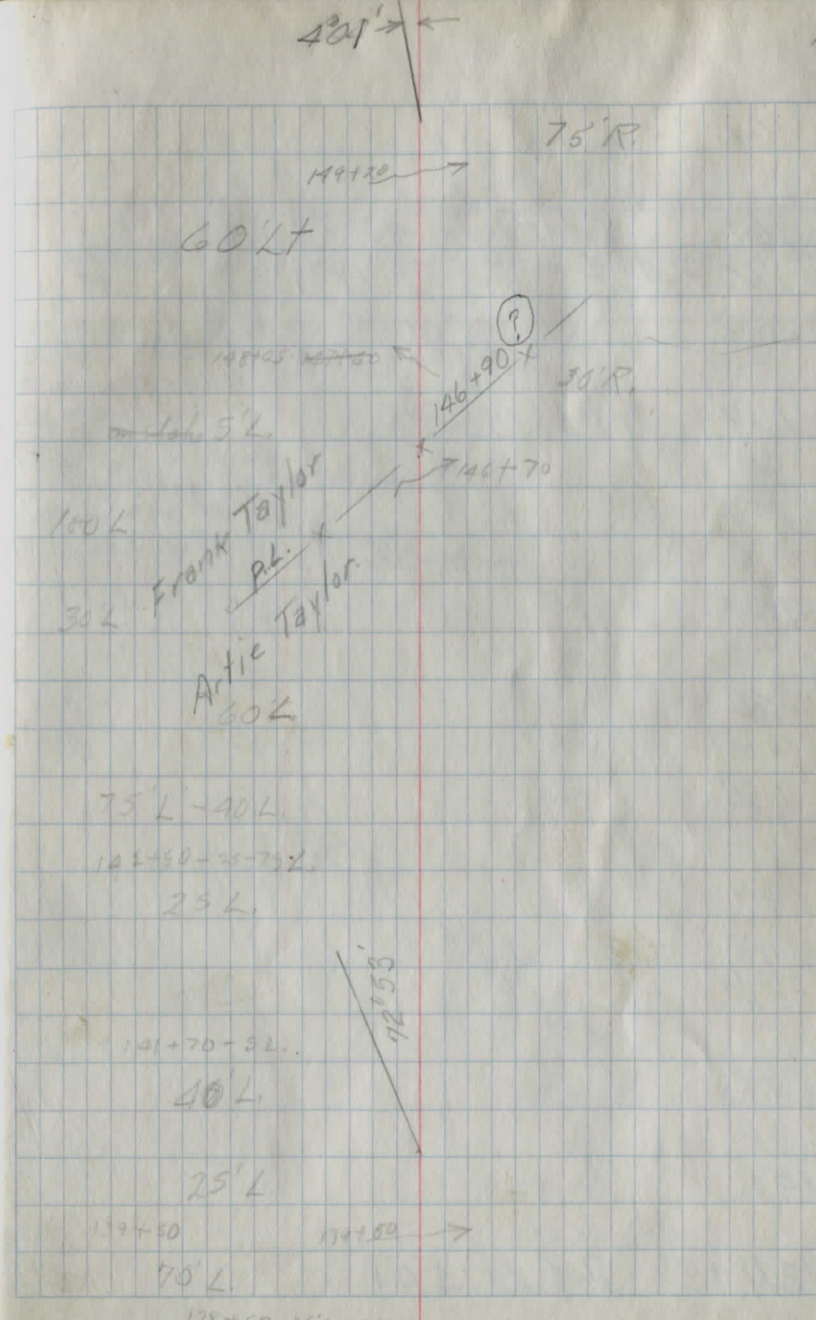
142   Obs. N 74° E

141

141   set 40' Rt.

Sta 140 + 75°   Def Lt   72° 53'   Hub Set

140   E = 60.0
      T = 182.3
      R = 247.
139   Equ



162

161 sidestakes 46' Rt. of ℄

Sta 160 + 40± Def Rt. 19°30' Hub set

160 160+40± set in line with Wedge W. Railing and 46.1 South of ℄ Bridge

159 Set at 158+90

158 Rotate (end of Tang. 16' to Left.

157

156

155

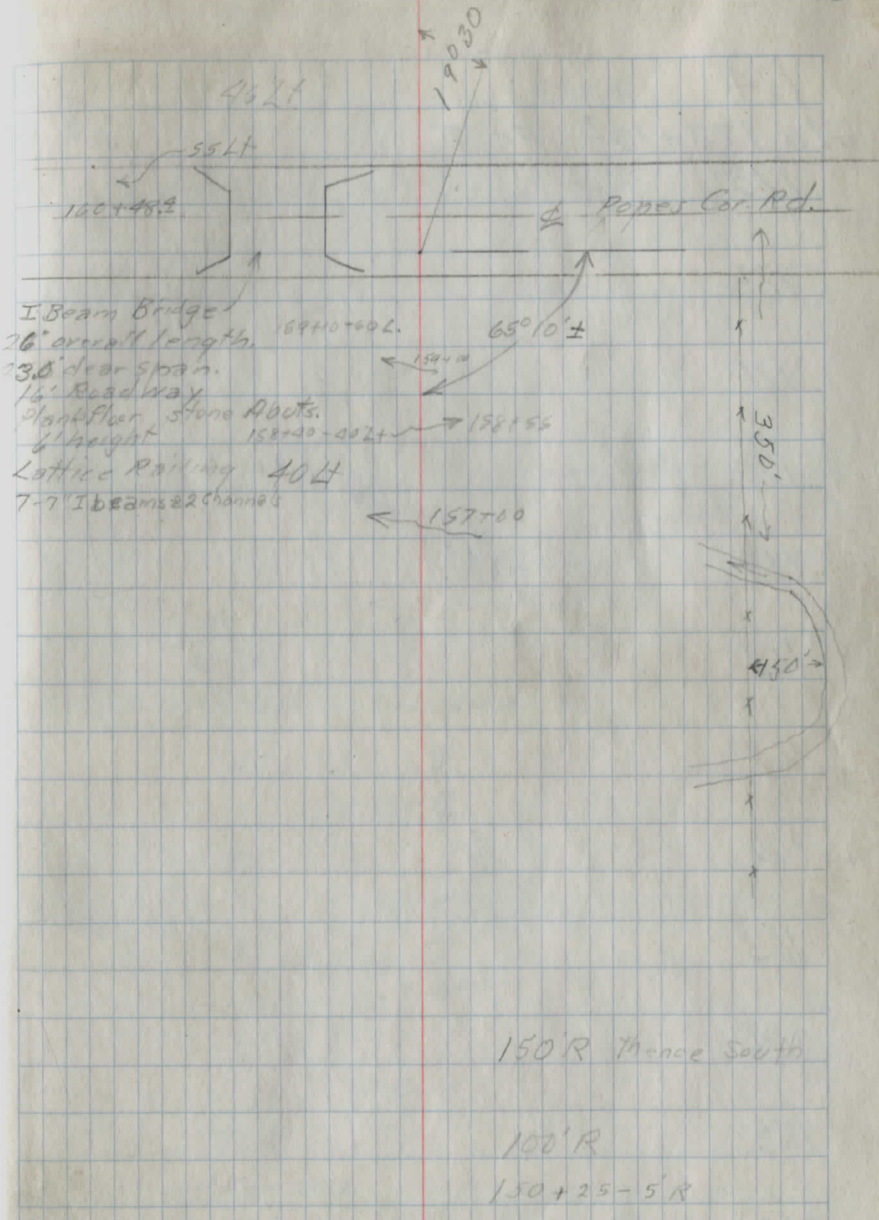
154 Sidestakes 30' Rt.

153

152

151

Sta 150 + 00 Def Lt 4°01



174

Sta 173+13.7 POT

Hub Set

173

172

171

170

169

168

167

166

165

164

163

162

Std stakes 46' Rt.

Obs. N 88° 30' E

330' R

enter woods

200 R.

225' R.

170+40 - 150R - 100R.

169+25

170+40 70R - 100R.

168+50 - 100 Lt.

60' Lt.

167+50 - 55 Lt

167+30

40' L

166+00

55' L

55' Lt

165+50 = 25L - 69L

164+50

25' Lt

163+00

70' Lt

162+65 - 100 Lt

183+10 End of Project ℄ 10' Lt

182 set at 182+20 60' Rt.

181 set 60' R.

180

179 Set 55' Rt.

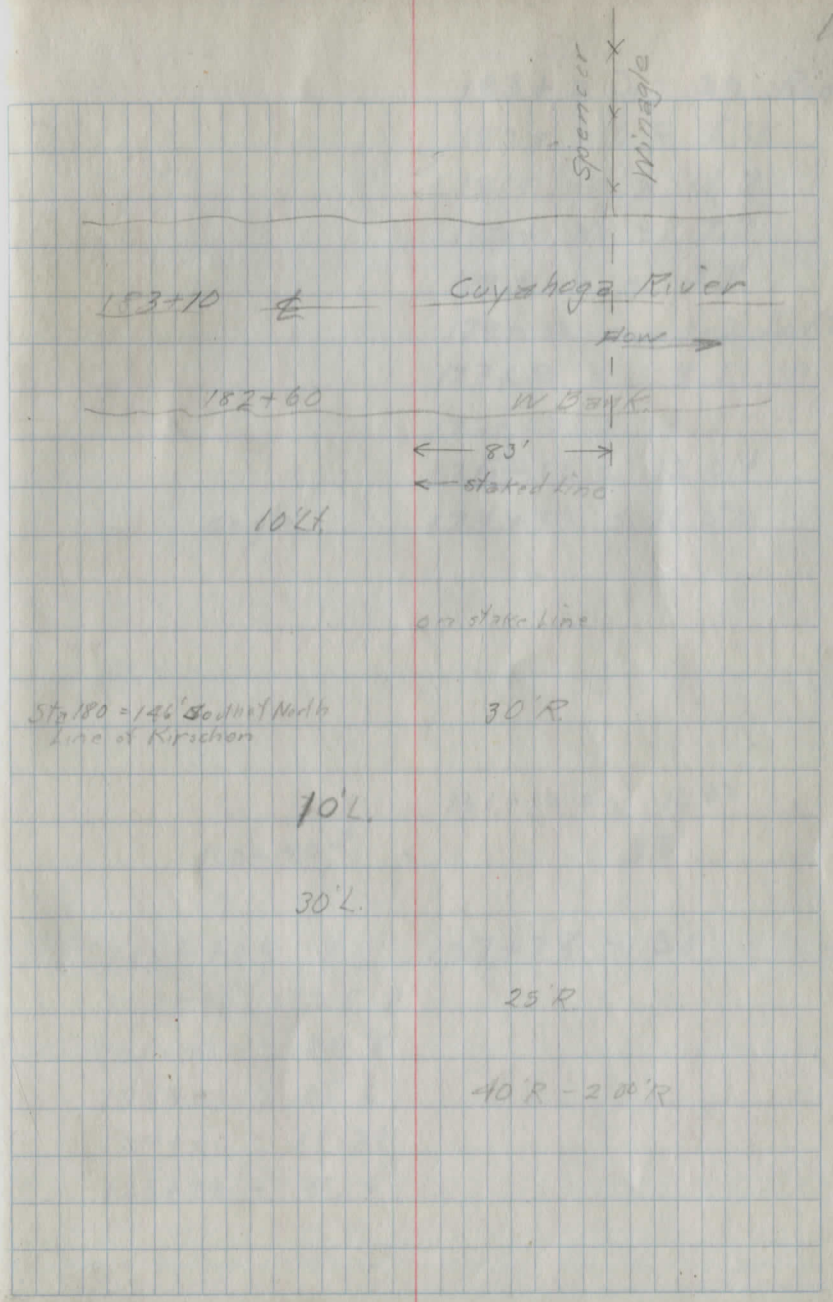
178

177

176

175

Sta 174+00 Def Rt 2°16' ℄ 46' Lt.



