

FIELD BOOK

381

47

KEUFFEL & ESSER CO.

DRAWING MATERIALS

AND

SURVEYING INSTRUMENTS.

NEW YORK.

CHICAGO. ST. LOUIS. SAN FRANCISCO. MONTREAL.

TABLES FOR EXCAVATIONS AND EMBANKMENTS.

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 18 FEET WIDE. SIDE SLOPES 1 TO 1.

FOR SINGLE TRACK EXCAVATION.

"Copyright, 1895, by Keuffel & Esser Co."

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

Calculated by Julien A. Hall, M. Am. Soc. C. E.

For Keith's Railroad Curve Labels see end of book.

Property of
County Engineers Office
Court House
Waterloo Iowa

BLACK HAWK COUNTY
ENGINEER'S OFFICE
COURT HOUSE
WATERLOO, IOWA 50703

Corner Stones

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Sec. 21 Big Creek - Opp.	" 59
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Sec. 21 Big Creek T87-12	Page 60

BLACK HAWK COUNTY
ENGINEER'S OFFICE
COURT HOUSE
WATERLOO, IOWA 50703

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Elev

Apr. 30, 1924

E. B. Spencer

H. Bown

6" Tile Line to
Drain Pond & Twp. Road
near South $\frac{1}{4}$ Cor. Sec. 32 Union Twp.

8+00				92.7			
6+50			7.21	97.16	92.20	4.96 ✓	4' - 11 $\frac{1}{2}$ "
5+50			6.17	98.20	91.87	6.33 ✓	6' - 4"
5+00			5.57	98.80	91.70	7.10 ✓	7' - 1 $\frac{1}{4}$ "
4+00			6.21	98.10	91.58	6.52 ✓	6' - 6 $\frac{1}{4}$ "
T.P.	7.30	104.37	1.07	97.07			
3+50			1.07	97.07	91.52	5.55 ✓	5' - 6 $\frac{1}{2}$ "
3+00			2.17	95.97	91.46	4.51 ✓	4' - 6"
2+00			3.60	94.54	91.34	3.20 ✓	3' - 2 $\frac{1}{2}$ "
1+00			4.70	93.44	89.37	4.07 ✓	4' - 1"
0+54			5.45	92.69	88.46	4.23 ✓	4' - 2 $\frac{3}{4}$ "
0+00				87.40			

8.66 89.48

10.19 87.95 87.4 Top of Tile

2.90 98.14 9.18 95.24

7.5 96.9

9.7 94.7 92.7 Top of Water

Bottom of Pond.

B.M. 4.42 104.42

100.00

Gail in Tel. pole near N-W Cor. of School House

Wat. 31-32

1 { 4 span - East Br.
73 ft.

2 { 2 span
39 ft.

3 { 1 span
21 ft.

Br. over Main Channel
4 span
105 ft.

1st.	East span - 19 ft. c.to c.
2nd.	29 ft. c.to c.
3rd.	$27\frac{1}{2}$ ft.
4th.	27.7 ft.

Spans

1st.	- 15 - Joists, Wood
2nd	- 6 I & 2 channels 10"
3rd	
4th	

Lengths of Four Bridges ³ on Black Hawk.

Black Hawk Creek.

Grade to Water level

11' -	1st. Abut.	50 24 = 120
11.75	1st. bent.	26 = 130
12.7	2nd.	26 = 130
12.5	3rd.	26 = 130
12.4	West Abut	26 = 130
		24 = 120

760'

Bennington 25-36

Two 6" tile lines on North side of Road
Dewar-Dunkerton Co. Road

2900' East of Culvert
646' West of Culvert

See page 9, and 38

19			8.25	122.61	
18	11.61	130.86	2.86	119.25	
17			5.61	116.50	
16			7.89	114.22	
15	10.43	122.11	2.12	111.68	
14			4.05	109.75	
13			5.78	108.02	
12			7.73	106.07	
11	9.41	113.80	2.31	104.39	
10			3.85	102.85	
9			5.29	101.41	
8			6.07	100.63	
7			7.09	99.61	
6			9.14	97.56	
5+00			8.12	97.98	
Water			13.02	93.68	
B.M.	6.70	106.70		100.00	
4+96			5.15	99.27	94.80
4			5.99	98.43	95.00
3			5.00	99.40	96.00
2			4.00	100.42	97.00
1			2.85	101.57	98.00
0+00			1.33	103.09	99.00
	4.42	104.42		100.00	

Outlet in 3x3x24 Culvert
x North headwall Conc. Culv.

Outlet in 3x3x24 Culvert

[West end of 6" Tile at 150' West of 0+00]
See Page 38

		5.11	99.05
3.50	104.16	9.32	100.66
1.92	109.98	11.59	108.06
0.10	119.63	11.33	119.53
		0.32	130.54
		2.68	128.18
		5.57	125.29

132.86

East end of 6" Tile line

A.P.

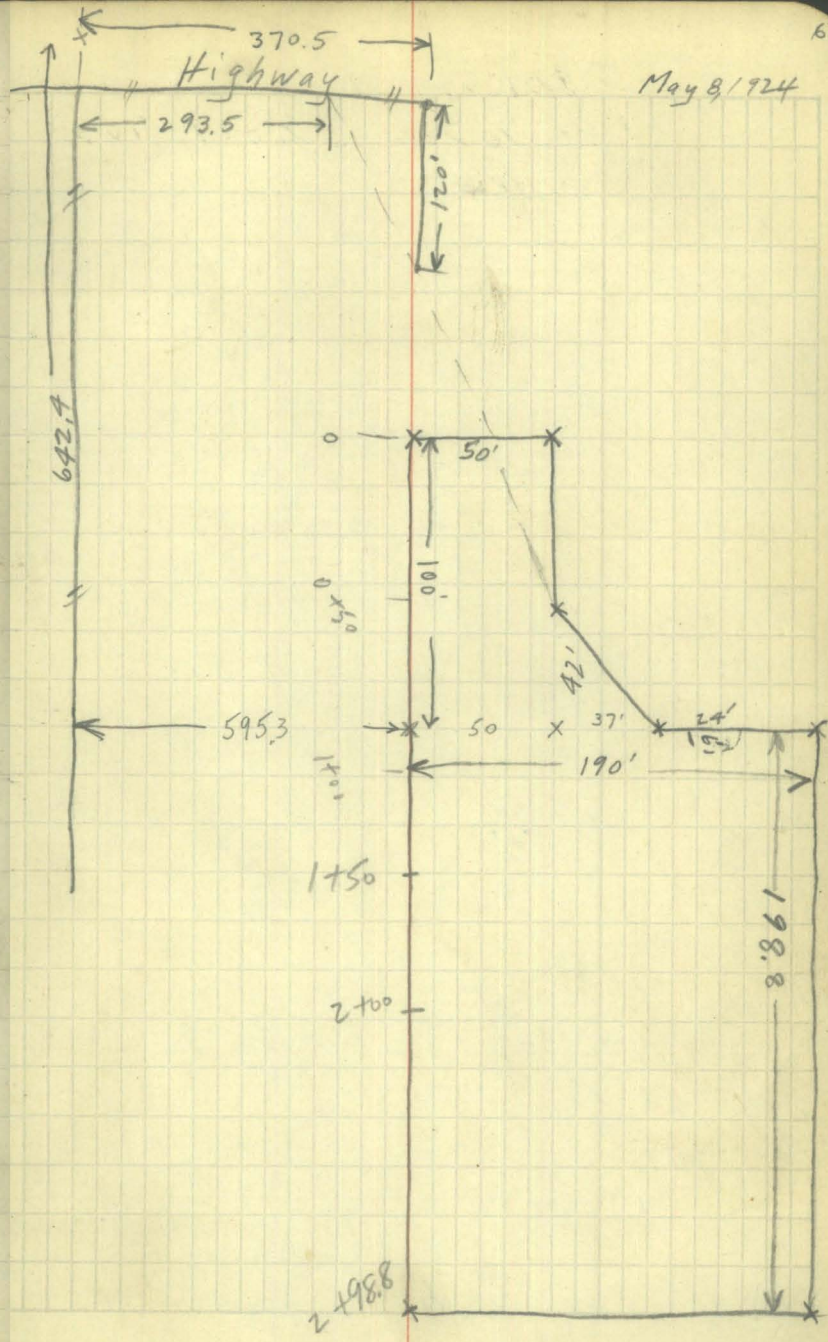
22

21

20

GRAVEL PIT
SE 1/4 Sec. 23 Eagle Twp.
Tobin Pit

May 8/1924



Tobin P.T.
S-E 1/4 Sec. 23 Eagle Twp.
X-Sec.

May 8, 1924
E.B. Spencer
Ivan C. Wilde
Harold Bown

Hub at N-W Cor. of P.T. 5.15 103.90

2+98.8 N-W Cor. of P.T.

2

1+50

7+50

1+00

50

0+50

0

N-E Cor. of P.T.

B.M.

9.05 109.05

9.05

100.00

100.00

103.90
5.15
Hub
103.8
5.2
0
104.4
4.6
50
104.8
4.2
100
103.3
5.7
150
101.1
7.9
190

104.1
4.2
0
104.3
4.7
50
104.9
5.0
100
102.9
6.6
150
104.4
4.6
50
104.9
4.6
100
103.1
5.9
150
101.0
8.0
190

104.0
5.0
0
104.0
5.0
33
103.9
5.1
50
103.8
5.2
86
103.9
5.6
100
103.0
6.0
107
100.2
8.8
109
99.6
9.4
116
99.5
9.5
124
102.4
6.6
127
101.7
7.3
150
100.0
9.0
190

103.4
5.6
0
103.3
5.7
29
103.0
6.0
50

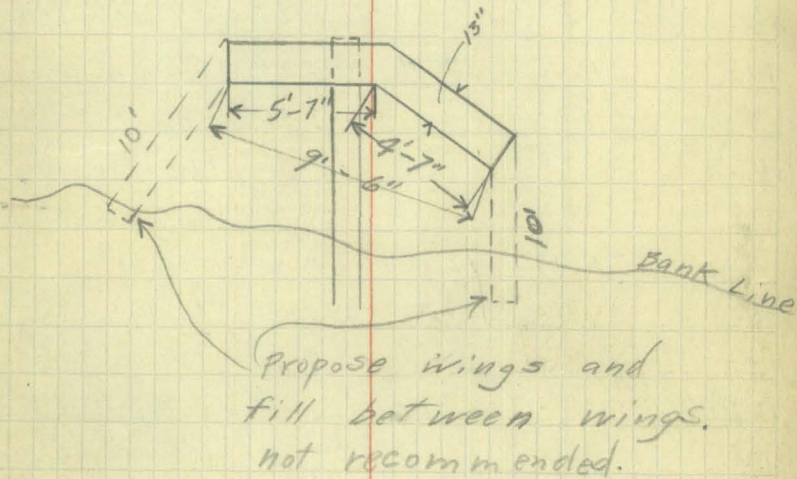
102.7
6.3
0
102.3
6.7
17
102.8
6.2
25
102.0
7.0
29
101.6
7.4
50

Top of Hub at S-E Cor. of Big Area
Vail in 1st. post S. of S-E Cor. of P.T.

109.00

Bulkhead for Drain. Dist. #4
May 7, 1924.

Top of bulkhead to
top of footing 4'-8"



Benn. 25-36

See Page 4 + 38

9

6" Tile on North side of Road
near West end of Mile.

East end of 6" Tile line

4.87 $4\frac{1}{2}$ - sta. T.5.43 $13\frac{1}{2}$ - " T.

5.51 15 - " "

5.13 $13\frac{1}{2}$ - " "

4.96 11 - " "

4.04 5 - " "

1900' - East of Culv.

496' - West of Culv.

133.58

131.10

128.62

126.13

123.65

121.17

118.68

116.2

113.70

111.2

108.70

106.98

105.36

103.55

101.83

100.12

98.40

97.27

96.13

95.00

94.80

94.65

100.00

1.30 135.11

2.92 133.49

4.85 131.56

7.25 129.16

0.90 126.30

3.56 123.64

6.96 120.24

9.70 117.50

0.95 115.23

3.46 112.72

5.38 110.80

7.10 109.08

9.05 107.13

1.65 105.45

3.23 103.87

4.68 102.42

5.44 101.66

6.46 100.64

8.51 98.59

8.10 99.00

12.45 94.65

107.10

10.11 136.41

11.97 127.20

10.73 116.18

7.10 107.10

3.80

4.03

4.02

3.82

3.72

3.58

3.62

3.75

4.02

4.39

4.51

3.59

4.20

Outlet in 3X3X24 Culvert

2 sta. 10ths.

5 sta. 10ths.

1 sta. 10ths.

5+00

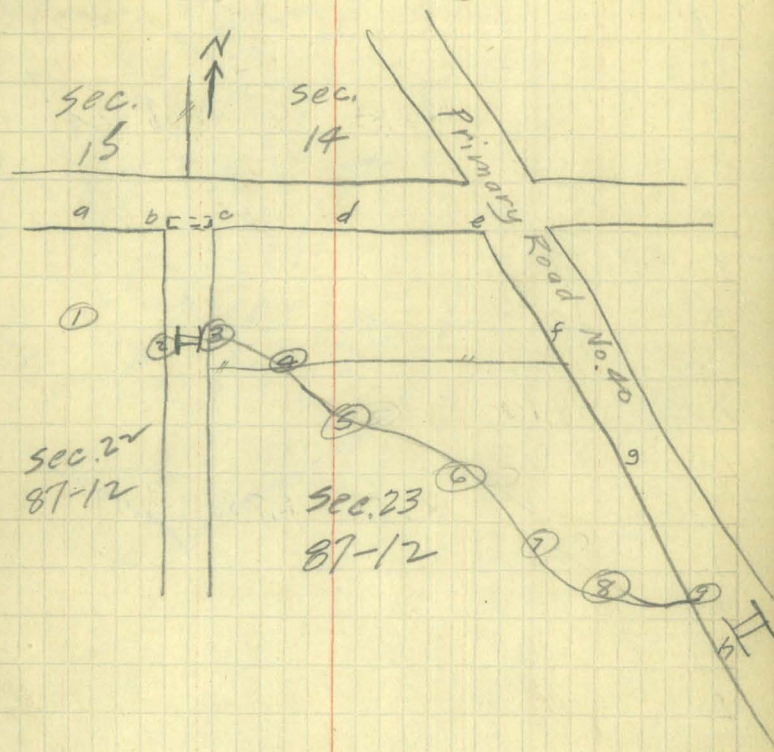
Outlet

B.M.

5.90 811.45
Levels near
Prim. Rd. #40

1			5.65	811.70	✓
2			6.05	811.30	✓
3			5.85	811.50	✓
4			5.95	811.40	✓
5 T.P.	6.05	817.35	4.80	811.30	✓
6			5.10	811.00	✓
7 T.P.	5.64	816.10	5.25	810.46	✓
8			5.65	810.06	✓
9			6.45	809.26	✓
h			6.45	809.26	✓
T. P.	6.01	815.71	9.05	809.70	✓
g			8.20	810.55	✓
T. P.	7.35	818.75	6.40	811.40	✓
f			6.65	811.15	✓
e			6.85	810.95	✓
d			6.50	811.30	✓
c			6.05	811.75	✓
b			6.35	811.45	✓
a			6.25	811.55	✓
B.M.	3.34	817.80		814.46	

May 19, 1924.



B.M. #7 P. Rd. Proj. #233 Sta. 185+92
Spike in corner post on NE corner of road
intersection El. 814.46

May 20, 1924

T, 1c Check
Dewar Readlyn Road
Elev. H.I.

