BRIDGES & CULVERTS

FIELD BOOK

364

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.

	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 Tabels see end of book.

BOOK 39

Site Plan McFarland Creek Bridge Pgs 82-85

Franklin Rd Sec A 86-
" " " BQC 93

Levels for new mat
July 1947 Pg 69

Woodland Ave Notes Pg 116
E Woodland Ave T.H. 176 " 128
Sherman Rd #77E (Munson) " 31-37
Hermitage Rd #81A (Chardon) " 19

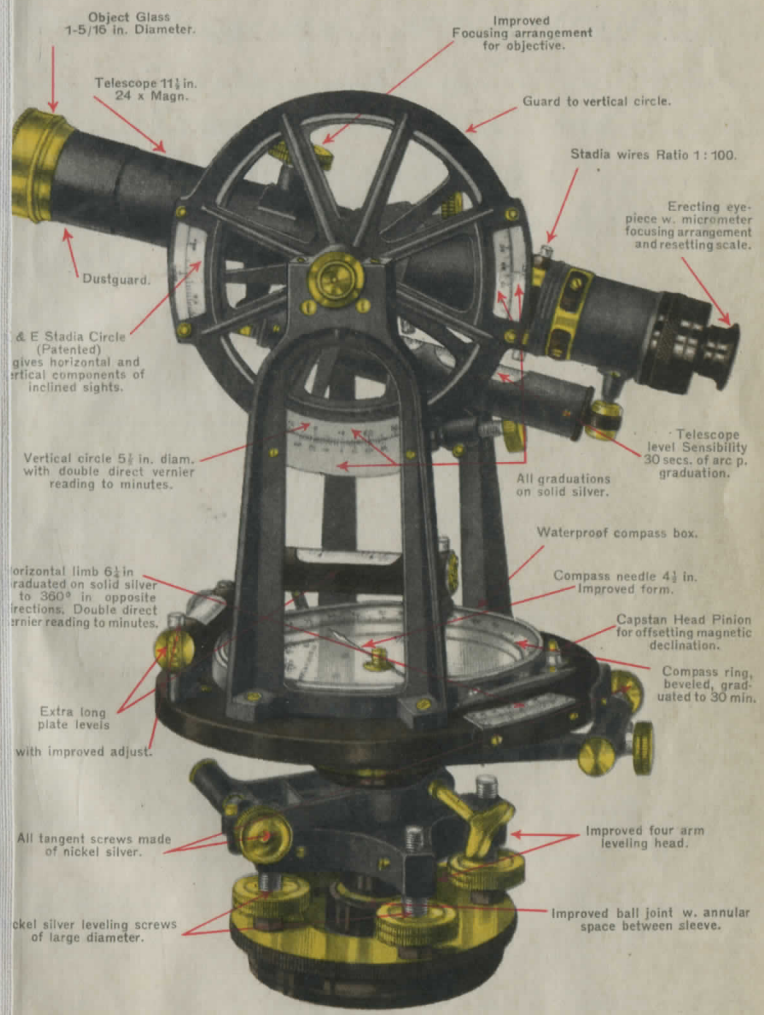
Sherman Rd (Align.) Sec F " 40-43 EAT
" Rd (Culvt.) Sec E " 44-46
Bainbridge Rd CH " Levels Sec. D Pg 150
Check Levels on Bridge - Bainbridge Rd
& Four Barrell on Franklin Rd. G. Pg. 156
McFarland Creek

Rockey Ave. Bainbridge Allot. Align. Pg 136
Levels Pg 140
(171) Samuel Lord Drive & Sec. - Chagrin Rd - Pool's 144
Sherman Rd (E.) @ #4 (Align) 49

EXTRA FINE ENGINEERS' TRANSIT

No. 5060 S

KEUFFEL & ESSER CO., N.Y.



ALSO MADE WITH

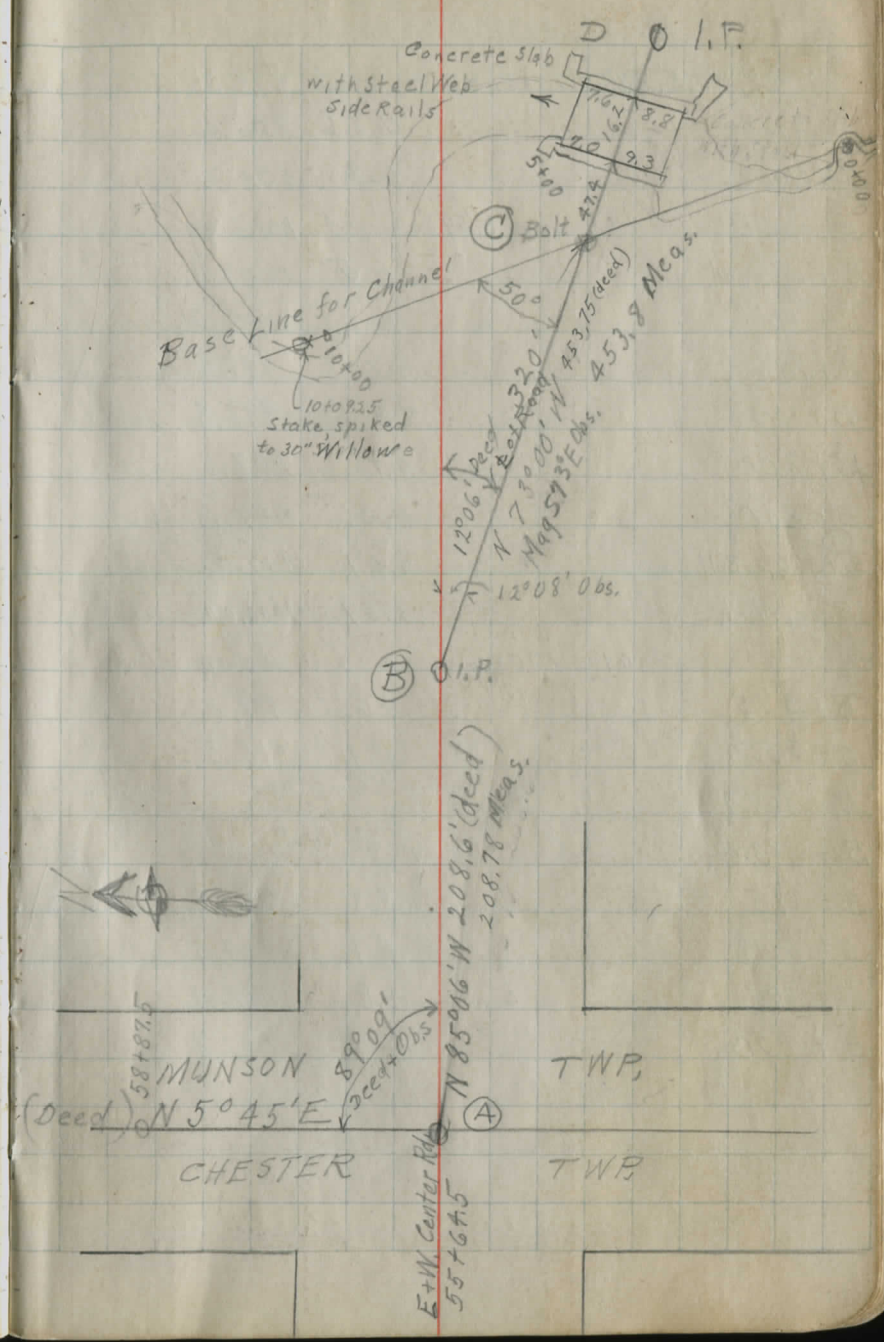
INTERNAL FOCUSING TELESCOPE

PRACTICALLY DUST AND MOISTURE PROOF.

Page	Township	Project
1-13	Munson	E. Br. Chagrin River E+W Center Rd. Harmistage
18-19	Chardon	Worthington's Corners North
14-17	Bainbridge	McFarland Creek, County Line Rd. FRANKLIN ST.
30	Munson	E&W Center Road
50	Bainbridge	— Solon Center Road
70	Hogsback	Bridge.
72-75	Bainbridge	— McFarland Creek Bridge 1939
68-74 & 102	"	" " " " 1947
47	SHERMAN RD	TR 97 (ROCK HAVEN)
48	"	" " (RELOCATED E. OF #4: 1977)

Aug. 10, 1931, Rain, 75° — Cloudy
Marks, Parks, Snyder.

Survey for Location of Bridge and Channel Change, East Branch of CHAGRIN RIVER, East + West Center Road, MUNSON TWP.
Present bridge was under-mined by flood of June 26, 1931



	8.89	1003.20		994.31
(A) on I.P.			7.20	996.00
(A) +100			6.3	996.9
(B) on I.P.	0.93	1003.59	3.54	1002.66
(B) on ground			0.5	1003.1
B+30			1.0	1002.6
B+75			4.0	999.6
B+100			4.8	998.8
B+200			6.1	997.5
B+300			6.3	997.3
(C) = (B)+320, on Bolt			6.07	997.52
Bench Mark			3.59	1000.00
	2.61	1002.61		1000.00
B+355			4.6	998.0
B+357			6.1	996.5
B+367.4				
B+383.6				
B+385			8.3	994.3
B+391			8.1	994.5
B+393			4.8	997.8
B+450			4.8	997.8

Town Line Road

B.M. spike, W. Root 36" Maple, 34' Right Sta 57+78,

59' South of B+310

Top of Iron Rod, driven horizontally in W. side of 15" Walnut

991.6	997.5	996.6	995.6	989.7
11.0	5.12	6.01	7.05	12.9
8	7.0	7	9.3	10
994.3	998.6	997.9	997.0	990.5
11.3	3.99	4.76	5.66	12.1
9	7.6	7	8.8	10

↑ at (C)

(D)

H.I. 1002.61

From Mag. North, Clockwise

Azimuth.	Dist.	Rod.	El.	
107°00'	133.75			
150°	72	8.2	994.4	
152°	71	10.8	991.8	
134°	63	7.6	995.0	
138°	55	9.5	993.1	
123°	65	7.6	995.0	
123°	64	11.3	991.3	
128°	115	6.0	996.6	General ground reading
86°	73	7.4	995.2	
85°	68	10.7	991.9	
46°	157	7.5	995.1	
55°	176	7.2	995.4	General Ground reading
45°	151	12.1	990.5	
41°	126	10.0	992.6	Gravel Bar
36°	111	10.3	992.3	
33°	104	9.2	993.4	
16°	87	8.8	993.8	
25°	120	9.5	993.1	
27°	130	11.2	991.4	
28°	134	10.0	992.0	
31°	155	12.6	990.0	
32°	163	7.7	994.9	
19°	152	8.2	994.4	
19°	149	13.7	988.9	
349°30'	118	7.4	995.2	

H.I				
1002.61	Azimuth	Dist	Rod	
	342°30'	115	13.0	989.6
	342°30'	140	9.1	993.5
	333°	140	10.4	992.2
	330°30'	140	12.2	990.4
	319°30'	135	7.2	995.4
	322°	135	14.5	988.1
	330°	100	7.5	995.1
	330°30'	105	14.1	988.5
	0°0'	87	9.1	993.5
	1°	92	10.7	991.9
	359°30'	115	12.4	990.2
	19°	131	10.7	991.9
	18°	138	12.2	990.4
	42°30'	88	8.7	993.9
	45°	93	11.0	991.6
	15°30'	52	6.2	996.4
	47°	58	5.6	997.0
	47°	65	8.0	994.6
	66°	51	6.1	996.5
	69°	54	10.7	991.9
	125°	25	5.4	997.2
	127°	29	11.1	991.5
	175°	33	5.3	997.3
	164°	38	8.4	994.2
	157°	41	8.1	994.5

H.I

1002.61 Azimuth Dist Bed

154°30' 42 10.8

CROSS-SECTIONS, Baseline for Channel

	2.63	1002.63		1000.00
10+75			16.6	986.0
10+60			13.8	988.8
10			11.5	991.1
9			11.7	990.9
8+85			11.8	990.8
8			13.4	989.2
7			12.3	990.3
6+50			9.9	992.7
6+20				
6,			13.7	988.9
5+90			7.5	995.1
5+60			6.7	995.9

990.6
12.0
54

991.8

Aug. 11, 1931, Cloudy, Showers, 75°

Marks, Parks, Snyder.

B.M.

986.9
15.7
Water Surface

Stream Bed

" Bank

988.4 988.0 987.5 988.7 988.2 991.1 991.1 990.9 990.4 990.0 989.7
14.2 14.6 15.1 13.9 13.4 11.5 11.5 11.7 12.2 12.6 12.9
49 45 42 40 23 20 0 10 20 30 42

990.5 991.3 991.0 990.6 990.9 988.4 989.6 990.9 991.5 991.7 991.7 991.8
12.1 11.3 11.6 12.0 11.7 13.2 12.8 11.7 11.1 10.9 10.9 10.8
50 40 30 22 10 6 2 0 5-10 20 30 40

990.1 990.5 990.0 990.3 991.2 990.5 990.3 990.8 991.4 991.8 991.9 991.5 990.6
12.5 12.1 12.6 12.3 11.4 12.1 12.3 11.8 11.2 10.8 10.7 11.1 12.0
61 55 45-42 40 28 16 2 0 10 20 30 40 Water Surface

993.3 993.6 990.0 990.1 989.2 988.8 989.8 991.6 992.0 991.6 991.5
9.3 9.0 12.6 12.5 13.4 13.8 12.8 11.0 10.6 11.0 11.1
42 30 28 15 0 7 9.5 10 20 30 40

993.8 994.1 990.0 990.0 990.3 990.3 991.4 991.9 992.7 992.6 993.7
8.8 8.5 12.6 12.6 12.3 12.3 11.2 10.7 9.9 10.0 8.9
50 34 29 15 0 2 4 12 15 25 40

993.4 994.1 989.6 990.1 991.5 992.2 992.7 993.2 993.3 994.5 993.7 994.8 994.8
9.0 8.5 13.2 12.5 11.1 10.4 9.9 9.4 9.3 8.1 8.9 7.8 7.8
52 40 36 14 8 7 0 10 13 17 25 30 40

990.6
12.0
Water Surface

995.1 16.0 986.6
7.5 7.5 7.5 20 995.1 989.6 988.9 990.5 990.9 991.1 991.0
40 25 15 13.0 1.2 13.7 0 12.1 10 11.7 20 11.5 30 11.6 40

995.0 995.3 995.4 995.4 995.1 994.6 993.3 993.0 990.6 991.5
7.6 7.3 7.2 7.2 7.5 8.0 9.3 9.6 12.0 11.1
43 30 20 10 0 4 8 16 25 40

996.0 995.8 995.8 995.9 996.1 996.0 994.4 994.3 994.0
6.6 6.8 6.8 6.7 6.5 6.6 8.2 8.3 8.6
35 23 13 0 10 20 29 36 45

1002.63

5+20			6.3	996.3
5+07			5.1	997.5
5+00			5.1	997.5
4+90			5.1	997.5
4+80			5.8	996.8
4+70			7.5	995.1
4+50			10.7	99 1.9
4			10.4	992.2
3			8.1	994.5
	9.72	1004.70	7.65	994.98
2+55			7.1	997.6
2			8.9	995.8
/			7.1	997.6
0+00			6.5	998.2

996.5 997.2 997.5 995.8 996.3 997.0 996.4
6.1 5.4 5.1 6.8 6.3 5.6 6.2
40 30 11 6 0 10 40
Rear

996.9 996.5 997.4 997.4 997.5 997.4 996.8 996.6 996.4
5.7 6.6 5.5 5.2 5.1 5.2 5.8 6.0 6.2
40 26 13 9 9 26 45 50
Road. Bank

996.9 997.2 997.0 996.8 997.2 997.9 997.7 996.5 994.9
5.7 5.4 5.6 5.8 5.4 4.7 4.9 6.1 7.7
40 20 10 0 13 17 29 33 43
Road Bank

997.2 997.4 997.2 995.1 994.1 992.5 990.3 996.6
5.4 5.2 5.4 7.5 8.5 10.1 12.3 6.0
40 20 8 0 9 10 15 36
Water Surface Bridge Slab

997.3 997.2 994.7 993.9 992.5 991.9 992.6 992.9 995.1 994.9
5.3 5.4 7.9 8.7 10.1 10.7 10.0 9.7 7.5 7.7
40 20 13 2 1.5 0 9 19 32 42

997.5 997.4 997.4 995.6 994.6 992.6 992.2 992.5 995.0 997.1 997.2 997.0
5.1 5.2 5.2 7.0 8.0 10.0 10.4 10.1 7.6 5.5 5.4 5.6
40 30 17 13 5 2 0 5 8 15 28 40

993.9 998.1 998.4 998.2 994.5 993.9 993.5 993.9 994.2 997.4 997.9 997.7
8.7 4.5 4.2 4.4 8.1 8.7 9.1 8.7 8.4 5.2 4.7 4.8
Water Surface 40 20 5 0 5 9 12 17 20 30 40

Top of Stake, Sta. 2+00

998.5 998.5 997.6 995.8 994.2 993.7 998.1
Bank rises 20'± 6.2 6.2 7.1 8.9 10.5 11.0 6.6
about 1:1 Slope 33 9 0 25 38 41 44-54

Water Surface
1004.7 1002.3 1000.8 995.6 995.8 996.8 998.8 999.3 998.8
0.0 2.4 3.9 9.1 8.9 7.8 5.9 5.4 5.9
40 32 26 15 0 26 31 38 48-55