183+00 = 20 Right
182+00 = 15.65
181+00 = 11.7
180+00 = 7.7
179+00 = 3.8
178+00 = 0.2 Left
177+00 = 4.1 "
176+00 = 8.1 "
175+00 = 12.04
angle 174+00 = 16.00

161+00 = 16.00

160+40.4 = 38

160+40.4 to 127+78 = 38

127+00 = 25.9
126+00 = 20.8
125+00 = 15.6
124+00 = 10.38
123+00 = 5.7

Levels on Black Brook Ditch

BM Found	4.43	1153.43		1149.00	←
	4.30	1154.45	3.28	1150.15	
	1.54	1145.79	10.20	1144.25	
BM #1			4.81	1140.98	1140.96
Flow Line			15.6	1130.2	
	3.06	1137.43	11.42	1134.37	
Flow 0-300			7.4	1130.0	
BM #2			0.81		1136.62
0			9.1	28.3	
1			8.7	28.7	
	2.98	1135.21	5.20	1132.23	
1+60			4.3	30.9	
2			4.4	30.8	
3			4.6	30.6	
3+40			4.5	30.7	
4+00			6.3	28.9	
4+05			5.1	30.1	
5			4.8	29.4	
6			5.3	29.9	
7			5.8	29.4	
7+10			7.8	27.4	
7+15			5.8	29.4	
8			6.7	28.5	
	5.60	1136.79	4.02	1131.19	
9			8.6	28.2	

Spike W. Root 24" Beech stump. Sta 11+18
1CH 32A Sec 8.

NE Cor. E. Curb of Bridge in Portage Co. 0-900
Bridge above →

Spike W. root 30" Maple 40' Rt old channel 0-200

		1136.79		
9+80		9.9	26.9	
9+90		11.9	24.9	
10		9.1	27.7	
11		9.5	27.3	
11+15		11.4	25.4	
11+25		9.2	27.6	
12		9.1	25.7	
BM #3		8.13		1128.66
	9.33	1137.99		
12+70		10.9	27.1	
12+85		13.0	25.0	
13		11.3	26.7	
14		13.1	24.9	
14+15		11.9	26.1	
14+20-35		14.6	23.4	
14+40-80		11.7	26.3	
14+85-95		14.1	23.9	
15 Gr		11.7	26.3	
15+20		12.6	25.4	
15+25-40		14.1	23.9	
15+45		11.6	26.4	
16		12.0	26.0	
16+30		12.7	25.3	
16+40		14.2	23.8	
16+60		12.1	25.9	

Spike W Root 30' Oak 90' Lt. Sta 12+70

		1137.99			
17			12.8	25.2	
	3.51	1129.72	11.78	1126.21	
18			4.4	25.3	
19			4.3	25.4	
20			5.2	24.5	
	1.07	1127.77	3.02	1126.70	
20+80	Ground		3.6	24.2	
20+85			5.6	22.2	
21			5.6	22.2	
21+30			3.1	24.7	
22			3.7	24.1	Ground at Hub
23			6.8	21.0	
24			4.7	23.1	
BM#4			2.80		1124.97 Spike NE root twin 15"Elm 40'Lt. of Stake Line 22+10
	2.91	1127.97	2.71	1125.06	
25			7.5	20.5	
26			4.6	23.4	
27			5.3	22.7	
28			5.6	22.4	
	4.24	1126.83	5.38	1122.59	T.P. #9
29			5.3	21.5	
30			6.6	20.2	
31			6.6	20.2	
31+40			5.2	21.6	
31+50			6.8	20.0	

		1126.83		
31+60			4.9	21.9
32			5.1	21.7
32+60			5.2	21.6
33			7.6	19.2
34			6.0	20.8
	4.22	1128.19	2.86	1123.97
35			9.4	18.8
36			9.9	18.3
Ground 6.5				
37			7.7	20.5
37+5	2.35	1128.24	2.30	1125.89
37+10			7.8	20.4
37+15			10.4	17.8
37+20			7.8	20.4
38			7.8	20.4
39			8.8	19.4
39+25			9.8	18.4
39+35			8.8	19.4
40			8.2	20.0
40+40			8.7	19.5
40+55			10.2	18.0
40+60			8.6	19.6
41			8.6	19.6
41+30			8.7	19.5
41+40			10.7	17.5
41+55			8.7	19.5

Spike Nail 15' Elm reference row 250' RT & Sta 38+00
also 150' RT Sta 40+50

		1128.24			
	6.80	1126.86	8.18	1120.06	
42			7.7	19.2	
43			7.7	19.2	
43+15			9.2	17.7	
43+25			7.5	19.4	
44			7.9	19.0	
44+15			9.5	17.4	
44+20			7.9	19.0	
45			8.6	18.3	
45+12			8.9	18.0	
45+25			10.4	16.5	
45+35			8.9	18.0	
BM 6	8.33	1127.97	7.22		1119.64
46			11.3	16.7	
47			10.2	17.8	
Ground at 46.			9.5	18.5	
48			11.1	16.9	
49			10.0	18.0	
50			12.2	15.8	
	8.22	1126.83	9.36	1118.61	
50+20			11.2	15.6	
50+30			8.2	18.6	
51			8.1	18.7	
52			9.1	17.7	
52+90			8.6	18.2	

Spike NE root 18" Elm 50' Rt ℄ Sta 45+50

small lateral Rgt at 50+30

		1126.83			
53+15			11.1	15.7	
53+30			8.6	18.2	
BM #7			4.30		1122.53
54			9.4	17.4	
55			9.5	17.3	
	3.33	1122.21	7.95	1118.88	
56			4.2	18.0	
57			5.0	17.2	
58			6.1	16.1	
59			7.9	14.3	
	6.09	1126.33	1.97	1120.24	
60			12.6	13.7	
61			10.8	15.5	
62			9.8	16.5	
61+85			12.6	13.7	
63			11.4	14.9	
63+95			13.3	13.0	
64+05			10.0	16.3	
65			11.2	15.1	
BM #8	4.82	1121.45	9.70		1116.63
66			7.0	14.5	
66+70			8.8	12.7	
67			8.8	12.7	
68			8.9	12.6	
69			7.3	14.2	

Spike W root 24" Maple 50' Lt. Sta 54+00

T.S. 60

Spike SW root 12" Elm 60' Lt & Sta 64+30

		1121.45			
	5.02	1119.87	6.60	1114.85	
70			5.4	14.5	
71			4.9	15.0	
72			5.3	14.4	
73			8.3	11.4	
73+10-60			5.8	14.1	
73+85					
74+10-60			6.7	13.2	
74+85			8.2	11.7	
	4.06	1118.18	5.75	1114.12	
BM=9			1.56		1116.62
75+15			4.1	14.1	
76			4.7	13.5	
76+80			5.0	13.2	
77			7.6	10.4	
77+60			7.6	10.6	
78			7.6	10.4	
78+15			5.5	12.7	
78+30-40			5.6	12.4	
78+60			7.6	10.6	
	9.98	1123.07	5.09	1113.09	
78+75			10.2	12.9	
79			12.0	11.1	
79+10			10.2	12.9	
79+80			10.2	12.9	

2½' water

Spike N Wroot 24" Elm 80'Rt & Sta 74+50 in fence row

2½' water

		1123.07			
79+90			11.1	12.0	
80			9.9	13.2	
81			10.2	12.9	
81+70			10.4	12.7	
82			14.0	09.1	
83			14.2	08.9	
84			12.7	10.4	
	1.02	1121.49	2.60	1120.47	
85			11.3	10.2	
86			12.4	09.1	
87			10.6	10.9	
87+60 ± Bridge			7.3	14.2	
Flow of Bridge			14.6	06.9	
BM #10			9.00		1112.49
	2.89	1116.05	8.33	1113.16	
88			7.7	08.4	
89			6.5	09.6	
88+80			7.3	08.8	
90			4.7	11.4	
91+10			5.5	10.6	
	3.88	1115.76	3.97	1112.08	
91+20-30			7.8	08.2	
91+40			4.7	11.3	
92			4.5	11.5	
93			5.3	10.7	

Seat bolt ends – 8.5

Spike SW root 30" Elm 100 Lt ℄ Sta 87+80 E. side road

		1115.96			
94			5.4	10.6	
	2.02	1113.54	444	1111.52	
94+30			4.2	09.3	
94+50-60			60	07.5	
94+65			30	10.5	
95			32	10.3	
96			38	09.7	
96+05-20			58	07.7	
96+25			32	10.3	
	4.01	1114.36	3.19	1110.35	
BM # 11			3.33		1111.03
97			4.7	09.7	
98			4.8	09.6	
99			55	08.9	
100			56	08.8	
	3.31	1113.25	442	1109.94	
100+10			46	08.7	
100+15-25			70	06.3	
100+30			41	09.2	
101			52	08.1	
101+15			52	08.1	
101+25			74	05.9	
101+30			42	09.1	
102			74	05.9	
102+30			3.9	09.4	

Spike NE root 30" Elm 25' Rt state line Sta 96+35

		1113.25				
103			49	08.4		
104			5.5	07.8		
105			54	07.9		
	3.18	1111.78	465	1108.60		
106			40	07.8		
106+50			49	06.9		
106+55-85			7.2	04.6		
107			47	07.1		
BM F12			3.32		1108.46	Spike N root 15" Elm 60' Rt ℄ Sta 107+00
108			48	07.0		
	3.63	1112.11	3.30	1108.48		
108+50			52	06.9		
108+60-70			84	03.7		
108+75			5.3	06.8		
109			53	06.8		
109+80			55	06.6		
110			80	04.1		
110+20			55	06.6		
110+85			7.5	04.6		
111			51	07.0		
112			5.0	07.1		
112+80			6.2	05.9		
112+90-113+00			8.3	03.8		
	3.37	1110.63	4.85	1107.26		
113+30			49	05.7		

		1110.63			
114			5.0	05.6	
115			5.1	05.5	
115+40			5.8	04.8	
115+45-60			7.6	03.0	
115+70			4.6	06.0	
116			5.4	05.2	
BM #13	5.16	1110.37	5.42		1105.21
117			5.3	05.1	
117+50			5.4	05.0	
117+65-70			7.3	03.1	
117+75			4.8	05.6	
119			5.7	04.7	
~~120~~	3.39	1109.40	4.36	1106.01	
120			5.3	04.1	
120+40			5.0	04.4	
120+50			7.6	01.8	
120+70			5.6	03.8	
121			5.2	04.2	
121+45			6.1	03.3	
121+50-60			7.7	01.7	
121+65			5.0	04.4	
	3.36	1108.39	4.37	1105.03	
121+90			5.3	03.1	
122			7.1	01.3	
122+10			7.1	01.3	