185	5.95	145.27	
186	8.98		
187	9.72	142.00	
	4.29	146.81	441 (151.22)
188	9.37	141.72	
189	9.58		
190	9.82		
191	10.10		
192	10.44		
193	11.17		
194	11.99	139.10	138.5
T.P.	2.12	143.21	7.58 (151.09)
195	7.06	138.27	
196	7.92		
197	8.62		
198	9.48		
199	10.37	134.96	
200	10.50	134.83	
200 + 39	10.53	134.80	
B.M.	5.54	139.79	(145.33) on north end West Headwall

Bridge Site Survey

Sec. 8-9 - 87-11

1/3 mile North of South end

May 22, 1928

D.A. = 960 Ac.

Sandy Foundation Material

Recommend 11' Abuts. & Piling or 12x6 Box

12x6x25-3 1/2" 58.7 yds. with Hand Rail
56.5 " with out " "

Water Level 10.5 95.0

High Water 6.2 99.3

Profile & Road

6 4.1 101.4

5 5.0 100.5

4 5.3 100.2

3+00 5.20 100.3

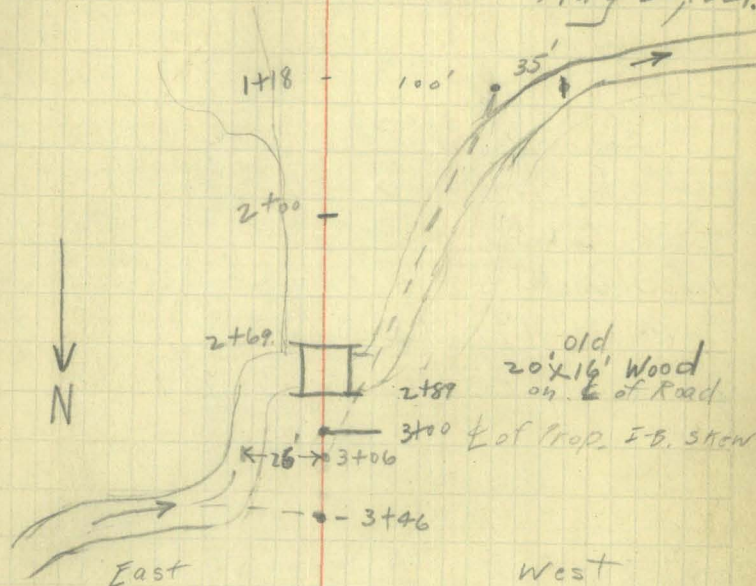
2+89 4.7 100.8

2+69 4.2 101.3

2 6.2 99.3

1 6.5 99.0

0 5.0 100.5



3+12

95.1	96.0	100.5	100.3	98.3	96.9	97.0	98.9	98.5
10.4	9.5	5.0	100.3	5.2	8.6	8.5	7.1	7.0
18	16	6	5.2	7	12	13	16	22

95.0

94.7

7.06
Cut 1 W. Hub
Cut 2 E. Hub

2+89

6.95 98.7 94.7
7.45 98.21 96.0

B.M.
B.M.

5.50 105.50

6.90 98.60
100.00

of 1/4 of Str. Bed

95.2	95.3	93.5	94.3	93.4	92.8
10.3	10.2	12.0	11.2	12.1	12.7
150	50	120	100	200	300

95.0	95.0	96.0	100.6	100.7	95.9	95.7	98.6	98.6
10.5	10.5	9.5	4.9	4.8	9.6	9.8	6.9	6.9
15	15	12	6	8	12	15	18	24

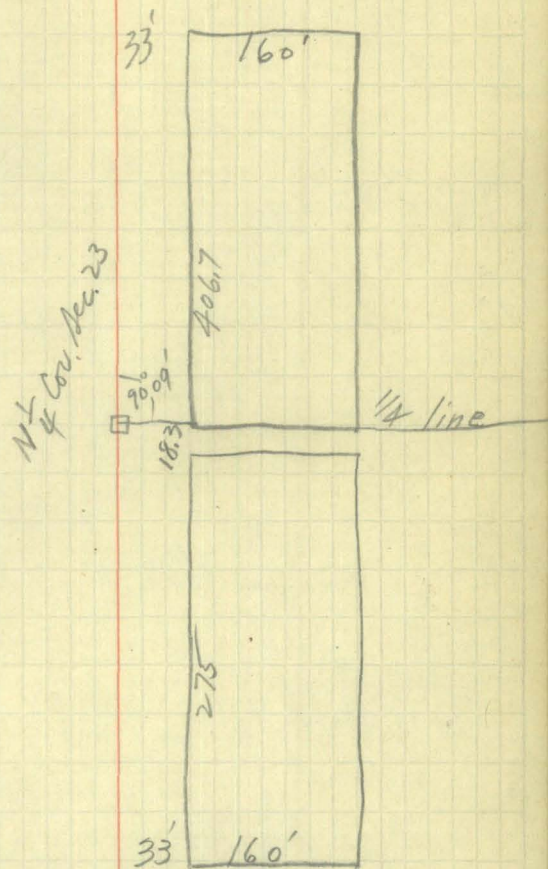
Nail in Fence Post West side of Road [40' South of
Nail in 1st. Tel. Pole So. of Wood Br. [End Wood Br.]

Black Hawk Creek Road #48
66' Width

Starting at SE cor. of Sec. 32
thence runs 46 rods West of the
South 1/4 post of Sec. #32 Twp. 89-13
West thence S 167° W 8 rods thence
S 84° W 10 rods thence N 76° W 20 rods
& 22 l. thence West 38 rods to Black Hawk
Creek thence N 82° W 108 rods thence
S 84° W 97 rods 8 l. to the
South 1/4 post of Sec. #31-89-13.

East Eagle Plat

Made May 1920.
by R.B. Slippy



Sec. 27-28-89-14

$D, A, = 1920 A_c,$

N
↑
+

7

460

6

+25

5

$\begin{array}{r} 90 \\ + 62 \\ \hline \end{array}$

443

4.

Stone slab Curb. 4X3 X18

3

+ 78

N. End

+46

S. End

2

1

0

Road Intersection

 $5 + 25 \leftarrow$

90

490

55

476 -

41

462

24'

940

2

6'

10

4

25

127

-17

430

~~*~~ 0 + 00

32 x 16 Wood Br.

Sch 00

House

Build 24×20 with 30° skew

Sec. 27-28-89-14

May 24, 1924

15

4+00

3+50

3+00

High Water
Water Level

4.65

7.8

97.8

94.7

Stream Profile

B.M.

4.10

98.35

7

1.7

100.8

6

3.8

98.7

5

4.7

97.8

4

5.3

97.1

3

3.45

99.0

+78

2.90

100.1

&

1.90

100.6

+46

2.40

100.0

7

4.55

97.9

1

3.85

98.60

0

2.45

100.00

B.M.

2.45

102.5

102.45

100.00

$$\begin{array}{r} 96.4 \\ 6.1 \\ \hline 246 \end{array}$$

$$\begin{array}{r} 95.0 \\ 7.2 \\ \hline 20 \end{array}$$

$$\begin{array}{r} 95.9 \\ 6.6 \\ \hline 16 \end{array}$$

$$\begin{array}{r} 96.8 \\ 5.7 \\ \hline 8 \end{array}$$

$$\begin{array}{r} 97.2 \\ 5.3 \\ \hline 9 \end{array}$$

$$\begin{array}{r} 96.9 \\ 5.6 \\ \hline 9 \end{array}$$

$$\begin{array}{r} 94.0 \\ 8.5 \\ \hline 14 \end{array}$$

$$\begin{array}{r} 93.4 \\ 9.1 \\ \hline 15 \end{array}$$

$$\begin{array}{r} 96.5 \\ 6.0 \\ \hline 27 \end{array}$$

$$\begin{array}{r} 95.3 \\ 7.2 \\ \hline 19 \end{array}$$

$$\begin{array}{r} 96.6 \\ 5.9 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 97.4 \\ 5.1 \\ \hline 7 \end{array}$$

$$\begin{array}{r} 97.9 \\ 4.6 \\ \hline 7 \end{array}$$

$$\begin{array}{r} 97.5 \\ 5.0 \\ \hline 7 \end{array}$$

$$\begin{array}{r} 96.9 \\ 5.6 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 94.4 \\ 8.1 \\ \hline 13 \end{array}$$

$$\begin{array}{r} 93.6 \\ 8.9 \\ \hline 14 \end{array}$$

$$\begin{array}{r} 96.4 \\ 6.1 \\ \hline 27 \end{array}$$

$$\begin{array}{r} 96.2 \\ 6.3 \\ \hline 24 \end{array}$$

$$\begin{array}{r} 95.5 \\ 7.0 \\ \hline 21 \end{array}$$

$$\begin{array}{r} 96.1 \\ 6.4 \\ \hline 12 \end{array}$$

$$\begin{array}{r} 99.0 \\ 3.5 \\ \hline 4 \end{array}$$

$$\begin{array}{r} 99.1 \\ 3.4 \\ \hline 3 \end{array}$$

$$\begin{array}{r} 98.9 \\ 3.6 \\ \hline 8 \end{array}$$

$$\begin{array}{r} 98.0 \\ 4.5 \\ \hline 9 \end{array}$$

$$\begin{array}{r} 96.1 \\ 6.4 \\ \hline 17 \end{array}$$

$$\begin{array}{r} 94.7 \\ 7.8 \\ \hline 20 \end{array}$$

West
$$\begin{array}{r} 94.6 \\ 4.9 \\ \hline 300 \end{array}$$

$$\begin{array}{r} 94.2 \\ 8.3 \\ \hline 200 \end{array}$$

$$\begin{array}{r} 94.0 \\ 8.5 \\ \hline 100 \end{array}$$

$$\begin{array}{r} 93.9 \\ 8.6 \\ \hline 100 \end{array}$$

$$\begin{array}{r} 93.5 \\ 9.0 \\ \hline 100 \end{array}$$
 East
$$\begin{array}{r} 92.7 \\ 9.6 \\ \hline 200 \end{array}$$

$$\begin{array}{r} 92.4 \\ 10.1 \\ \hline 333 \end{array}$$

102.5

Nail in Tel. pole 2nd. pole N. of Br. West side.

11' Abut.

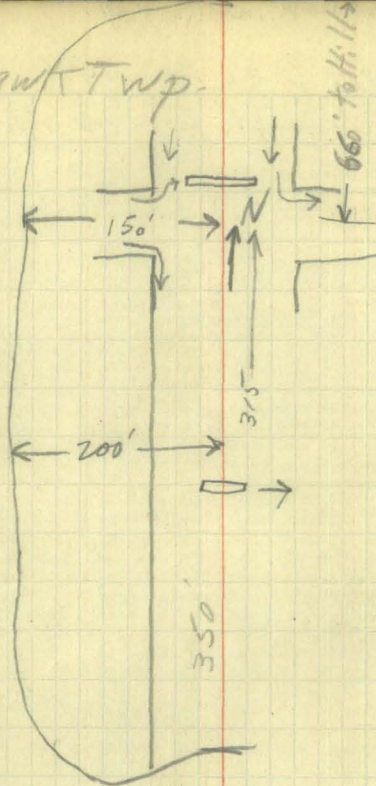
$$\begin{array}{r} 3.61 \\ 1.7 \\ \hline 2.91 \end{array}$$

Nail in pile at end of N-W wing.

May 24, 1924,

$$D.A. = 3A_c$$
$$D.A. = 3 A_c.$$

24" x 34"



	West Ditch		E Road	
6			2.1	102.9
5	5.6	99.4	3.8	101.2
4	7.5	97.5	6.2	98.8
3		96.6	6.7	98.3
2	8.7	96.3	6.3	98.7
1	6.6	98.4	4.2	101.8
D 300' S. & Gulch	2.2	102.8	0.8	104.2

B.M.	5.00	(105.00)	100.00
------	------	----------	--------

Vail in Elec. Pole West end of Culv.

3400

West

$\frac{99.4}{1.5/133}$	$\frac{97.8}{1.2/23}$	$\frac{96.6}{8.4/20}$	$\frac{96.7}{8.3/16}$	$\frac{98.2}{6.8/10}$	$\frac{98.3}{6.7/6.7}$	$\frac{97.3}{7.7/14}$	$\frac{95.5}{9.5/17}$	$\frac{95.5}{9.5/20}$	$\frac{95.0}{10.0/21}$	$\frac{94.3}{10.7/32}$	$\frac{92.5}{12.5/100}$	$\frac{90.3}{14.7/200}$
------------------------	-----------------------	-----------------------	-----------------------	-----------------------	------------------------	-----------------------	-----------------------	-----------------------	------------------------	------------------------	-------------------------	-------------------------

96. 乙

95.4

	3,40	103.40	100.00	
Hob W.			6.54	96.86 96.6 to F.L.
" E.			8.00	95.4 Grade

Sec. 3-10
75' West of E $\frac{1}{4}$ - $\frac{1}{4}$ Cor.

Item #13

4.30 104.30 1 100.00

1.33 = 1'-4" 6.37 97.93 96.6

4.9 99.4

1.63 = 1'-8" 6.57 97.73 96.1

N. Hub
& Rd.
S. Hub.

6	3.2	103.7	✓
5	5.9	101.0	✓
4	7.4	99.5	✓
3	7.2	99.7	✓
2	4.5	102.4	✓
1	0.9	106.00	✓

300' West of Culv.

B.M. 6.9 106.90 100.00

Black Hawk Twp.

4x16 Wood

Build

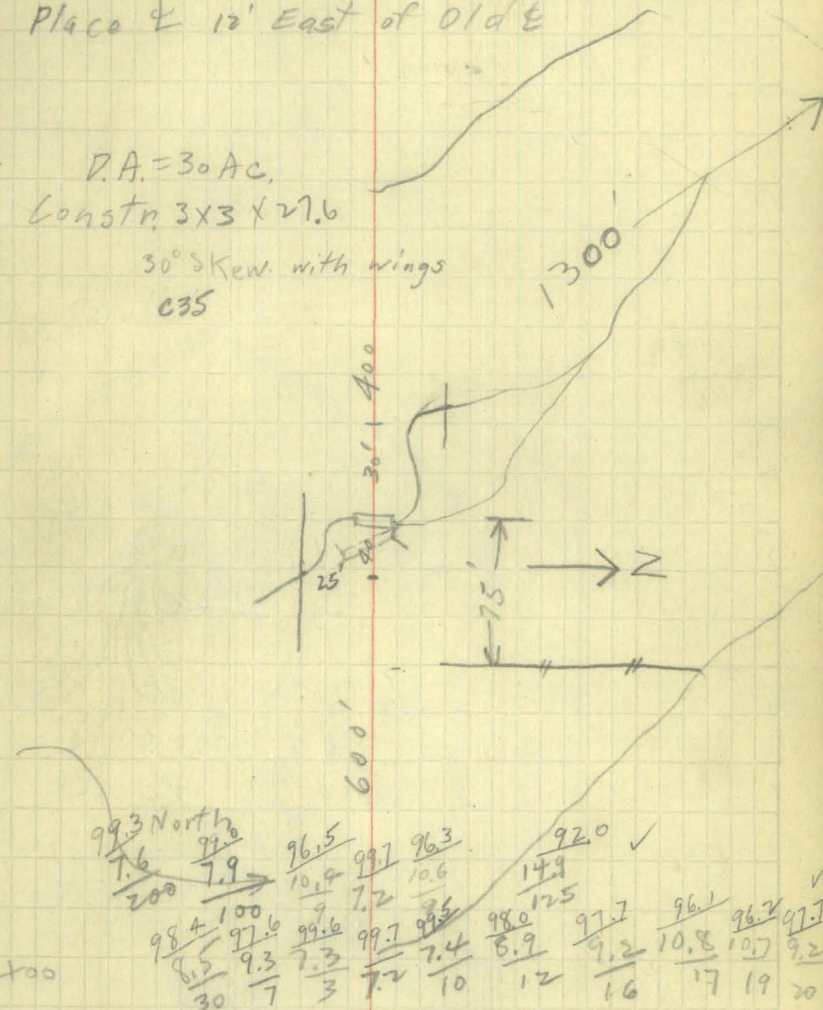
30° Skew.