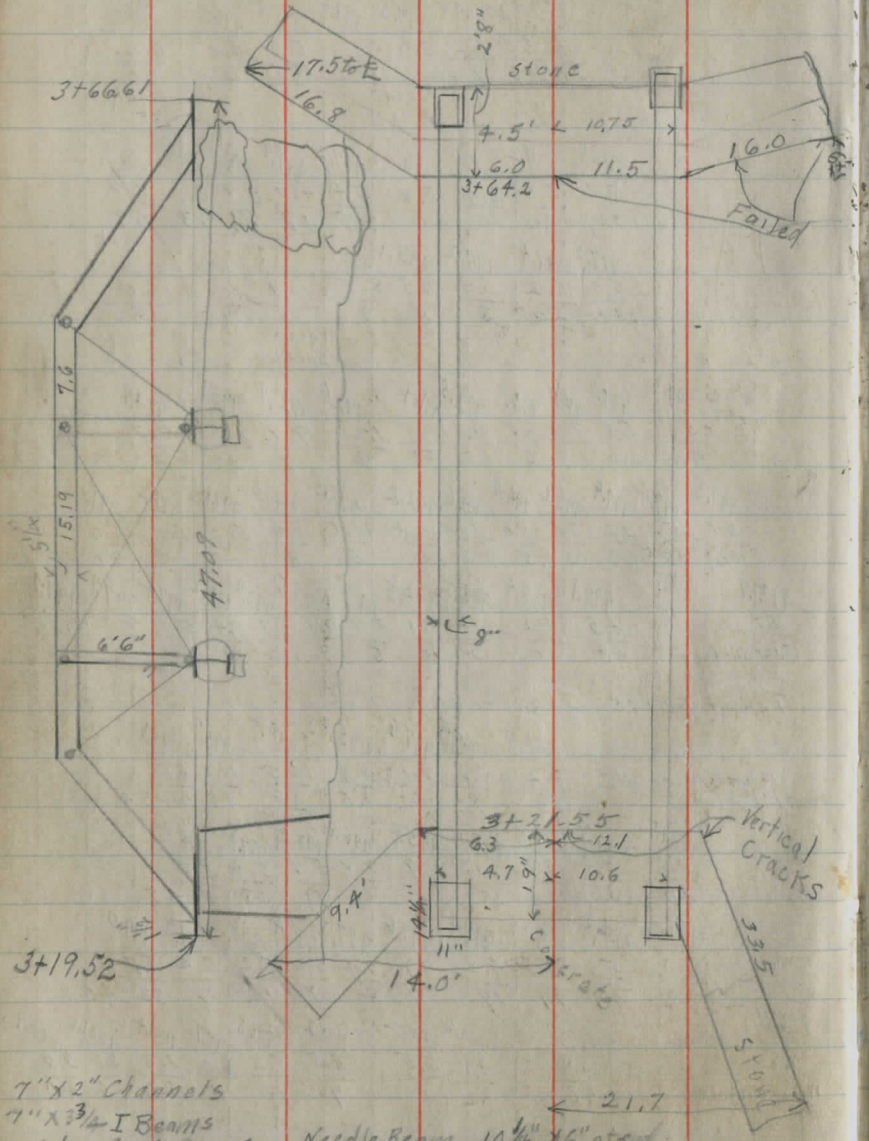
999.4 999.2 997.4 997.6 997.3 996.4 996.5 999.3 999.0
5.3 5.5 7.3 7.1 7.4 8.3 8.2 5.4 5.7
40 29 19 0 4 7 12 17 32-40

996.9 1000.9 1000.6 998.2 998.2 996.5 998.1 1001.4 1001.1 1000.9
7.8 3.8 4.1 6.5 6.5 8.2 6.0 3.3 3.6 3.8
Water Surface 40 22 0 7 10 15 20 24 40

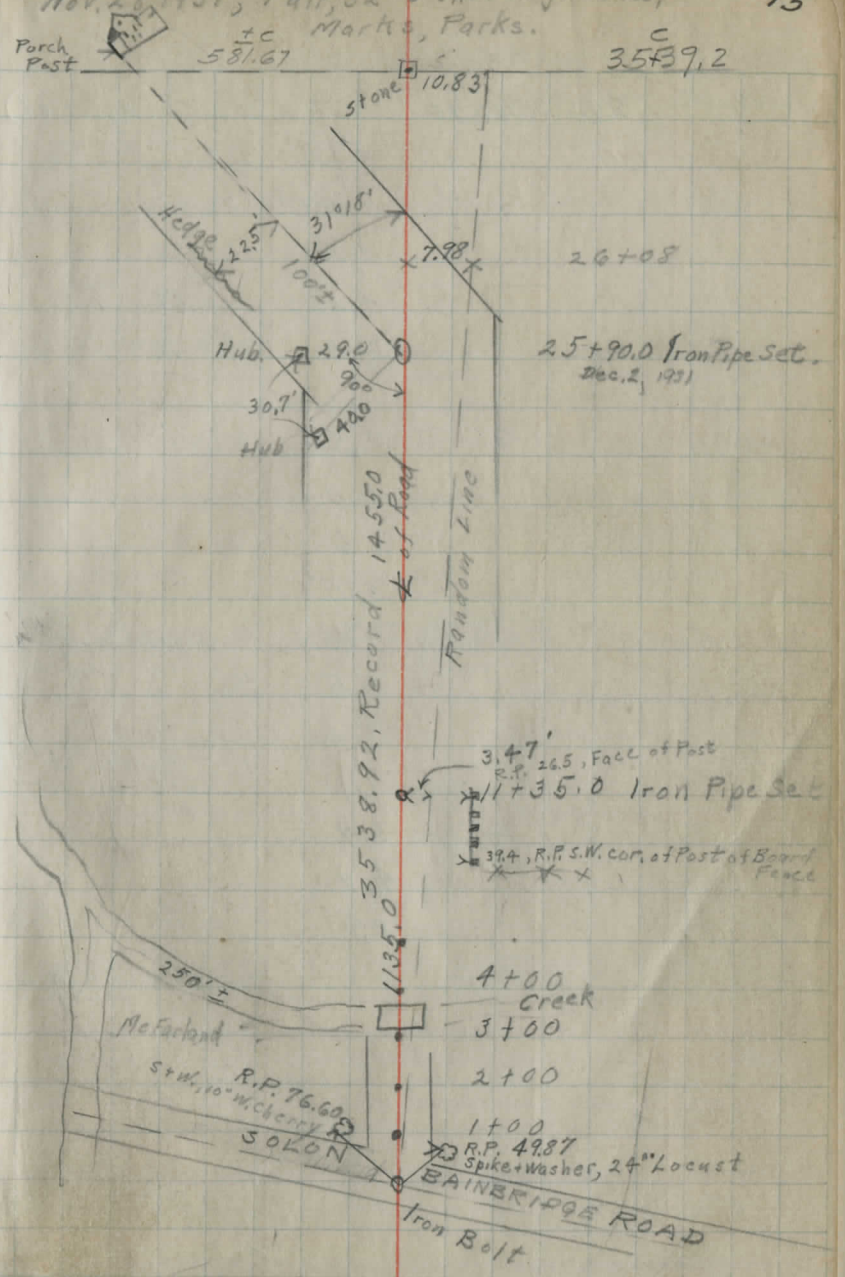
McFarland Creek Bridge

So-called County Line Road

BAINBRIDGE



Nov. 28, 1931, Fair, 32° 3" snow on ground, Marks, Parks.



	5.94	105.94		100.00 (Assumed)
			4.18	101.76
			5.00	100.94
			4.06	101.88
			4.26	101.68
			15.7	90.2
0+00			2.5	
1			3.0	
2			3.6	
3			3.5	
3+20.5			3.4	
3+66.1			3.5	
4			5.4	
4+50			7.1	
5			6.9	
6			4.9	
6+50			2.4	

B.M. spike, S.W. Root, 36" Maple, 12½'± Left, Sta. 4+07

Bridge Seat, N.W. cor.

" " N.E. "

" " S.E. "

" " S.W. "

Stream Bed.

Road Profile

Floor, Plank S. End of Bridge floor

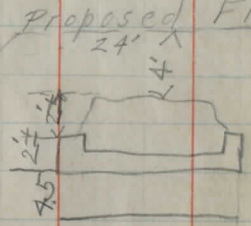
" N. " " " "

Survey for Culvert on Road in CHARDON TWP. Running Northerly from Worthington's Corners to Hermitage Road (Concord Twp., Lake Co.) over East Side of Little Mountain.

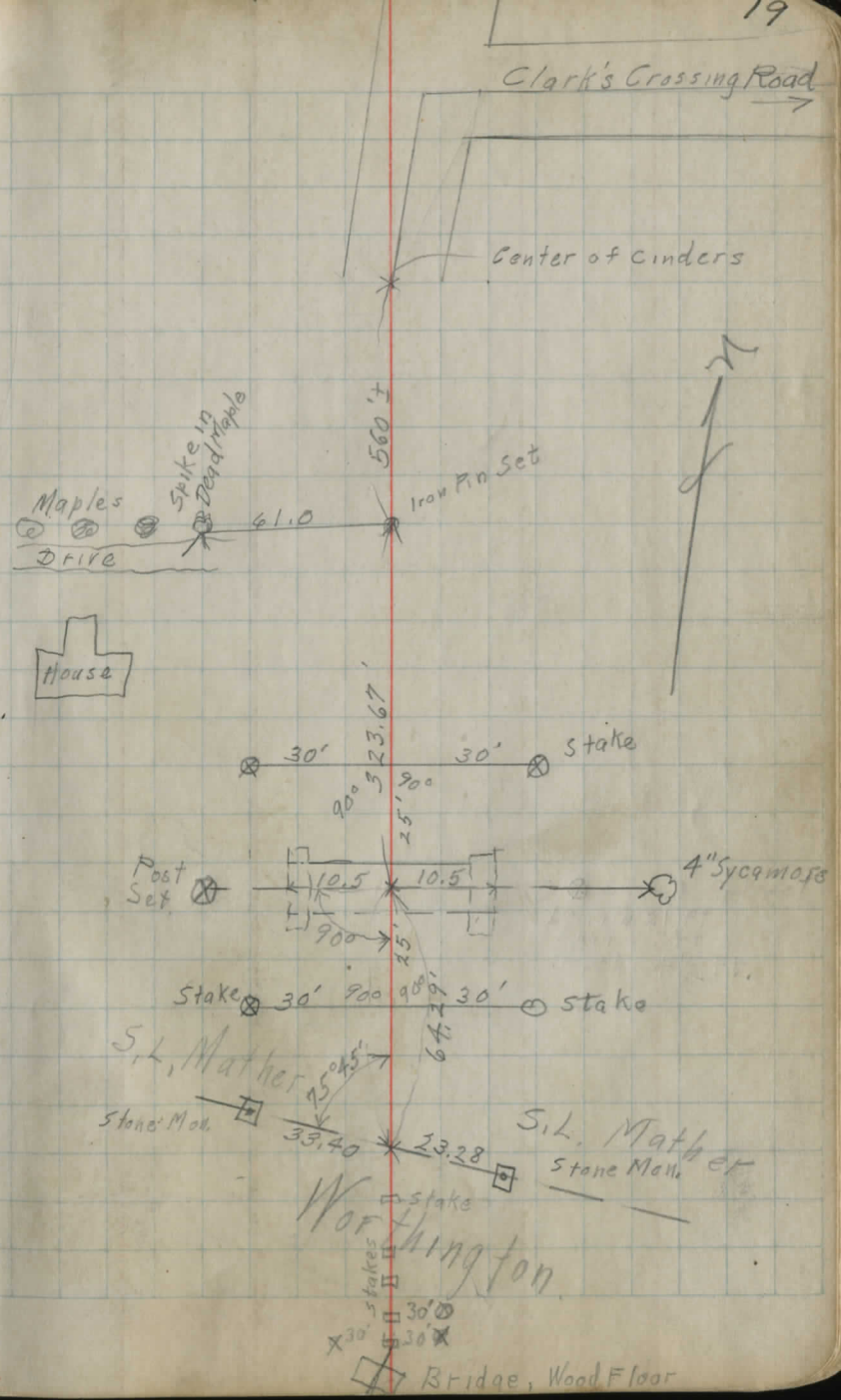
Aug. 22, 1931, Fair, 75° North Wind.

W.C. Marks, D.R. Parks, T. Snyder.

Alf Robinson + Tractor Driver Grading Road.



Old Stone Culvert, Length, 21.0'
Span 3.
Depth 4.5'



℄ Location Solon Bainbridge
Center Road County Line easterly
Note: Station Numbering is continuation
of Cuyahoga Improvement

Sta 130+76.10 Def Lt 0°30'45" Pin Found

Restaked See page 50

See page 50

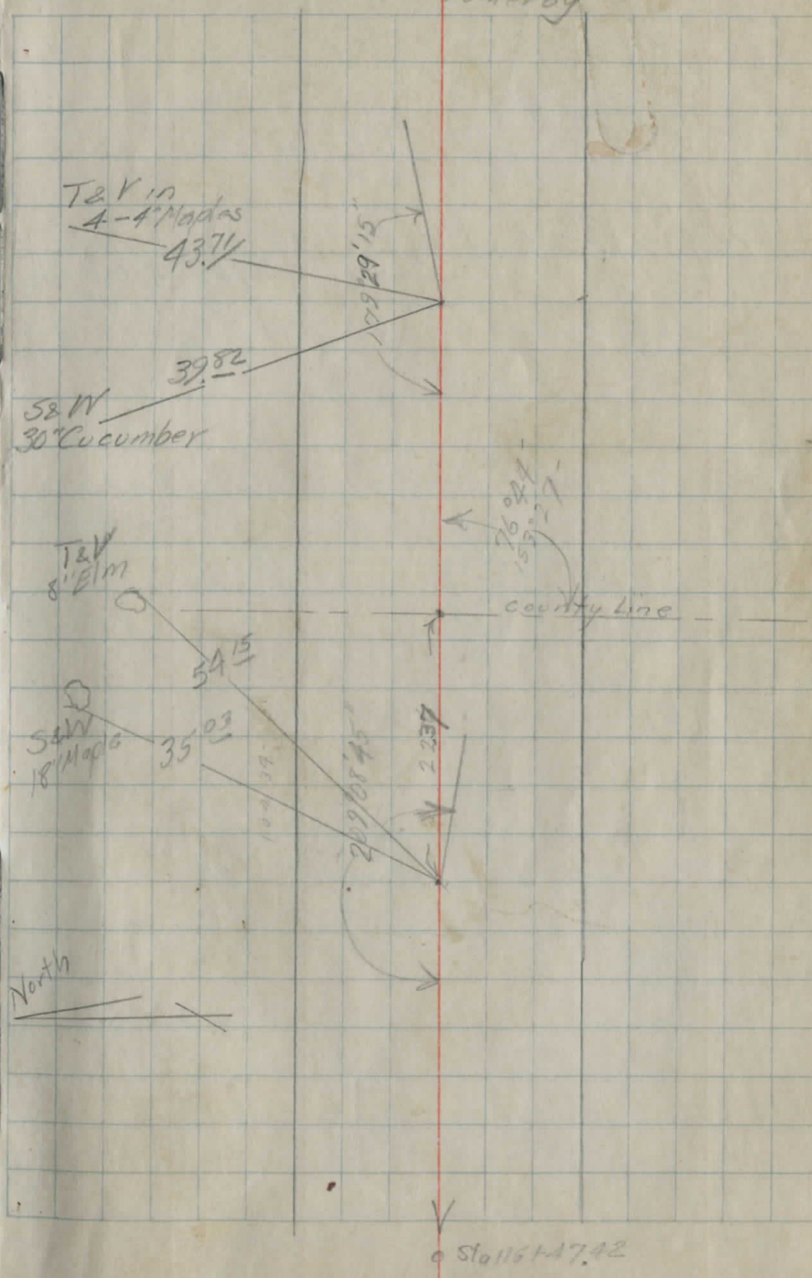
Note: Pipe on County Line is 22.36 ft. East of
Sta 124+57.62 and on ℄ Tangent

Sta 124+57.62 PI Def Rt 29°08'45" Hub Found

Δ = 29°08'45"
D = 5°22'34" 5.376
T = 277.17
E = 35.32
L = 542.33
PC = 121+80.45
PT = 127+22.78
R = 1065.77

1/9/34

Richey
Goodrich
Dietz
Pomeroy

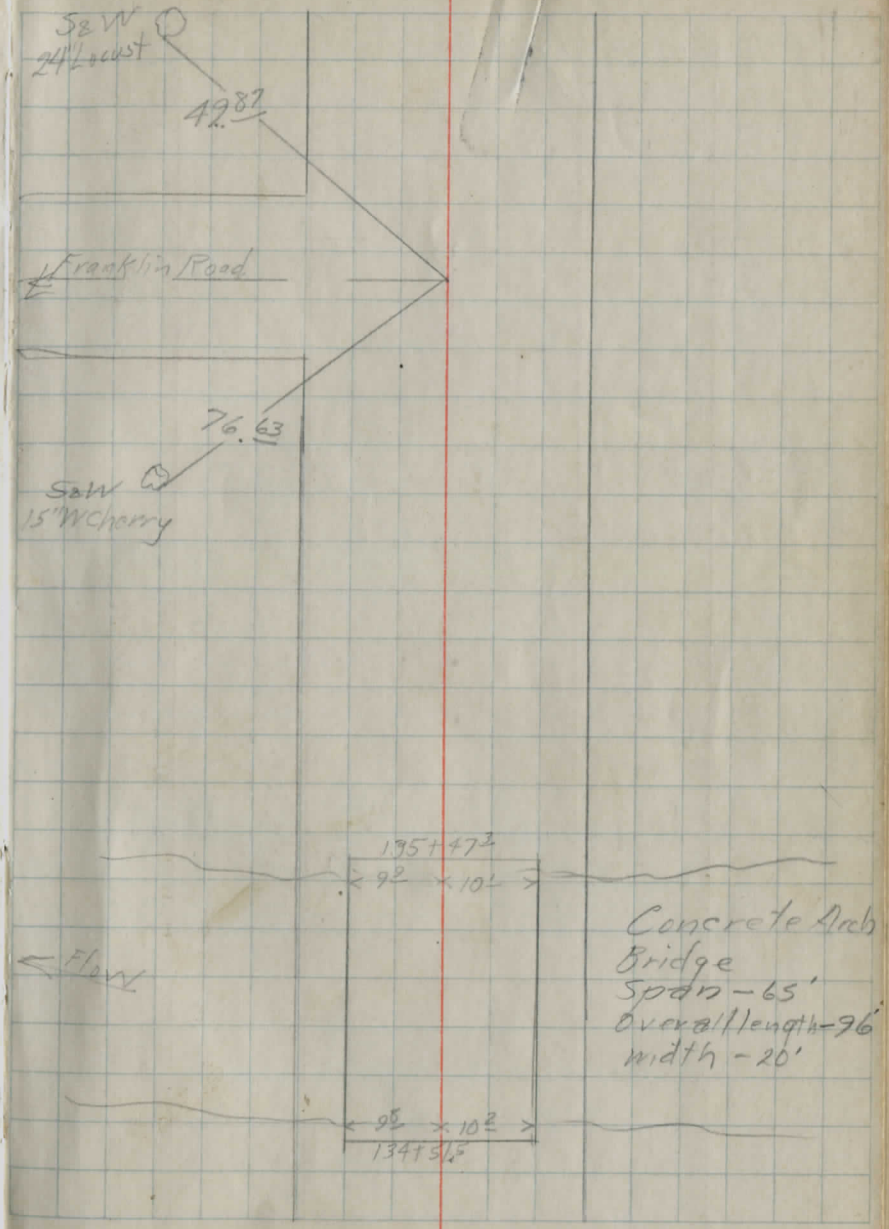


Sta 138+93.79 End of Project

Rod Found 18" below Surface

13893.7
12457.6
1436.1
22.9
1413.7

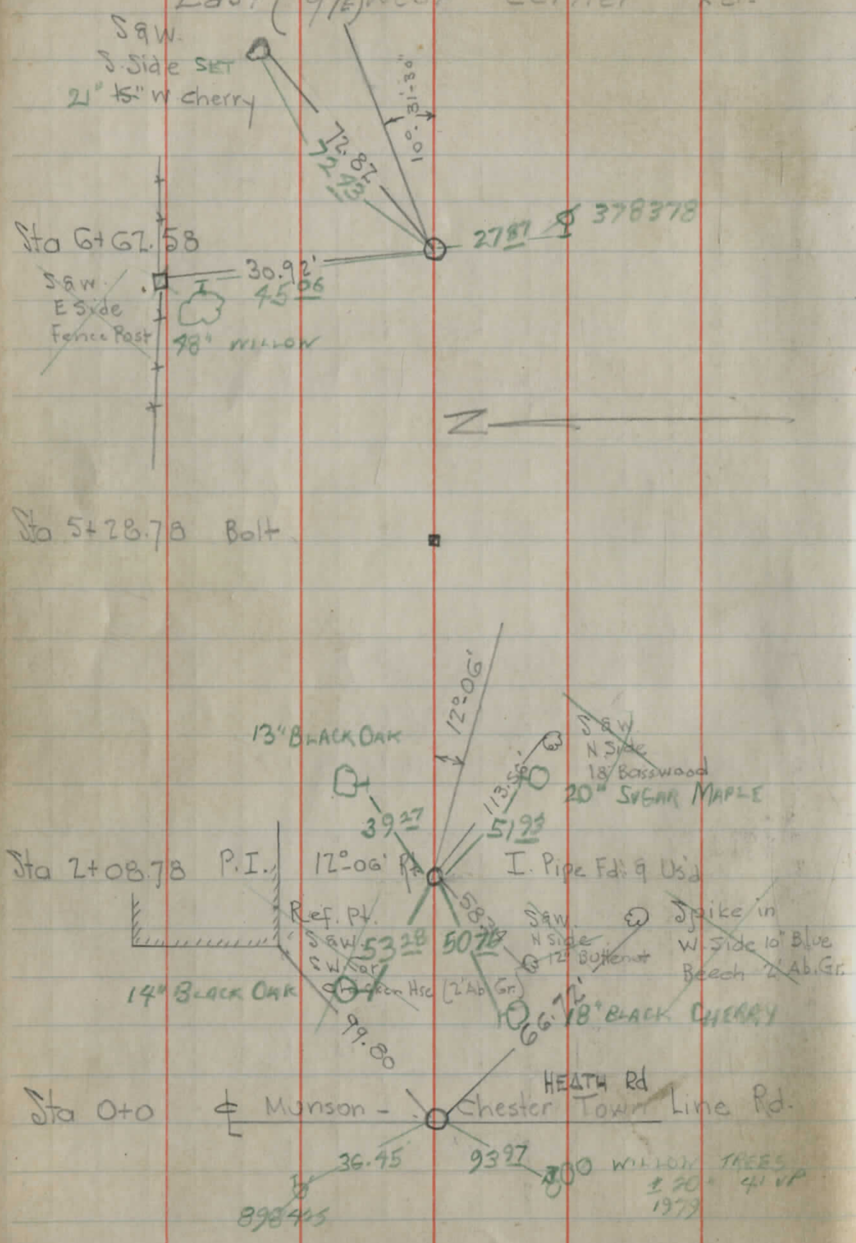
Length



Sept. 10, 1935 (cloudy)