Spike N root 15' Elm 30' Rt ℄ Sta 116 +40

Sta 119

		1108.39			
122+10			40	04.4	
123			41	04.3	
124			45	03.9	
125			44	04.0	
126			54	03.0	
	440	1108.39	440	1103.99	
126+50			53	03.1	
BM 14			525		1103.14
126+55-65			88	99.6	
126+80			64	02.0	
127			52	03.2	
128			50	03.4	
129			57	02.7	
~~130~~	224	1107.17	346	1104.93	
130			35	03.7	
131+20			52	02.0	
131+25-40			86	98.6	
131+50			60	01.2	
132			60	01.2	
132+25			62	01.0	
132+30-40			79	99.3	
132+45			45	02.7	
133			61	01.1	
	335	1106.54	398	1103.49	
133+20			61	1100.4	

Spike NE root 36" Elm 45' Rt & Sta 126+60

TS 133

		1106.54			
133+25 - 35			7.7	98.8	
133+40			4.4	02.1	
133+60			5.9	1100.6	
+65			7.7	98.8	
+75			7.7	98.8	
+80			5.1	01.4	
135			5.7	1100.8	
135 Ground at Hub			5.0	01.5	
BM #15			3.91		1102.63
136			6.1	1100.4	
	4.02	1105.41	5.15	1101.39	
137			4.4	01.0	
137+80			5.8	99.6	
138			7.8	97.6	
138+20			7.8	97.4	
138+50			4.6	1100.8	
139			5.0	1100.5	
139+25			5.6	99.8	
	3.61	1104.59	4.43	1100.98	
139+40-55			6.9	97.7	
139+60			4.7	99.9	
140			5.5	99.1	
141			7.3	97.3	
142			8.4	94.2	
	3.91	1104.30	4.20	1100.39	

Spike N root 30" Swamp Oak 25' Rt sta to Line 134+60

		1104.30		
143			5.1	99.2
143+10			5.8	98.5
143+40			4.5	99.8
143+60			7.0	97.3
143+70			4.4	99.9
144			4.4	99.9
145			7.7	96.6
	3.44	1103.89	3.85	1100.45
146			4.3	99.6
146+60			5.0	98.9
146+65-85			6.9	97.0
146+80			5.4	98.5
147			5.1	98.8
148			5.3	98.6
148+05-15			7.9	96.0
148+20			5.3	98.6
BM#16			3.97	1099.92
	3.42	1104.00	3.31	1100.58
149			5.5	98.5
149+15-25			8.5	95.5
149+35			5.2	98.8
150+15			6.0	98.0
150+25-35			7.0	97.0
150+50			5.6	98.4
151			6.0	98.0

Spike N. root 18" Elm 42' Rt. Sta 146+60

		1104.00		
152			5.1	98.9
153			5.3	98.7
	3.22	1102.71	4.51	1099.49
154			4.6	98.1
155			4.6	98.1
156			4.6	98.1
156+60			5.5	97.2
157			5.0	97.7
157+60			5.5	97.2
157+55-70			8.4	94.3
157+75			5.9	96.8
158			6.5	96.2
158+40			6.9	95.8
	6.64	1104.21	5.14	1097.57
158+50-60			10.1	94.1
158+70-90			7.5	96.7
158+95-55			10.0	94.2
159+10			7.1	97.1
Flow S end Bridge 160+48			11.0	93.2
H_2O Level "			8.0	96.2
Floor			3.7	1100.5
Flow N. end Bridge			10.8	93.4
BM #17			4.57	1099.64
161			8.1	96.1
161+50			7.7	96.5

T.S. 153

(Road Notes show Bridge Creek Sta 13+35.8 and a B.M. West Side 24" Hickory East of Sta 14+30 = Elv 1100.0
B.M. Spk S.W. Root 24" Maple Rt Sta 00-35 = Elv 1105.52
B.M. E. Root 48" Ash Lt Sta 31+25 = Elv 1166.72 (about 20' South of Henderson S. P/L)

SW Cor. North Bridge Seat 11' Lt Sta ~~146+40~~ 160+40

		1104.21		
161+90			8.8	95.4
162			8.8	95.4
162+10			7.3	96.9
162+45			8.4	95.8
162+50-60			10.6	93.6
	3.64	1100.91	6.94	1097.27
162+65			4.4	96.5
163			4.5	96.4
163+40			4.4	96.5
163+60-			5.6	95.3
163+75-90			7.2	93.7
163+90			5.2	95.7
164			5.2	95.7
164+30			6.0	94.9
164+40-50			7.8	93.1
164+65			4.1	96.8
165			4.5	96.4
165+40			6.5	94.4
165+50			4.7	96.2
166			4.6	96.3
166+20			4.6	96.3
166+30-45			8.4	92.5
166+50			6.1	94.8
167			7.7	93.2
	2.07	1099.96	3.02	1097.89

T.S. 163

		1099.76			
167+30			7.5	92.5	
167+40			4.4	95.6	
167+70			6.0	94.0	
168			3.3	96.7	
168+70			4.6	95.4	
169+10			5.0	95.0	
169+15-25			7.9	92.1	
169+40			3.7	96.3	
170			4.0	96.0	
BM #18			3.34		1096.62
171			4.7	95.3	
172			5.0	95.0	
	2.94	1098.88	4.02	1095.94	
173			5.2	93.7	
174			3.2	95.7	
175			4.9	94.0	
176			5.6	93.3	
177			5.9	93.0	
	2.43	1097.29	4.02	1094.86	
178			3.5	93.8	
Channel 20'R			7.4	89.9	
179			3.6	93.7	
Channel 20'R			7.7	89.6	
BM #19			3.95		1093.34
180			4.0	93.3	

Spike & NW root 15" Hickory 75' Rt & Sta 170+35

TS 177

Spike SE root 24" Maple 120' Lt & Sta 180+20
20' S. of Kirschen North Line and 200' W. of W. Bank of River

1097.29

181	4.8	92.5	
Channel 45 Rt	7.2	90.1	
182	5.7	92.6	
Channel 35 Rt	10.0	87.3	
H_2O Level River	6.0	91.3	
182+70	9.5	87.8	

Check Levels

BM #9	3.95	1097.29			1093.34
	4.01	1098.87	2.43	1094.86	
	4.21	1100.14	2.94	1095.93	ok
BM #8			3.50	1096.64	"
	2.71	1100.60	2.25	1097.89	ok
	7.78	1104.71	3.67	1096.93	
BM #7			5.14	1099.57	1099.64

BM #7	5.14	1104.78			1099.64
BM			4.93	1099.85	100.00

BM Popes Cor. Rd. = Spike W. side 18" Hickory 40' Rt & Road 100' Lt & Sta 161+00

BM	5.17	1105.11		1099.64
N bdge	Floor		4.6	1100.5
" "	W F/L		13.5	1091.6
" "	E F/L		12.3	1092.8
S "	Floor		5.0	1100.1
" "	E F/L		12.0	1093.1
" "	20' E of ℄ rd		9.5	1095.6
T.P.	4.42	1106.60	2.93	1102.18
T.P.	2.93	1099.72	9.81	1096.79
T.P.	6.83	1102.85	3.70	1096.02
BM			7.51	1095.34

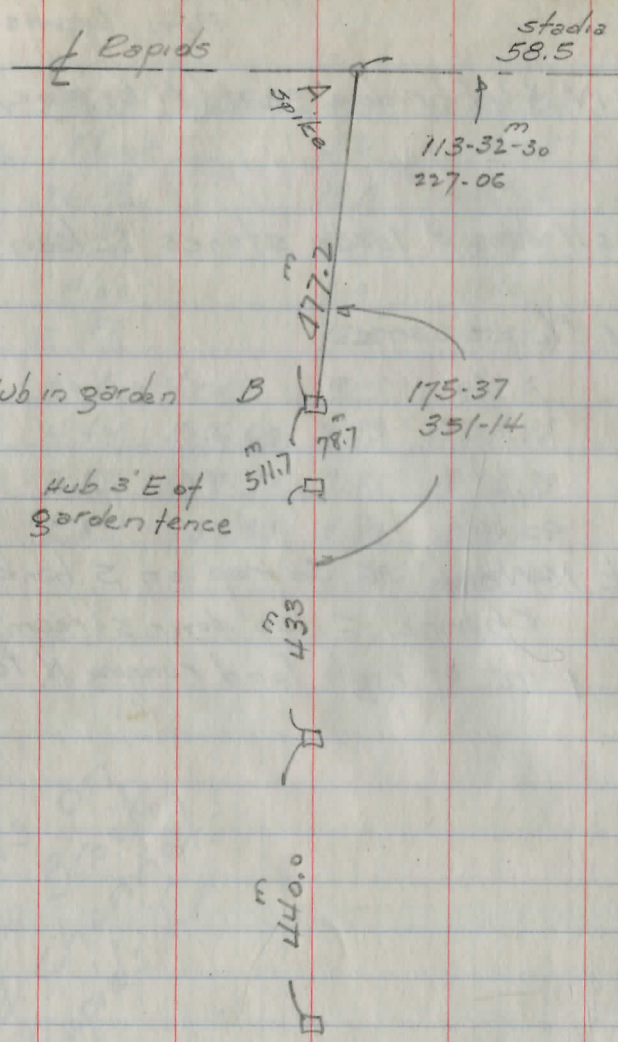
Levels on Black Brook Flood channel at Rapids Rd

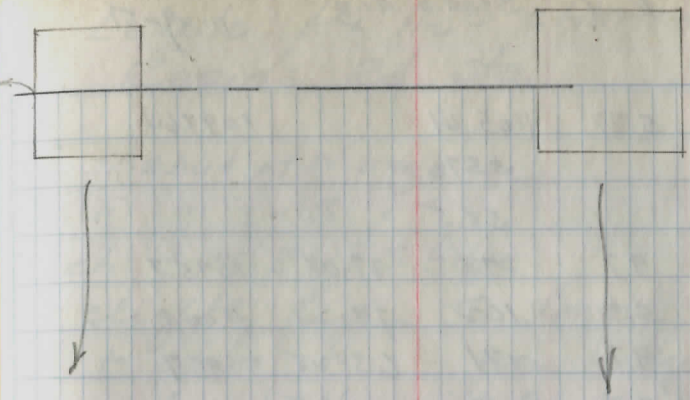
SW & N bridge seat (N bridge)

small dam & large stones clean

W F/L = ± same

Spk NW side 36" So map on S bank of S Channel ± 150' downstream from point of high land running N to channel





Tel. wires = west side rd & low
CEI " = east side " & high

Black Brook Flood Channel

11-29-51

Set at BS on	Rod	Stadia	Ang	11-29-51	
BM.	5.77	1105.41		1099.64	
A-EN		3.57			
		58.5			
1	9.7	78	27-08	1095.7	
2	5.3	162	79-20	1100.1	
3	9.7	171	63-25	95.7	
4	9.4	± 184	54-25	96.0	
T.P. #1	4.87	1107.06	3.22	1102.19	(02.18)
B-A	12.5	263	54-27	94.6	
	8.8	171	102-57	98.3	
	13.6	200	" "	93.5	
	11.4	306	" "	95.7	
	13.7 ±	257	135-40	93.4	
T.P. #2			10.26	1096.80	(96.79)