Place & 12' East of Old E

P.A. = 30 AC.

Constn. 3x3 x 27.6

30° Skew. with wings
C35



100

Trail in North Cor. Post. at $\frac{1}{4}$ - $\frac{1}{4}$ Cor.

May 24, 1924

1/3 South of north end.

Sec 1-2

Replace old Vitrified Clay Pipe

Black Hawk Twp.

May 24, 1924

5.75 105.75 100.00

W. Hub 8.23 97.52 97.32 = 2 1/2"

E. Rd. 5.4 100.35

E. Hub 8.63 97.12 96.82 = 3 1/2"

400

West					East				
99.5	98.1	97.1	100.1	100.3	100.0	96.9	96.5	93.5	
8.3	9.7	8.7	7.7	7.8	10.9	11.3	14.3		
31	15	12	10	7.5	10	16	21	100	

5+50 1.4 106.4

5 3.8 104.0

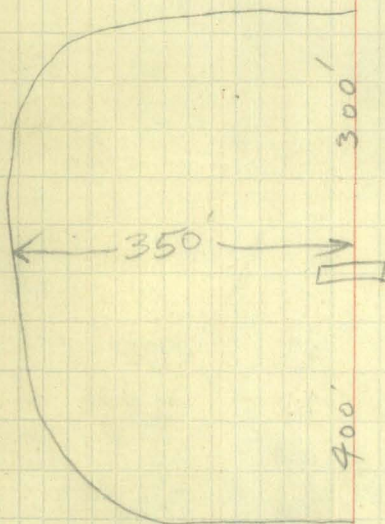
4 6.8 101.0

3 7.5 100.3

2 6.9 100.9

1 4.9 102.9

0 300'S. of Culv. 2.0 105.8



Rolling

D. A. = 6 A c u

Constr. 2x2x24

str. wings,

B.M. 7.81 107.81 100.00

Vail in Fence Post West of W. end Culv.

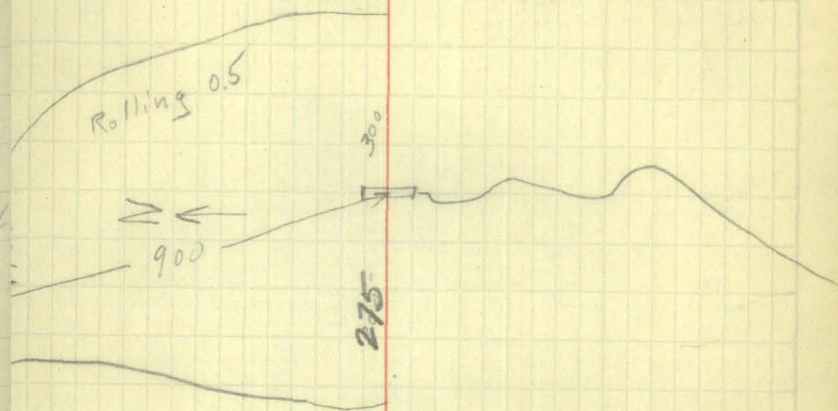
250' West of East end

not in Sec. 2-11 Black Hawk Twp.

	4.20	104.20	100.00	
N. Hub	.66 = 8"	6.54	97.66	97.00
✓		5.25	98.95	
S. Hub.	.66 = 8"	7.00	97.20	96.54

6	4.8	102.1
5	4.8	102.1
4	7.7	99.2
3 & Culv.	7.1	99.2
2	6.9	100.0
	3.5	103.4
1 x 50' E. of Culv.	1.8	105.1
B.M.	6.90	106.90
		100.00

Sec. 3-10 Black Hawk Twp
12" Concr. pipe in place,



D.A. = 10 AC,
Constr. 2x2x24'
24" Conc. pipe
Big enough.

93.1	97.9	96.6	96.6	98.1	99.2	98.7	97.2	97.6	98.5	99.2	100.8
13.8	9.5	10.3	10.3	8.8	7.7	8.2	9.7	9.4	8.4	7.7	6.1
100	17	16	12	9	7	15	19	22	24	31	100

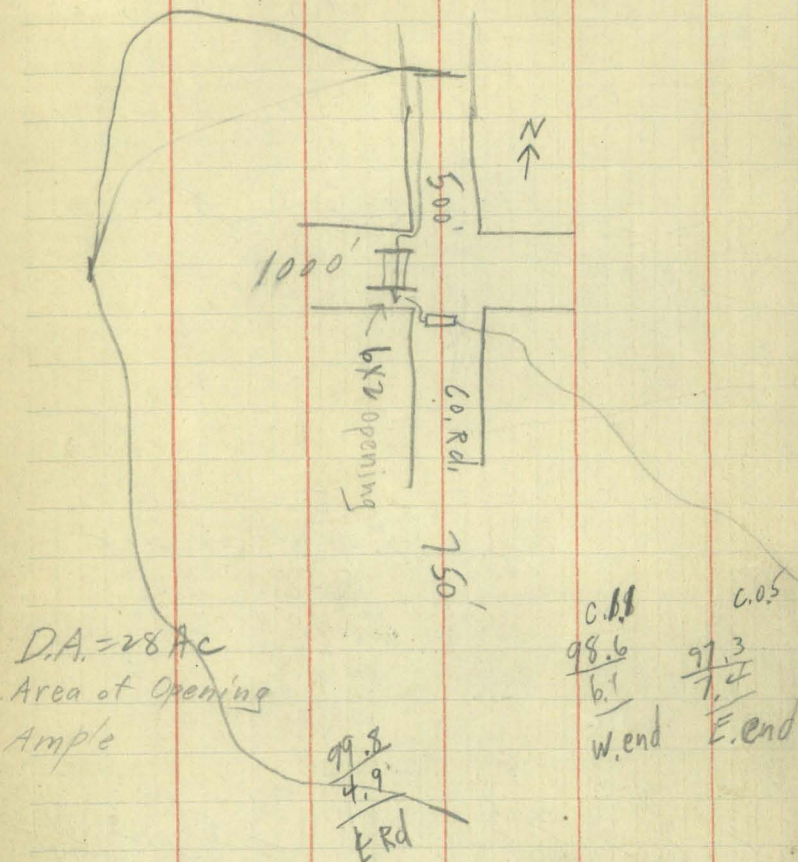
ail in Fence Post North of North end Culvert.

North end Sec. 15 Black Hawk
62' South of Corner

on County Road

14 1/2
13 1/2
20

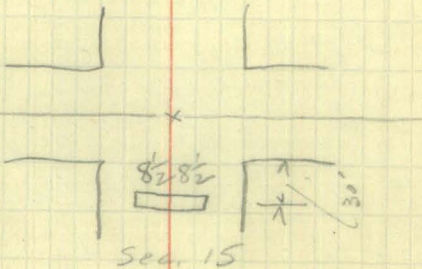
Extend to 29' 6" to b.



This culvert replaced
by 3X3X28 Concrete Box 6"

total Yds. = 17.3 ay.

extra Cu. Yds = 8.0



Extend 6' on
Both ends.



C. 1.18
98.6
6.1
—
W. end

C. 0.5
97.3
7.4
—
E. end

6.5
F.L.

6.2
Cul. F.L.

6.8
W. End

97.8
6.9
—
W. End

96.8
7.9
—
E. End

10.7
100

1' 7 1/2"
1'-0"

8.33
6.25
—
2.10

8.35

8.5
7.6
—

B.M.

4.70

104.70

100.00

all in 1st. Elec. pole S. of Culv.

West Line Sec. 31 Orange Twp.
about 800' S. of NW Cor. Sec. 31

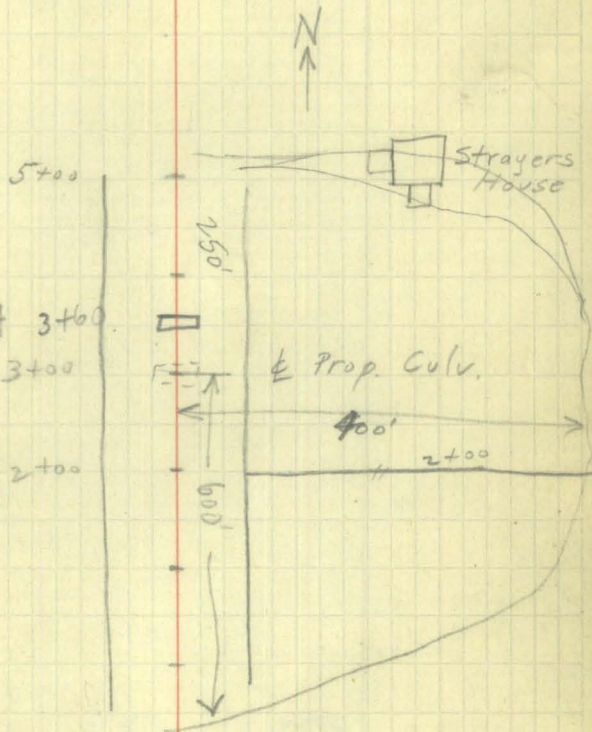
Culvert in Place
at 3+60

D.A. = 8 Ac.

B.M.	5.91	105.91	100.00
Ditch E.		6.45	
Hub E.	7"	5.94	6.49
Dit. W.		6.98	7.02
Hub W.	1'-6"	5.52	7.02
		4.90	

Place 24" X 28' - Cir. Conc.

Buried
Culv. at 3+60



6	5.5	102.4
5	5.9	102.0
4	6.8	101.1
3	6.8	101.1
2	6.1	101.8
1	3.9	104.0
0	1.2	106.7

B.M.	7.95	107.95	100.00
------	------	--------	--------

96.3	100.0	99.5	99.6	100.5	100.7	100.4	100.7	101.0	103.2	107.9
+ 100	94.3 West	13.6	11.6	7.9	8.4	8.3	7.4	101.1	100.7	100.4
200	100	16	15	13	12	10	13	15	23	100

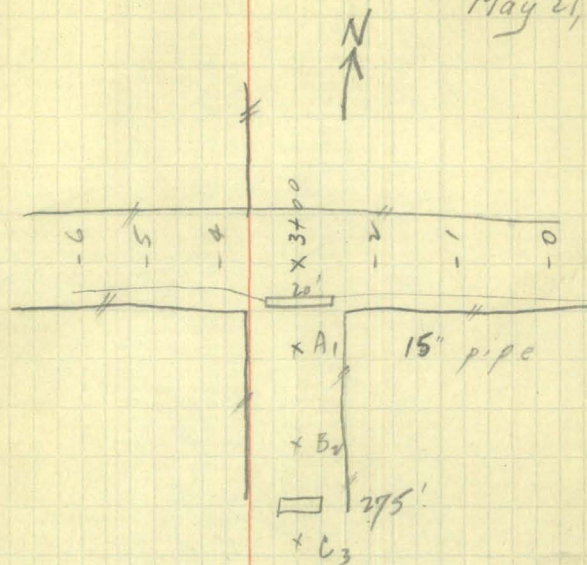
Nail in Elec. Pole West side of Road at Sta. 3

Sec. 14-15-22-23 T87N-R12W

22

May 27, 1924

Constr 3x2x32



	Profile Ditch		Profile Road	
C ₃ 300's.	7.9	810.2	5.00	813.1
B ₂ 200's	7.5	811.6	5.00	813.1
A ₁ 100's.	7.2	810.9	5.14	813.0
6	6.00	812.11	4.95	813.2
5	6.45	811.66	4.9	813.2
4	6.7	811.4	5.3	812.8
3 Sec. Corner			5.1	813.0
2	6.48	811.6	5.17	813.0
1	6.62	811.5	5.24	812.9
0	7.08	811.0	5.56	812.5

811.4

811.05

West 811.5 812.9 813.2 813.0 811.7
 6.6 5.2 4.9 5.1 6.4
 10 10 10 10 10
 title of C₁ V.

818.1

B.M.
 B.M. 3.65 818.11 4.12 813.99
 814.46

Vail in New Cor. Post at SE. Corner
 No. 7 on Primary Rd. #40

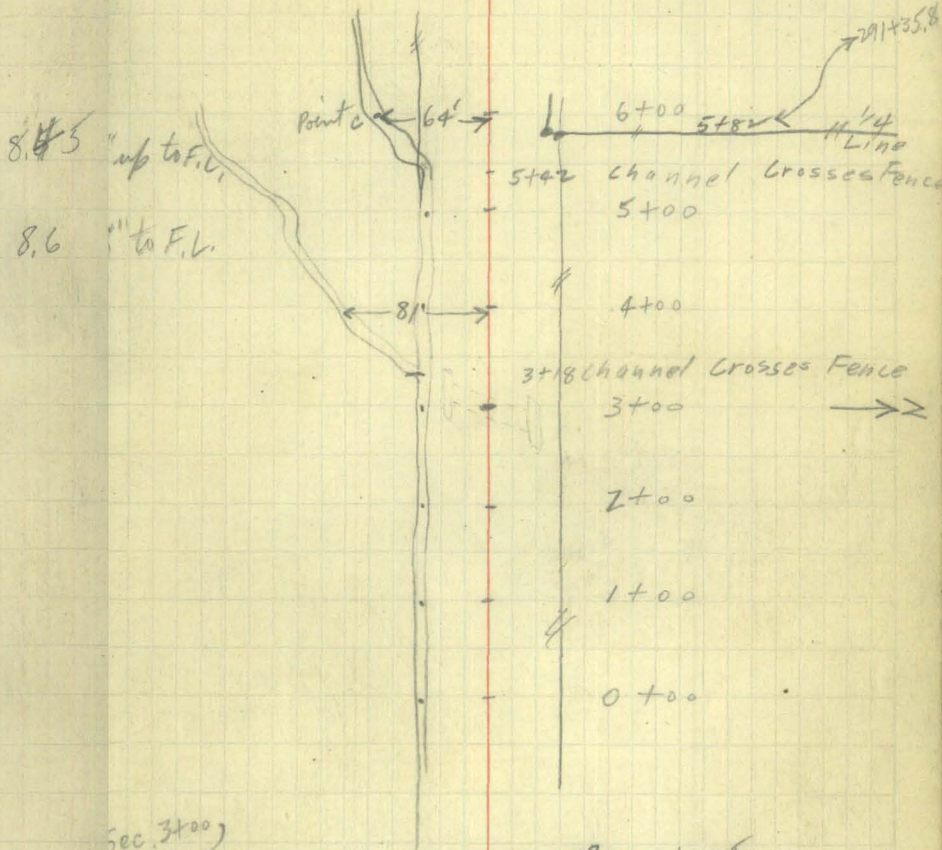
Sec. 16-21 T87N R12W
Culv. Survey

May 27, 1924

5X3X32.3

8.7
5.0
7.9

8.6 "up to F.L.
8.6 "to F.L.