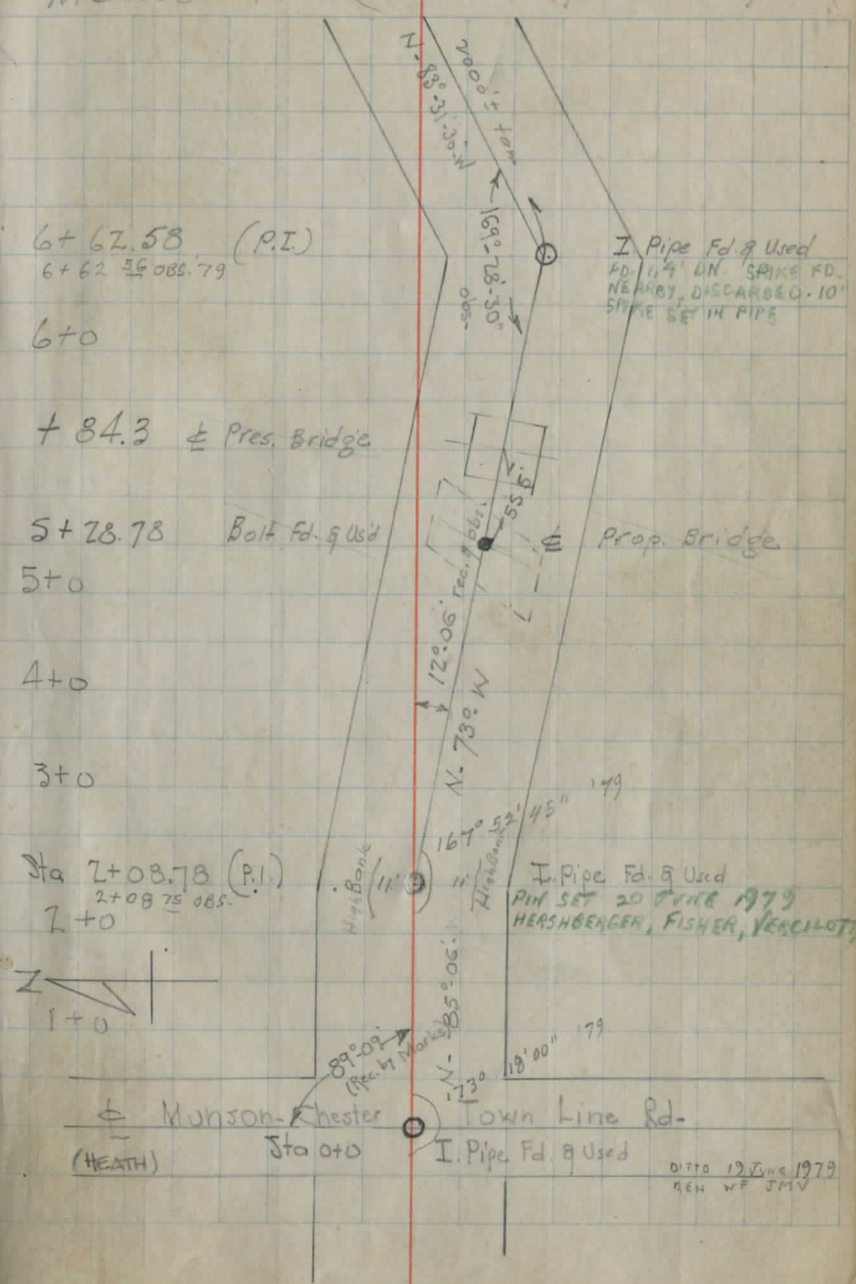
Sherman

East (#97E) West Center Rd.



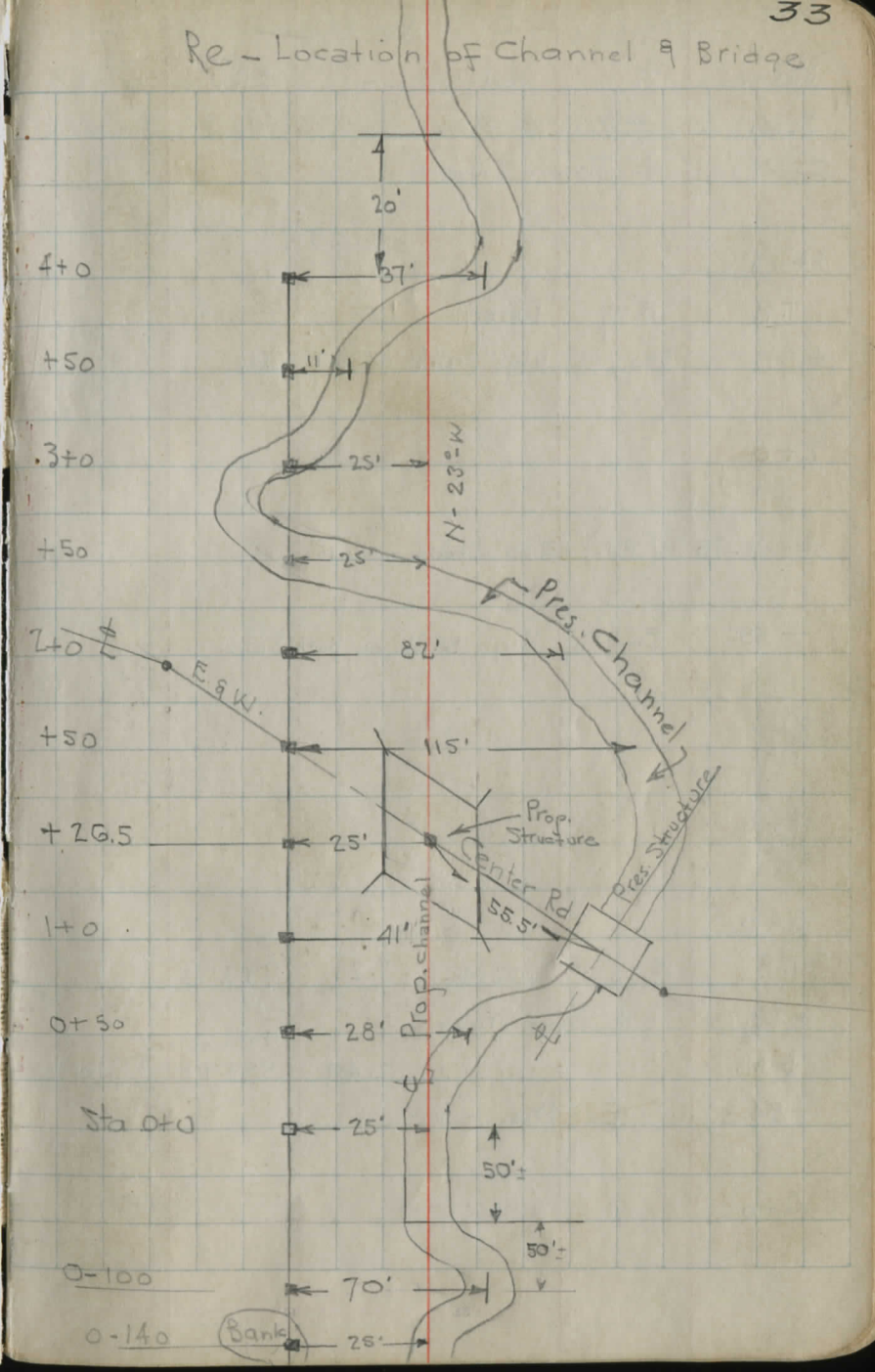
S. Gould Jr.
H. Hill Jr.
G. Driels

MUNSON TP- (Location of Bridge & Channel)



E. & W. Center Rd. Munson Tp.

Re-Location of Channel & Bridge



E. & W. Center

Sta	+	H.I.	−	Elev.	Rems
B.M.	4.91	999.22		994.31	B.M. Spike W. Root 36" Maple 34' Rt Sta 57+98 Town Line Rd.
0+0	℄ Town Line Rd.				
1+0					
T.P.	8.27	1005.93	1.56	997.66	
+75	Beg. of High Bank on Both Sides				
2+0					
+08.78	(P.I.) also change in Gr.				
+55	End of High Bank on Both Sides				
3+0					
4+0					
5+0					
T.P.	4.73	1002.46	8.20	997.73	
+78.78	℄ Prop. Bridge				
B.M.			2.49	999.97	Top of Iron Rod W. Side 15" Butternut 60' Rt. Sta 5+14.
+84.3	℄ Pres. " "				
6+0					

Road (x-Sections)

North	℄	South
	1.9	
2.7 / 14' ℄ Tr. Rd.	2.5	
4.5 / 4' ℄ T/R	4.6	
	3.0	
	2.4	
	4.3	
	6.4	
	7.6	
	8.1	
	4.5	
	4.3	
	3.9	

E. & W Center Rd.

Sta	+	H I	-	Elev.	Remk
		1002.46			
6+62.58	(P.I)				
7+0					
8+0					

Monson Tp-

North	℄	South
℄ T/R $\frac{4.3}{61}$	5.0	
	4.2	
	2.5	

Cross-Sections Relocation of channel & Bridge

Sta	+	H.I.	−	Elev	Remis
B.M.	1.78	1001.78		1000.00	Top of Iron Rod W. Side 15" Buttfarnut 60' Rt Sta 5+14
0-140					
0-100					
0+0					
0+50					
T.P. & B.M.	2.30	1002.30	1.78	1000.00	
1+0					
+50					
2+0					
+50					
3+0					
+50					
4+0					

West ℄ East

7.7 Pr. chan.

4.0 8.7 ch 45'

9.4

4.8/25' 4.5/21' 6.8/16' 6.8/6' 9.3 10.1/8' (ch)

5.3/25' 5.3/7' 7.7 11.3/16' (ch)

4.7/25' 6.6/15' 6.0 10.1 (ch) 90°

6.5/25' 6.5 6.8/9' 8.6/44' 10.7/57' (ch)

13.4 (ch) 25' 11.0/19' 9.5

12.3 (ch) 25' 10.9

9.6/25' 12.8 (ch) 14' 11.3

12.0/25' 11.8 12.8 (ch) 12'

Sharman Rd.

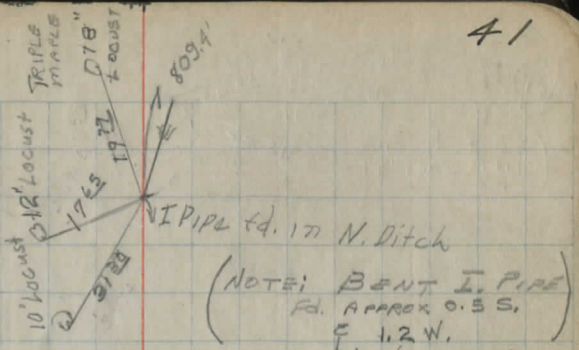
10-5-5?
H. Patterson
P. Young
D. Parks

11+98.53	PI	Δ = 21°-21'-30"	RT

Sta 0+0 to Sta. 3+70
Stakes set S. Side Rd.
30' offset at 100' intervals

Sta 3+70 to Sta 4+70
Stakes set N. Side

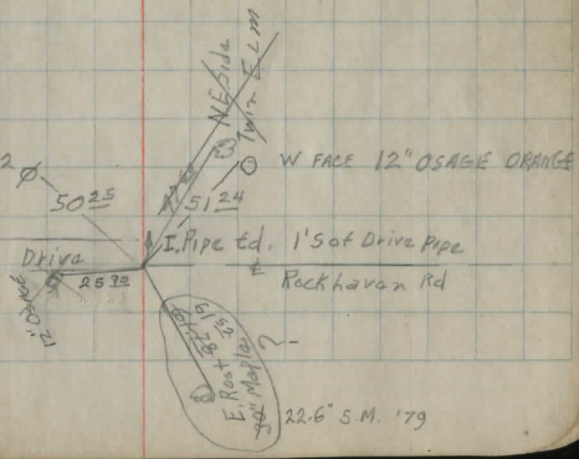
0+0 Intersection Sherman & Rockhaven



(NOTE: BENT I. PIPE
Fd. APPROX 0.5 S.
& 1.2 W.
4/15/64 RAD
H.L.P.

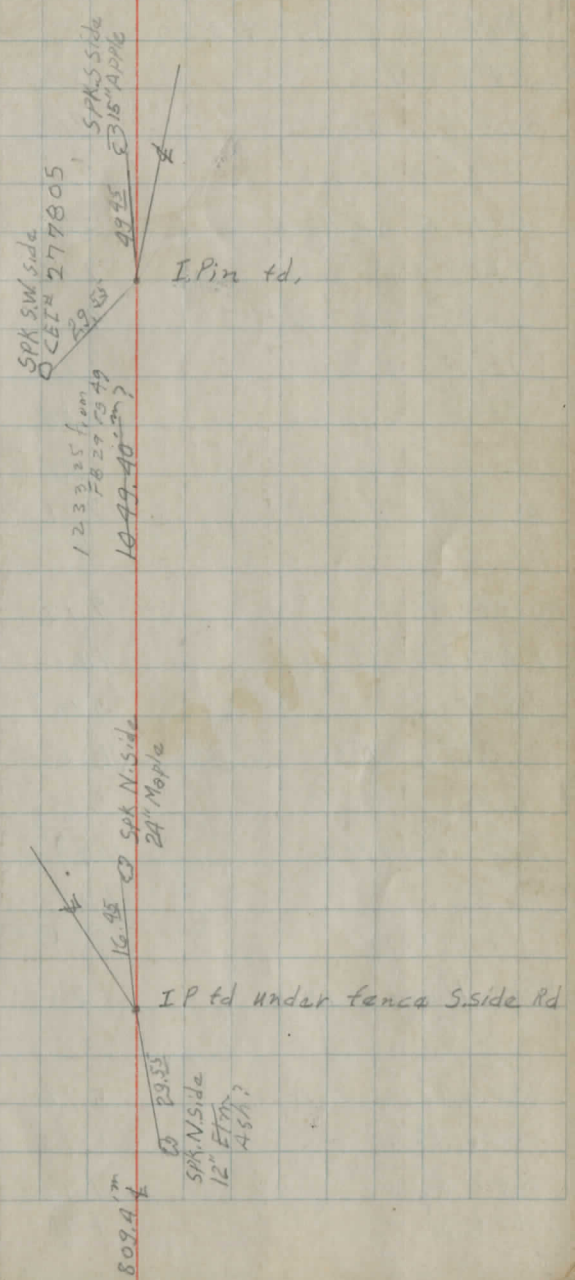
ALSO SEE Pg. 47.