Levels Hi H_2O channel. 46

Rapids Rd Sta. Easterly

S abut of N bdge

" " " S "

ch. ± 35' E of S bdge

slightly higher S lowers N & W & NE

± chan from bridge E for

maybe up N ± 500 very brushy

small log weirs

Higher SW lower W N & E & SE

Ch. Not so much brush here on E

higher NE

Ch

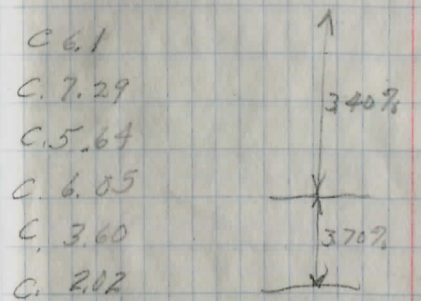
Drainage Ditch Troy Cemetery

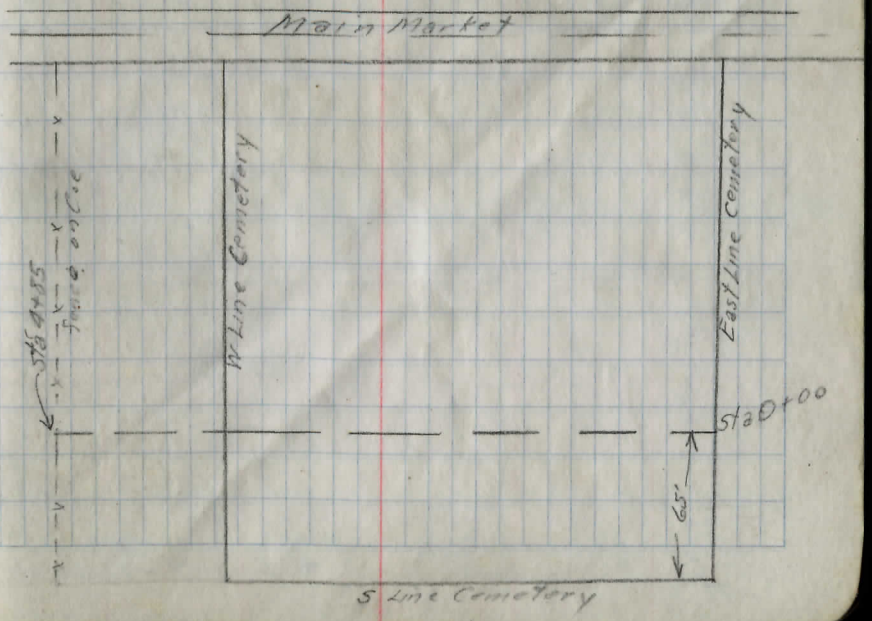
Stakes on N. Line of drive and 65' N. of S. fence line.

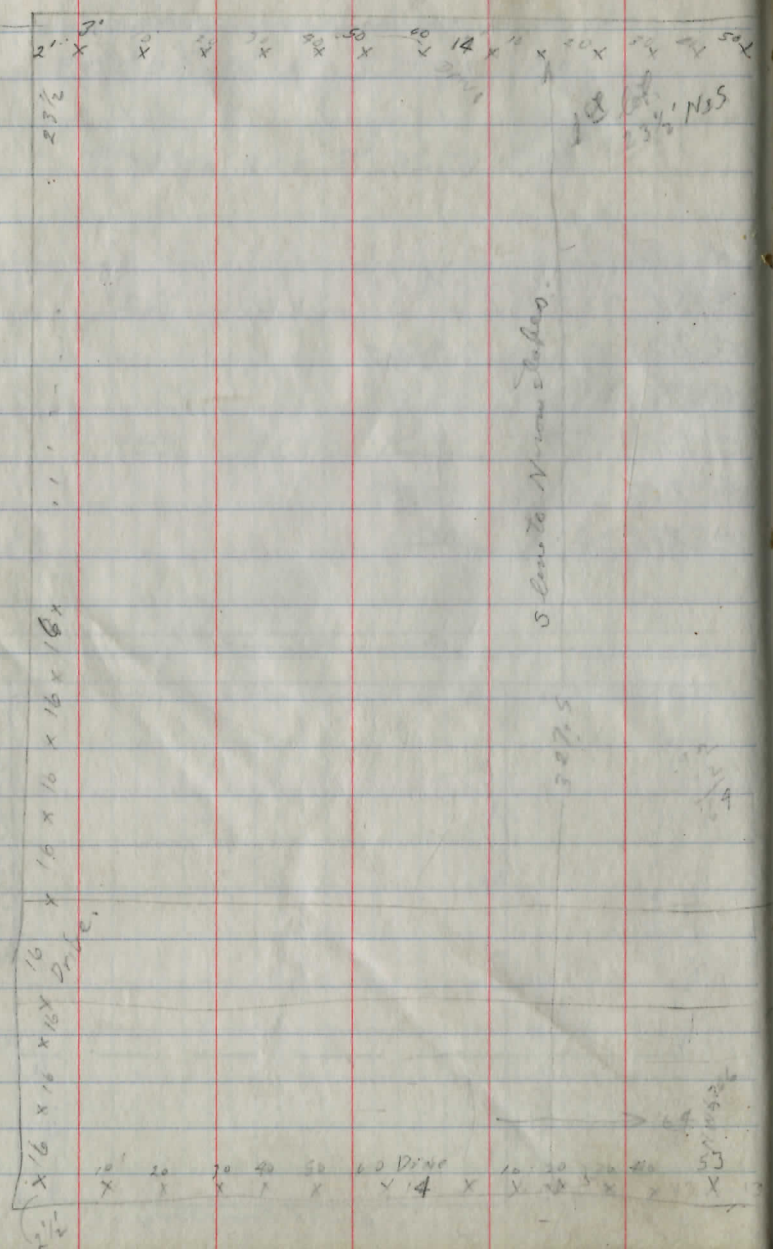
Stakes are 8' North of ℄

					Grade.
0	2.66	102.56		100.00	93.90
1			4.77	97.79	90.50
2			9.82	92.74	87.10
3	1.55	91.30	12.81	89.75	83.70
4			7.70	83.60	80.00
4+83			12.28	79.02	77.00

C 6.1
C. 7.29
C. 5.64
C. 6.05
C. 3.60
C. 2.02







100.00
4.14
104.14
990
4

990
4.14
5.76

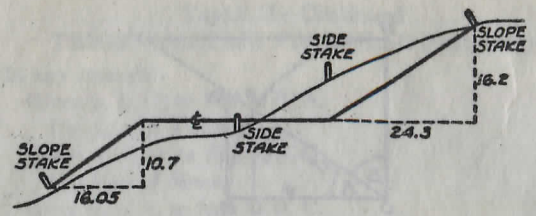


TABLE I.—DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

SLOPE 1½ TO 1. ROADWAY OF ANY WIDTH

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	0.00	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	0
1	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	1
2	3.00	3.15	3.30	3.45	3.60	3.75	3.90	4.05	4.20	4.35	2
3	4.50	4.65	4.80	4.95	5.10	5.25	5.40	5.55	5.70	5.85	3
4	6.00	6.15	6.30	6.45	6.60	6.75	6.90	7.05	7.20	7.35	4
5	7.50	7.65	7.80	7.95	8.10	8.25	8.40	8.55	8.70	8.85	5
6	9.00	9.15	9.30	9.45	9.60	9.75	9.90	10.05	10.20	10.35	6
7	10.50	10.65	10.80	10.95	11.10	11.25	11.40	11.55	11.70	11.85	7
8	12.00	12.15	12.30	12.45	12.60	12.75	12.90	13.05	13.20	13.35	8
9	13.50	13.65	13.80	13.95	14.10	14.25	14.40	14.55	14.70	14.85	9
10	15.00	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	10
11	16.50	16.65	16.80	16.95	17.10	17.25	17.40	17.55	17.70	17.85	11
12	18.00	18.15	18.30	18.45	18.60	18.75	18.90	19.05	19.20	19.35	12
13	19.50	19.65	19.80	19.95	20.10	20.25	20.40	20.55	20.70	20.85	13
14	21.00	21.15	21.30	21.45	21.60	21.75	21.90	22.05	22.20	22.35	14
15	22.50	22.65	22.80	22.95	23.10	23.25	23.40	23.55	23.70	23.85	15
16	24.00	24.15	24.30	24.45	24.60	24.75	24.90	25.05	25.20	25.35	16
17	25.50	25.65	25.80	25.95	26.10	26.25	26.40	26.55	26.70	26.85	17
18	27.00	27.15	27.30	27.45	27.60	27.75	27.90	28.05	28.20	28.35	18
19	28.50	28.65	28.80	28.95	29.10	29.25	29.40	29.55	29.70	29.85	19
20	30.00	30.15	30.30	30.45	30.60	30.75	30.90	31.05	31.20	31.35	20
21	31.50	31.65	31.80	31.95	32.10	32.25	32.40	32.55	32.70	32.85	21
22	33.00	33.15	33.30	33.45	33.60	33.75	33.90	34.05	34.20	34.35	22
23	34.50	34.65	34.80	34.95	35.10	35.25	35.40	35.55	35.70	35.85	23
24	36.00	36.15	36.30	36.45	36.60	36.75	36.90	37.05	37.20	37.35	24
25	37.50	37.65	37.80	37.95	38.10	38.25	38.40	38.55	38.70	38.85	25
26	39.00	39.15	39.30	39.45	39.60	39.75	39.90	40.05	40.20	40.35	26
27	40.50	40.65	40.80	40.95	41.10	41.25	41.40	41.55	41.70	41.85	27
28	42.00	42.15	42.30	42.45	42.60	42.75	42.90	43.05	43.20	43.35	28
29	43.50	43.65	43.80	43.95	44.10	44.25	44.40	44.55	44.70	44.85	29
30	45.00	45.15	45.30	45.45	45.60	45.75	45.90	46.05	46.20	46.35	30
31	46.50	46.65	46.80	46.95	47.10	47.25	47.40	47.55	47.70	47.85	31
32	48.00	48.15	48.30	48.45	48.60	48.75	48.90	49.05	49.20	49.35	32
33	49.50	49.65	49.80	49.95	50.10	50.25	50.40	50.55	50.70	50.85	33
34	51.00	51.15	51.30	51.45	51.60	51.75	51.90	52.05	52.20	52.35	34
35	52.50	52.65	52.80	52.95	53.10	53.25	53.40	53.55	53.70	53.85	35
36	54.00	54.15	54.30	54.45	54.60	54.75	54.90	55.05	55.20	55.35	36
37	55.50	55.65	55.80	55.95	56.10	56.25	56.40	56.55	56.70	56.85	37
38	57.00	57.15	57.30	57.45	57.60	57.75	57.90	58.05	58.20	58.35	38
39	58.50	58.65	58.80	58.95	59.10	59.25	59.40	59.55	59.70	59.85	39
40	60.00	60.15	60.30	60.45	60.60	60.75	60.90	61.05	61.20	61.35	40
41	61.50	61.65	61.80	61.95	62.10	62.25	62.40	62.55	62.70	62.85	41
42	63.00	63.15	63.30	63.45	63.60	63.75	63.90	64.05	64.20	64.35	42
43	64.50	64.65	64.80	64.95	65.10	65.25	65.40	65.55	65.70	65.85	43
44	66.00	66.15	66.30	66.45	66.60	66.75	66.90	67.05	67.20	67.35	44
45	67.50	67.65	67.80	67.95	68.10	68.25	68.40	68.55	68.70	68.85	45
46	69.00	69.15	69.30	69.45	69.60	69.75	69.90	70.05	70.20	70.35	46
47	70.50	70.65	70.80	70.95	71.10	71.25	71.40	71.55	71.70	71.85	47
48	72.00	72.15	72.30	72.45	72.60	72.75	72.90	73.05	73.20	73.35	48
49	73.50	73.65	73.80	73.95	74.10	74.25	74.40	74.55	74.70	74.85	49
50	75.00	75.15	75.30	75.45	75.60	75.75	75.90	76.05	76.20	76.35	50

Computed by L. Leland Locke.