	Ditch		Road	
Point C	9.2	837.4		
6			3.7	842.9
5	9.7	836.9	4.5	842.1
4	10.0	836.6	5.1	841.5
3+00			5.8	840.8
✓	10.4	836.2	6.0	840.6
1	11.0	835.6	6.2	840.4
0	11.9	834.7	6.5	840.1

Sec. 3+00

$\begin{array}{r} 7.2 \\ 9.4 \\ 200 \end{array}$
 $\begin{array}{r} 37.8 \\ 88 \\ 100 \end{array}$
 $\begin{array}{r} 40.0 \\ 6.6 \\ 32 \end{array}$
 $\begin{array}{r} 39.4 \\ 7.2 \\ 29 \end{array}$
 $\begin{array}{r} 52.0 \\ 10.4 \\ 21 \end{array}$
 $\begin{array}{r} 37.8 \\ 8.8 \\ 15 \end{array}$
 $\begin{array}{r} 39.2 \\ 7.4 \\ 11 \end{array}$
 $\begin{array}{r} 40.6 \\ 6.0 \\ 8 \end{array}$
 $\begin{array}{r} 40.8 \\ 5.8 \\ 5.8 \end{array}$
 $\begin{array}{r} 40.8 \\ 5.8 \\ 12 \end{array}$
 $\begin{array}{r} 38.0 \\ 8.6 \\ 18 \end{array}$
 $\begin{array}{r} 37.6 \\ 9.0 \\ 28 \end{array}$
 $\begin{array}{r} 39.5 \\ 7.1 \\ 31 \end{array}$

846.6

B.M. 7.95 846.61 843.61

Nails in Cor. fence post about 24' N. of $\frac{1}{4}$ cor. stake.
at Center Sec. 16-21

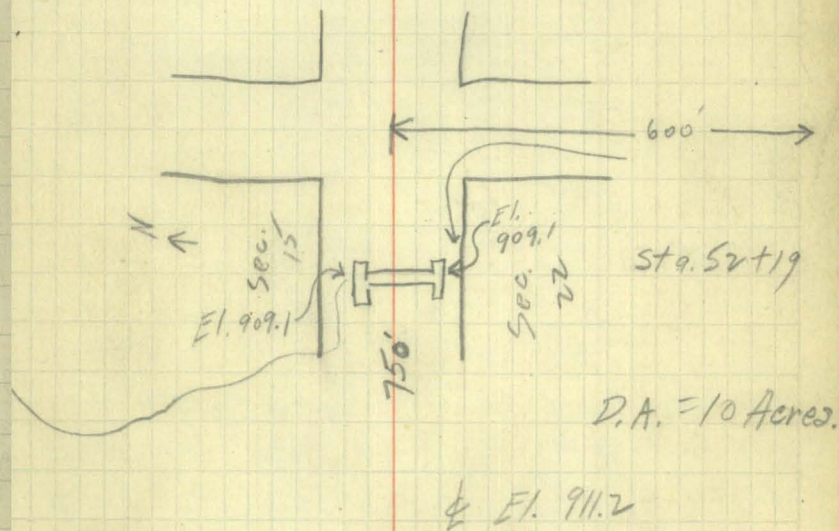
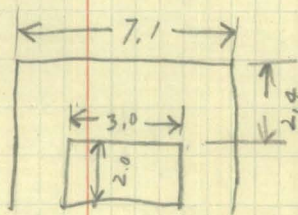
Sec. 15-22 Eagle Twp.

3 x 2 x 18.3

Extend to 26.3

4' - N. end.

4' - S. end.



6" tile on Co. Road
East side of Sec. 24
Spring Creek Twp.

May 29, 1924

B.M.

8.42 100.02

Top of tile

West side

6	Outlet	11.05	97.39	9.45	98.99	97.4	1.59✓	1'-7"
5		8.3	100.1	6.78	101.96	98.8	3.16✓	3'-2"
4		6.4	107.0	4.23	104.21	100.2	4.01✓	4'-0"
3		13.5 ¹²⁶	108.44	11.45	106.68	103.2	3.48✓	3'-5 ³ / ₄ "
2		10.5	107.6	8.55	109.58	106.2	3.38✓	3'-4 ¹ / ₂ "
1		7.5	110.6	5.36	112.77	109.2	3.57✓	3'-7"
0		4.2	113.9	1.91	116.22	112.2	4.02✓	4'-0 ¹ / ₄ "
			118.13					

East side

B.M.	8.05	108.05		100.00				
6+37.4	Outlet	11.75	96.69	9.20✓	99.24	96.70	2.54✓	2'-6 ¹ / ₂ "
6		9.4	98.6	7.35	100.70	97.15	3.55✓	3'-6 ¹ / ₂ "
5		7.8	100.2	6.41	101.64	97.6	4.04✓	4'-0 ¹ / ₂ "
4		5.8	102.2	4.13	103.92	100.42	3.50✓	3'-6"
3	T.R.	3.4	104.6	1.62	106.43	103.24	3.19✓	3'-2 ¹ / ₄ "
2		10.4 ¹¹⁷⁰	118.73	8.82	109.31	106.06	3.25✓	3'-3"
1		7.1	111.0	5.14	112.69	108.88	3.81✓	3'-9 ³ / ₄ "
0		4.5	113.6	2.39	115.74	111.7	4.04✓	4'-0 ¹ / ₂ "

B.M.

8.05

100.00

ail in Willow stump Rt. of 6+21

6" Tile on Co. Road

May 29, 1924.

	South Side Road						
	Ditch		Hub				
0	4.9	112.4	3.05	114.22	110.5	172	3'-8 3/4"
1	5.0	112.3	3.15	114.12	110.0	59.4.12	about 700' West of East end of
2	6.4	110.9	4.78	112.49	108.48	4.01	Sec. 13-24 Spring Creek.
3	6.50 3.0	117.27 109.6	1.80	110.77	106.96	3.81	4'-0"
4	4.7	107.9	3.37	109.20	105.44	3.76	3'-9 3/4"
5	6.8	106.8	5.08	107.49	103.92	3.57	3'-9"
6	8.3	104.3	6.21	106.36	102.4	3.96	3'-7"
7	9.1	103.5	7.21	105.36	101.94	3.42	3'-11 1/2"
8	7.75 4.6	112.57 103.1	2.88	104.82	101.45	3.35	3'-5"
9	4.9	102.8	3.29	104.41	101.0	3.41	3'-4 1/4"
10	5.5	102.2	4.14	103.56	99.5	4.06	3'-5"
11	7.3	100.4	5.67	102.03	98.0	4.03	4'-0 3/4"
12	9.8	97.9	8.00	99.70	95.95	3.75	4'-0 1/2"
13	13.8	93.9	12.14	95.56	93.9	1.66	3'-9"
							outlet 1'-8"
B.M.	7.70	107.70		100.00			tail in Tel. pole on South side sta. 12 + 78

8.33 102.14

North side Road 98.3

10+50	9.5	101.0	7.53	102.94	99.0	3.94 ✓	3-11 $\frac{1}{2}$ "	37 ft. across Road
10	9.1	101.4	7.06	103.41	99.4	4.00 ✓	4'-0"	Cross Road Connect at 10+80 on South side
9	8.3	102.2	6.22	104.25	100.2	4.05 ✓	4'-0 $\frac{1}{2}$ "	
8	7.8	102.7	5.83	104.64	101.0	3.64 ✓	3'-7 $\frac{3}{4}$ "	
7	7.3	103.2	5.62	104.85	101.8	3.05 ✓	3'-0 $\frac{1}{2}$ "	
6	6.5	104.0	4.60	105.87	103.17	2.70 ✓	2'-8 $\frac{1}{2}$ "	
5	3.05	110.47	9.85	107.42	104.54	2.88 ✓	2'-10 $\frac{1}{2}$ "	
4	11.7	105.6	7.80	109.47	105.91	3.56 ✓	3'-7"	
3	10.1	107.2	6.29	110.98	107.28	3.70 ✓	3'-8 $\frac{1}{2}$ "	
2	8.1	109.2	4.76	112.51	108.65	3.86 ✓	3'-10 $\frac{1}{2}$ "	
1	6.5	110.8	3.09	114.18	110.02	4.16 ✓	4'-2"	
0	4.9	112.4	2.70	114.59	111.39	3.18 ✓	3'-2 $\frac{1}{4}$ "	
	4.4	112.9						700' West of East end Sec. 13-24 Spring Creek Township
		117.27						

Re-Cross Section

To bin Pit

28

May 31, 1924

2+98

2+00

1+60

1+00

0

B.M.

1.87

105.77

2.98

102.79

103.90

105.1	99.9	100.9	100.3	99.5	98.1	101.1
0.7	5.9	4.9	5.5	6.3	7.7	
90	96	114	136	170	185	190
104.0	100.0	100.1	100.1	99.5	97.5	97.8
1.8	5.8	5.7	5.7	6.3	8.3	8.0
96	99	109	152	174	186	193
104.0	100.1	99.8	99.6	99.3	97.5	97.6
1.8	5.4	6.0	6.2	6.5	8.3	8.2
95	91	115	140	175	184	192
103.2	101.8	100.4	99.6	98.9	98.5	100.1
1.9	4.9	5.4	6.2	6.9	7.3	5.7
57	83	87	122	133	165	180
						Hub

3.0
0 3.7
2.7

Tobin P.H.
Channel Change

0+90

0+79

0+50

0+10

0+00

5.84

106.7

106.64

4.66

106.66

100.8

102.00

N. Top of Water 9.7

96.1

S. Top of Water 8.9

96.9

0+90

0+79

0+50

0+10

0+00

3.82

105.8

105.77

7.65

98.12

ub at 0+00

$$\begin{array}{r} 10.8 \\ 5.9 \\ 0 \end{array}$$

$$\begin{array}{r} 100.9 \\ 5.8 \\ 10 \end{array}$$

$$\begin{array}{r} 99.9 \\ 6.8 \\ 11 \end{array}$$

$$\begin{array}{r} 98.5 \\ 8.2 \\ 13 \end{array}$$

$$\begin{array}{r} 96.7 \\ 10.0 \\ 14 \end{array}$$

$$\begin{array}{r} 96.7 \\ 1.0 \\ 16 \end{array}$$

$$\begin{array}{r} 96.2 \\ 10.5 \\ 17 \end{array}$$

$$\begin{array}{r} 95.8 \\ 10.9 \\ 19 \end{array}$$

$$\begin{array}{r} 96.2 \\ 10.5 \\ 22 \end{array}$$

$$\begin{array}{r} 97.0 \\ 9.7 \\ 23 \end{array}$$

$$\begin{array}{r} 101.9 \\ 4.8 \\ 0 \end{array}$$

$$\begin{array}{r} 101.9 \\ 4.8 \\ 8 \end{array}$$

$$\begin{array}{r} 99.6 \\ 7.1 \\ 9 \end{array}$$

$$\begin{array}{r} 98.5 \\ 8.2 \\ 11 \end{array}$$

$$\begin{array}{r} 97.9 \\ 8.8 \\ 12 \end{array}$$

$$\begin{array}{r} 97.5 \\ 9.2 \\ 13 \end{array}$$

$$\begin{array}{r} 97.0 \\ 9.7 \\ 14 \end{array}$$

$$\begin{array}{r} 96.4 \\ 10.3 \\ 18 \end{array}$$

$$\begin{array}{r} 95.4 \\ 11.3 \\ 21 \end{array}$$

$$\begin{array}{r} 96.1 \\ 10.6 \\ 22 \end{array}$$

$$\begin{array}{r} 98.0 \\ 8.0 \\ 23 \end{array}$$

$$\begin{array}{r} 98.0 \\ 8.0 \\ 23 \end{array}$$

$$\begin{array}{r} 101.8 \\ 4.9 \\ 0 \end{array}$$

$$\begin{array}{r} 101.8 \\ 4.9 \\ 5 \end{array}$$

$$\begin{array}{r} 98.2 \\ 8.5 \\ 11 \end{array}$$

$$\begin{array}{r} 98.0 \\ 8.7 \\ 15 \end{array}$$

$$\begin{array}{r} 97.0 \\ 9.7 \\ 16 \end{array}$$

$$\begin{array}{r} 97.4 \\ 9.3 \\ 18 \end{array}$$

$$\begin{array}{r} 96.2 \\ 10.1 \\ 19 \end{array}$$

$$\begin{array}{r} 101.7 \\ 5.0 \\ 29 \end{array}$$

$$\begin{array}{r} 101.9 \\ 4.8 \\ 0 \end{array}$$

$$\begin{array}{r} 101.9 \\ 4.8 \\ 3 \end{array}$$

$$\begin{array}{r} 98.7 \\ 8.0 \\ 7 \end{array}$$

$$\begin{array}{r} 98.0 \\ 8.7 \\ 12 \end{array}$$

$$\begin{array}{r} 96.9 \\ 9.8 \\ 13 \end{array}$$

Total = 225 Cu. yds. Excavation

$$\begin{array}{r} 100.8 \\ 5.0 \\ 0 \end{array}$$

$$\begin{array}{r} 100.7 \\ 5.1 \\ 0 \end{array}$$

$$\begin{array}{r} 100.6 \\ 5.2 \\ 19 \end{array}$$

$$\begin{array}{r} 99.2 \\ 6.6 \\ 20 \end{array}$$

$$\begin{array}{r} 99.0 \\ 6.8 \\ 25 \end{array}$$

$$\begin{array}{r} 95.4 \\ 10.4 \\ 28 \end{array}$$

$$\begin{array}{r} 101.7 \\ 4.1 \\ 10 \end{array}$$

$$\begin{array}{r} 101.5 \\ 4.3 \\ 10 \end{array}$$

$$\begin{array}{r} 101.8 \\ 4.0 \\ 10 \end{array}$$

$$\begin{array}{r} 101.7 \\ 4.1 \\ 19 \end{array}$$

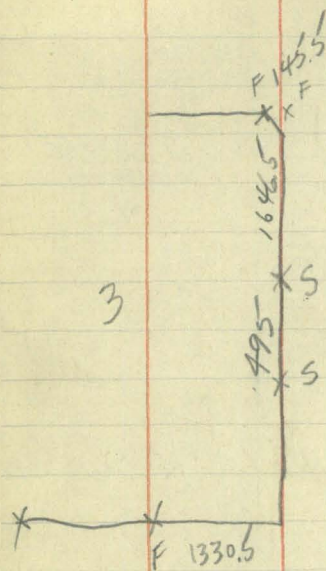
$$\begin{array}{r} 100.9 \\ 4.9 \\ 19 \end{array}$$

$$\begin{array}{r} 97.8 \\ 8.0 \\ 19 \end{array}$$

$$\begin{array}{r} 96.7 \\ 9.1 \\ 21 \end{array}$$

$$\begin{array}{r} 95.7 \\ 10.1 \\ 36 \end{array}$$

Sec. 2-3 - 88-13



Tile Check

Dewar - Readlyn Road

222	East side	8.62	
221		8.82	
220		9.03	
219		9.17	
218		9.37	
217	(158.75)	9.51	
216		9.92	
215		10.20	
214		10.66	
10+50		10.80	
B.M.		4.18	154.57
9+50		11.11	
9		11.41	
8		12.35	146.30
7.9	9.95	2.58	148.70
7		5.71	
6		6.73	
5		7.65	
4		8.15	
3		8.70	
2		9.15	
1		9.57	
0		9.66	141.63
	5.10	151.28	146.18

Hob			3.72	155.78
226			7.09	
225			7.74	
224			8.46	
223			9.09	150.41
T.P.	5.55	(159.50)	4.90	153.85
222			8.62	150.13
221			8.70	
220			9.06	
219			9.19	
218			9.41	
217			9.58	149.17
T.P.	6.20	158.75	6.10	152.55
216			9.89	148.76
215			10.20	
214 Ho			10.55	
West				
		158.65		

226

225

224

223

East
159.50

7.13

7.75

8.49

9.14

Four ^{on} Bridges
 Black Hawk Creek
 Near South Line Sec. 32
 Waterloo Twp.

June 3, 1929.

11+90.4
 11+44
 10
 31' Right to Cor. past
 E Road North 536' South to Cor. Sec.

9469.2 State 12' Right $\angle 9^{\circ}59'$ Left, $\frac{1}{2}$ 3' Le

8+36
 8+26 Cross. Fence

7+58 Top of West Bank

7+00

6+29 Top of East Bank

6

5+06.8 $\angle 23^{\circ}-15'$ Left 6' Left to $\frac{1}{2}$

5

4

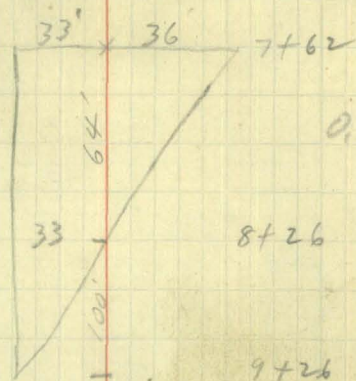
3

2+67.3 $\angle 18^{\circ}-13'$ Right 4' Right to $\frac{1}{2}$

2

1

0+00 E 22X16 Wood Br.