1198.53' ℄



30+57.33 PI Δ = 5°-16-20 Rt 2/12/93
(5°-16-20) Rt Gary Paine

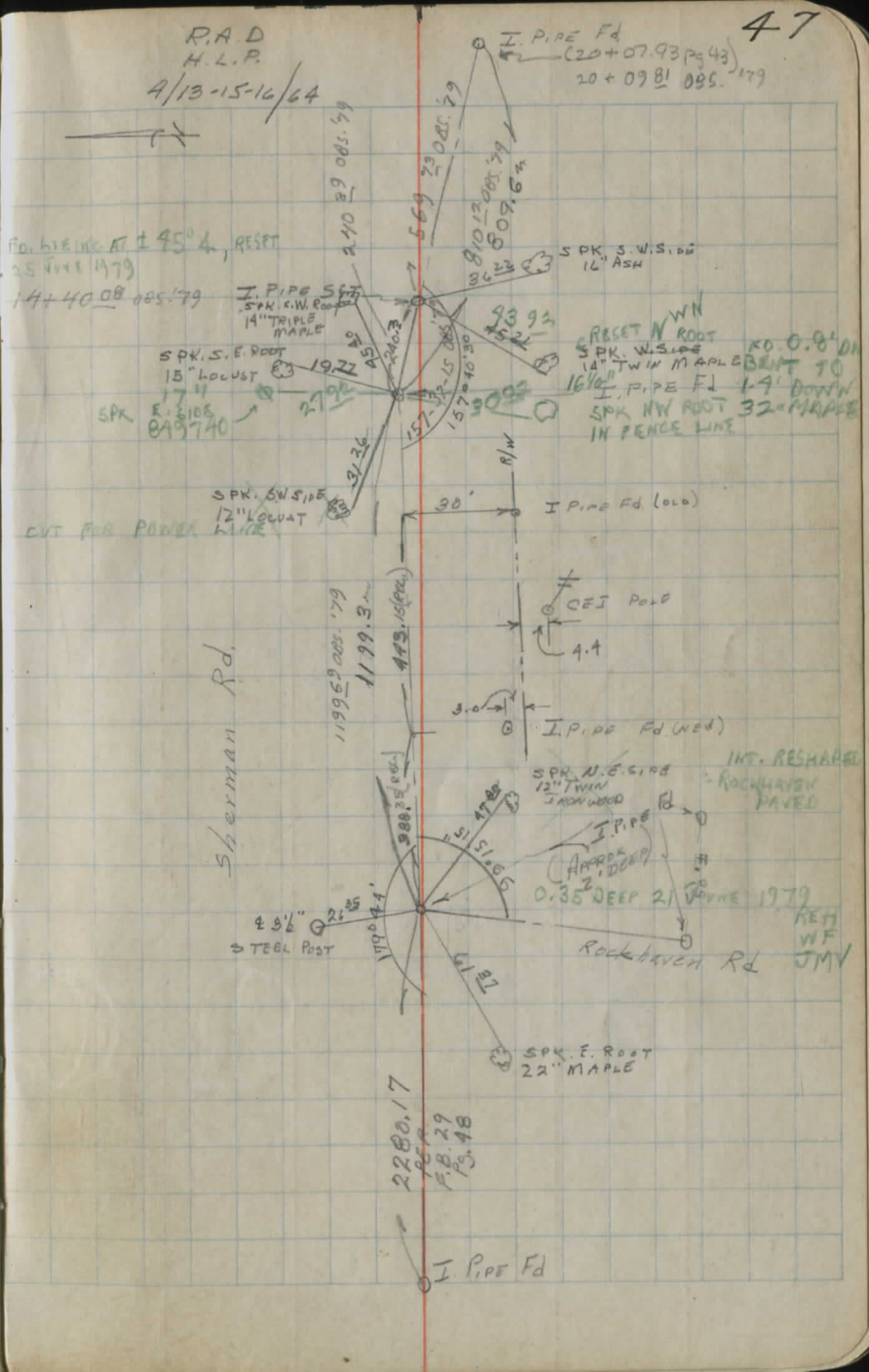
20+07.93 P.I. Δ = 48°-42' Lt



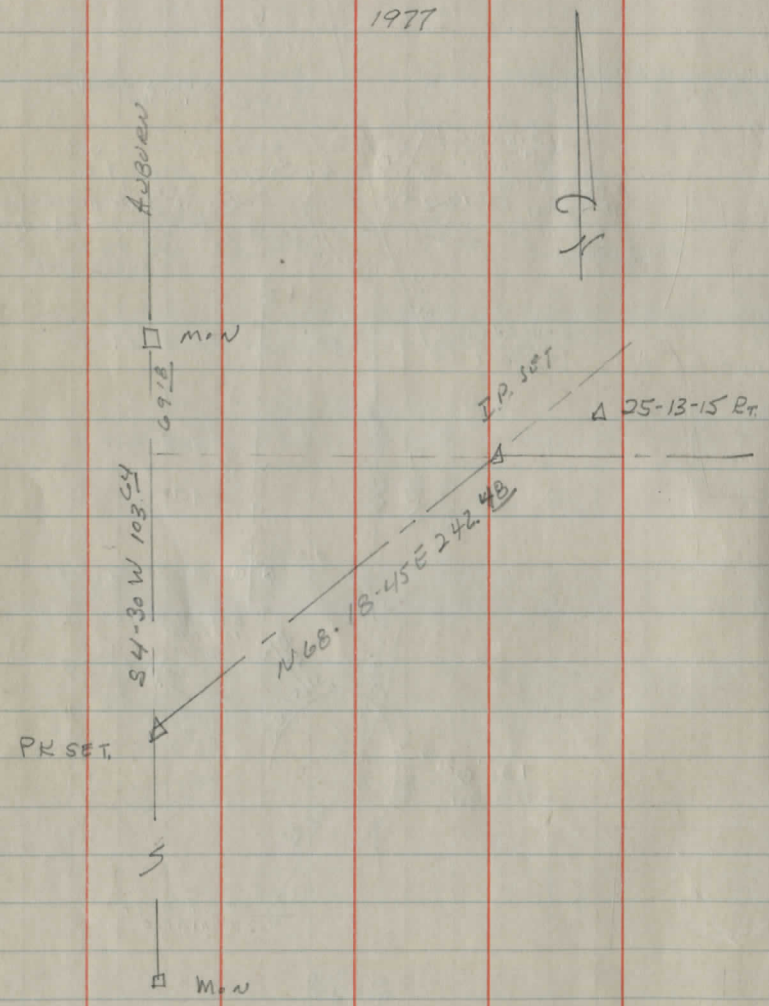
Sherman Rd. Culvt.
1st structure W. of Rockhaven

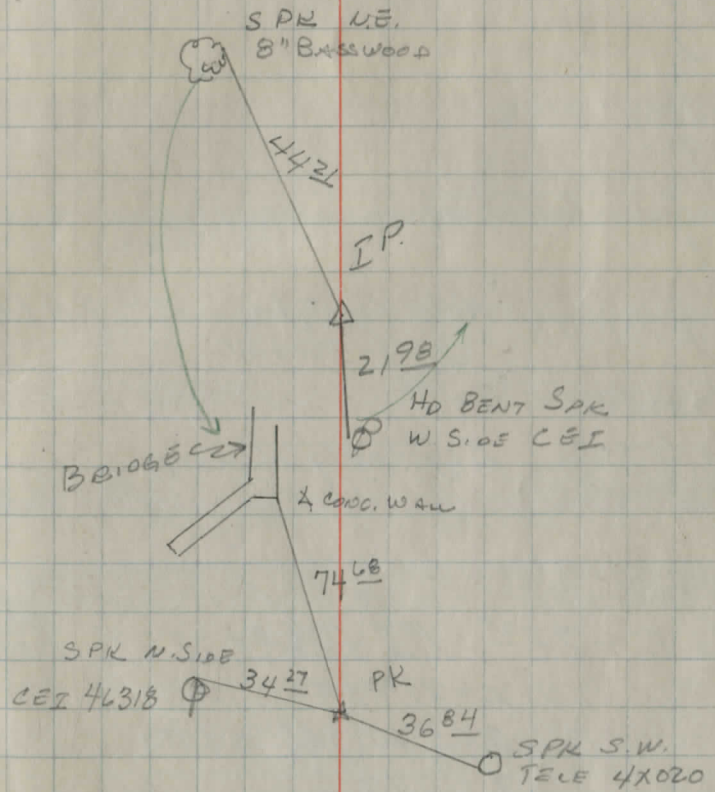
B.M.	3.70	103.70	100.00	Spk NE side CEI 589115 ± 30' W & 30' S. of structure
0+10 & Rd & Bridge		3.61	100.09	
Inlet F/L.	0+08 N.	8.88	94.82	
0+35 N.	& Creek	9.10	94.60	
0+35 N	Top Bank	5.87	97.83	
+70 N	& Creek	7.46	95.24	Creek turns E. here
+70 N	Top Bank	4.75	98.95	
1+00 N	& Creek	8.00	95.70	
2+00 N	& Creek	6.50	97.20	
Driveway		4.30	99.40	
Basement	Door	7.31	96.39	
Outlet F/L.		9.13	94.57	
& Creek S.	0+30	9.60	94.10	
Top Bank		5.45	97.25	
In Creek	0+60	11.80	91.90	? Channel ± 2' deeper in & Creek Big Pond
Top Bank		5.55	98.15	
In Creek	1+00	11.00	92.70	Channel Narrows at this point
Top Bank		6.41	97.29	
In Creek	1+30	12.20	91.50	
F/L Spillway of Lake		9.85	93.85	
0+50 & Rd.	W	5.72	97.98	
1+00 & Rd.	W	6.93	96.77	
1+50 & Rd.	W	7.73	95.97	
2+00 & Rd.	W	7.90	95.80	

		103.70		
0+50 ℄ Rd. E.			1.68	102.02
T.P.	11.80	114.63	0.87	102.83
1+00 ℄ Rd. E			9.56	105.07
1+50 ℄ Rd E			4.00	110.63
2+00 ℄ Rd. E			0.00	114.63



#4 @ SHERMAN (ESTLY)
RELOCATED & TO OCCUPIED
1977





₵ Location Bainbridge Solon Center Road. Restaked
Sec A

Note: Sidestakes set 30' Lt.

5

4

3

2

Note County Line is 22.37 E of P.I. and on Tangent.

1

Sta 0+00 Beginning of Imp.

Sta 0−22.37 P.I Def Rt 29°09' Hub Found

$\Delta = 29°08'45"$ ✓

$D = 5°22'34" = 5.3761°$

2+54 = 0°00' $T = 277.17$

2+00 = 1°17 $E = 35.32$

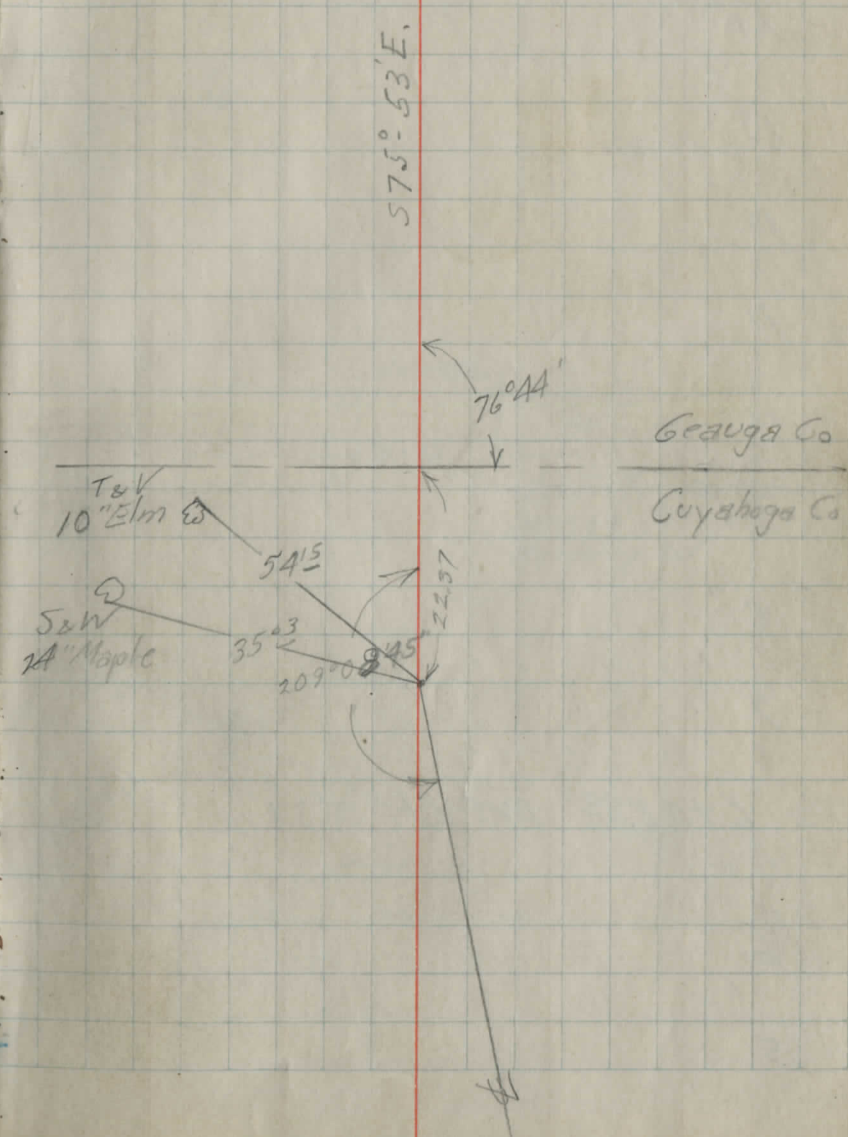
1+50 = 2°38 $L = 542.33$

1+00 = 3°58 $PC =$ = 121+86.45 } Cuyahoga Engineer notes

0+50 = 5°19 $PT = 2+54.80$ = 127+22.78

0+00 = 6°39 $R = 1065.77$

0−22 =



Sta 14+25.20 End of Imp. Pin Found

14

13

12

11

10

9

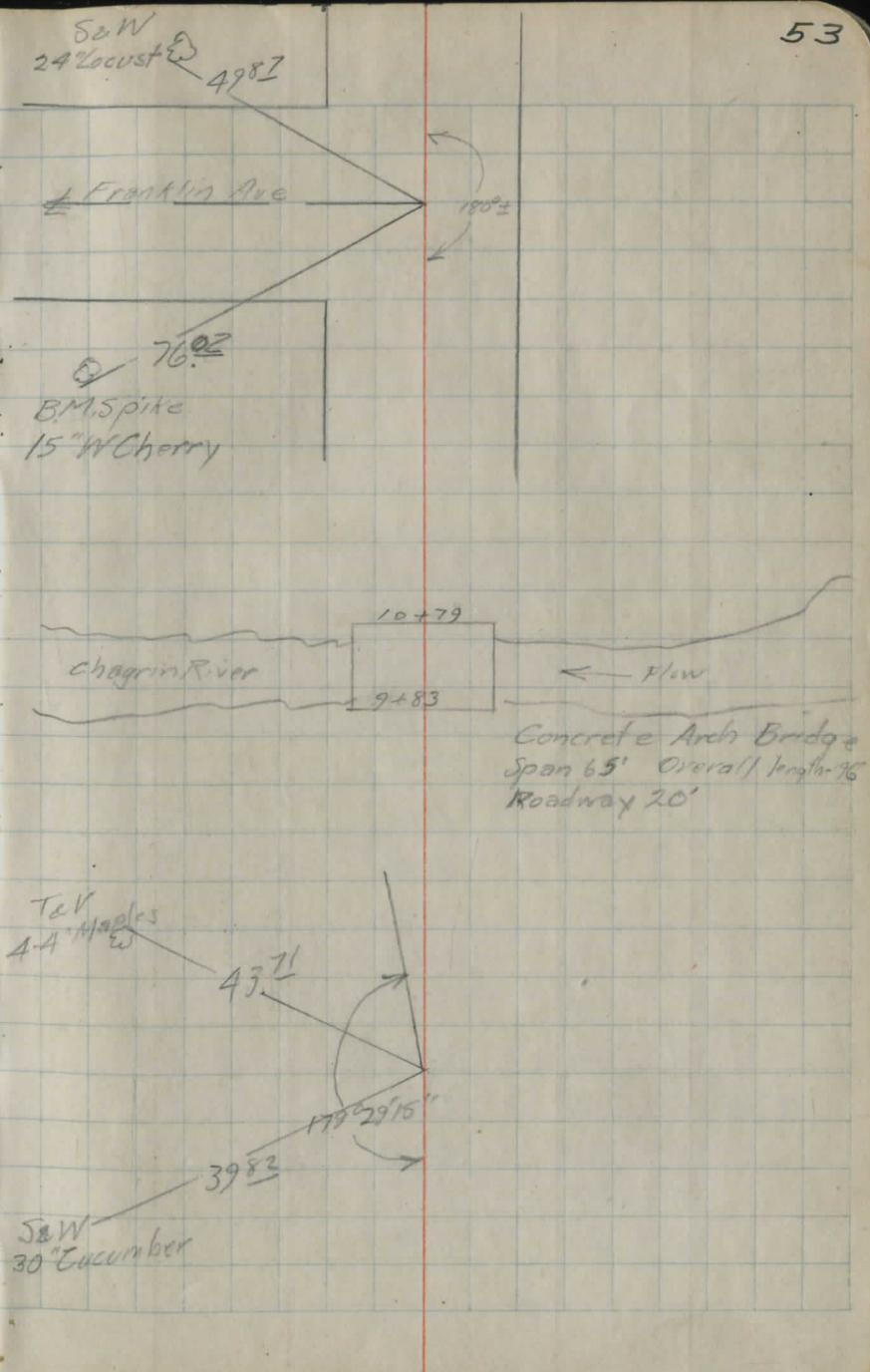
8

7

Sta 6+08.00 Def Lt. 0°31' Pin Set

6

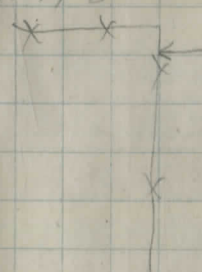
5



Topography

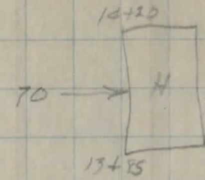
Left		℄	Rt.
		2+54	20 T
T	31	2+50	
15"M	25	2+45	
12"M	25	2+15	
24"A	25	1+80	
		1+45	35 T
←	28	1+50	
15"M	30	1+25	
10"E	35	1+00	
T	31	0+90	
18"M	39	0+75	
		0+25	39' T OBTC.
←	43	0+50	
10"E	40	0+38	

12"M		22	3+85	
15"Conc.		22	3+56	
			3+60	19 T
10"M			3+18	
	end	23	3+18	
Drive			3+00	
			2+54	20 end
T		18	2+78	
15"M		22	2+76	
←		22	2+76	



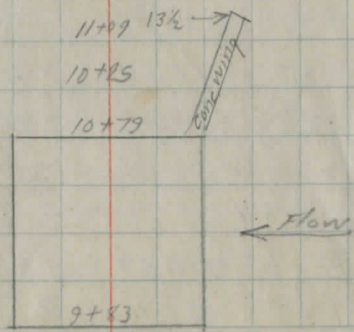
9+80 → x
9+52 23 T
9+45 Drive x
Drive 9+35
x 26 9+30 x
x T 20 8+71
8+65 . 21 T
15" Wa ✿ 21 8+25 x
18" M x✿ 20 7+50
Drive 7+30
7+45 20 T
← 20 x 20 → x
15" M ✿ 19 6+85
T 17 6+70 x
2-4" M ✿ x 20 6+45
8" WC ✿ 22.5 6+35
30" Cuc ✿ 20.5 5+85 x
6+10 18 T
15" Stump x 20 5+10
4+92 17 T
x T 18 4+72 x
2-10" Wa ✿ 24 4+72
← 24 x
x x

℄



13+70 Drive
13+26 9 T
13+60 10 → x
x ← 27 13+30
15" Wa ✿ 27 12+80 x
T 21 12+55
x
24" A ✿ 26 12+40 x
10" M ✿ 26 12+70
x ← 27 12+30 x
24" M ✿ 27 12+02 x
11+95 8 T
11+10 9' → x
11+10 13 T
11+09 13½ →
T 20 10+25
10+79

Concrete Arch
Bridge Span 65'
Overall length - 96'
Roadway - 20



Bench Mark Levels for Bainbridge

BM #9	4.61	943.98			939.37
	2.52	943.07	3.43	940.55	
BM #10	8.45	946.10	5.42		937.65
	11.48	957.49	0.09	946.01	
	11.58	968.08	0.99	956.50	
BM #11	9.41	968.08	9.41		958.67
	1.99	969.42	0.65	967.43	
	1.09	957.91	12.60	956.82	
	0.34	946.46	11.79	946.12	
BM	2.46	938.25	10.67		935.79
	6.96	943.83	1.38	936.87	
	1.45	938.10	7.18	936.65	
	5.65	942.81	0.94	937.16	
	12.68	944.62	10.87	931.94	
	11.58	955.69	0.51	944.11	
BM	1.63	955.69	1.63		954.06
	0.78	944.31	12.16	943.53	
	0.00	931.73	12.58	931.73	
	2.31	921.22	12.82	918.91	
	2.87	916.25	7.84	913.38	
BM #4	1.88	914.24	3.89		912.36
BM #3					903.25
BM #2	5.11	914.49	4.86		909.38
	11.88	925.76	0.61	913.88	

Solon Road

Head Vertical Bolt SE ∠ Bridge 8' Rt ℄ Sta 17+41 of Bainbridge Geauga Lake Rd. Sec. C

Spike E root 10" Elm 15' Lt ℄ Sta 27+25

Spike SE root 42" Elm 60' NW of Sta 33+85
End of Sec C

NE ∠ S Headwall (Concrete) Culvert 1500' NW of B-GL Rd

Spike SW root 15" Maple 100' SE of Miners Cor. N Side Road

Spike S root 15" W. Cherry 75' NW of Sta 14+25
NW ∠ Franklin Ave and Bainbridge Solon Rd

Spike E root 42" Willow 75' Rt ℄ Sta 9+70 (Assumed BM for Bridge Imp.)