TABLE No. 1

Distance of slope stake from side or shoulder stake for any width roadway, slope 1½ to 1. If ground is nearly level, the cut or fill at side stake is located by the double entry method in left column and top row. The number in body of table in same row and column gives distance from side stake to slope stake. If ground is not level estimate the difference in elevation between the side stake and slope stake, lower target by this amount if cut, elevate if fill. Add this amount to cut or fill and find distance in table. Set up rod at this point, and line of sight should cut target. If it does not make the slight adjustment necessary.

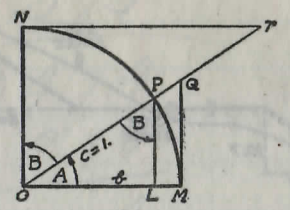


Table II

TRIGONOMETRIC FORMULAE

$\angle A = \angle MOP \qquad \angle B = \angle PON = \angle OPL$

$R = OB = c = 1$

$$\sin A = \frac{a}{c} = \frac{a}{1} = a = \cos B = LP$$

$$\cos A = \frac{b}{c} = \frac{b}{1} = b = \sin B = OL$$

$$\tan A = \frac{a}{b} = \frac{MQ}{OM} = \frac{MQ}{1} = MQ = \cot B = MQ$$

$$\cot A = \frac{NT}{ON} = \frac{NT}{1} = NT = \tan B = NT$$

$$\sec A = \frac{OQ}{OM} = \frac{OQ}{1} = OQ = \csc B = OQ$$

$$\csc A = \frac{OT}{ON} = \frac{OT}{1} = OT = \sec B = OT$$

$$\text{vers } A = \frac{LM}{OP} = LM = \text{covers B \#}$$

$$\text{covers } A = \frac{OP - LP}{OP} = OP - LP = \text{vers B}$$

$$\text{exsec } A = PQ = \text{coexsec B}$$

$$\text{coexsec } A = PT = \text{exsec B}$$

$$\sin \tfrac{1}{2}A = \sqrt{\frac{1-\text{Cos A}}{2}} \qquad \cos \tfrac{1}{2}A = \sqrt{\frac{1+\text{Cos A}}{2}}$$

$$\sin 2A = 2 \sin A \cos \qquad \cos 2A = \cos^2 A - \sin^2 A$$

$$\text{Law of Sines} \quad \frac{\sin A}{a} = \frac{\sin B}{B} = \frac{\sin C^1}{C}$$

$$\text{Law of Cosines} \quad c^2 = a^2 + p^2 - 2\,ab \cos C$$

$$\text{Law of Tangents} \quad \frac{a+b}{a-b} = \frac{\tan \tfrac{1}{2}(A+B)}{\tan \tfrac{1}{2}(A-B)}$$

Table II—Continued

TRIGONOMETRIC FORMULAE (continued)

In any triangle:

Given a, b, C; to find c, B, A.

Use Law of Tangents.

Given A, B, c; to find a, b, C.

Use Law of Sines.

Given a, b, c; to find A, B, C.

$$\text{Let } \frac{a+b+c}{2} = s, \sqrt{\frac{(s-a)\ (s-b)\ (s-c)}{s}} = r$$

$$\cos \tfrac{1}{2}A = \sqrt{\frac{s(s-a)}{bc}}$$

$$\tan \tfrac{1}{2}A = \frac{r}{s-a}$$

$$\tan \tfrac{1}{2}B = \frac{r}{s-b}$$

$$\tan \tfrac{1}{2}C = \frac{r}{s-c}$$

Area of a triangle:

$$\text{Area} = \tfrac{1}{2}\,ab \text{ Sin C}$$

$$\text{Area} = \sqrt{s(s-a)\ (s-b)\ (s-c)}$$

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$$\text{Vol.} = \frac{h}{6}(B+b+4M)$$

h = altitude; b B = bases; M = midsection

Table III

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	.10000

Table IV

Inches in Decimals of a Foot

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

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

Table V.—Radii, Ordinates and Deflections

Deg.	Radius	Mid. Ord.	Tan. Offset	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Offset	Def. for 1 Foot
0° 10′	34377.5	.036	.145	0.05′	7°	819.02	1.528	6.105	2.10′
20	17188.8	.073	.291	0.10	20′	781.84	1.600	6.395	2.20
30	11459.2	.109	.436	0.15	30	764.49	1.637	6.540	2.25
40	8594.42	.145	.582	0.20	40	747.89	1.673	6.685	2.30
50	6875.55	.182	.727	0.25					
					8	716.78	1.746	6.976	2.40
1	5729.65	.218	.873	0.30	20	688.16	1.819	7.266	2.50
10	4911.15	.255	1.018	0.35	30	674.69	1.855	7.411	2.55
20	4297.28	.291	1.164	0.40	40	661.74	1.892	7.556	2.60
30	3819.83	.327	1.309	0.45					
40	3437.87	.364	1.454	0.50	9	637.28	1.965	7.846	2.70
50	3125.36	.400	1.600	0.55	20	614.56	2.037	8.136	2.80
					30	603.80	2.074	8.281	2.85
2	2864.93	.436	1.745	0.60	40	593.42	2.110	8.426	2.90
10	2644.58	.473	1.891	0.65					
20	2455.70	.509	2.036	0.70	10	573.69	2.183	8.716	3.00
30	2292.01	.545	2.181	0.75	30	546.44	2.292	9.150	3.15
40	2148.79	.582	2.327	0.80	11	521.67	2.402	9.585	3.30
50	2022.41	.618	2.472	0.85	30	499.06	2.511	10.02	3.45
					12	478.34	2.620	10.45	3.60
3	1910.08	.655	2.618	0.90	30	459.28	2.730	10.89	3.75
10	1809.57	.691	2.763	0.95	13	441.68	2.839	11.32	3.90
20	1719.12	.727	2.908	1.00	30	425.40	2.949	11.75	4.05
30	1637.28	.764	3.054	1.05	14	410.28	3.058	12.18	4.20
40	1562.88	.800	3.199	1.10	30	396.20	3.168	12.62	4.35
50	1494.95	.836	3.345	1.15					
					15	383.07	3.277	13.05	4.50
4	1432.69	.873	3.490	1.20	30	370.78	3.387	13.49	4.65
10	1375.40	.909	3.635	1.25	16	359.27	3.496	13.92	4.80
20	1322.53	.945	3.718	1.30	30	348.45	3.606	14.35	4.95
30	1273.57	.982	3.926	1.35	17	338.27	3.716	14.78	5.10
40	1228.11	1.018	4.071	1.40	18	319.62	3.935	15.64	5.40
50	1185.78	1.055	4.217	1.45	19	302.94	4.155	16.51	5.70
5	1146.28	1.091	4.362	1.50	20	287.94	4.374	17.37	6.00
10	1109.33	1.127	4.507	1.55	21	274.37	4.594	18.22	6.30
20	1074.68	1.164	4.653	1.60	22	262.04	4.814	19.08	6.60
30	1042.14	1.200	4.798	1.65	23	250.79	5.035	19.94	6.90
40	1011.51	1.237	4.943	1.70	24	240.49	5.255	20.79	7.20
50	982.64	1.273	5.088	1.75					
					25	231.01	5.476	21.64	7.50
6	955.37	1.309	5.234	1.80	26	222.27	5.697	22.50	7.80
10	929.57	1.346	5.379	1.85	27	214.18	5.918	23.35	8.10
20	905.13	1.382	5.524	1.90	28	206.68	6.139	24.19	8.40
30	881.95	1.418	5.669	1.95	29	199.70	6.360	25.04	8.70
40	859.92	1.455	5.814	2.00	30	193.18	6.583	25.88	9.00

Note. Chord Deflection =2 times tangent deflection.

Table VI.—Tangents and Externals to a 1° Curve

Central Angle	Tangent	External	Central Angle	Tangent	External	Central 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	518.08	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 VI.—Tangents and Externals to a 1° Curve

Central Angle	Tangent	External	Central Angle	Tangent	External	Central 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	658.3
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 VI.—Tangents and Externals to a 1° Curve

Central Angle	Tangent	External	Central Angle	Tangent	External	Central 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 VI.—Tangents and Externals to a 1° Curve

Central Angle	Tangent	External	Central Angle	Tangent	External	Central 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	5808.2	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 VII.—Corrections for Tangents and Externals

These corrections are to be added to the approximate values, found by dividing the tangent, or external, for a 1° curve (Table VI) by the degree of curve, in order to obtain the true tangents, or externals. Intermediate values may be obtained by interpolation.