7+62 = W. end of Prop. Br.
 6+25 = E. End of Prop. Br.

One New pile x 5 Backing Plank required
 on Black Hawk Road, also repair
 N-E wing.

E. Br. on Black Hawk - 15' bent ^{with backing plank} beside
 new cap and 3 extra sway braces.

Profile

B.M. #1		5.32	99.97	
T.P.	3.59	105.29	9.85	101.70
11+90.4		0.0	111.6	
11		0.9	110.7	
10		2.7	108.9	
9+69.2		3.5	108.1	
9		4.7	106.9	
8+36		7.2	104.4	
8+24		9.4	102.15	
B.M.	7.55	111.6	0.50	104.00
8+00		5.5	99.0	
		104.50		

ail in Last pile at N-W. cor. Br.

Prop. Gr. of New Br.		103.25	
2.85	104.55	101.70	
1.30	103.25	103.25	

Dist. Azi.

325' 356° 36'
232' 347° 35'

st end of Br.
est end of Br.

▷ 9+69.2 Back Tangent 0° 00'

32 piling delv. 37
on Nov. 5, 1924

7+58		6.3	98.2	
7+51		12.3	92.2	
High water		6.2	98.3	
7+50		13.0	91.5	0.7 deep
west end		1.1	103.4	
old Br.		0.6	103.9	
7+00		12.3	92.2	
6+80		14.1	89.8	2.4 deep
6+70		14.0	90.5	1.7 deep
6+45		14.1	89.8	2.4 deep
East end old Br.		2.3	102.2	
B.M. #2		2.80	101.70	Nail in Last Tall piling at S-E Cor. Big Br.
6+40	Top of Water	12.3	92.2	
6+29		4.7	99.8	
6+10		2.9	101.6	
6		3.0	101.5	
5+06.8	4.15 104.50	4.45	100.35	
5		4.4	100.4	
4		4.1	100.7	
3		4.7	100.1	
2+67.3		5.0	99.8	
2		5.0	99.8	
1		4.3	100.5	
0+00	Floor	3.3	101.5	FL. $\frac{95.35}{9.45}$ of Br.
B.M. #1	4.80 104.80		100.00	Nail in End of Cap at South Cor. of Br. 0+11

Tile Check

Benn-25-6

38

Ditch -1+50

4.56 104.90

-1+50

1.64 107.82 102.00 5.82

-1+00

3.59 105.87 101.00 4.87

0+00

6.34 103.12 99.00 4.12

7 Sta. 10ths,
5 Sta. 10ths,

T.P. 2+00

9.05 109.46 3.81 100.41

9+00

5.10 99.12

8+00

6.40

7+00

7.62

6+00

8.60

5+00

8.95

Page 9
8 6 2 1/2
82 1/2 Sta. 10ths,

B.M.

4.22 104.22

100.00

Cedar Falls Sec. 29-32.

800' West of Jct. with Prim. Rd's

2 1/2 x 3 stone Slab in Place

Constr. 5 x 3 x 2 ft 45° wings.

just west

D.A. = 90 Acres

93.3
91.9
1.4

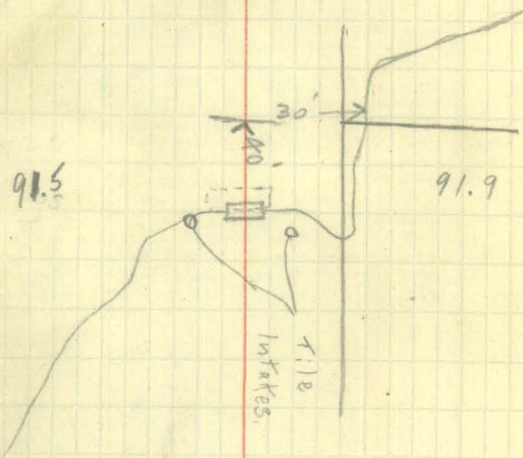
93.4
91.5
1.9

40

June 9, 1924

July 5 x 3 x 2 ft
45° wings

5.1	99.6	94.5	
S. Hub	6.2	93.4	1'-11"
N. Hub	6.3	93.3	1'-5"



6	2.4	
5	3.9	
4	4.5	
3 &	4.7	95.3
2	5.9	
1	5.4	
0 - 300' East of Col. V.	4.8	

100	91	8.5	91	South	91.7	94.9	95.3	95.0	91.7	92.7	92.8	
33	200	100	25	16	10	9	4.7	5.0	8.3	1.3	1.2	North 92.9
								10	10	17	24	100
												200
												300

B.M.

5.5 (100.00)

94.5

11 in. Cor. Post on S. side of road.

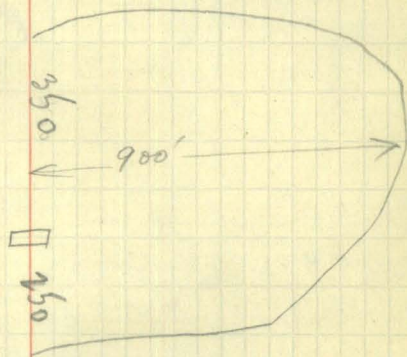
105.5

Sec. 36 - Cedar Falls,
 $\frac{1}{2}$ mi. N. of South Line.

37

June 9, 1924,

41



5+35		0.0	
5		1.2	
4		3.8	
3+00	±	5.4	102.15
2		5.2	
1		3.2	
0	= 300' South	3.3	

4.8 106.95 102.15

B.M.		7.52	99.43
W. Hub	0' - 5"	8.04	98.91
E. Hub	0' - 4" Cut	7.18	99.77

98.5
99.5

13.6	West	97.8	98.3	101.5	102.2	102.2	99.4	East	99.7
200	11.1	98.9	9.3	6.1	5.4	5.4	8.2	7.9	5.2
100	30	17	9	8	18	19	31	100	200
									3.5
									1.6
									30

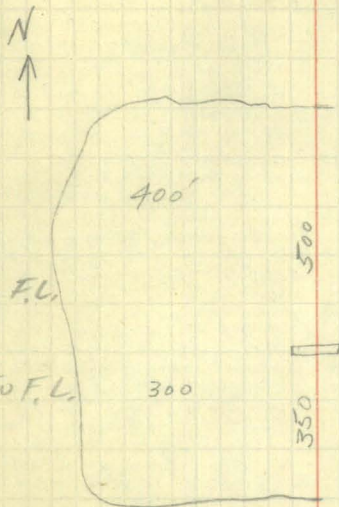
B.M. 7.55 107.55

100.00

107.6
 → Nail in Elec. pole S. of Cut, west side of Road.

Sec. 18 E. Waterloo Twp.
About 60 rods N. of South end
12" Corr. in place

June 10, 1924.



D.A. = 6.890.

18"

18" x 28"

	5.22	105.22	100.00	
W. Hub	7.03	98.19	97.2	0" to F.L.
W. D.it.	8.00	97.22		
E. Hub	7.62	97.60	96.6	0" to F.L.
E. D.it.	8.6	96.62		
6	1.3	103.8		
5	3.0	102.1		
4	4.1	101.0		
3	5.1	100.0		
2	5.2	99.9		
1	4.3	100.8		
0 = 300' South of E	2.1	103.0		

96.7
East
 $\frac{3.6}{100}$ $\frac{4.8}{33}$ $\frac{6.6}{25}$ $\frac{7.2}{18}$ $\frac{7.9}{15}$ $\frac{5.3}{13}$ 5.1 $\frac{5.8}{7}$ $\frac{8.0}{9}$ $\frac{8.4}{17}$ $\frac{9.1}{33}$ $\frac{10.6}{100}$ $\frac{12.5}{200}$

B.M. 5.11 105.11 100.00

Elm
tail in Big Tree N. of Culv. E. side of Road

Sec. 18 E. Waterloo Twp.
 15" Iron and Vit. pipe in place
 310 ft. S. of Center of Sec. 18

Road Road Pitch

2.59

102.57

100.00

Hub E.

4.60

97.97

96.2 $1.77 = 1'-9"$

Dit. E.

6.25

96.32

Hub. W.

6.51

96.06

95.6

46 = $5\frac{1}{2}"$ to F.L.

Dit. W.

6.72

95.85

8

1.6

7

3.7

6

5.1

5 & Culv.

5.6

7.3

4

5.3

7.2

3

3.1

3.1

5.4

2+50

2.5

4.9

2

3.5

5.75

1

4.3

6.7

0 = 500' South

4.1

6.45

-100

3.8

3.8

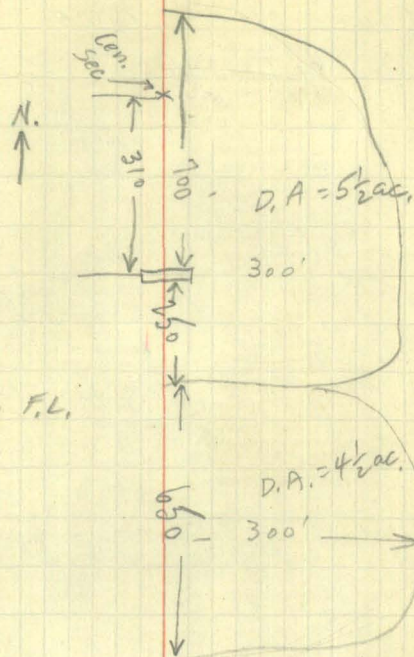
5.9

B.M.

3.47

103.47

100.00



24" X 28"

17.5 West 95.6
 200 13.1 100 7.9 30 7.9 7.7 10 6.5 9 97.9 5.6 14 96.2 7.3 18 5.4 29

oil in Tel. pole about 100' S. of Culv. E. side Road.

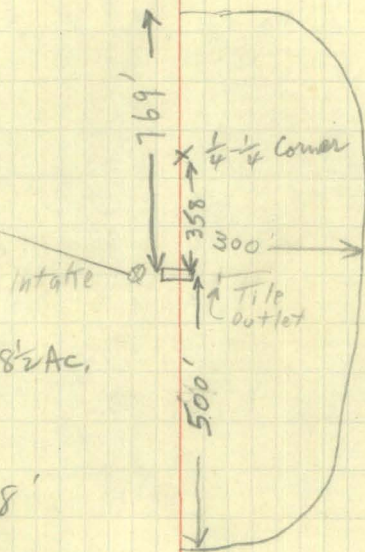
Sec. 18 E. Waterloo Twp.
358 ft. S. of North $\frac{1}{4}$ - $\frac{1}{4}$ Corner
15" Conc. & Vit. pipe

June 10, 1929

E.F.L.	7.7		
E. Hub	7.55	7.7	0.15" to F.L.
W.F.L.	8.4		
W. Hub	8.16	8.4	0.24" to F.L.
&	4.5		

D.A. = 8 $\frac{1}{2}$ Ac.

24" X 28"



D.A. = 8 Ac,
24"

6	1.3	101.1
5	2.6	99.8
4	3.85	98.52
3 & Culv.	4.0	98.4
2	3.5	98.9
1	0.9	101.5
0 + 70	0.0	
0 = 300 S.		
B.M.	2.31	102.4
		102.37
		100.00

89.4	90.9	95.0	95.1	96.9	98.4	97.6	95.4	95.7	97.9
15.0	11.3	7.4	7.3	5.5	4.0	4.8	7.0	6.7	4.5
200	100	32	13	9	4.0	13	16	29	31

ail in Big Cotton Wood N. of Culv. E. side of Rd.

Sec. 18 E. Waterloo Twp

100' S. of North end
and 70' S. of North "

2 - 12" Culv. in place

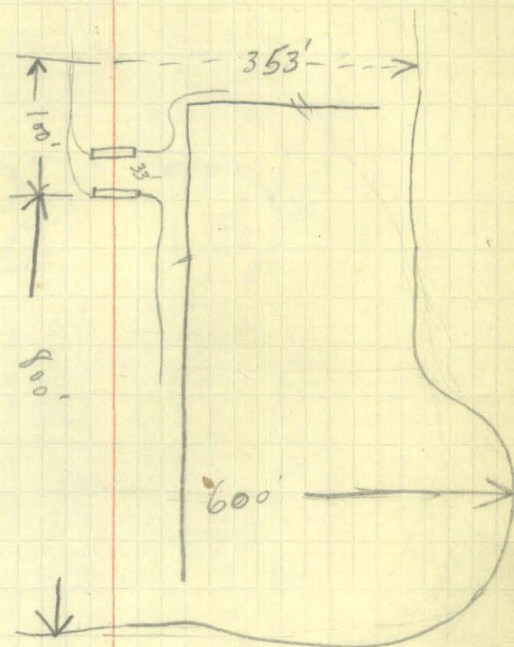
Road

Ditch

100.00

E. E.L.	7.00		7.2	
E. Rd.	4.5			
W. F.L.	8.1		8.1	
E. Hub.	<u>5.78</u>	7.2	1.42	5" to F.L. D.A. = 10 Ac.
W. Hub.	7.36	8.1	1.74	" to F.L.
		7.36		

30' x 28'



5458	2.1	102.2	3.7	100.6
5	4.0	100.3	5.2	99.1
4	5.3	99.0	6.4	97.9
3+00 E North pipe	4.8	99.5	7.3	97.0
2	4.7	99.6	6.8	97.5
1	4.0	100.3	6.1	98.2
0 - 300' South	2.9	101.4	5.5	98.8

B.M.

4.29

104.3
104.29

West 1/4
10.5 95.2 95.3 95.5 96.4 98.8 99.5 98.9 97.3 21.0 East 1/4 98.2 99.8
13.8 9.1 9.0 8.5 7.9 5.5 4.8 5.4 7.0 7.3 6.1 4.5
200 100 80 19 13 10 11 12 19 22 29

ail in 1st. Tel. S. of Culv. East side of Road

Sec. 15-16 E. Waterloo
20X16 Wood Br.
112 ft. S. of Cen. Section

June 10, 1924.

Staked July 11, 1924.

D.A. - 420 AC,

Twin 6X4X24 Rd.

~~12X4X30~~

30° Skew

L Wings.

High water 6.5 100.5

Top Water 8.6 98.4

5+50 0.4 106.6

5 1.6 105.4

4 3.6 103.4

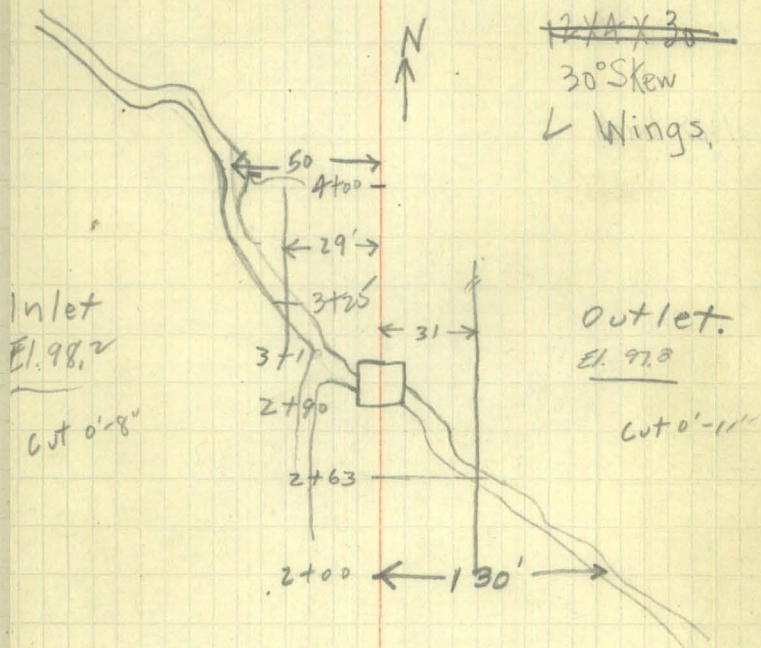
3 4 Br. 5.0 102.0

2 6.6 100.4

1 1+70 7.0 100.0

0 6.8 100.2

B.M. 7.03 107.00
107.03 100.00



West

98.6	97.8	98.3	98.4	98.2	102.00	112.0	102.0	97.8	98.0	97.4	96.9	97.3
8.4	9.2	8.7	8.6	8.8	5.05	5.0	5.03	9.2	9.0	9.6	10.1	9.8
300	200	100	30	10	8	50	8	9	31	100	200	300

il in New Tel. pole 100' N. of Br. West side.