X cut NW Cor. NW Abutment of Bridge Sta 7+83

		925.76				
	12.20	937.57	0.39	925.37		
	11.66	948.50	0.73	936.84		
	11.30	959.27	0.53	947.97		
BM #1	7.23	959.27	7.23		952.04	Spike S. root 15" Maple 40' Lt & Sta 0+75
	12.47	970.43	1.31	957.96		

H.I.

Cross Sections Bainbridge Solon Road Sec A

		97043		
0-100			7.0	963.4
0-200			4.0	66.4
0-300			2.6	67.8
0+00			11.9	58.5
0+50				
	1.93	96081	11.55	958.88
0+50			5.6	55.2
BM 1			8.78	952.03 ✓ 952.04
1+00			9.9	50.9
	1.10	951.22	10.69	950.12
1+50			5.1	46.1
2+00			10.1	41.1
	1.24	939.67	12.79	938.43
3			9.3	30.4
3+50			12.1	27.6
	1.72	929.25	12.14	927.53
4			4.7	24.6
5			8.0	21.3
6			12.7	916.6

$\frac{-30}{9.4}$ $\frac{26}{9.6}$ $\frac{20}{12.8}$ $\frac{19}{12.1}$ $\frac{10}{11.9}$ $\frac{19}{12.7}$ $\frac{16}{13.5}$ $\frac{43}{00}$ $\frac{47-}{-3.0}$

$\frac{48}{1.4}$ 10:1 up

$\frac{30}{4.8}$ $\frac{22}{5.0}$ $\frac{17-15}{6.0}$ $\frac{13}{6.6}$ $\frac{11}{6.1}$ $\frac{21}{6.7}$ $\frac{22}{5.7}$ —

10:2 up — $\frac{30}{11.3}$ $\frac{25}{10.2}$ $\frac{11}{10.4}$ $\frac{16}{10.5}$ $\frac{21}{11.2}$ $\frac{40}{0.9}$ — 10:2 up

$\frac{30}{11.0}$ $\frac{20}{6.4}$ $\frac{16}{6.0}$ $\frac{13}{7.0}$ $\frac{11}{5.9}$ $\frac{16}{6.3}$ $\frac{21}{7.1}$ $\frac{22}{5.6}$ $\frac{30}{1.3}$ 10:3 up.

10:2 down — $\frac{25}{1.5.0}$ $\frac{20}{11.5}$ $\frac{15}{10.5}$ $\frac{11}{10.9}$ $\frac{16-18}{12.2}$ $\frac{19}{11.1}$ $\frac{30}{11.0}$

— — $\frac{-26}{10.7}$ $\frac{15}{9.7}$ $\frac{5}{9.4}$ $\frac{8}{11.1}$ $\frac{10}{9.9}$ $\frac{30}{7.5}$

some section at 3+00

$\frac{-25}{40}$ $\frac{17}{43}$ $\frac{14}{49}$ $\frac{12-11}{5.5}$ $\frac{10}{4.7}$ $\frac{6}{4.7}$ $\frac{8}{5.7}$ $\frac{11}{3.8}$ $\frac{20}{8.5}$ 10:3 up.

$\frac{-25}{32}$ $\frac{20}{5.2}$ $\frac{10}{7.5}$ $\frac{7}{7.3}$ $\frac{5}{8.0}$ $\frac{10}{8.0}$ $\frac{12}{9.1}$ $\frac{14}{8.2}$ $\frac{30}{6.6}$

— $\frac{30}{3.0}$ $\frac{20}{3.6}$ $\frac{15}{4.9}$ $\frac{3}{12.0}$ $\frac{8}{12.0}$ $\frac{8}{11.8}$ $\frac{15}{11.9}$ $\frac{17}{12.1}$ $\frac{19}{12.2}$ $\frac{30}{12.6}$

	BS	HI	FS	Elev	
		929.25			
6+60			16.3	913.0	
	0.71	917.66	12.30	916.95	
7			6.8	910.9	
8			8.8	908.9	
9			10.1	907.6	
9+40			10.3	907.4	
BM#2	4.98	914.36	8.28	909.38	909.38
W. end Bridge 9+83			5.5	908.9	
Sta 10			5.1	909.3	
℄ 10+31			4.7	909.7	
E. end Bridge 10+79			5.4	909.0	
Flow			18.5	895.9	
11			5.0	909.4	
12			4.9	909.5	
13			4.6	909.8	
14			4.0	910.4	
14+25 (End of Project)			3.4	911.0	
BM#4			2.00	912.36	912.36

(over)

L R

6+60 same as 6+00

30/6.7 19/5.3 8/6.4 5/7.7 4/7.0 — 14/6.8 15+16/7.5 18/6.9 30/6.6

30/12.0 12/10.6 9/10.5 7/9.7 — 9/8.8 13/9.8 30/10.4 —

30/12.2 22/11.8 13/11.2 11/10.4 — 7/10.2 12/12.0 30 —

same section as 9+00

30/7.2 17/6.8 16/5.6 12/9.8 11/5.1 — 6/5.2 8/5.0 20/9.7 30/13.0

26/4.6 23/4.6 15/5.4 13/4.9 — 1/4.9 2/5.7 4/5.0 10/5.1 16/6.4 30/7.3

25/4.1 18/4.7 16/5.2 14/4.8 — 1/4.6 3/5.5 5/4.6 9/3.7 13/4.0 30/5.9

30/3.6 — — — — 4/4.4 — — 30/4.0

100/4.2

	+		−	
66		914.36		
15+0			3.0	911.

Check Levels to McFarland Creek Bridge

BM #4	2.56	914.92		912.36
Assumed BM			7.73	907.19
	7.17	914.36		907.19
			1.97	912.39

Check Levels to Corners of Corrugated pipe Culvert

BM.	5.97	913.16		907.19
NE			2.15	911.01
SE			2.35	910.81
SW			2.92	910.24
NW			3.69	909.47
Flow Wend N Pipe			15.87	891.29
Flow Wend S. Pipe			15.42	891.74

67

36" Maple
Spike SW root 13 Lt E Sta 4+07 of McFarland Creek Bridge Imp.

NE Cor. E Headwall
SE " E "
SW " W "
NW " W "

3.63
12.24
87

McFARLAND CREEK

July 47

4 Barrel

	+	HI	−	
BM	4.22	911.41		907.19
~~SE & EXIST mat.~~				
T.P			11.62	899.79
T.P	3.78	903.57		
SE & EXIST MAT			5.23	898.34
MARK ON W ANGLE, S. ABUT.			3.23	
SPIKE E. ROOT STUMP W. OF S. ABUT.			5.23	
STK. W. OF N. CUT			3.23	
NE. CORNER OLD MAT			5.76	
STK E OF N CUT 1.5' ABVE GRD.			3.73	
LARGE TOP ROCK 15' W. N CUT			2.76	

+ 10.8 − TO TOP S. ABUT.

MARK ON E. S. ABUT. STAKE 1' E

See 79 102 for channel notes E. of bridge

at Grade

C - 2'-0"

Gr

C 2'-0"

C 1'-6"

5.23
2.76
C − 2.47

See align stks pg 74

	+	HI	Ref.	Grade	
TO	2.40	1002.40	4.90		1000.00
Bottom of Footings		A	Cut 10.00	987.50	
		B	8.90 Cut 6.00		
		C	7.90 Cut 7.00		
		D	Cut 7.50		

Sta 5+66.78 West Abutment

E	4.30	998.10	Hub 20' W.	
F.	3.68	998.72	Hub 20' E	

Sta 5+85.28 East Abutment

1002.40
4.23
998.17

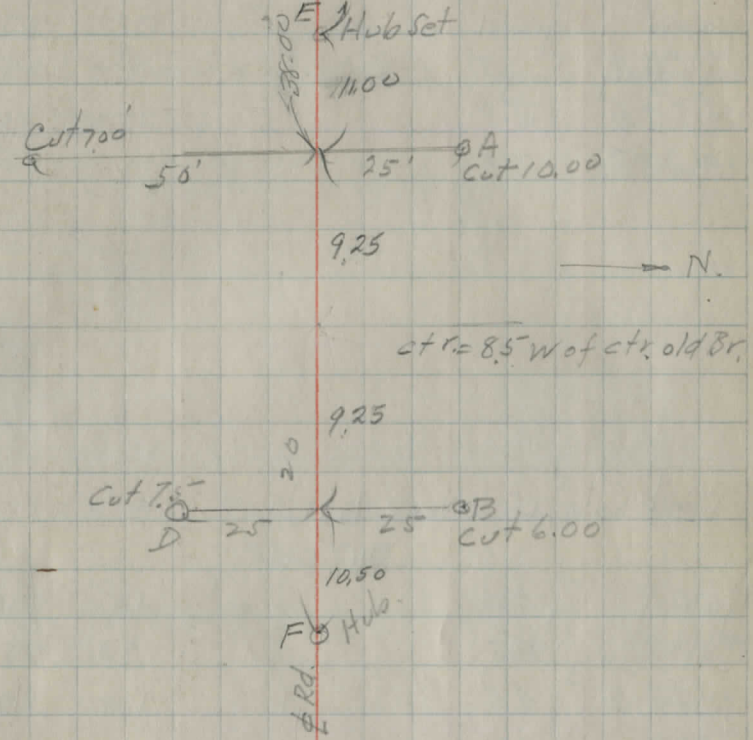
1002.40
Footer 987.50
14.90
7.4

4.56

Stakes for Bridge
E & W Center Road Munson 9-28-38
B M Buttermut. ⊙IP Fd - 2+08.78

5+28.78 ℄ Bolt. Fd.

Graber
Richards
H. Root



⊙ I.P. Fd. 6+67.58.

± apr 1, '39

McFarland Creek Bridge

Test hole #1 (Far left)
911.60

Ground	Gravel		12.95	898.65
Soft gray	clay		2.70	895.95
"	"	"	13.20	882.45

Test hole #2 (Near left)
911.60

Ground	Gravel		13.0	898.60
Soft gray	clay		2.4	896.20
"	"	"	13.2	883.40

B.M.	5.55	914.70		909.15
B.M.			7.76	906.94
B.M	4.66	911.60		906.94
Channel bottom			16.5	895.10

Test Borings

1939

Test hole #3 (Near right)
911.60

Ground - Sand & gravel	12.0	899.60
Soft ~~gray~~ clay	12.5	897.10
" " "	13.2	886.40

Test hole #4 (Far right)
911.60

Ground Sandy loam	10.9	900.70
Gravel	1.00	899.70
Soft gray clay	3.3	896.40
" " "	13.2	883.70

X in West Abutment. N.W. Corner bridge over Chagrin River, Solon-Bainbridge Rd.
Spike in S.W. Root of first maple N of bridge on left side

Stakes for McFarland Creek Bridge 1939

July 47

BM spk Sfoot 36" Map

13.05

E=907.19

N

See Pg 68

I.P. Fd top hill

I.P. N side barricade

Reinf bar ± 18" back of cut

See page 102 for channel E. of bridge

Spk Fd & replaced with reinf. bar S edge abut.

I.P. set 16' Spk N side 50" Elm

3+24.72 ℄ of S. pilings

Iron pipe (fd) Top of hill

Iron bolt

22'

Spk

19'

Spk

19'

Spk

22'

Iron bolt

Bainbridge Solon Road

T. Hub (fd)

10/19/39 Pomeroy Richards Clause

Check Levels McFarland Creek Bridge

	+	H.I.	−	El.	9/12/35 M.R.
B.M.	5.46	912.65		907.19	
N. end W. Headwall			5.58	907.07	909.47
" " E	"		1.13	911.52	911.01
S " E	"		1.63	911.02	910.81
" " W	"		2.36	910.29	910.24
F.L. #1 pipe	E end		14.14	898.51	
" #1 "	W "		15.43	897.22	897.74
" #2 "	" "		16.11	896.54	
" #2 "	E "		14.03	898.62	
" #3	W "		17.39	895.26	
" #3	E "		13.86	898.79	
" #4	W "		17.87	894.78	897.29
" #4	E "		13.73	898.92	

Note: Pipes numbered 1-2-3-4 from S to N.

5-27-46 Cont'd

913.29

FL Pipe #3	E			15.53	897.76		
" " "	W		±	12.61 (top pipe) +	8.66 =	21.27	= 892.02
" " 4	W		±	12.90 +	8.66 =	21.56	= 891.73
" " "	E			14.90	898.39		

Spike S.W. Root 22" Maple 4 ± 07 13' Lt

4/22/40 Pomeroy – Richards

Check Levels McFarland Creek Bridge

	+	H.I.	−	
B.M.	4.49	911.68		907.19
H. end	W head'l		4.90	906.78
" "	E "		0.17	911.51
S "	" "		0.66	911.02
" "	W "		1.49	910.19
FL. #1	E end		13.22	898.46
" "	W "		13.90	897.78
" #2	" "			
" "	E "			
" #3	W "			
" "	E "			
" #4	W "		17.03	894.65
" "	E "		12.85	898.83

5-29-46

	+	H.I.	−		
BM	6.10	913.29		907.19	
BM set			7.50	905.79	
NE ∠ Conc Cap			2.41	910.88	
SE ∠ " "			2.09	911.20	
SW ∠ " "			3.02	910.27	
NW ∠ " " Gone					
FL Pipe #1 E			14.77	898.52	
" " " W			16.44	896.85	895.23
" " 2 "		±	top 9.40	+ 8.66 =	18.06
" " " E			14.73		
				898.56	

Cont'd pg 77

8-9

8

8.75
.69
.61
8.65

4) 2.70
.675

.66
.72
1.17

46^m = ¢ holes
7
322
3
325 = cir

104
3
312
15
327

.69
.76
.49
.89
2.83
.71

McFarland Creek Bdge.

	Change from Oct. '39 to May '46	May 46	Mar. 44	Oct 39	Apr 40
Top NE 4 Conc. cap		910.88	911.41		911.51
SE " " "		911.20	911.11		911.02
SW " " "		910.27	910.25		910.19
FL Pipe #1 E	Nil	898.52		898.51	898.46
" " " W	-0.37	896.85		897.22	897.78
" " 2 W	-1.31	895.23		896.54	
" " " E	-0.06	898.56		898.62	
" " 3 E	-0.86	897.76		898.62	
" " " W	-3.24	892.02		895.26	
" " 4 W	-3.05	891.73		894.78	894.65
" " 4 E	-0.54	898.38		898.92	898.83

all pipes removed & replaced Sept 1947

Note: Pipes numbered 1-2-3-4 south to north

FL elevs on west May 46 are approx.

8-9

8

$46^{m} = ¢ holes$

7

322

3^{2}

$325^{2''} = cir$

8.75
.69
.61
8.65

4) 2.70
.675

.66
.72
1.17

104
3
312
15
327

.69
.76
.49
.89
283
.71

4/22/40 Pomeroy - Richards

BM.
H. enc
" "
S "
" "
FL. #1
" "
" #2
" "
" #3
" "
" #4
" "

5

BM
BM
NE4C
SE4
SW4
NW4
FL
"
"
"

Cont'd pg 77

	10/19/39	9/12/35
Spk S.W root 22" Maple		
	907.07	909.47
	911.52	911.01
	911.02	910.81
	910.29	910.24
	898.51	
in pipe	897.22	897.74
	894.78	897.29
	898.92	

Bridge & W side rd

Spk SW root 36" (22") Map. (1st Map N of
" E root 15" Elm 35' NW of bridge

See pg 77 for numbering of pipe

April 14 1942
Pomeroy - Hosford - Gundersen

Check levels McFarland Creek Bridge

	+	HI	-	E
BM.	6.71	913.90		907.19
NW ¼			7.51	906.39
NE ¼			2.40	911.50
SE ¼			2.83	911.07
SW ¼			3.67	910.23

May 11 43

BM	6.59	913.78		907.19
NW			7.75	906.03
NE			2.15	911.63
SE			2.69	911.09
SW			3.52	910.26

Aug. 13 1943

BM	6.85	914.04		907.19
NW	.11		8.11	905.93
NE			2.41	911.63
SE			2.92	911.12
SW			3.76	910.28

See pg 84

9-12-35	10-19-39	4-22-40
Spike SW root 30" Map. (1st N of bge)		
909.47	907.07	906.78
911.01	911.52	911.51
910.81	911.02	911.02
910.24	910.29	910.19

7-9-42 Form. Wood.

I.P. fd (on top of hill) see ref pg 83

R.P. spk E side 30" Map 18.79

Spk 90°

R.P. BM spike 13.46

8937 to spk 3+19.85 no abut.?

± N

Timber ret. wall back filled with Large rocks N.G.

±18'

9.8'

Stone facing both sides. 18" Conc. cap

43.7

22' Rdwy

Plank mat. under entire structure

25.5'

No abut.?

Stone wick 2' wide

14.50 → 11.4

3"

Spk Sta 3+19.85

Conc. ret. wall. Bad crack N end top ext. diag. 5'. to bottom

4 - 8.5' x 25.5' galv. plate pipe

Sq W in stump

Sq W 28" Locust

16.60

49.57

0+0

℄ Solon-Bain. road

Bolt set from ref

Note: This point set 1' too far E. Moved 1' West & ref. corrected 10-29-42

84.78

N.W. 4 metal

Cottage

McFARLAND BRIDGE

1+50 1+40 2+40 3+35

90° 90° 90°

8.8 9.1 9.85 13.2 9.5 9.45 14.0

120 85 25 41 31 20 9

6.4 5.9 12.0 10.4 10.3

140 110 60 48 18

±63 63 11.2 9.1 8.4 9.65 10.5 6.3 4.6

210 180 170 140 75 60 38 29 0

E 2

1+40

0

pipe fd see pg 82

face of 4th post

26.5

Paddock

Spk S side C.E.I.