For Tangents Add

Central Angle	Degree of 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
110°	.51	1.03	1.56	2.08	2.61	3.14	3.67	4.21	4.76	5.31	5.86	6.43	7.01	7.60
120°	.62	1.25	1.93	2.52	3.16	3.81	4.45	5.11	5.77	6.44	7.12	7.80	8.50	9.22

For Externals Add

Central Angle	Degree of 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	.046	.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
110°	.268	.536	.806	1.08	1.35	1.63	1.91	2.20	2.48	2.76	3.05	3.35	3.66	3.96
120°	.360	.721	1.08	1.45	1.82	2.19	2.57	2.95	3.33	3.72	4.11	4.50	4.91	5.32

Table VIII.—Corrections for Sub-Chords and Long Chords

FOR SUB-CHORDS ADD										Excess of Arc per 100 ft.
D	10	20	30	40	50	60	70	80	90	
4°	.00	.00	.01	.01	.01	.01	.01	.01	.00	.02
6	.00	.01	.01	.02	.02	.02	.02	.01	.01	.05
8	.01	.02	.02	.03	.03	.03	.03	.02	.01	.08
10	.01	.02	.03	.04	.05	.05	.05	.04	.02	.13
12	.02	.04	.05	.06	.07	.07	.07	.05	.03	.18
14	.02	.05	.07	.08	.09	.10	.09	.07	.04	.25
16	.03	.06	.09	.11	.12	.12	.12	.09	.05	.33
18	.04	.08	.11	.14	.15	.16	.15	.12	.07	.41
20	.05	.10	.14	.17	.19	.20	.18	.15	.09	.51
22	.06	.12	.17	.21	.23	.24	.22	.18	.10	.62
24	.07	.14	.20	.25	.28	.28	.26	.21	.12	.74
26	.09	.17	.24	.29	.32	.33	.31	.25	.15	.86
28	.10	.19	.27	.34	.37	.38	.36	.29	.17	1.00
30	.11	.22	.31	.39	.43	.44	.41	.33	.19	1.15
32	.13	.25	.36	.44	.49	.50	.47	.38	.22	1.31
34	.15	.28	.40	.50	.55	.57	.53	.43	.25	1.48
36	.17	.32	.45	.56	.62	.64	.59	.48	.28	1.66
38	.18	.36	.51	.62	.70	.71	.66	.53	.31	1.86
40	.21	.40	.56	.69	.77	.79	.73	.59	.35	2.06
42	.23	.44	.62	.76	.85	.87	.81	.65	.38	2.28
44	.25	.48	.68	.84	.94	.96	.89	.72	.42	2.50
46	.27	.52	.75	.92	1.02	1.05	.98	.78	.46	2.74
48	.30	.57	.81	1.00	1.12	1.14	1.06	.86	.50	2.99
50	.32	.62	.89	1.09	1.21	1.24	1.15	.93	.55	3.24
52	.35	.67	.96	1.18	1.31	1.35	1.25	1.01	.59	3.52
54	.38	.73	1.04	1.28	1.42	1.46	1.35	1.09	.64	3.80
56	.41	.78	1.12	1.38	1.53	1.57	1.46	1.17	.69	4.09
58	.44	.84	1.20	1.48	1.65	1.69	1.57	1.26	.74	4.40
60	.47	.91	1.29	1.59	1.76	1.81	1.68	1.35	.80	4.72

LONG CHORDS				
D	200	300	400	500
1	199.99	299.97	399.92	499.85
2	199.97	299.88	399.70	499.39
3	199.93	299.73	399.32	498.63
4	199.88	299.51	398.78	497.57
5	199.81	299.24	398.10	496.20
6	199.73	298.90	397.26	494.53
7	199.63	298.51	396.28	492.57
8	199.51	298.05	395.14	490.31
9	199.38	297.54	393.86	487.75
10	199.24	296.96	392.42	484.90
12	198.90	295.63	389.12	478.34
14	198.51	294.06	385.22	470.65
16	198.05	292.25	380.76	461.86
18	197.54	290.21	375.74	452.02
20	196.96	287.94	370.17	441.15
22	196.32	285.44	364.06	429.30
24	195.63	282.71	357.43	416.53
26	194.87	279.76	350.30	402.89
28	194.06	276.59	342.69	388.43
30	193.18	273.20	334.61	373.20
32	192.25	269.61	326.08	357.28
34	191.26	265.81	317.12	340.73
36	190.21	261.80	307.77	323.61
38	189.10	257.60	298.03	305.99
40	187.94	253.21	287.94	287.94
42	186.72	248.63	277.51	269.54
44	185.44	243.87	266.78	250.85
46	184.10	239.93	255.78	231.95
48	182.71	233.83	244.51	212.92

Note.—When a chord of less than 100 ft. is used the corrections given in the above table should be added to the nominal length of chord to get the length which should be used in order that the 100 ft. points will check with those obtained by using the standard 100 ft. chord. Thus in locating a 14° curve by 25 ft. chords measure 25'.06 for each chord. Long chords are useful in passing obstacles.

Table IX.—Middle Ordinates for Rails in Feet

Deg. of Curve	LENGTH OF RAILS							Deg. of Curve	LENGTH OF RAILS						
	32	30	28	26	24	22	20		32	30	28	26	24	22	20
1°	.022	.020	.016	.013	.011	.009	.008	16°	.356	.313	.273	.236	.200	.170	.139
2	.045	.038	.034	.029	.025	.021	.017	17	.378	.333	.290	.252	.213	.180	.148
3	.037	.058	.051	.044	.037	.031	.026	18	.400	.351	.306	.265	.225	.190	.156
4	.089	.079	.069	.060	.050	.042	.035	19	.423	.371	.324	.280	.238	.201	.165
5	.112	.099	.086	.074	.063	.053	.044	20	.445	.392	.341	.296	.250	.212	.174
6	.134	.117	.102	.088	.076	.064	.052	21	.466	.410	.357	.309	.262	.222	.182
7	.156	.137	.120	.104	.088	.074	.061	22	.487	.430	.375	.325	.275	.233	.191
8	.179	.158	.137	.119	.100	.085	.070	23	.509	.450	.390	.338	.287	.243	.199
9	.201	.175	.153	.133	.112	.095	.078	24	.531	.469	.408	.354	.299	.253	.208
10	.223	.196	.171	.148	.125	.106	.087	25	.552	.486	.424	.367	.311	.263	.216
11	.245	.216	.188	.163	.139	.117	.096	26	.573	.506	.441	.382	.323	.274	.225
12	.268	.236	.206	.179	.151	.128	.105	27	.594	.524	.457	.396	.335	.284	.233
13	.290	.254	.222	.192	.163	.138	.113	28	.618	.545	.475	.411	.348	.294	.242
14	.312	.275	.239	.207	.175	.148	.122	29	.638	.564	.491	.424	.361	.303	.250
15	.334	.295	.257	.223	.188	.159	.131	30	.660	.583	.508	.438	.374	.313	.259

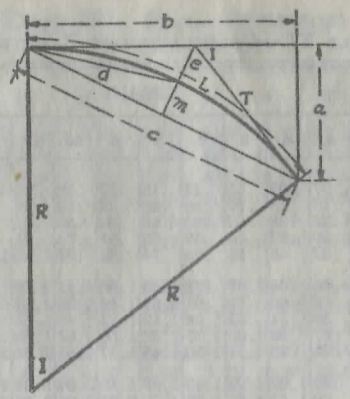

Table X

CURVE FORMULAE FOR SIMPLE CURVES

Compiled by J. Calvin Locke, C.E.

(1) $c = \sqrt{2Ra}$ (2) $c = \sqrt{a^2+b^2}$

(3) $c = \sqrt{2R\,(R-\sqrt{(R+b)\,(R-b)})} = \sqrt{2R(R-\sqrt{R^2-b^2})}$

(4) $c = 2\sqrt{m\,(2R-m)}$

(5) $c = 2R \sin \frac{1}{2} I$ (6) $c = 2T \cos \frac{1}{2} I$

(7) $e = R \operatorname{exsec} \frac{1}{2} I$

(8) $e = R \tan \frac{1}{2} I \tan \frac{1}{4} I$ (9) $e = T \tan \frac{1}{4} I$

(10) $b = \sqrt{a\,(2R-a)}$

(11) $b = \sqrt{\left(c+\frac{c^2}{2R}\right)\left(c-\frac{c^2}{2R}\right)} = \sqrt{c^2-\frac{c^4}{4R^2}}$

(12) $b = R \sin I$ (13) $b = a \cot \frac{1}{2} I$

(14) $R = \frac{a^2+b^2}{2a} = \frac{c^2}{2a}$ (15) $R = \frac{d^2}{2m} = \frac{c^2+4m^2}{8m}$

(16) $d = \sqrt{R\,(2R-\sqrt{(2R+c)\,(2R-c)})} = \sqrt{R(2R-\sqrt{4R^2-c^2})}$

(17) $d = \sqrt{2Rm}$ (18) $d = 2R \sin \frac{1}{4} I$ (19) $m = \frac{d^2}{2R}$

(20) $m = R \mp \sqrt{\left(R+\frac{c}{2}\right)\left(R-\frac{c}{2}\right)} = R \mp \sqrt{R^2-\frac{c^2}{4}}$

(21) $m = R \operatorname{vers} \frac{1}{2} I$ (22) $m = R \sin \frac{1}{2} I \tan \frac{1}{4} I$ (23) $m = \frac{1}{2} c \tan \frac{1}{4} I$

(24) $a = \frac{c^2}{2R}$ (25) $a = R - \sqrt{(R+b)\,(R-b)} = R - \sqrt{R^2-b^2}$

(26) $a = 2R\,(\sin^2 \frac{1}{2} I)^2$ (27) $a = R \operatorname{vers} I$ (28) $a = R \sin I \tan \frac{1}{2}$

(29) $a = b \tan \frac{1}{2} I$ (30) $a = T \sin I$ (31) $T = R \tan \frac{1}{2} I$