June 11, 1924

Eagle Twp. Sec. 14-23

near East end.

3X2X17 in Place

5.7 N.

10.1 S. to Headwall

Extend to 26'

100' N. of cor. stone 11.5

100' S. of Cor. stone 2.9

5+00 14.2

4+00 8.4

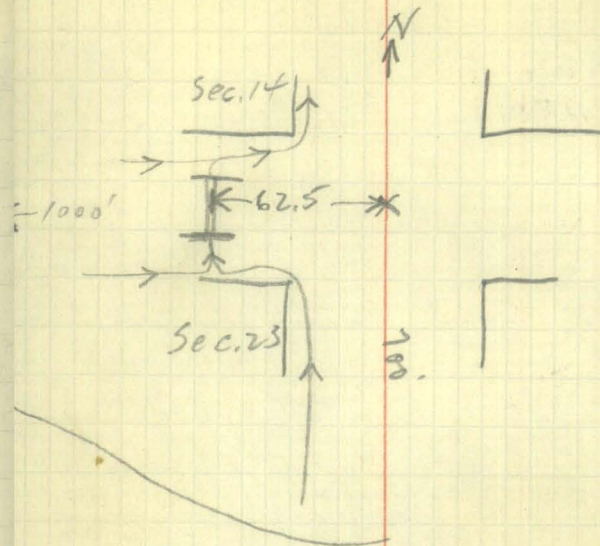
3+62.5 Cor. stone 7.1

3+00 & Culv. 5.4

✓ 3.8

1 1.8

0+50-250' West 0.3



North

3	17	9.2	8.3	8.3	8.6	5.1	4.9	7.8	7.7	5.8
26	22	19	14	9	6	5	5.4	11	12	21
					900'					25

South

B.M. 4.47 896.59

B.M. 4.72 901.06 896.34

ail in Elec. pole at S-W. cor. of X-road
 X on S. Head Wall

Repair of Tile Line
Prim Rd. #59
at Hoover Corner
N-W side of Road
on Outside of Curve.

48
June 16/1924,

Relay 89' - 6"
Dig up 50' - 8"
139'

13.3 92.43

325' - 8" required

4+64	4.35	101.38	100.83	Top of 6"
3+93	3.06	102.67	100.83	1.84 ✓
2+93	4.40	101.33	98.62	2.65 ✓
1+93	6.34	0.61	99.39	95.65
0+93		3.00	97.00	92.62
0+43		6.35	93.65	89.59
0+00		7.58	92.42	88.08
0+00		12.48	87.52	86.78
0+00		9.78	90.22	86.78

Top of 8"

100.00

Stripping on Tobin Pit

June 21, 1924

1+64

1+50

1+00

0+50

0+00

$$\frac{2.4}{0}$$

$$\frac{2.4}{0}$$

$$\frac{2.7}{0}$$

$$\frac{2.8}{0}$$

$$\frac{2.7}{0}$$

$$\frac{3.3}{99}$$

$$\frac{3.3}{99}$$

$$\frac{2.3}{99}$$

$$\frac{2.4}{51}$$

$$\frac{2.9}{50}$$

$$2.9 \times 100 = 290$$

$$2.9 \times 100 = 290$$

$$2.5 \times 100 = 250$$

$$2.6 \times 51 = 133$$

$$2.8 \times 50 = 140$$

172

500

355

253

1280 cu yds

1st. stripping 1879

Tobin Total on pit 3159 cu yds

Norden Pit

2131

Gunn Pit

750

Eagle 13-24

350' East of West end

D. A. = 140 Ac.

C = 0.4

19' x 16' Wood Br.

7x2 opening on Twp. Rd. NW. of Wood Br.

High water;

5.5

882.36

B.M.

7.2

888.09

880.89

4.

9.3

78.79

77.7 N. 0.9 = 1'-1"

9.1

78.99

77.2 S. 7.9 = 1'-9 1/2"

6.2

881.7

7.2

880.7

7.2

880.7

4.5

883.4

4.6

883.3

1.8

0.0

6

5

4

3+00

2

1

0+56

0

B.M.

6.97

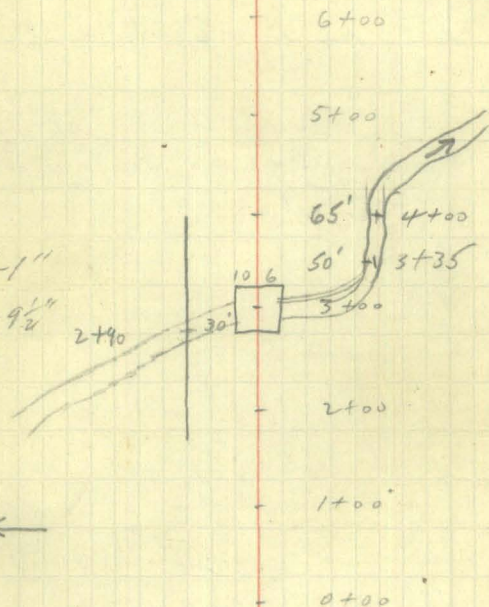
887.86

880.89

ailin Elec. pole N. side of Br.

+10

79.7	83.6	83.4	83.4	78.5	78.4
9.6	7.8	8.2	4.3	4.5	4.5
21	17	14	8	6	10
					15



79.2 North

70	76	86	77.5	76.9	83.4	76.8	South
300	200	100	30	10	4.5	11.1	11.7
						24	100
							12.3
							200

79.0 79.5 F.B.

8.9	8.4	5.0	4.7	4.7	6.8	7.5	8.6
24	13	8			10	14	16

Mt Vernon Twp. Sec 1-12
 1/3 mi. West of East end.

20 x 16 Wood Br.

D.A. = 1700 Ac.

High water about top of Br. floor.

6.42 106.42 100.00
 103.30
 3.12

6 = 300' W. of Br.

5	2.4	104.1
4	3.7	102.8
3	4.8	101.7
2	5.3	101.2
1	4.8	101.7
0	3.7	102.8
	2.3	104.2

B.M. 6.45 106.45 100.00

106.5

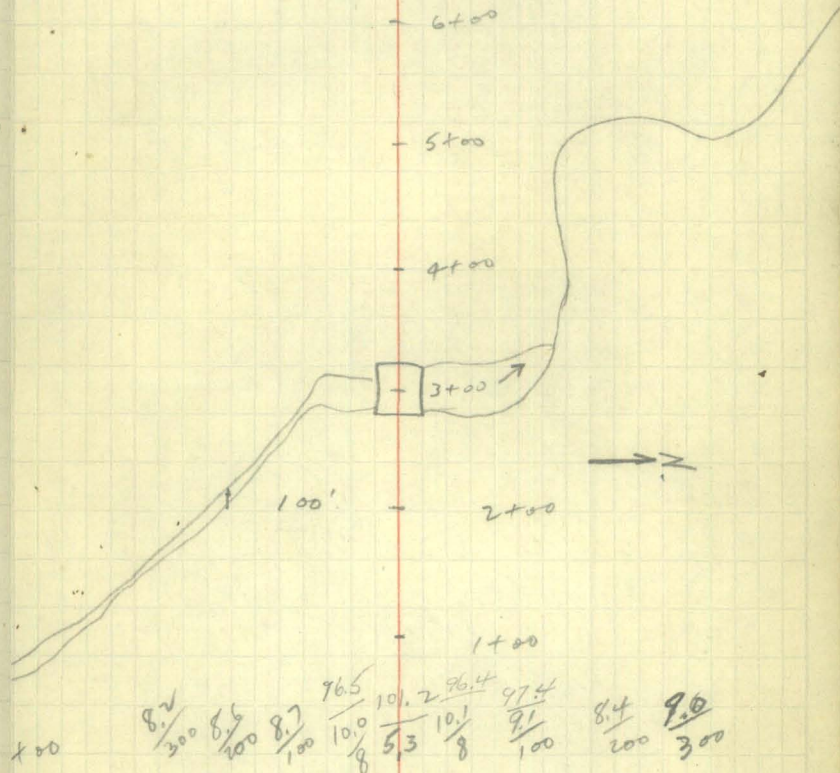
51

3+41

2+89

97.1	101.2	101.5	101.5	98.9
9.4	5.3	5.0	5.0	North
11	7	7	7	7.6
98.2	97.8	101.2	101.3	101.0
8.3	8.7	5.3	5.2	5.5
14	9	6	9	11
				8.8

June 2, 1924



Trail in 3rd. Big Cottonwood East of Br.

Benn - 18-19

June 21, 1924

approx Center of mile

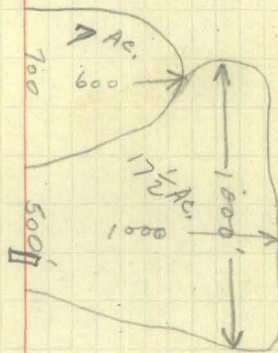
26' x 2' x 15.2

22.57

South North

9.3-5.9

15.2 b. to b. all parapets

$$\begin{array}{r} 95.24 \\ 94.62 \\ \hline .62 \end{array}$$


6 = 300 ft. West

3.7

5

3.0

4

4.7

3

4 Culv.

5.2

2

3.3

1

0.5

0

2.1

5.24

105.24

Hub South

10.62

94.62

95.24 Raise 0' - 7 1/2"

Hub North

7.92

97.32

96.24

08 = 1' - 1"

N. F.L.

9.00

96.24

11.4
29South
Fl. 10.1
1196.3
8.9
5.6
10
9
Floor

5.2

5.2
68.5
795.4
9.8
88.0
28

B.M.

5.24

105.24

100.00

19.1 in N. Cor. Post about 30' East of Culv.

Benn. 23-26

About 1/4 mi. East of West end

1 1/2 x 1 1/2 x 16 in place

Constr. 2 x 2 x 24

6 " 300' West	2.0	
5	4.2	
4	5.4	
3 & Culv	5.1	100.7
2	4.5	
1	2.3	
0 + 28	0.1	

B.M. 5.76 105.76 100.00

5.68

105.68
98.2

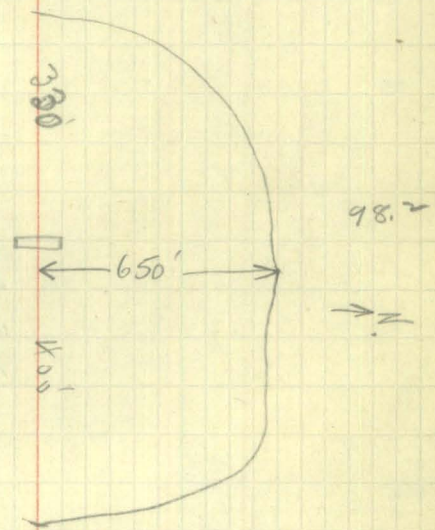
100.00

D.A. = 10 Ac.

7.48

7.78

97.9



9.9 8.4 7.9 7.9 98.3 100.1 100.7 100.2 98.3 98.0
 00 200 100 32 17 7.5 5.7 105.1 5.6 7.5 7.7
 f.v. 10
 North
 6.9 7.5 6.4
 31 11.00 11.00
 West East
 Ditch Ditch

Vail in Tel. pole 50' West of Culv. North side

Cedar Falls Sec. 33-34

About 50 Rods S. of N. end

3½ x 2½ x 20 stone slab in place

$$D.A. = 95 \text{ Ac.}$$

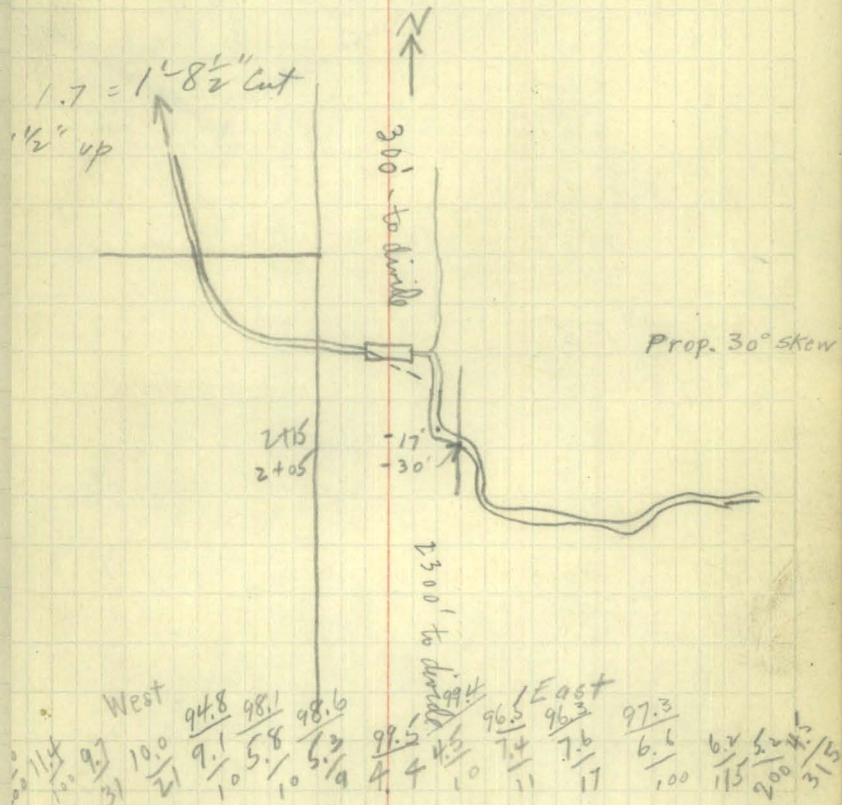
Const. 4x3 - Skew 30° 24' Rd. way.

27'-8 $\frac{1}{2}$ " b. to b.