23.82

39.4

4 board

B.M. 4.41 911.60

9/7/19

B.M.	5.48	912.67		907.19
So end bridge & ℄ rd			3.6	909.07
100' So. of above			3.65	909.02
N end bridge ℄ rd			4.8	907.87
± 75 N above			6.3	906.37
± 125 " "			6.4	906.27
NW℄ top conc. caps			6.44	906.23
NE			1.08	911.59
SE			1.60	911.07
SW			2.49	910.18
± F.L. east ctr.			15.0	897.67
± " West " 2nd pipe fm N			16.2	896.47
BM	1.19	908.38		907.19
± 115 W of rd ℄ (chan)			11.7	896.68
± 190' " " " "			12.2	896.18
3-28-44				
B.M.	6.66	913.85		907.19
NE			2.44	911.41
NW			8.51	905.34
SW			3.60	910.25
SE			2.74	911.11
			5.51	908.34

McFARLAND BRIDGE (cont.)

Apr. 14 Elevs.

906.39	= down 0.16
911.50	= up 0.09
911.07	= same
910.23	= down 0.05

Aug 13 1943

911.63	down	.22
905.93	"	.59
910.28	"	.03
911.82	"	.01

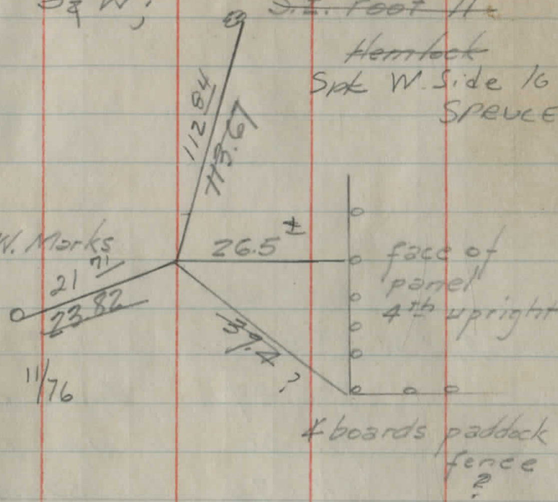
SEE PG 78

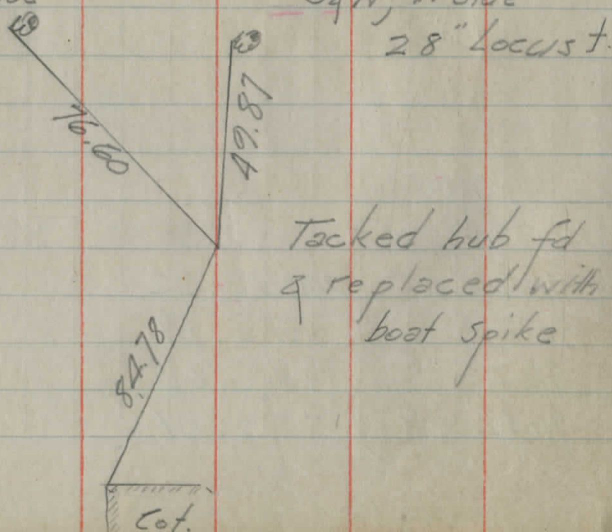
FRANKLIN ROAD

10-30-42
Pomeroy
clark

I.P. fd
11+35 ± per W. Marks
Spk; S.E. side
C.E.I. #522626

Fd & Re Ref 11/76



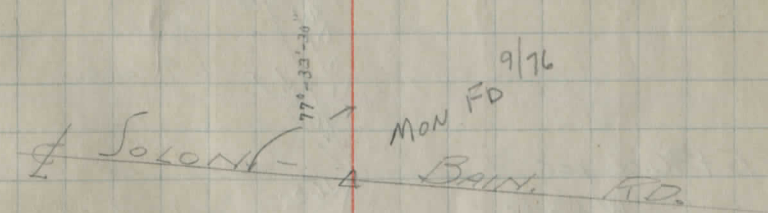


0+0

Tacked hub fd
& replaced with
boat spike

Solon - Bain road northerly
to Co. line

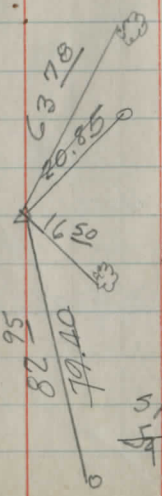
△ P.O.T.



Note: All measurments made
on tangents.

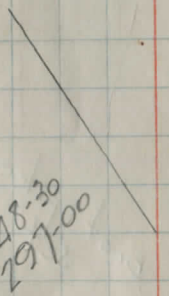
33+61

Culv't.

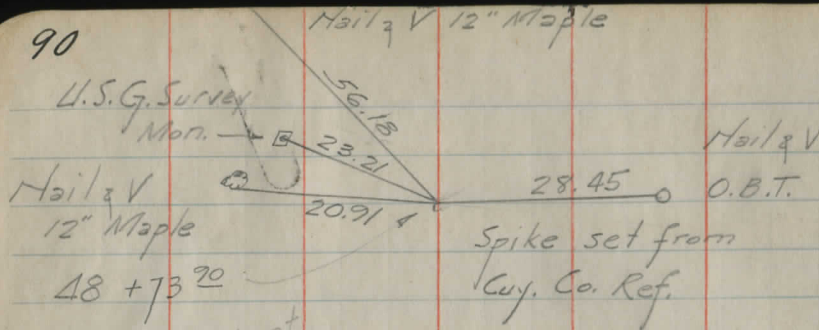


25+90.00 per
W. Marks

Fd & ReRef
11/76



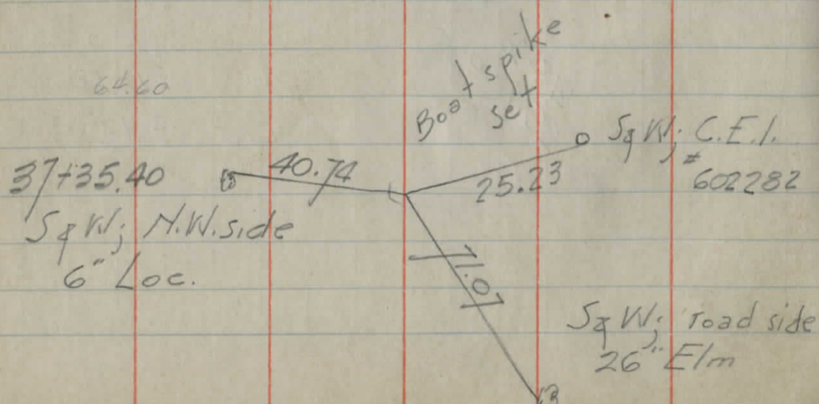
Δ = 31-30
Ext = ± 12'

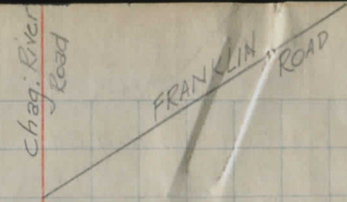


48 + 73.90

See tablet sheet pg. 160 for ref. per Cuy. Co. (this book)

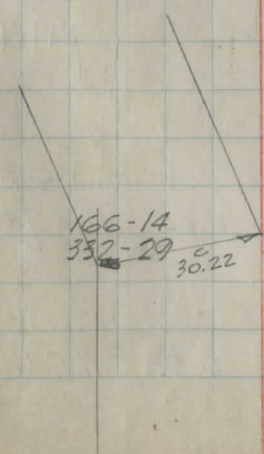
64.60





3735.40
2390
1145.40

Δ = 13-45-30 Lt
D = 6°
R = 954.93'
T = 115.20'
L =
E = 6.91'



Δ = 13°-45'-30" Lt.
Ext. to stay in R/W

5-11-43
Parr - Hall - Randles

LEVELS FRANKLIN

B.M.	4.44	104.44		100.00	Ass.
32					
33				101.7	
33+61					
				99.3	
34				99.7	
35				103.3	
T.P.	12.55	116.33	0.66	103.78	
36				112.7	
T.P.	11.45	127.25	0.53	115.80	

ROAD Sta to

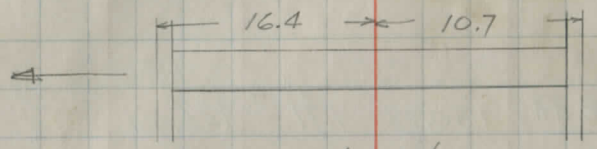
Spike S.W side 24" Ash (?) ± 50' Rt
Sta 34±40

S N

+5.8

See next pg.

7.7 6.8 2.8 2.7 3.0 7.1 1.5 11.9
30 25.5 13 5 12 24 30



3.2' x 6.6' Stone Box O.K.

16.9 5.2 5.1 5.1 16.7
F.L. 16.4 Hdwl 10.7 Hdwl F.L.

13.1 12.6 5.1 4.7 5.0 11.2 11.4
30 24 9 7 18 30

98.9 99.3 100.8 102.8 103.1 101.9 106.5
5.5 4.6 3.6 1.6 1.1 1.3 2.5 +2.1
30 21 16 10 10 15 30

3.5 3.6 3.7 5.0
5 12 14

		127.25		
36				
37				121.1
+50				124.1
+70				125.0
TP.	5.44	130.98	1.71	125.54
38				125.5
39				126.2
40				126.7
41				126.9
BM	13.30	113.30		100.00
32				109.4
T.P.	11.18	124.00	0.48	112.82
				119.9
31				123.6

120.8 123.4 120.0

6.4 3.8 7.2
30 21 30

3.0 2.1 6.8 6.2 6.1 6.1 6.7 +2.5
30 21 7.5 6.5 12 14 30

3.8 3.3 3.7 3.1 3.3 3.4 +0.2 +1.5
30 17 12 9 11 20 30

9.4 7.1 3.0 2.7 2.3 2.5 2.8 +1.5
30 19 12.5 7 9 12.5 30

7.6 6.1 7.1 5.6 5.45 5.6 5.8 3.7 3.1
30 15 12 7 10 13 18 26

5.6 5.2 5.9 5.1 4.8 5.2 5.7 3.7 3.6
30 11 9 7 11 13 17 24

4.3

4.1

#

3.9

4.1

30+50 = 0.40

May 3 44

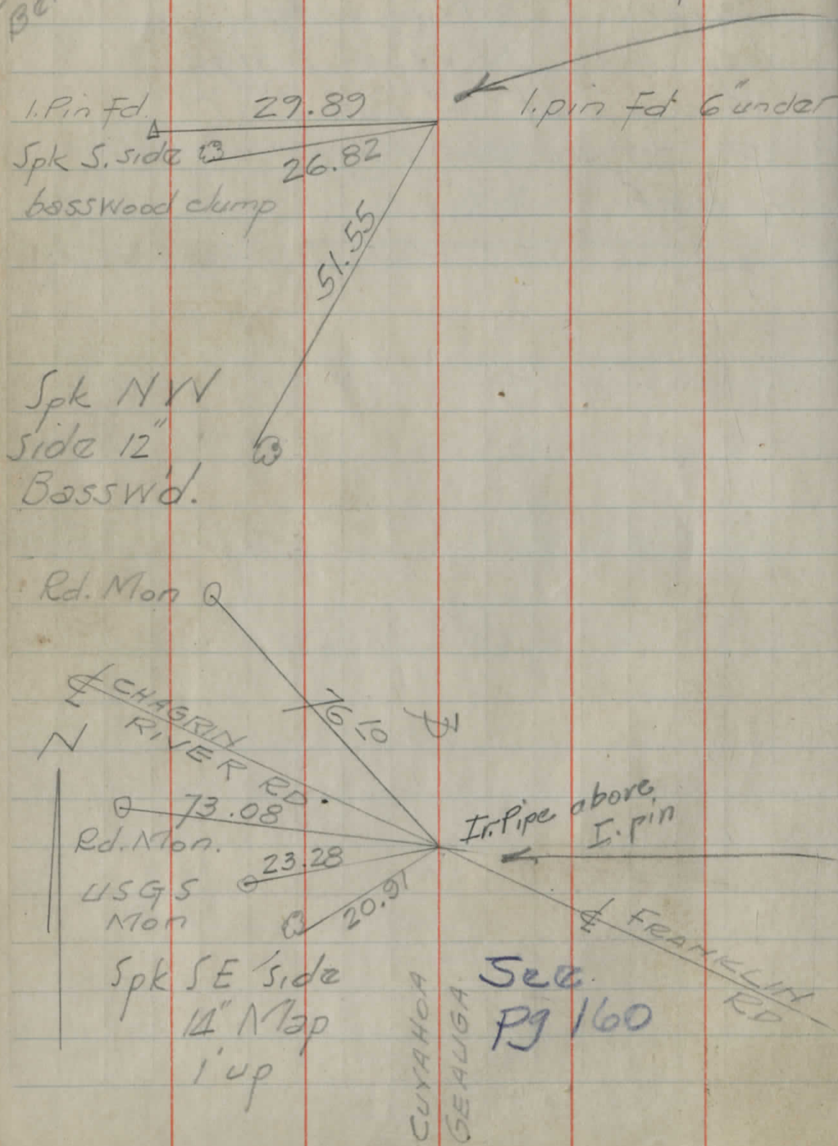
	4.41	911.60		907.19
HW ±			6.23	905.37
			15.3	
			17.5	
			14.1	
			13.9	
			12.9	

Narrows ± 20' W of brdge
deep hole H.W. ± brdge
Wooden mat 2nd pipe fm H
Ch. 25' up fm brdge
H_2O level " " " "