(32) $I = \frac{L}{R} \times 57.295780$ (33) $R = \frac{L}{I} \times 57.295780$

(34) $L = IR \times 0.01745329$ (35) $L = \frac{8d-c}{3}$

(36) Area Seg. $= \frac{LR - R^2 \operatorname{Sin} I}{2} = \frac{LR - Rb}{2}$

Table XI.—Calculation of Earthwork

Width	HEIGHT														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.02	.04	.06	.07	.09	.11	.13	.15	.17	.18	.20	.22	.24	.26	.28
2	.04	.07	.11	.15	.18	.22	.26	.30	.33	.37	.41	.44	.48	.52	.56
3	.06	.11	.17	.22	.28	.33	.39	.44	.50	.56	.61	.67	.72	.78	.83
4	.07	.15	.22	.30	.37	.44	.52	.59	.67	.74	.81	.89	.96	1.04	1.11
5	.09	.19	.28	.37	.46	.56	.65	.74	.83	.93	1.02	1.11	1.20	1.30	1.39
6	.11	.22	.33	.44	.56	.67	.78	.89	1.00	1.11	1.22	1.33	1.44	1.55	1.67
7	.13	.26	.39	.52	.65	.78	.91	1.04	1.16	1.30	1.42	1.55	1.68	1.81	1.94
8	.15	.30	.44	.59	.74	.89	1.04	1.19	1.33	1.48	1.63	1.78	1.92	2.08	2.22
9	.17	.33	.50	.67	.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50
10	.18	.37	.56	.74	.93	1.11	1.30	1.48	1.67	1.85	2.04	2.22	2.41	2.59	2.78
11	.20	.41	.61	.82	1.02	1.22	1.43	1.63	1.83	2.04	2.24	2.44	2.65	2.85	3.06
12	.22	.44	.67	.89	1.11	1.33	1.56	1.78	2.00	2.22	2.44	2.67	2.89	3.11	3.33
13	.24	.48	.72	.96	1.20	1.44	1.68	1.92	2.16	2.41	2.65	2.89	3.13	3.37	3.61
14	.26	.52	.78	1.04	1.30	1.55	1.81	2.08	2.33	2.59	2.85	3.11	3.37	3.63	3.89
15	.28	.56	.83	1.11	1.39	1.67	1.94	2.22	2.50	2.78	3.06	3.33	3.61	3.89	4.17
16	.30	.59	.89	1.18	1.48	1.78	2.07	2.37	2.67	2.96	3.26	3.56	3.85	4.15	4.44
17	.31	.63	.94	1.26	1.57	1.89	2.20	2.52	2.83	3.15	3.46	3.78	4.09	4.41	4.72
18	.33	.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00
19	.35	.70	1.06	1.41	1.76	2.11	2.46	2.82	3.17	3.52	3.87	4.22	4.57	4.92	5.28
20	.37	.74	1.11	1.48	1.85	2.22	2.59	2.96	3.33	3.70	4.07	4.44	4.81	5.18	5.56
21	.39	.78	1.17	1.55	1.94	2.33	2.72	3.11	3.50	3.89	4.28	4.67	5.06	5.44	5.83
22	.41	.81	1.22	1.63	2.04	2.44	2.85	3.26	3.67	4.07	4.48	4.89	5.30	5.70	6.11
23	.43	.85	1.28	1.70	2.13	2.56	2.98	3.41	3.83	4.26	4.68	5.11	5.54	5.96	6.39
24	.44	.89	1.33	1.78	2.22	2.67	3.11	3.56	4.00	4.44	4.89	5.33	5.78	6.22	6.67
25	.46	.92	1.39	1.85	2.31	2.78	3.24	3.70	4.17	4.63	5.09	5.56	6.02	6.48	6.94
26	.48	.96	1.44	1.92	2.41	2.89	3.37	3.85	4.33	4.82	5.30	5.78	6.26	6.74	7.24
27	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50
28	.52	1.04	1.55	2.07	2.59	3.11	3.63	4.15	4.67	5.18	5.70	6.22	6.74	7.26	7.78
29	.54	1.07	1.61	2.15	2.68	3.22	3.76	4.30	4.83	5.37	5.91	6.44	6.98	7.52	8.06
30	.56	1.11	1.67	2.22	2.78	3.33	3.89	4.44	5.00	5.55	6.11	6.67	7.22	7.78	8.33
31	.57	1.15	1.72	2.30	2.87	3.44	4.02	4.59	5.17	5.74	6.32	6.89	7.46	8.04	8.61
32	.59	1.18	1.78	2.37	2.96	3.56	4.15	4.74	5.33	5.92	6.52	7.11	7.70	8.30	8.89
33	.61	1.22	1.83	2.44	3.05	3.67	4.28	4.89	5.50	6.11	6.72	7.33	7.94	8.55	9.17
34	.63	1.26	1.89	2.52	3.15	3.78	4.40	5.04	5.67	6.29	6.93	7.56	8.18	8.81	9.44
35	.65	1.30	1.94	2.59	3.24	3.89	4.53	5.18	5.83	6.48	7.13	7.78	8.42	9.08	9.72
36	.67	1.33	2.00	2.67	3.33	4.00	4.66	5.33	6.00	6.67	7.33	8.00	8.67	9.33	10.00
37	.68	1.37	2.06	2.74	3.42	4.11	4.79	5.48	6.17	6.85	7.54	8.22	8.91	9.59	10.28
38	.70	1.41	2.11	2.82	3.52	4.22	4.92	5.63	6.33	7.03	7.74	8.44	9.15	9.85	10.56
39	.72	1.44	2.17	2.89	3.61	4.33	5.05	5.78	6.50	7.22	7.95	8.67	9.39	10.11	10.83
40	.74	1.48	2.22	2.96	3.70	4.44	5.18	5.92	6.67	7.41	8.15	8.89	9.63	10.37	11.11

Table gives cu. yds. in 1 ft. of a triangle of given width and height. Corrections for tenths of width are one tenth the values found under each height considering the widths from 1 to 9 as tenths and similarly the corrections for tenths of height are one tenth the figures opposite width considering the heights from 1 to 9 as tenths. Thus if w = 16.2 and h = 5.3, cu. yds. = 1.48 + .028 + .089 = 1.597 cu. yds. or practically 160 cu. yds. per 100 ft. If w exceeds 40 ft., use one-half and multiply result by 2, if both w and h are large use one-half of each and multiply result by 4. Any cross-section may be divided into triangles by the following rule. To the triangle of the sum of the outside cuts (or fills) = h, and ½ the roadbed = w, add the triangles formed by taking the distance out to each break in turn (= w's) by the difference between the cuts (or fills) on each side of it (= h's) always subtracting the outer from the inner.

Table XII. Stadia Reductions

Vertical Heights

Minutes	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
0....	0.00	1.74	3.49	5.23	6.96	8.68	10.40	12.10	13.78	15.45	17.10
2....	0.06	1.80	3.55	5.28	7.02	8.74	10.45	12.15	13.84	15.51	17.16
4....	0.12	1.86	3.60	5.34	7.07	8.80	10.51	12.21	13.89	15.56	17.21
6....	0.17	1.92	3.66	5.40	7.13	8.85	10.57	12.26	13.95	15.62	17.26
8....	0.23	1.98	3.72	5.46	7.19	8.91	10.62	12.32	14.01	15.67	17.32
10....	0.29	2.04	3.78	5.52	7.25	8.97	10.68	12.38	14.06	15.73	17.37
12....	0.35	2.09	3.84	5.57	7.30	9.03	10.74	12.43	14.12	15.78	17.43
14....	0.41	2.15	3.90	5.63	7.36	9.08	10.79	12.49	14.17	15.84	17.48
16....	0.47	2.21	3.95	5.69	7.42	9.14	10.85	12.55	14.23	15.89	17.54
18....	0.52	2.27	4.01	5.75	7.48	9.20	10.91	12.60	14.28	15.95	17.59
20....	0.58	2.33	4.07	5.80	7.53	9.25	10.96	12.66	14.34	16.00	17.65
22....	0.64	2.38	4.13	5.86	7.59	9.31	11.02	12.72	14.40	16.06	17.70
24....	0.70	2.44	4.18	5.92	7.65	9.37	11.08	12.77	14.45	16.11	17.76
26....	0.76	2.50	4.24	5.98	7.71	9.43	11.13	12.83	14.51	16.17	17.81
28....	0.81	2.56	4.30	6.04	7.76	9.48	11.19	12.88	14.56	16.22	17.86
30....	0.87	2.62	4.36	6.09	7.82	9.54	11.25	12.94	14.62	16.28	17.92
32....	0.93	2.67	4.42	6.15	7.88	9.60	11.30	13.00	14.67	16.33	17.97
34....	0.99	2.73	4.48	6.21	7.94	9.65	11.36	13.05	14.73	16.39	18.03
36....	1.05	2.79	4.53	6.27	7.99	9.71	11.42	13.11	14.79	16.44	18.08
38....	1.11	2.85	4.59	6.33	8.05	9.77	11.47	13.17	14.84	16.50	18.14
40....	1.16	2.91	4.65	6.38	8.11	9.83	11.53	13.22	14.90	16.55	18.19
42....	1.22	2.97	4.71	6.44	8.17	9.88	11.59	13.28	14.95	16.61	18.24
44....	1.28	3.02	4.76	6.50	8.22	9.94	11.64	13.33	15.01	16.66	18.30
46....	1.34	3.08	4.82	6.56	8.28	10.00	11.70	13.39	15.06	16.72	18.35
48....	1.40	3.14	4.88	6.61	8.34	10.05	11.76	13.45	15.12	16.77	18.41
50....	1.45	3.20	4.94	6.67	8.40	10.11	11.81	13.50	15.17	16.83	18.46
52....	1.51	3.26	4.99	6.73	8.45	10.17	11.87	13.56	15.23	16.88	18.51
54....	1.57	3.31	5.05	6.79	8.51	10.22	11.93	13.61	15.28	16.94	18.57
56....	1.63	3.37	5.11	6.84	8.57	10.28	11.98	13.67	15.34	16.99	18.62
58....	1.69	3.43	5.17	6.90	8.63	10.34	12.04	13.73	15.40	17.05	18.68
60....	1.74	3.49	5.23	6.96	8.68	10.40	12.10	13.78	15.45	17.10	18.73

Horizontal Corrections

Dist.	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
100...	0.0	0.0	0.1	0.3	0.5	0.8	1.1	1.5	1.9	2.5	3.0
200...	0.0	0.1	0.2	0.5	1.0	1.5	2.2	3.0	3.9	4.9	6.0
300...	0.0	0.1	0.4	0.8	1.5	2.3	3.3	4.5	5.8	7.4	9.1
400...	0.0	0.1	0.5	1.1	2.0	3.0	4.4	6.0	7.8	9.8	12.1
500...	0.0	0.2	0.6	1.4	2.5	3.8	5.5	7.5	9.7	12.3	15.1
600...	0.0	0.2	0.7	1.6	2.9	4.6	6.5	8.9	11.6	14.7	18.1
700...	0.0	0.2	0.8	1.9	3.4	5.3	7.6	10.4	13.6	17.2	21.1
800...	0.0	0.2	1.0	2.2	3.9	6.1	8.7	11.9	15.5	19.6	24.2
900...	0.0	0.3	1.1	2.4	4.4	6.8	9.8	13.4	17.5	22.1	27.2
1000...	0.0	0.3	1.2	2.7	4.9	7.6	10.9	14.9	19.4	24.5	30.2

Table XII. Stadia Reductions

Vertical Heights

Minutes	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
0	18.73	20.34	21.92	23.47	25.00	26.50	27.96	29.39	30.78	32.14
2	18.78	20.39	21.97	23.52	25.05	26.55	28.01	29.44	30.83	32.18
4	18.84	20.44	22.02	23.58	25.10	26.59	28.06	29.48	30.87	32.23
6	18.89	20.50	22.08	23.63	25.15	26.64	28.10	29.53	30.92	32.27
8	18.95	20.55	22.13	23.68	25.20	26.69	28.15	29.58	30.97	32.32
10	19.00	20.60	22.18	23.73	25.25	26.74	28.20	29.62	31.01	32.36
12	19.05	20.66	22.23	23.78	25.30	26.79	28.25	29.67	31.06	32.41
14	19.11	20.71	22.28	23.83	25.35	26.84	28.30	29.72	31.10	32.45
16	19.16	20.76	22.34	23.88	25.40	26.89	28.34	29.76	31.15	32.49
18	19.21	20.81	22.39	23.93	25.45	26.94	28.39	29.81	31.19	32.54
20	19.27	20.87	22.44	23.99	25.50	26.99	28.44	29.86	31.24	32.58
22	19.32	20.92	22.49	24.04	25.55	27.04	28.49	29.90	31.28	32.63
24	19.38	20.97	22.54	24.09	25.60	27.09	28.54	29.95	31.33	32.67
26	19.43	21.03	22.60	24.14	25.65	27.13	28.58	30.00	31.38	32.72
28	19.48	21.08	22.65	24.19	25.70	27.18	28.63	30.04	31.42	32.76
30	19.54	21.13	22.70	24.24	25.75	27.23	28.68	30.09	31.47	32.80
32	19.59	21.18	22.75	24.29	25.80	27.28	28.73	30.14	31.51	32.85
34	19.64	21.24	22.80	24.34	25.85	27.33	28.77	30.19	31.56	32.89
36	19.70	21.29	22.85	24.39	25.90	27.38	28.82	30.23	31.60	32.93
38	19.75	21.34	22.91	24.44	25.95	27.43	28.87	30.28	31.65	32.98
40	19.80	21.39	22.96	24.49	26.00	27.48	28.92	30.32	31.69	33.02
42	19.86	21.45	23.01	24.55	26.05	27.52	28.96	30.37	31.74	33.07
44	19.91	21.50	23.06	24.60	26.10	27.57	29.01	30.41	31.78	33.11
46	19.96	21.55	23.11	24.65	26.15	27.62	29.06	30.46	31.83	33.15
48	20.02	21.60	23.16	24.70	26.20	27.67	29.11	30.51	31.87	33.20
50	20.07	21.66	23.22	24.75	26.25	27.72	29.15	30.55	31.92	33.24
52	20.12	21.71	23.27	24.80	26.30	27.77	29.20	30.60	31.96	33.28
54	20.18	21.76	23.32	24.85	26.35	27.81	29.25	30.65	32.01	33.33
56	20.23	21.81	23.37	24.90	26.40	27.86	29.30	30.69	32.05	33.37
58	20.28	21.87	23.42	24.95	26.45	27.91	29.34	30.74	32.09	33.41
60	20.34	21.92	23.47	25.00	26.50	27.96	29.39	30.78	32.14	33.46