	4.40	104.40	100.00	
E. Hob			6.2	98.20 96.5
W. H			9.53	94.87 95.0
6			1.4	
5			3.1	
4			4.4	
3+00	✓	Colv.	4.4	
2			4.2	
1			3.9	
0			2.9	
		300' South		

	4.18	104.18		100.00	
E. Hub	1.00	1'-0"	6.68	97.50	96.5
W. Hub	1.74	1'-9"	7.44	96.74	95.0

B.M.	3.9	(103.90)	100.00
------	-----	----------	--------



Double 24"

Culv. West of Hudson

.68

55

B.M.	3.83	103.83	100.00	tail in N-E. Cor. post
Hub. E.		7.05	96.78	96.187"
100' E.		7.75	96.08	
Hub W.		6.95	96.88	96.287"
100' W.		7.85	95.98	

15" Culvert W. of Hudson

B.M.	6.09	106.09	100.00	tail in High Tension Pole
S. Hub		6.31	99.78	99.10.68 - 8" to FL
S. Ditch		8.4	99.10	
S-E "		4.7		
N-E		6.0		
N. Hub		6.60	99.49	98.952.54 - 6 1/2" to FL
N. Ditch		7.14	98.95	
N-W		7.32		
S-W		8.38		

Mahood Pit

2.4 ft. fall
bottom of pit
to creek

70 X 200
pit

Depth of
stripping

56

0+00

0+50

1+00

1+50

2+00

2.3

2.4

2.2

2.3

2.5

2.4

2.2

3.2

3.3

2.8

70

2.4

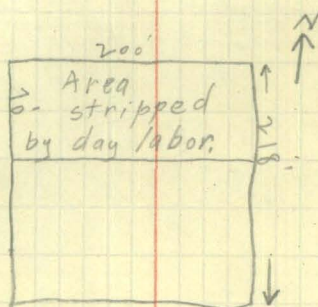
2.3

2.2

2.8

2.65

$$\text{Area stripped} = \frac{2.6 \times 70 \times 200}{27} = 1350 \text{ c.y.}$$

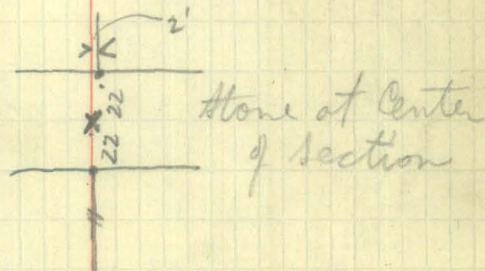
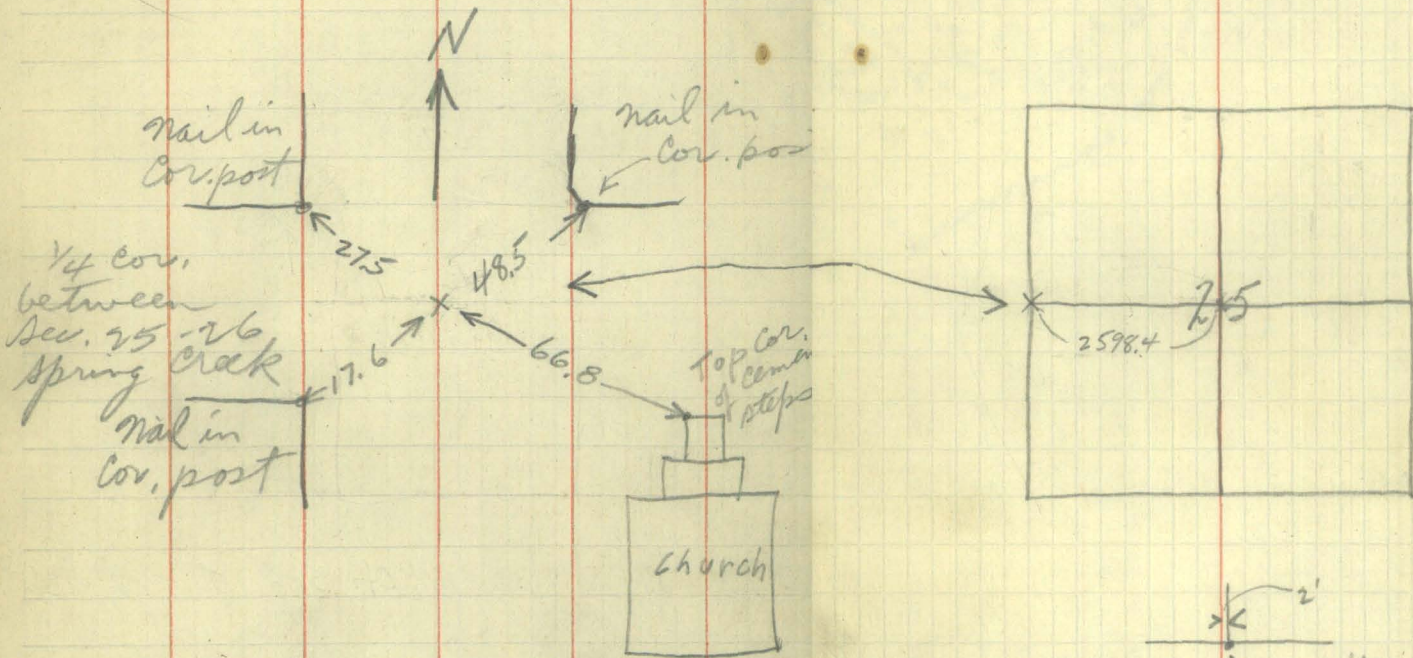


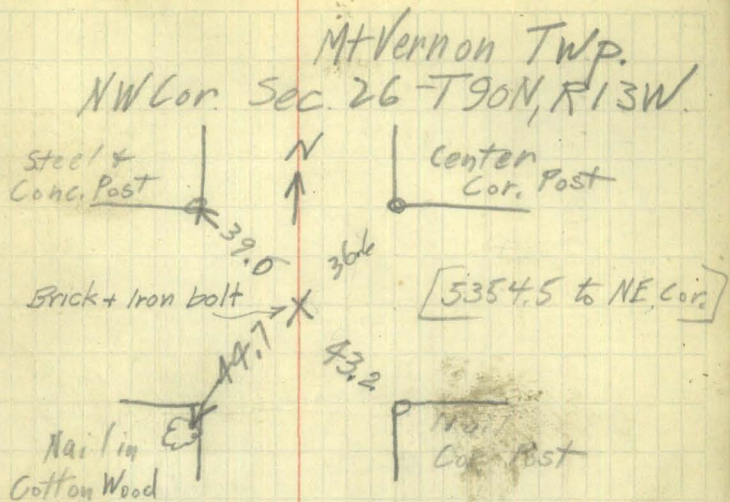
Pit in SW $\frac{1}{4}$ of Sec. 15 T87, R12

Sec. 25 - T87N - R11W.
Spring Creek Twp.

June 6, 1924

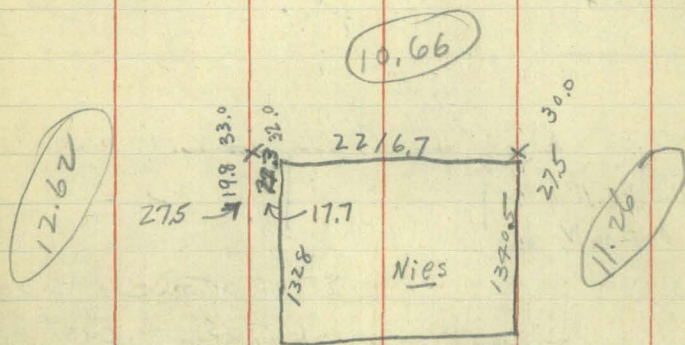
Found stone at center of
section and at West $\frac{1}{4}$ corner.





Set stone at $\frac{1}{2}$ cor.
2677.25 ft. East of
above corner.

Also - NE Cor. Sec. 27-90-13



$$\frac{2216 \times 1334}{43560} = 67.86 \text{ Acres.}$$

W. 67.10 Acres of $\frac{1}{2}$ of
 $\frac{1}{4}$ of Sec. 21, T87, R12

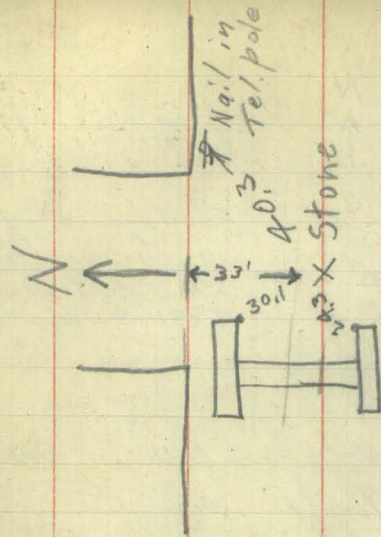


May 19, 1924



50' R. of W. from S.W. Cor. Sec 32,
 T87N, R11W - North 1300' to South
 R. of W. line of Old Cedar Rapids
 and Cedar Falls Road.

17' on East side of Sec. line
 and 33' on West side of line



Stone at
NW Cor. of
Sec. 21
87-12

Stone 7.3 feet South
of E of Culvert.

Sec. 21 - 87-12

Stone Found at NW

Cor. of Sec. 21.

33' from N. Highway
Fence

2632.08

39.88

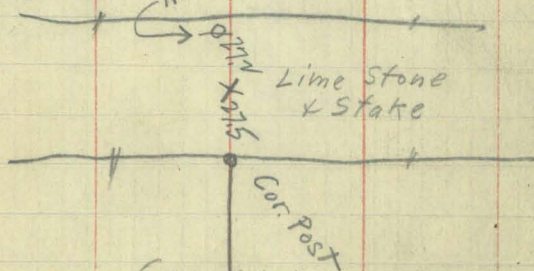
1329.3 to Stone
2630.76
1315.38
1223
19.93

Stone found
located 1924

West $\frac{1}{4}$ Cor. sec. 21

Sec. 16

Nail in Tel. pole



Sec. 21

Stone Found at N-E Cor. of
Nies 67.10 Acres.
in Sec. 21 T87N, R12W.

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.= $23^{\circ} 20'$ to the R. at Station
542+72.

Ext. in Tab. IV opposite $23^{\circ} 20' = 120.87$
 $120.87 + 12 = 10.07$. Say a 10° Curve.

Tan. in Tab. IV opp. $23^{\circ} 20' = 1183.1$
 $1183.1 + 10 = 118.31$.

Tab. V. correction for A. $23^{\circ} 20'$ for a 10° Cur. = 0.16
 $118.31 + 0.16 = 118.47 = \text{corrected Tangent}$.

(If corrected Ext. is required find in same way)
Ang. $23^{\circ} 20' = 23.33^{\circ} + 10 = 2.3333 = \text{L. C.}$

$2^{\circ} 19\frac{1}{2}' = \text{def. for sta. } 542$	I. P. = sta. 542+72
$4^{\circ} 49\frac{1}{2}' = \text{ " " " } +50$	Tan. = 1.18.47
$7^{\circ} 19\frac{1}{2}' = \text{ " " " } 543$	B. C. = sta. 541+53.53
$9^{\circ} 49\frac{1}{2}' = \text{ " " " } +50$	L. C. = 2.33.33
$11^{\circ} 40' = \text{ " " " } 543+$	E. C. = sta. 543+86.86
86.86	

$100 - 53.53 = 46.47 \times 3' (\text{def. for 1 ft. of } 10^{\circ} \text{ Cur.}) = 139.41' =$
 $2^{\circ} 19\frac{1}{2}' = \text{def. for sta. } 542.$

Def. for 50 ft. = $2^{\circ} 30'$ for a 10° Curve.

Def. for 36.86 ft. = $1^{\circ} 50\frac{1}{2}'$ for a 10° Curve

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

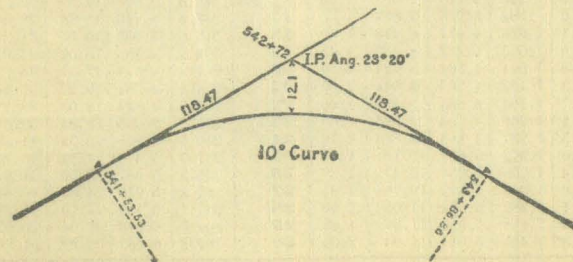


TABLE I. — Minutes in Decimals of a Degree.

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	$\frac{1}{8}$	3-16	$\frac{1}{4}$	5-16	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
.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'	84377.7	.036	.145	.291	0.05	7°	819.0	1.528	6.105	12.21	2.10
20	17189.9	.073	.291	.582	0.10	20'	781.8	1.600	6.395	12.79	2.20
30	11459.9	.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	50'	716.8	1.748	6.976	13.95	2.40
1 10'	5729.6	.218	.873	1.745	0.30	20	688.2	1.819	7.266	14.53	2.50
20	4911.2	.255	1.018	2.036	0.35	30	674.7	1.855	7.411	14.82	2.55
30	4297.3	.291	1.164	2.327	0.40	40	661.7	1.892	7.556	15.11	2.60
40	3819.8	.327	1.309	2.618	0.45	50	637.3	1.965	7.846	15.69	2.70
50	3437.9	.364	1.454	2.909	0.50	20	614.6	2.037	8.136	16.27	2.80
1 20'	3125.4	.400	1.600	3.200	0.55	30	603.8	2.074	8.281	16.56	2.85
30	2864.9	.436	1.745	3.490	0.60	40	593.4	2.110	8.426	16.85	2.90
40	2644.6	.473	1.891	3.781	0.65	50	573.7	2.183	8.716	17.43	3.00
50	2455.7	.509	2.036	4.072	0.70	20	546.4	2.292	9.150	18.30	3.15
1 30'	2292.0	.545	2.181	4.363	0.75	30	521.7	2.402	9.585	19.18	3.30
40	2148.8	.582	2.327	4.654	0.80	40	499.1	2.511	10.02	20.04	3.45
50	2022.4	.618	2.472	4.945	0.85	50	478.3	2.620	10.45	20.91	3.60
1 40'	1910.1	.655	2.618	5.235	0.90	20	459.3	2.730	10.89	21.77	3.75
20	1809.6	.691	2.763	5.526	0.95	30	441.7	2.839	11.32	22.64	3.90
30	1719.1	.727	2.908	5.817	1.00	40	425.4	2.949	11.75	23.51	4.05
40	1637.3	.764	3.054	6.108	1.05	50	410.3	3.058	12.18	24.37	4.20
50	1562.9	.800	3.199	6.398	1.10	20	396.2	3.168	12.62	25.24	4.35
1 50'	1495.0	.836	3.345	6.689	1.15	30	383.1	3.277	13.05	26.11	4.50
20	1432.7	.873	3.490	6.980	1.20	40	370.3	3.387	13.49	26.97	4.65
30	1375.4	.909	3.635	7.271	1.25	50	359.3	3.496	13.92	27.84	4.80
40	1322.5	.945	3.781	7.561	1.30	20	348.5	3.606	14.35	28.70	4.95
50	1278.6	.982	3.926	7.852	1.35	30	338.3	3.716	14.78	29.56	5.10
1 60'	1228.1	1.018	4.071	8.143	1.40	40	319.6	3.935	15.64	31.29	5.40
20	1185.8	1.055	4.217	8.433	1.45	50	302.9	4.155	16.51	33.01	5.70
30	1146.3	1.091	4.362	8.724	1.50	20	287.9	4.374	17.37	34.73	6.00
40	1109.3	1.127	4.507	9.014	1.55	30	274.4	4.594	18.22	36.44	6.30
50	1074.7	1.164	4.653	9.305	1.60	40	262.0	4.814	19.08	38.16	6.60
1 70'	1042.1	1.200	4.798	9.596	1.65	50	250.8	5.035	19.94	39.87	6.90
20	1011.5	1.237	4.943	9.886	1.70	20	240.5	5.255	20.79	41.58	7.20
30	982.6	1.273	5.088	10.18	1.75	30	231.0	5.476	21.64	43.28	7.50
40	955.4	1.309	5.234	10.47	1.80	40	222.3	5.697	22.50	44.99	7.80
50	929.6	1.346	5.379	10.76	1.85	20	214.2	5.918	23.35	46.69	8.10
1 80'	905.1	1.382	5.524	11.05	1.90	30	206.7	6.139	24.19	48.38	8.40
20	881.9	1.418	5.669	11.34	1.95	40	199.7	6.360	25.04	50.07	8.70
30	859.9	1.455	5.814	11.63	2.00	50	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	635.92	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	43.08	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	63.68	27	1375.6	162.81
10	358.81	11.22	10	864.82	64.99	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	409.08	14.58	10	916.03	72.76	10	1437.4	177.55
20	417.41	15.18	20	924.56	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 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°	5890.5	2444.9	101°	6950.6	3278.1	111°	8386.7	4386.1
10°	5847.5	2457.1	10°	6971.3	3294.1	10°	8362.7	4407.6
20°	5804.6	2469.3	20°	6992.0	3310.1	20°	8388.9	4429.2
30°	5861.7	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°	8992.8	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,

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		For Tangents Add														
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	.79	.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	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	.771	.845	.922	1.01	
70°	.080	.159	.240	.321	.403	.485	.568	.652	.735	.819	.906	.994	1.08	1.17	
75°	.095	.182	.266	.353	.440	.528	.617	.707	.797	.877	.977	1.07	1.18	1.29	
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	.885	1.06	1.25	1.43	1.62	1.80	1.99	2.18	2.38	2.58	
100°	.200	.401	.604	.809	1.02	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.	$\frac{1}{2}$ 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.