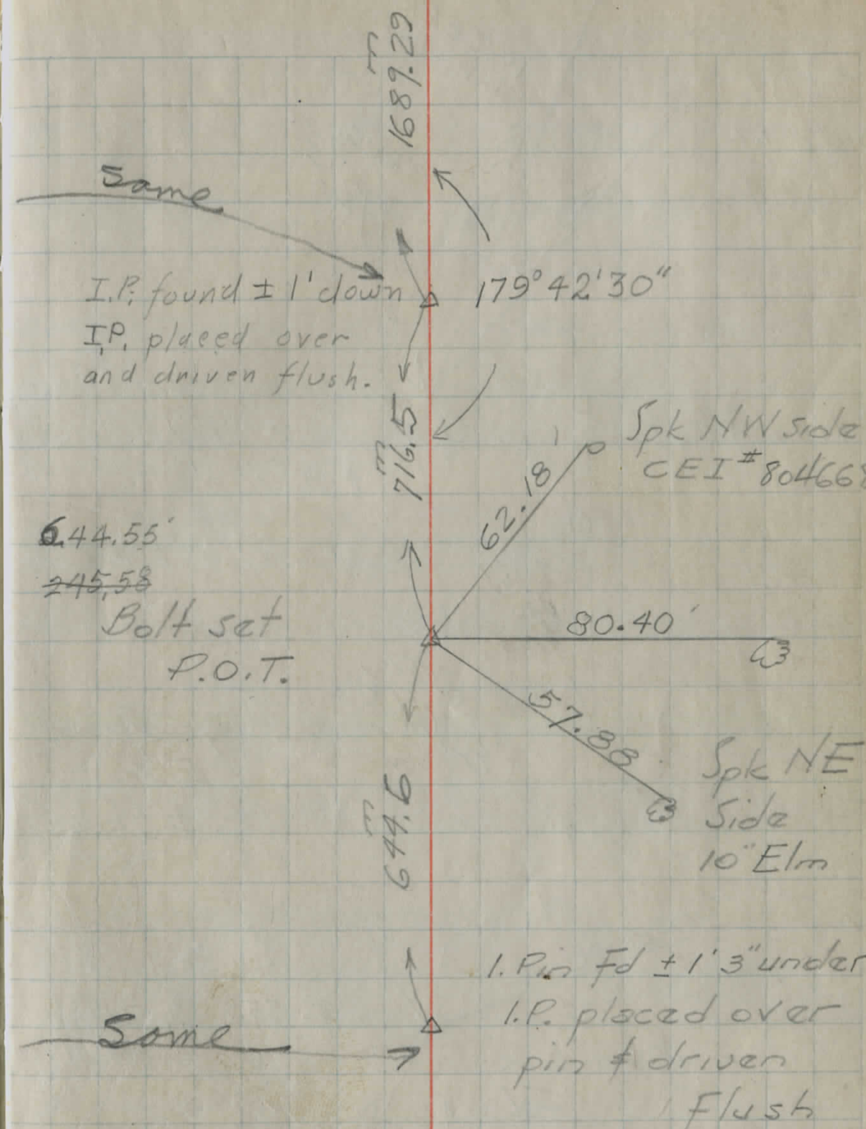
July '46

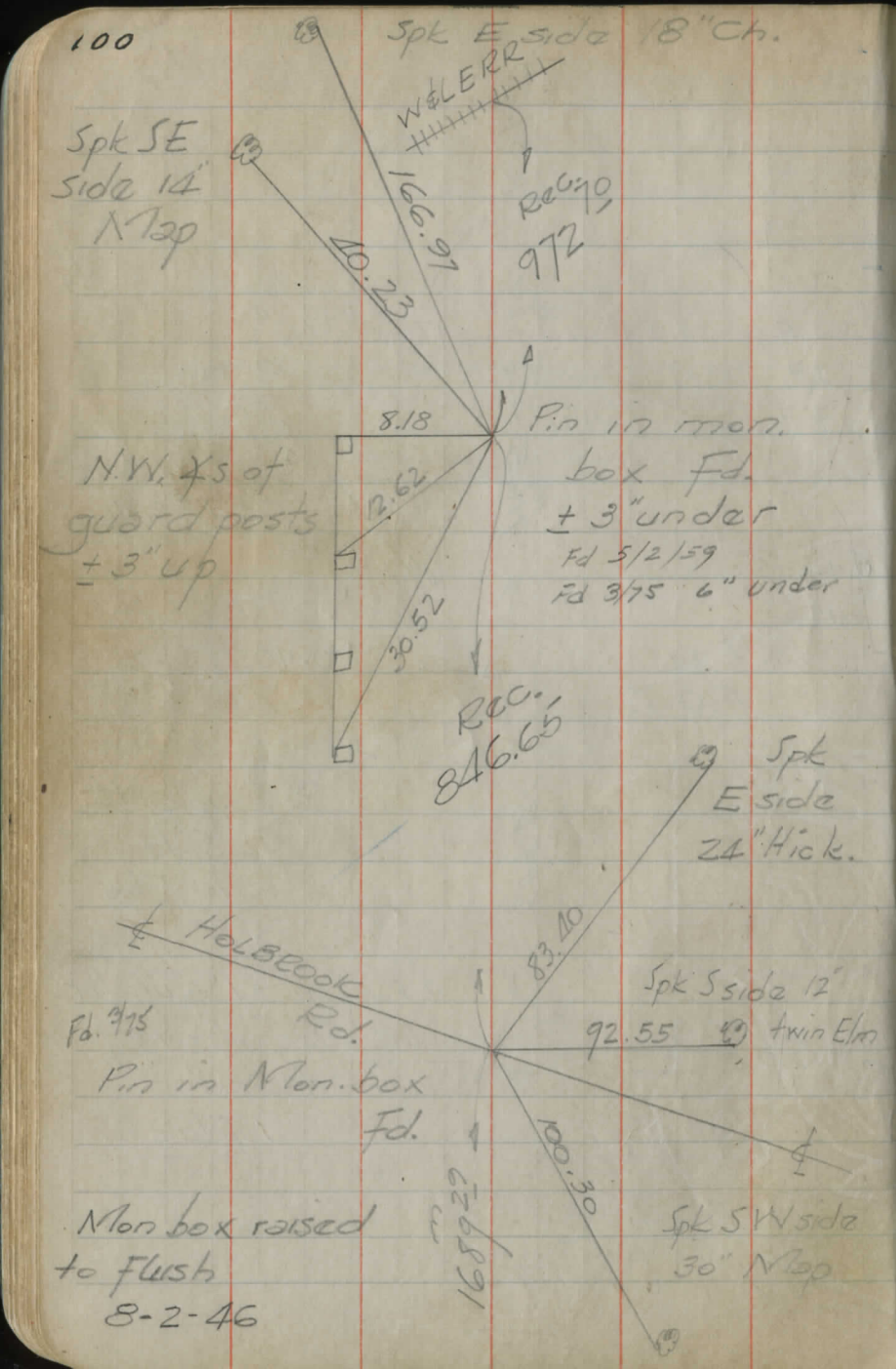
Pom
Con
Bell

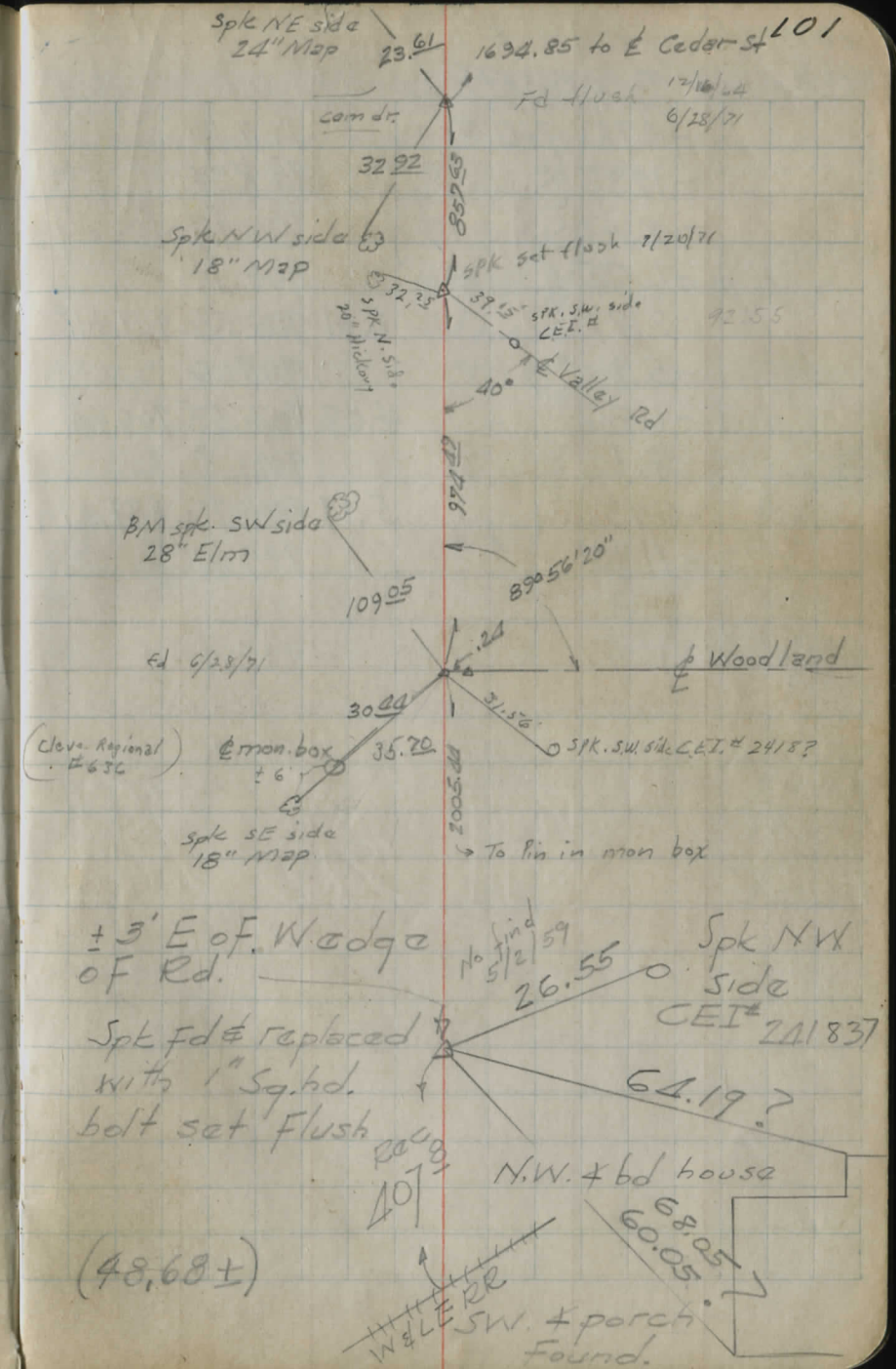
FRANKIN ROAD
CHAGRIN River Rd
Northerly



See
Pg 160




Spk E side 18" Ch.
WELLER
Rec'd 972
Spk SE side 14" Map
166.97
40.23
8.18
12.62
30.52
Pin in mon. box Fd. ± 3" under
Fd 5/2/59
Fd 3/75 6" under
N.W. ∠s of guard posts ± 3" up
Rec'd 846.65
Spk E side 24" Hick.
83.40
Spk S side 12" twin Elm
92.55
℄ Holbrook Rd.
Fd. 3/75
Pin in Mon. box Fd.
100.30
Spk SW side 30" Map
Mon box raised to Flush 8-2-46


Spk NE side 24" Map
23.61
1694.85 to ℄ Cedar St
Fd flush 12/16/64 6/28/71
comdr.
32.92
852.65
Spk NW side 18" Map
Spk set flush 7/20/71
32.75
37.45
Spk. S.W. side CEI #
Spk N. side 20" Hickory
92.55
40°
℄ Valley Rd
974.40
B.M. spk. SW side 28" Elm
109.05
S 89°56'20" E
Fd 6/28/71
.24
℄ Woodland
30.00
31.56
(Cleve. Regional #637)
℄ mon. box ± 6" r
35.70
Spk. S.W. side CEI # 2418?
Spk SE side 18" Map
200.00
To Pin in mon box
± 3' E of W. edge of Rd.
No find 5/2/59
Spk NW side CEI # ZA1837
26.55
Spk Fd & replaced with 1" Sq. hd. bolt set Flush
64.19?
Rec'd 40'
N.W. ∠ bd house
68.85
60.05
(48.68±)
WELLER
SW. ∠ porch Found.

Sept 18 '47

Channel E. of McFarland Creek

	+3.76	910.89		907.19	
	-12.35			898.54	
	-8.40		Cut from Top Stk	902.49	902.49
	-6.75			904.14	
	-2.87		6.61	908.02	901.41
	-5.9			905.0	
	-6.36		4.09	904.53	900.44
	-8.1			902.8	
	-6.13		5.29	904.76	899.47
	-11.15			899.75	

Channel grade = .08%

New bridge Channel Grade

Spk S W root 30" 24" Maple W side Rd ±50' N. of bdge

Top plank deck at bridge

bottom old channel 370 E. of bdge

" " " 400 E. of bdge at ford

Top stk 270 E of bdge

Grnd " " " "

Top stk 180 " " " "

Grnd " " " "

Top stk 90 " " " "

New channel 90 " " "

902.5
898.5 .08

370) 4.00
37
300
296
.9720
898.50
97
899.47
900.44
901.41
.08
902.49

Sept 18-1947

McFarland Creek bridge

		H I	
BM.	+4.74	911.93	907.19
	-13.25		898.68
	-13.36		898.57
	-13.31		898.62
	-13.34		898.59

Oct. 28 1947

B M	+13.76	910.95	907.19
	-12.34		898.61
	-12.37		98.58
	-12.29		98.66
	-11.86		99.09
	-12.22		98.73
	-12.22		98.73
	-12.09		98.86
	-12.12		98.83

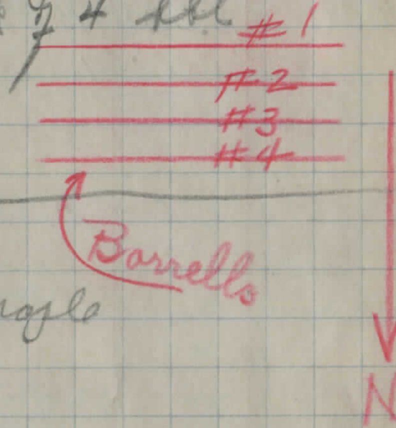
Spk SW root 24" maple

NW ¼ plank deck of 4 bbl

SW ¼ " "

SE ¼ " "

NE ¼ " "



Spk SW root 24" maple

W. end #1

" " #2

" " #3

" " #4

E. end Nth bbl #4

" " #3

" " #2

" " #1

July, 20, 1948

McFarland Creek Bridge

	+	HI	−	
B.M.	5.38	912.57		907.19
		1	13.49	899.08
			13.93	98.64
			14.00	98.57
			13.97	98.60
			14.35	898.22
			14.25	98.32
			14.41	98.16
			14.33	98.24
			14.25	98.32
			14.18	98.39
			14.27	98.30
			14.26	98.31
			13.91	898.66
			13.70	898.87
			13.81	898.76
			13.85	898.72

Franklin Rd. C.H. #188
Sec A.

Maynard
Temple.
Canfield

Spk S, W. root 24" Maple
W. end #4 Bbl (North)
#3 Bbl
#2 Bbl Down stream
#1 Bbl

→ Plank on deck #1 Bbl E. end
How to W. end
Plank on deck #2 Bbl E end
How to W end
#3 Bbl E end
W end
#4 Bbl E end
W end

E. End #1 Bbl (water runs under)
E. End #2 Bbl Up stream
#3
#4

Aug. 14th 1950

McFarland Creek Bridge { Franklin Rd. C.H. # 188 Sec A

	+	H.I.	—		1948
B.M.	4.84	912.03		907.19	
			12.99	899.04	99.08
			13.40	898.63	98.64
			13.51	898.52	98.57 SOME H2O
			13.45	898.58	98.60 DRY
			13.28	898.75	98.31
			13.44	898.59	98.39
			COVERED		
			COVERED		
			13.75	898.28	98.20
			13.75	898.28	98.32
			13.90	898.13	98.16
			COVERED		
			13.43	898.60	98.72
			13.33	898.70	98.76
			13.18	898.85	98.87
MAY NOT BE CLEAR DOWN TO METAL			13.45	= COVERED 898.58	98.66

?

BARREL RIDGES

Spk. S.W. root 24" Map { W. side of Road ±50' N. of bridge

outlet W. end # 4 Bbl (North)

3

2

1

2 flows to 3
part of 4 flows
to 3 on outlet

Plank on dock # 4 Bbl. W. end

3 " "

2 " "

1

4 Bbl E. End

3 " "

2

1

INLET E. END # 4

" 3

" 2

" 1

COVERED - DRY

McFARLAND & Barrell
4/25/51

B.M.	1.03	908.62		907.19
			9.57	899.05
			9.98	898.64
			10.07	898.55
			10.04	898.58
			10.30	898.32
			10.00	898.62
BM	2.25	909.44		907.19
			10.65	898.79
			10.74	898.70
			10.64	898.80
			10.64	"
BM	2.94	910.13		907.19
			11.07	899.06
			11.52	898.61
10-19-54			11.60	898.53
			11.58	898.55
			10.97	899.16
			12.03	898.10
T.P.	2.19	910.00	7.32	907.81
			11.35	898.65
			11.30	898.70
			11.15	898.85
			11.25	898.75

outlet W end #4 (North
" #3
" 2
" 1

End of plank #1 W end
" " " 4 " "

Inlet end pipe #4

outlet #4 = North
3
2
1
W end mat between #4 & #3
" " " " send #1

Inlet #4
3
2
1

CH HO 11

May 55

BM	6.84	915.99		909.15	
T.P	11.34	927.15	0.18	915.81	
T.P.	10.42	937.36	0.21	926.94	
T.P.	11.39	948.73	0.02	937.34	
T.P	10.62	959.16	0.19	948.54	
0 to 0			1.03		958.13
T.P	10.36	968.90	0.62	958.54	
BM			9.14		
0-100			5.43		63.47
0-200			2.38		66.52
0-300			1.31		67.59
0-400			0.95		67.95
0-500			0.15		68.75
0-100	Super				
0 to 0	"				

BM	6.65	915.80		909.15	
14+20			4.44	11.36	
100' N on ℄ Franklin			6.01	09.79	
200'			7.27	08.53	
3000'			7.23	08.57	
400'			8.68	07.12	
BM			8.92	906.88	907.19
500'			9.98	05.82	

X NW ℄ Chag Bridge

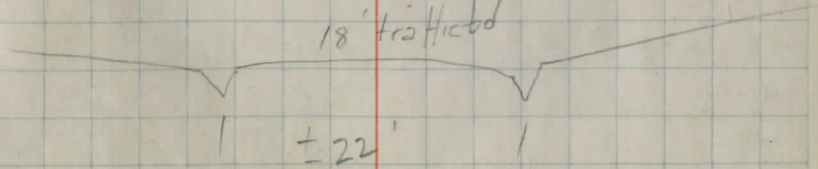
Conc Mon on tang at Co line

5.70
S
11.02
S

5.08
N
10.62
N

X NW ℄ Chag. bridge

Note: Occ ℄ Franklin = 24' W of R/W ℄



77+0		15.95	
		4.77	
28+0		6.2	
PI		2.95	
" +50	on Fields	0.25	
" +100		0.76	
" +150		3.1	
" +200		7.8	
T.P.	0.5%	10.92	10.4
300		7.4	
400		10.2	
500		11.8	
Super	on curve	53 ± 60	
62+24	Super		
66+65			
97+02.78		3.56	
97		3.63	
98		2.74	
100' SW on Geauga Lk		4.0	
200' " " " "		4.1	

refx outlet hdw / 28+

S 4.81 N 7.72

20' berm – berm

S 4.10 N 5.73

S 4.27 N 3.66

there is more Super ± 50' E

S 5.96 N 4.94

300'	4.8	± 18' Traffic Bd
400'	6.5	28' ditch-ditch
500	8.1	

cont'd pg 130

4-24-51
LEWIS & MAYNARD

PROFILE of Woodland Ave
STARTING AT B.M. on Oak St

	+	HI	−	ELV
B.M.	1.67	933.85		932.18
T.P.	0.92	922.27	12.50	921.35
T.P.	1.67	914.41	9.53	912.74
			6.8	907.6
1+00			6.0	908.4
2+00			2.2	912.2
T.P.	13.15	927.02	0.54	913.87
T.P.	2.24	904.97	11.68	902.73
			12.54	892.43
4+00			2.7	924.3
T.P.	12.38	939.40	0.0	927.02
6+0			3.7	935.7
T.P.	7.62	946.40	0.62	938.78
8+0			4.4	942.0
9+0			4.3	942.1
10+0			4.6	941.8
11+0			4.5	941.9
12+0 TP	0.50	940.70	6.20	940.20
14+0			8.9	931.8
15+0			10.6	930.1
T.P. B.M.	6.04	935.29	11.45	929.25
16+0			5.5	929.8
18+0			5.0	930.3
.467			11.5	923.8

VERT SPK NW ROOT 20" MAPLE ±41' E FALLS LAUNDRY EAST LINE
ON S. SIDE OAK STREET

℄ OAK & FRANKLIN
SOUTH ON FRANKLIN ℄

(SIDEWALK)

W.F.L. or OUTLET CULVERT S of FALLS LAUNDRY

CUYAHOGA COUNTY ENGINEER 1951

RIVET HEAD BRONZE PLATE IN CONC MONUMENT
WEST SIDE FRANKLIN ± 1516' SOUTH OF OAK ST

± ⅓ ROCKER AVE

1.8' CSP I.P. CULVERT OUTLET F.L. WEST

	+	H.I. ✓ 935.29	−	ELEV	
19+0			5.3	930.0	
20+0			1.8	933.5	
T.P.	12.42	947.71 ✓	0.0	935.29 ✓	
21+0			7.9	939.8	
22+0			6.5	941.2	
23+0			5.1	942.6	
24+0			2.9	944.8	
T.P.	11.82	959.53 ✓	0.0	947.71 ✓	
25+0			10.0	949.5	
26+0			3.6	955.9	
27+0			0.4	959.1	
T.P.	3.63	962.76 ✓	0.40	959.13 ✓	
+41.5±			2.30	960.46 ✓	
1+0			4.4	958.4	
2+0			5.4	957.4	
+12 CULVERT P 10 S N CARRIES H2O FROM AKRON SOUTH					
+65 AKRON			5.3	957.5	UP 500721
3+0			4.8	958.0	
4+0			3.8	959.0	
T.P.	6.38	965.34 ✓	3.80	958.96 ✓	
5+0 BEDFORD			7.9	957.4	
6+0			6.8	958.5	
7+0			4.4	960.9	
8+0			4.2	961.1	

℄ Franklin & Woodland 48' CULVERT (12") NEEDED

℄ EAST ON WOODLAND

← 7.7 5.5 6.8 C.B. N.G.

WAS OVER FOR 30' EAST CUL SHOULD BE ±30' EAST OF NOW

OLCT 11.6 ± 6" pipe 4 ± 90 10.6

		965.34		
8+68				10" CIP FULL
9+0			2.9	962.4
TP 9+46	7.91	970.82	2.43	962.91
10			8.6	962.2
11+0			8.9	961.9
12+0			5.9	964.9
+65 FLY to			0.9	969.9
TP.	10.26	980.35	0.73	970.09
13			8.4	972.0
14+0			5.1	975.3
BM.	3.63	982.38	1.60	978.75
15+0			6.6	975.8
				12"X 24 COFF.
15+		±℄ FINDLEY		
14+95				
		12"x 26	Corr	
15+30			6.4	976.0
16			4.1	978.3
17			0.7	981.7
T.P.	5.61	987.88	0.11	982.27
17+59		±℄ Geneva		12"x 18 Corr Subway

5.4 O.F.L. 3.1 4.6 I.FL.

℄ R.R.