Horizontal Corrections

District	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
100	3.6	4.3	5.1	5.9	6.7	7.6	8.5	9.5	10.6	11.7
200	7.3	8.6	10.1	11.7	13.4	15.2	17.1	19.1	21.2	23.4
300	10.9	13.0	15.2	17.6	20.1	22.8	25.6	28.6	31.8	35.1
400	14.6	17.3	20.2	23.4	26.8	30.4	34.2	38.2	42.4	46.8
500	18.2	21.6	25.3	29.3	33.5	38.0	42.7	47.7	53.0	58.5
600	21.8	25.9	30.4	35.1	40.2	45.6	51.3	57.3	63.6	70.2
700	25.5	30.2	35.4	41.0	46.9	53.2	59.8	66.8	74.2	81.9
800	29.1	34.6	40.5	46.8	53.6	60.8	68.4	76.4	84.8	93.6
900	32.8	38.9	45.5	52.7	60.3	68.4	76.9	85.9	95.4	105.3
1000	36.4	43.2	50.6	58.5	67.0	76.0	85.5	95.5	106.0	117.0

Table XIII.—Sines, Cosines, Tangents, Cotangents

Deg.	sin 0′	tan 0′	sin 10′	tan 10′	sin 20′	tan 20′	sin 30′	tan 30′	sin 40′	tan 40′	sin 50′	tan 50′	Deg.
0	0000	0000	0029	0029	0058	0058	0087	0087	0116	0116	0145	0145	89
1	175	0175	0204	0204	0233	0233	0262	262	291	291	320	320	88
2	349	349	378	378	407	407	436	437	465	466	494	495	87
3	523	524	552	553	581	582	610	612	640	641	669	706	86
4	698	699	727	729	756	758	785	787	814	816	843	864	85
5	872	875	901	904	929	934	958	963	987	992	1016	1022	84
6	1045	1051	1074	1080	1103	1110	1132	1139	1161	1169	190	198	83
7	219	228	248	257	279	287	305	317	334	346	363	376	82
8	392	405	421	435	449	465	478	495	507	524	536	554	81
9	564	584	593	614	622	644	650	673	679	703	708	733	80
10	736	763	765	793	794	823	822	853	851	883	880	914	79
11	908	944	937	974	965	2004	994	2035	2022	2065	2051	2095	78
12	2079	2126	2108	2156	2136	186	2164	217	193	247	221	278	77
13	250	309	278	339	306	370	334	401	363	432	391	462	76
14	419	493	447	524	476	555	504	586	532	617	560	648	75
15	588	679	616	711	644	742	672	773	700	805	728	836	74
16	756	867	784	899	812	931	840	962	868	994	896	3026	73
17	924	3057	952	3089	939	3121	3007	3153	3035	3185	3062	217	72
18	3090	249	3118	281	3145	314	173	346	201	378	228	411	71
19	256	443	283	476	311	508	338	541	365	574	393	607	70
20	420	640	448	673	475	706	502	739	529	772	557	805	69
21	584	839	611	872	638	906	665	939	692	973	719	4006	68
22	746	4040	773	4074	800	4108	827	4142	854	4176	881	210	67
23	907	245	934	279	961	314	987	348	4014	383	4041	417	66
24	4067	452	4094	487	4120	522	4147	557	173	592	200	628	65
25	226	663	253	699	279	734	305	770	331	806	358	841	64
26	384	877	410	913	436	950	4462	986	488	5022	514	5059	63
27	540	5095	566	5132	592	5169	617	5206	643	243	669	280	62
28	695	317	720	354	746	392	772	430	797	467	823	505	61
29	848	543	874	581	899	619	924	658	950	696	975	735	60
30	5000	774	5025	5812	5050	851	5075	890	5100	930	5125	969	59
31	150	6009	175	6048	200	6088	225	6128	250	6168	275	6208	58
32	299	249	324	289	348	330	5373	371	398	412	422	453	57
33	446	494	471	536	495	577	519	619	544	661	568	703	56
34	592	745	616	787	640	830	664	873	688	916	712	959	55
35	736	7002	760	7046	783	7089	807	7133	831	7177	854	7221	54
36	878	265	901	310	925	355	948	400	972	445	995	490	53
37	6018	536	6041	581	6065	627	6088	673	6111	720	6134	766	52
38	157	813	180	860	202	907	225	954	248	8002	271	8050	51
39	293	8098	316	8146	338	8195	361	8243	383	292	406	342	50
40	428	391	450	441	472	491	494	541	517	591	539	642	49
41	561	693	583	744	604	796	626	847	648	899	670	952	48
42	691	9004	713	9057	734	9110	756	9163	777	9217	799	9271	47
43	820	325	841	380	862	435	884	490	905	545	926	601	46
44	947	657	967	713	988	770	7009	827	7030	884	7050	942	45
45	7071	1.0000	7092	1.0058	7112	1.0117	133	1.0176	153	1.0235	173	1.0295	44
Deg.	60′ cos	60′ cot	50′ cos	50′ cot	40′ cos	40′ cot	30′ cos	30′ cot	20′ cos	20′ cot	10′ cos	10′ cot	Deg.

Table XIII.—Sines, Cosines, Tangents, Cotangents (Continued)

Deg.	sin 0′	tan 0′	sin 10′	tan 10′	sin 20′	tan 20′	sin 30′	tan 30′	sin 40′	tan 40′	sin 50′	tan 50′	Deg.
46	7193	1.0355	7214	1.0416	7234	1.0477	7254	1.0533	7274	1.0599	7294	1.0661	43
47	314	.0724	333	.0786	353	.0850	373	.0913	392	.0977	412	.1041	42
48	431	.1106	451	.1171	470	.1237	490	.1303	509	.1369	528	.1436	41
49	547	.1504	566	.1571	585	.1640	604	.1708	623	.1778	642	.1847	40
50	660	1.1918	7679	1.1988	7698	1.2059	7716	1.2131	7735	1.2203	7753	1.2276	39
51	771	.2349	790	.2423	808	.2497	826	.2572	844	.2647	862	.2723	38
52	880	.2799	898	.2876	916	.2954	934	.3032	951	.3111	969	.3190	37
53	986	.3270	8004	.3351	8021	.3452	8039	.3514	8056	.3597	8073	.3680	36
54	8090	.3764	107	.3848	124	.3934	141	.4019	158	.4106	175	.4193	35
55	192	.4281	208	.4370	225	.4460	241	.4550	258	.4641	274	.4733	34
56	290	.4826	307	.4919	323	.5013	339	.5108	355	.5204	371	.5301	33
57	387	.5399	403	.5497	418	.5597	434	.5697	450	.5798	465	.5900	32
58	480	.6003	496	.6107	511	.6212	526	.6319	542	.6426	557	.6534	31
59	572	.6643	587	.6753	601	.6864	616	.6977	631	.7090	646	.7205	30
60	660	1.7321	8675	1.7437	8689	1.7556	8704	1.7675	8718	1.7797	8732	1.7917	29
61	746	.8040	760	.8165	774	.8291	788	.8418	802	.8546	816	.8676	28
62	829	.8807	843	.8940	857	.9074	870	.9210	884	.9347	897	.9486	27
63	910	.9626	923	.9768	936	.9912	949	2.0057	962	2.0204	975	2.0353	26
64	988	2.0503	9001	2.0655	9013	2.0809	9026	.0965	9038	.1123	9051	.1283	25
65	9063	.1445	075	.1609	088	.1775	100	.1943	112	.2113	124	.2286	24
66	135	.2460	147	.2637	159	.2817	171	.2998	182	.3183	194	.3369	23
67	205	.3559	216	.3750	228	.3945	239	.4142	250	.4342	261	.4545	22
68	272	.4751	283	.4960	293	.5172	304	.5386	315	.5605	325	.5826	21
69	336	.6051	346	.6279	356	.6511	367	.6746	377	.6985	387	.7228	20
70	397	2.7475	9407	2.7725	9417	2.7980	9426	2.8239	9436	2.8502	9446	2.8770	19
71	455	.9042	465	.9319	474	.9600	483	.9887	492	3.0178	502	3.0475	18
72	511	3.0777	520	3.1084	528	3.1397	537	3.1716	546	.2041	555	.2371	17
73	563	.2709	572	.3052	580	.3402	588	.3759	596	.4124	605	.4495	16
74	613	.4874	621	.5261	628	.5656	636	.6059	644	.6470	652	.6891	15
75	659	.7321	667	.7760	674	.8208	681	.8657	689	.9136	696	.9617	14
76	703	4.0108	710	4.0611	717	4.1126	724	4.1653	730	4.2193	737	4.2747	13
77	744	.3315	750	.3897	757	.4494	763	.5107	769	.5736	775	.6382	12
78	781	.7046	787	.7729	793	.8430	799	.9152	805	.9894	811	5.0658	11
79	816	.1446	822	5.2257	827	5.3093	833	5.3955	838	5.4845	843	.5764	10
80	9848	5.6713	9853	5.7694	9858	5.8708	9863	5.9758	9868	6.0844	9872	6.1970	9
81	877	6.3138	881	6.4348	886	6.5606	890	6.6912	894	.8269	899	.9682	8
82	903	7.1154	907	7.2687	911	7.4287	914	7.5958	918	7.7704	922	7 9530	7
83	925	8.1443	929	8.3450	932	8.5555	936	8.7769	939	9.0098	942	9.2553	6
84	945	9.5144	948	9.7882	951	10.078	954	10.385	957	10.711	959	11.059	5
85	962	11.430	964	11.826	967	12.250	969	12.706	971	13.197	974	13.727	4
86	976	14.300	978	14.924	980	15.605	981	16.350	983	17.169	985	18.075	3
87	986	19.081	988	20.206	989	21.470	990	22.903	992	24.542	993	26.432	2
88	994	28.636	9995	31.242	9996	34.368	997	38.189	997	42.964	9998	49.104	1
89	9998	57.290	9999	68.750	9999	85.940	9999	114.58	1.000	171.88	1.000	343.77	0
Deg.	60′ cos	60′ cot	50′ cos	50′ cot	40′ cos	40′ cot	30′ cos	30′ cot	20′ cos	30′ cot	10′ cos	10′ cot	Deg.

78.7
433
511.7 . . . Cottage CH 59.

157.2
320
477.2

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