$T = R \tan \frac{1}{2} I$	$R = T \cot. \frac{1}{2} I$	Chord def. = $\frac{\text{chord}}{R}$
$T = 50 \tan. \frac{1}{2} I$	$R = 50$	
$\text{Sin. D} = \frac{50}{R}$	Sin. D	No. chords = $\frac{1}{2} I$
$\text{Sin. D} = 50 \tan. \frac{1}{2} I$	$E = R \text{ ex. sec. } \frac{1}{2} I$	
	$E = T \tan \frac{1}{2} I$	Tan. def. = $\frac{1}{2}$ chord de

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 External to a 1° curve. Tan. and Ext. to any other radius may be found, nearly enough, by dividing the Tan. 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 2.

Natural Sines

deg.	0'	10'	20'	30'	40'	50'	deg.	0'	10'	20'	30'	40'	50'	deg.
0	0000	0029	0058	0087	0116	0145	89	40	6428	6450	6472	6494	6517	6539
1	0175	0204	0233	0262	0291	0320	88	41	6561	6583	6604	6626	6647	6670
2	0349	0378	0407	0436	0465	0494	87	42	6691	6713	6734	6756	6777	6799
3	0523	0552	0581	0610	0640	0669	86	43	6820	6841	6862	6884	6905	6926
4	0698	0727	0756	0785	0814	0843	85	44	6947	6967	6988	7009	7030	7050
5	0872	0901	0929	0958	0987	1016	84	45	7071	7092	7112	7133	7153	7173
6	1045	1074	1103	1132	1161	1190	83	46	7193	7214	7234	7254	7274	7294
7	1219	1248	1279	1305	1334	1363	82	47	7314	7335	7355	7375	7395	7415
8	1392	1421	1449	1478	1507	1536	81	48	7431	7451	7470	7490	7509	7528
9	1564	1593	1622	1650	1679	1708	80	49	7547	7566	7585	7604	7623	7642
10	1736	1765	1794	1822	1851	1880	79	50	7660	7679	7698	7716	7735	7753
11	1908	1937	1965	1994	2022	2051	78	51	7771	7790	7808	7826	7844	7862
12	2079	2108	2136	2164	2193	2221	77	52	7880	7898	7916	7934	7951	7969
13	2250	2278	2306	2334	2363	2391	76	53	7986	8004	8021	8039	8056	8073
14	2419	2447	2475	2504	2532	2560	75	54	8090	8107	8124	8141	8158	8175
15	2588	2616	2644	2672	2700	2728	74	55	8192	8208	8225	8241	8258	8274
16	2756	2784	2812	2840	2868	2896	73	56	8290	8307	8323	8339	8355	8371
17	2924	2952	2979	3007	3035	3062	72	57	8387	8403	8418	8434	8450	8465
18	3090	3118	3145	3173	3201	3228	71	58	8480	8496	8511	8526	8542	8557
19	3256	3283	3311	3338	3365	3393	70	59	8572	8587	8601	8616	8631	8646
20	3420	3448	3475	3502	3529	3557	69	60	8660	8675	8689	8704	8718	8732
21	3584	3611	3638	3665	3692	3719	68	61	8746	8760	8774	8788	8802	8816
22	3746	3773	3800	3827	3854	3881	67	62	8829	8843	8857	8870	8884	8897
23	3907	3934	3961	3987	4014	4041	66	63	8910	8923	8936	8949	8962	8975
24	4067	4094	4120	4147	4173	4200	65	64	8988	9001	9013	9026	9038	9051
25	4226	4253	4279	4305	4331	4358	64	65	9063	9075	9088	9100	9112	9124
26	4384	4410	4436	4462	4488	4514	63	66	9135	9147	9159	9171	9182	9194
27	4540	4566	4592	4617	4643	4669	62	67	9205	9216	9228	9239	9250	9261
28	4695	4720	4746	4772	4797	4823	61	68	9272	9283	9293	9304	9315	9325
29	4848	4874	4899	4924	4950	4975	60	69	9336	9346	9356	9367	9377	9387
30	5000	5025	5050	5075	5100	5125	59	70	9397	9407	9417	9426	9436	9446
31	5150	5175	5200	5225	5250	5275	58	71	9455	9465	9474	9483	9492	9502
32	5299	5324	5348	5373	5398	5422	57	72	9511	9520	9528	9537	9546	9555
33	5446	5471	5495	5519	5544	5568	56	73	9563	9572	9580	9588	9596	9605
34	5592	5616	5640	5664	5688	5712	55	74	9613	9621	9628	9636	9644	9652
35	5736	5760	5783	5807	5831	5854	54	75	9659	9667	9674	9681	9689	9696
36	5878	5901	5925	5948	5972	5995	53	76	9703	9710	9717	9724	9730	9737
37	6018	6041	6065	6088	6111	6134	52	77	9740	9747	9753	9759	9766	9772
38	6157	6180	6202	6225	6248	6271	51	78	9781	9787	9793	9799	9805	9811
39	6293	6316	6338	6361	6383	6406	50	79	9816	9822	9827	9833	9838	9843

Natural Cosines

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

Natural Tangents

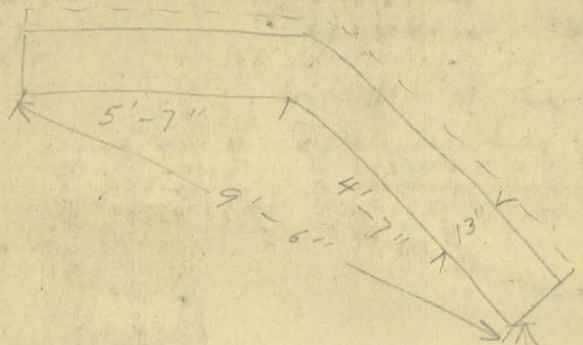
deg.	0'	10'	20'	30'	40'	50'	deg.	0'	10'	20'	30'	40'	50'	deg.
0	0000	0029	0058	0087	0116	0145	89	40	8391	8441	8491	8541	8591	8642
1	0175	0204	0233	0262	0291	0320	88	41	8603	8744	8796	8847	8899	8952
2	0349	0378	0407	0437	0466	0495	87	42	9004	9057	9110	9163	9217	9271
3	0524	0553	0582	0612	0641	0670	86	43	9325	9380	9435	9490	9545	9601
4	0699	0729	0758	0787	0816	0846	85	44	9657	9713	9770	9827	9884	9942
5	0875	0904	0934	0963	0992	1022	84	45	1.0000	1.0058	1.0117	1.0176	1.0235	1.0295
6	1051	1080	1110	1139	1169	1198	83	46	1.0355	1.0416	1.0477	1.0533	1.0599	1.0661
7	1228	1257	1287	1317	1346	1376	82	47	1.0724	1.0786	1.0850	1.0913	1.0977	1.1041
8	1405	1435	1465	1495	1524	1554	81	48	1.1106	1.1171	1.1237	1.1303	1.1369	1.1436
9	1584	1614	1644	1673	1703	1733	80	49	1.1504	1.1571	1.1640	1.1708	1.1778	1.1847
10	1763	1793	1823	1853	1883	1914	79	50	1.1918	1.1988	1.2059	1.2131	1.2203	1.2276
11	1944	1974	2004	2035	2065	2095	78	51	1.2349	1.2423	1.2497	1.2572	1.2647	1.2723
12	2126	2156	2186	2217	2247	2278	77	52	1.2799	1.2876	1.2954	1.3032	1.3111	1.3190
13	2309	2339	2370	2401	2432	2462	76	53	1.3270	1.3351	1.3432	1.3514	1.3597	1.3680
14	2493	2524	2555	2586	2617	2648	75	54	1.3764	1.3848	1.3934	1.4019	1.4106	1.4193
15	2679	2711	2742	2773	2805	2836	74	55	1.4281	1.4370	1.4460	1.4550	1.4641	1.4733
16	2867	2899	2931	2962	2994	3026	73	56	1.4826	1.4919	1.5013	1.5108	1.5204	1.5301
17	3057	3089	3121	3153	3185	3217	72	57	1.5399	1.5497	1.5597	1.5697	1.5798	1.5900
18	3249	3281	3314	3346	3378	3411	71	58	1.6003	1.6107	1.6212	1.6319	1.6426	1.6534
19	3443	3476	3508	3541	3574	3607	70	59	1.6643	1.6753	1.6864	1.6977	1.7090	1.7205
20	3640	3673	3706	3739	3772	3805	69	60	1.7321	1.7437	1.7556	1.7675	1.7797	1.7917
21	3839	3872	3906	3939	3973	4006	68	61	1.8040	1.8165	1.8291	1.8418	1.8546	1.8676
22	4049	4074	4108	4142	4176	4210	67	62	1.8807	1.8940	1.9074	1.9210	1.9347	1.9486
23	4245	4279	4314	4348	4383	4417	66	63	1.9626	1.9768	1.9912	2.0057	2.0204	2.0353
24	4452	4487	4522	4557	4592	4628	65	64	2.0503	2.0655	2.0809	2.0965	2.1123	2.1283
25	4663	4699	4734	4770	4806	4841	64	65	2.1445	2.1609	2.1775	2.1943	2.2113	2.2286
26	4877	4913	4950	4986	5022	5059	63	66	2.2460	2.2637	2.2817	2.2998	2.3183	2.3369
27	5095	5132	5169	5206	5243	5280	62	67	2.3559	2.3750	2.3945	2.4142	2.4342	2.4545
28	5317	5354	5392	5430	5467	5505	61	68	2.4751	2.4960	2.5172	2.5386	2.5605	2.5826
29	5543	5581	5619	5658	5696	5735	60	69	2.6051	2.6279	2.6511	2.6746	2.6985	2.7228
30	5774	5812	5851	5890	5930	5969	59	70	2.7475	2.7725	2.7980	2.8239	2.8502	2.8770
31	6009	6048	6088	6128	6168	6208	58	71	2.9042	2.9319	2.9600	2.9887	3.0178	3.0475
32	6249	6289	6330	6371	6412	6453	57	72	3.0777	3.1084	3.1397	3.1716	3.2041	3.2371
33	6494	6536	6577	6619	6661	6703	56	73	3.2709	3.3052	3.3402	3.3759	3.4124	3.4495
34	6745	6787	6830	6873	6916	6959	55	74	3.4874	3.5261	3.5656	3.6059	3.6470	3.6891
35	7002	7046	7089	7133	7177	7221	54	75	3.7321	3.7760	3.8208	3.8657	3.9136	3.9617
36	7265	7310	7355	7400	7445	7490	53	76	4.0108	4.0611	4.1126	4.1653	4.2193	4.2747
37	7536	7581	7627	7673	7720	7766	52	77	4.3315	4.3897	4.4494	4.5107	4.5736	4.6382
38	7813	7860	7907	7954	8002	8050	51	78	4.7046	4.7729	4.8430	4.9152	4.9894	5.0658
39	8098	8146	8195	8243	8292	8342	50	79	5.1446	5.2257	5.3093	5.3955	5.4845	5.5764

3.25
2.5
16.25
6.50
8.125

deg.	60'	50'	40'	30'	20'	10'	deg.	60'	50'	40'	30'	20'	10'	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	42.904	49.104	1							
89	57.290	68.750	85.940	114.588	171.865	343.770	0							

Natural Cotangents

Top to Footing
4'-8"



98.6
1.8
96.8
96.3

105.00
6.3
98.70
97.8
97.9

105.00
6.13
98.87
67

51.7
27 14.00
135
50
27
730

89
50
139 97.5
96.8

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 14 FEET WIDE. SIDE SLOPES 1 1/2 TO 1.

FOR SINGLE TRACK EMBANKMENT.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	30
0	7.0	7.2	7.3	7.5	7.6	7.8	7.9	8.1	8.2	8.4	0
1	8.5	8.7	8.8	9.0	9.1	9.3	9.4	9.6	9.7	9.9	1
2	10.0	10.2	10.3	10.5	10.6	10.8	10.9	11.1	11.2	11.4	2
3	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9	3
4	13.0	13.2	13.3	13.5	13.6	13.8	13.9	14.1	14.2	14.4	4
5	14.5	14.7	14.8	15.0	15.1	15.3	15.4	15.6	15.7	15.9	5
6	16.0	16.2	16.3	16.5	16.6	16.8	16.9	17.1	17.2	17.4	6
7	17.5	17.7	17.8	18.0	18.1	18.3	18.4	18.6	18.7	18.9	7
8	19.0	19.2	19.3	19.5	19.6	19.8	19.9	20.1	20.2	20.4	8
9	20.5	20.7	20.8	21.0	21.1	21.3	21.4	21.6	21.7	21.9	9
10	22.0	22.2	22.3	22.5	22.6	22.8	22.9	23.1	23.2	23.4	10
11	23.5	23.7	23.8	24.0	24.1	24.3	24.4	24.6	24.7	24.9	11
12	25.0	25.2	25.3	25.5	25.6	25.8	25.9	26.1	26.2	26.4	12
13	26.5	26.7	26.8	27.0	27.1	27.3	27.4	27.6	27.7	27.9	13
14	28.0	28.2	28.3	28.5	28.6	28.8	28.9	29.1	29.2	29.4	14
15	29.5	29.7	29.8	30.0	30.1	30.3	30.4	30.6	30.7	30.9	15
16	31.0	31.2	31.3	31.5	31.6	31.8	31.9	32.1	32.2	32.4	16
17	32.5	32.7	32.8	33.0	33.1	33.3	33.4	33.6	33.7	33.9	17
18	34.0	34.2	34.3	34.5	34.6	34.8	34.9	35.1	35.2	35.4	18
19	35.5	35.7	35.8	36.0	36.1	36.3	36.4	36.6	36.7	36.9	19
20	37.0	37.2	37.3	37.5	37.6	37.8	37.9	38.1	38.2	38.4	20
21	38.5	38.7	38.8	39.0	39.1	39.3	39.4	39.6	39.7	39.9	21
22	40.0	40.2	40.3	40.5	40.6	40.8	40.9	41.1	41.2	41.4	22
23	41.5	41.7	41.8	42.0	42.1	42.3	42.4	42.6	42.7	42.9	23
24	43.0	43.2	43.3	43.5	43.6	43.8	43.9	44.1	44.2	44.4	24
25	44.5	44.7	44.8	45.0	45.1	45.3	45.4	45.6	45.7	45.9	25
26	46.0	46.2	46.3	46.5	46.6	46.8	46.9	47.1	47.2	47.4	26
27	47.5	47.7	47.8	48.0	48.1	48.3	48.4	48.6	48.7	48.9	27
28	49.0	49.2	49.3	49.5	49.6	49.8	49.9	50.1	50.2	50.4	28
29	50.5	50.7	50.8	51.0	51.1	51.3	51.4	51.6	51.7	51.9	29
30	52.0	52.2	52.3	52.5	52.6	52.8	52.9	53.1	53.2	53.4	30
31	53.5	53.7	53.8	54.0	54.1	54.3	54.4	54.6	54.7	54.9	31
32	55.0	55.2	55.3	55.5	55.6	55.8	55.9	56.1	56.2	56.4	32
33	56.5	56.7	56.8	57.0	57.1	57.3	57.4	57.6	57.7	57.9	33
34	58.0	58.2	58.3	58.5	58.6	58.8	58.9	59.1	59.2	59.4	34
35	59.5	59.7	59.8	60.0	60.1	60.3	60.4	60.6	60.7	60.9	35
36	61.0	61.2	61.3	61.5	61.6	61.8	61.9	62.1	62.2	62.4	36

Calculated by Julien A. Hall, M. Am. Soc. C. E.

MADE IN GERMANY.

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