NEEDS ±18" CULVERT NONE HERE

LINES WITH EAST END SCHOOL bldg

O FOR OHIO - OUTSIDE RING FOR COVER ON CISTERN FRONT SCHOOL

FL

969.8
12.6
100' ℄

7.7
FL

13.2
100'
ditch

8.9
FL

8.0
FL

FL
6.0

982.4
5.5
℄
100'

982.7
+54
5.2

5.4
FL

985.4
2.2
100'
℄

		987.88		
18+0			4.5	983.4
19+0			3.1	984.8
T.P.	7.21	992.43	2.66	985.22
20			5.5	986.9
				12" X
	plank trestle			boiler tanks
20+14 = ≠ ℄ Huron				
	Z ←			
21			2.0	990.4
+50			1.1	991.3
22			0.8	991.6
T.P.	5.60	997.53	0.50	991.93
+64 = ℄ Kent				
23			4.8	992.7
24			2.6	994.9
25			0.6	996.9
T.P.	5.83	1002.58	0.78	996.75

5.4 FL

987.1 — 987.7 — 987.4 — 989.8

down ← 5.3 ℄ 100' — 4.7 ℄ 50' — 5.0 ℄ — 2.6 ℄ 100'

6.1 FL

Drainage ditch

993.4 level 4.1 100' — 12" corr. NG — 992.3 5.2 ℄ — 991.5 6.0 100 — 989.5 8.0 200 → up Gradual

Z ←

1002.58
12" x Corr NG

± 25₂ → (written as ±25₂)

25 + 13
= ± ℄
Lorain

Z ←

C I P
NG

T.P.	10.77	1007.52		996.75
26			8.9	998.6
27			6.0	1001.5

±70 ±12" Corr NG
- - - - - - - →

+ 60
= ℄
Medinna

28			5.0	1002.5
± 50	lost drive			
+ 90	Begin pucker brush		2.8	1004.7
BM	2.73	1004.47	5.78	1001.74

Check-back

T.P.	0.52	996.71	8.28	996.19
T.P.	0.82	986.05	11.48	985.23
T.P.	4.00	979.83	10.22	975.83
BM			1.04	978.79 (978.75)

999.2	997.1	994.4	993.9	
3.4	5.5	8.2	9.7	→ down big Ravine
100' ℄	℄ ℄	100	200	

Z ←

1003.6	1002.5	999.7	993.5	
3.9	5.0	7.8	14.0	down
100	℄ ℄	100	200	→ I 3' in 60

No surface E of Medina

Spk NW root 24" Oak 40' S of Woodland & 60' W of Medina

Cistern school hse

979.83

℄ Elyria

T.P.	0.60	967.89	12.54	967.29	
10+50	100' N		10.0	957.9	
Dayton South = up					
E Rail	at ℄ Woodland		4.92	962.97	
W Rail	" "	"	5.08	962.81	
T.P.	1.75	967.91	6.73	961.16	
	Bedford 100' N		10.3	952.9	
T.P.	6.77	964.53	5.15	957.76	
T.P.			4.10	960.43	960.46
BM set			4.80	959.73	

W of Medina 21' d-d
W of Lorain 22' d-d CEI ± 16' S
W " Huron 23' d-d CEI ± 13' S
Extra base Geneva
to 20' E of ℄ Huron
W of Findlay 25' d-d ± 15' S to CEI
" to 18" pipe on ± 45° skew SE-NW
Dayton to Elyria = add extra base

	964.1	970.6	970.6	970.8	
	15.7	9.2	9.2	9.0	
down	100' N	20' N	30' S	60' S	→ up

12" × 24' Corr across Elyria S side Woodl'd

grad. down on N

down N boilers × Bed. on S side Wood

Spk SE root 30" Elm 100' N of Wood land on W side Franklin

100' W of W&LE (N.K.P.) 26' d-d CEI ± 20'
H_2O just W of Akron goes NWly ± 120'
Ø ℄ thru 15" pipe under hse

W of Akron

12" × 52' pipe req'd across Woodland at Franklin

L.L.S.' SET ON PIPE AT AKRON, BS ON BOLT ON FRANKLIN (NOT USED)

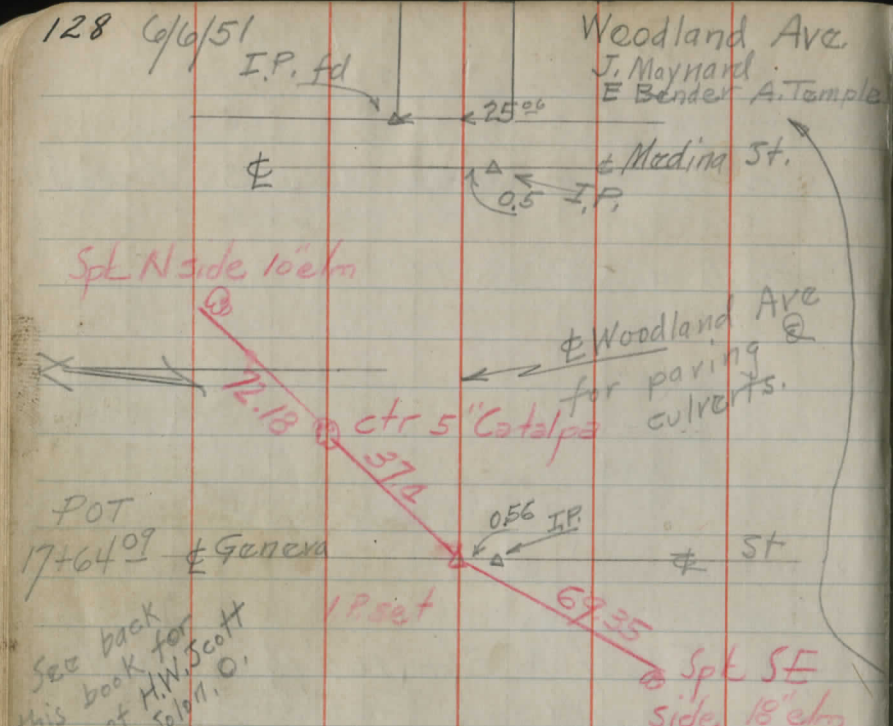
BS = 25 E of 17 AT MEDINA AND 25' S of MONTGOMERY'S SN BI.T.

MY SPK AT GENEVA 7" N of 17.

6/6/51

Woodland Ave.

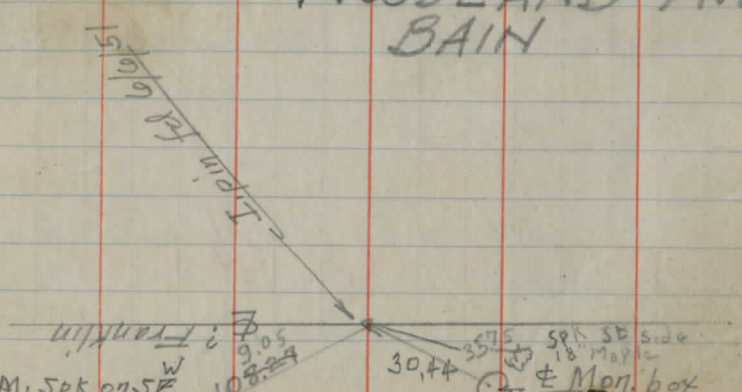
J. Maynard
E Bender A. Temple



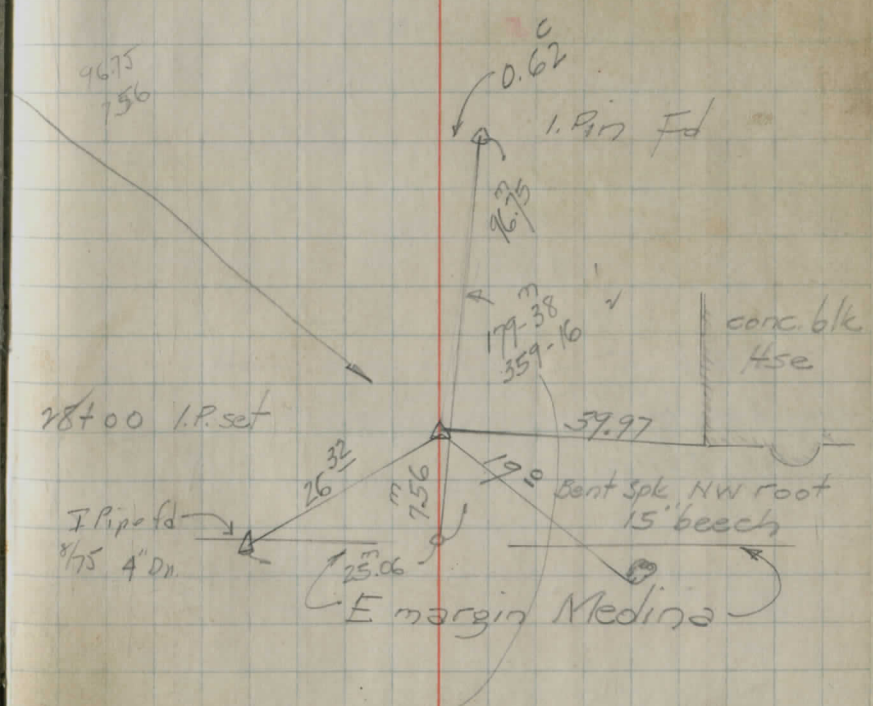
6-9-51

All stks at 15' exc 27+0 = 20'

WOODLAND AVE
BAIN

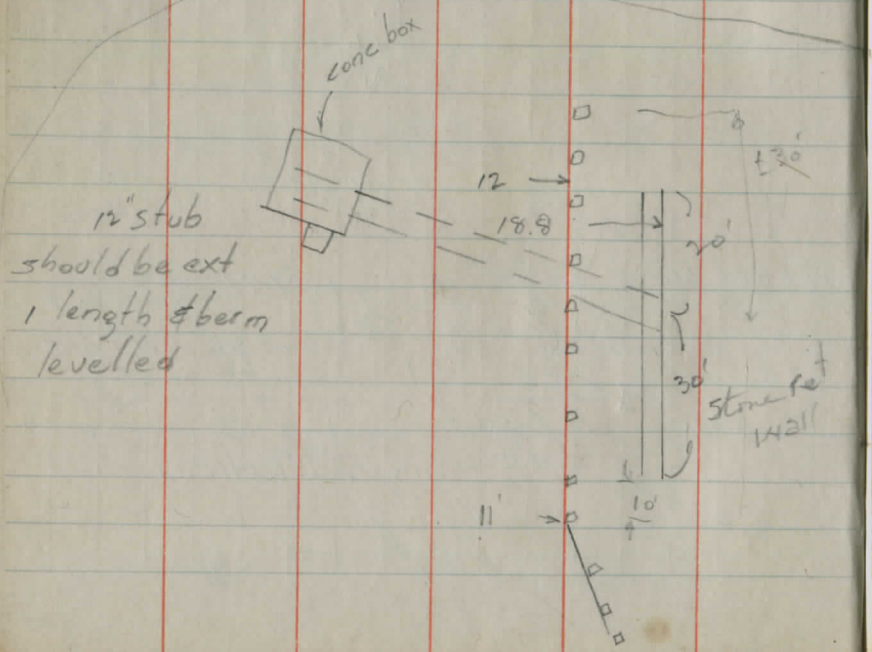


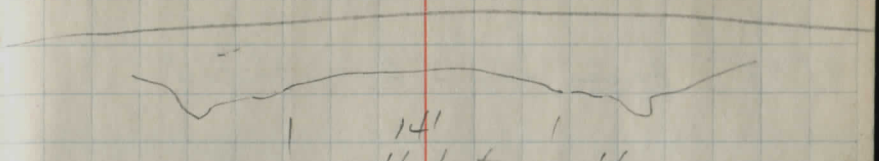
	Edge	Edge
27	9'	9'
26+50	7'	9.5'
26+0	8'	9.5'
22+0	9'	13'
21+0	8'	14'
20+0	7'	15'
19+0	7'	15'



ENGLISH DR

103 5.53
102+84 5.07
102 2.82





100	200	300	400	500 Eng Drive
5.2	5.1	5.2	6.0	6.9

N ℄ S

Borings No 11

	9'	4"	9'
6+03	1/2" loose then blue clay		± 3" mixed into heavy clay
9+78	bridge should be surfaced		
22+5	7' 2"	4"	8' ± 6"

at Franklin drive S 1,03
" 6+03 drive N ± 1,05

AKRON So

1E 16'x10"

1W 16'x10"

2E 16'x10"

3&4E board fence between NR

2W NR

E Small hse next to conc blk Not occ

3W = Grey hse & white trim 16'x10"

5E 16'x10"

4W 16'x10"

H. Patterson
P. Young
G. Diedrich

Rocker @ Ave Bound at
VALLEY
10-6-60

11765.93

IP Fd
7-8-71
GP

IP Pin Set

SPK NE Side CEI 815506

Δ = 12°-30-

20.63

23.26

SPK NW Side
16" Hemlock

18.18

SPK NE Side 8" Cherry

8+24.01

SPK Set Pot

24.42

SPK W Side
9" Cherry

2+54.55

IP Fd
7-7-71
GP

39.00

28.72

I.P. Set

ROCKER
Δ = 47°-19' Lt.
VALLEY

SPK S Side
30" Elm

CEI
141824 (TEL)

42-22-39.88

FV 30" Elm

0+00

IP Fd
7-7-71
GP

I.P. Set

AXLE FD
18 DEC. '78
C½ OF

SPK Set
Pot

Stone Mon

751.17' dead
755.82

Stone Mon

SPK S.E. Side
16" Elm

SPK NE Side
CEI #341839

24.62

19.62

SPK Set

28+56.34

IP Fd
7-8-71
GP

Medina
& to & Woodland 667.35

90°-17'-50"

26+43.56

SPK. Set Pot

17.62

15.17

CEI #539985

NW Side
16" Elm

NW Cone Porch Slab

SPK NE. Side

105.75

CEI
#212167

39.51

15+59.45

IP Fd
7-8-71
GP

Concrete
E to E Woodland = 668.86'

89°-54'

16+77.73

IP Fd
7-8-71
GP

I.P. Pin Set

Δ = 12°-12'-10" Lt

50.75

45.31

CEI

CEI

A. Patterson
P. Young
G. Diedrich

Bainbridge Allot. 10-6-60

Rocker Ave

BM.	3.92	103.92		100.00	spk NW
19+0					
18+0					Rocker Ave
17+0					
16+15					
15+0					
.0+50					
1+00					Finley Dr.
+50					
T.P.	5.73	104.84	4.81	99.11	
2+00					
+50					
775	Put in X rd. Culvt.				
3+00	20" x 16' Conc. pipe				

Side CEI # 335413 NE4 Finley Dr. Sta 16+50

N	℄	S
102.62	03.32	
1.3	0.6	
12		
99.92	100.72	99.92
4.0	3.2	4.0
12		12
98.82	99.72	99.02
5.1	4.2	4.9
12		15
98.22	98.82	
5.7	5.1	
12		
99.32	100.42	
4.6	3.5	
9		
98.32	98.72	98.02
5.6	5.2	5.9
12		9
98.12	98.92	97.62
5.8	5.0	6.3
9		12
97.62	98.82	97.12
6.3	5.1	6.8
9		12
98.04	99.34	97.34
6.8	5.5	7.5
10		12
98.14	99.94	96.84
6.7	4.9	8.0
9		12
98.14	98.64	
6.7	5.2	
9		
97.74		97.54
7.1		7.3
12		667

See Pg 142 for channel work

104.84

Channel West

		Elev
0+0	7.90	96.94
+50	8.30	96.54
1+00	8.90	95.94

Samuel Lord Dr.
Chagrin Rd. E. 700'

	+	HI	−	Elev.
B.M.	10.81	110.81		100.00
0+0				
+50				
1+00				
+50				
T.P.	10.38	118.59	2.60	108.21
2+00				
+50				
3+0				
+50				
4+00				
+50				
5+00				
+50				
T.P.	7.74	125.00	1.33	117.26

Spk E. side C.E.T. & opp. Samuel Lord on Chagrin Rd.

N

98.66 / 11.45 / 50 — 99.43 / 11.38 — 99.61 / 12.20 / 50

109.01	103.07	101.16	103.16	103.54	102.36	100.76	103.28	103.25	
6.80	7.74	9.65	7.65	7.27	8.45	10.05	7.58	7.46	
30	24	26	22		18	18	21.5	30	
106.66	106.03	104.91	103.76	105.67	106.28	105.44	103.47	105.20	106.15
4.15	4.28	5.90	7.05	5.16	4.57	5.37	7.34	5.61	4.66
30	26	20	17	12.5		12	16.5	21	28
108.62	108.10	107.05	106.16	107.42	107.36	107.71	107.12	108.20	
2.19	2.71	3.76	4.66	3.39	1.45	2.90	3.69	2.61	
30	25	20	16	12.5		12.5	16	21	
110.75	109.98	108.84	109.78	110.47	109.74	108.24	109.23		109.85
7.84	5.61	9.75	8.61	8.12	7.85	10.35	9.36		8.74
30	21	16	9		12.5	16.5	21		30
112.08	110.74	110.44	111.61	111.84	111.63	111.00	110.51		111.63
6.51	7.85	8.15	6.98	6.75	6.96	8.59	8.08		6.71
30	19	145	9			16	18		30
112.38	112.48	111.54	112.69	113.09	112.14	111.20	112.06		112.86
5.61	6.11	7.05	5.90	5.58	6.45	7.39	6.53		5.71
30	20	15	10		12	17	22		30
112.75	113.37	112.75	113.85	113.95	113.54	112.59	113.05		112.88
4.84	5.22	5.84	4.74	4.64	5.05	6.09	5.54		4.99
30	20	18	11		12.5	14	21		30
113.96	113.87	113.64	113.93	114.49	113.85	112.35	113.90		114.32
4.63	4.72	4.90	4.66	4.00	4.74	5.24	4.64		4.26
30	22	17	13		12.5	16	19		30
113.17			114.34	115.15	114.94	114.54			115.42
5.43	Lawn		4.28	3.44	3.65	4.05	Lawn		3.17
30			16		9	13			30
113.39			115.70	116.05	115.75	114.96	116.80		117.79
5.20	Lft. Drive		2.89	2.54	2.84	3.63	1.71		0.87
30			12		8	15	23		30
113.13		116.25	116.84	117.26	116.84	114.85	116.84		117.79
5.46	Lawn	2.94	1.75	1.33	1.70	3.74	1.70		0.80
30		19	12		7	15	22		30

		125.00			
6+70					
+50					
7+40					
T.P.	2.03	118.13	8.90	116.10	
T.P.	0.75	108.79	10.09	108.04	(100.09)
B.M.	11.91	111.99	8.81	99.98	
1+31					
2+38					
T.P.	7.18	118 ~~82~~ 90	0.17	111. ~~84~~ 72	
3+16					
3+52					
3+70					
4+88					
T.P.	10.05	12~~8~~5.47	3.50	11~~5~~0.42	
5+99					
6+50					
T.P.	3.12	11~~8~~7.98	10.63	11~~5~~4.84	
T.P.	2.05	10~~8~~8.98	11.03	10~~6~~9.93	
B.M.			8.97	99.99	

N.

113.13	117.43	118.52	119.88	119.84			119.53
11.87	7.57	6.48	6.02	6.16	Asp. Drive		5.47
30	18	12		7			30
114.31	119.76	120.67	121.00	120.88			121.27
10.06	5.24	4.43	4.06	4.12	Asp Drive		3.73
30	17	10		7			30
116.00	122.20	122.83	123.16	122.93	122.19	118.30	121.74
5.00	2.80	2.17	1.84	2.07	2.81	6.70	3.26
30	16	11		8	15	22	30

S

8/25/21

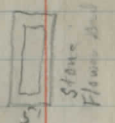
Drive Profiles

107.44	107.03	108.76	109.41	107.57			
4.55	2.96	3.23	3.58	4.42	Drive N. (Gravel)		# 7320
150	100	50	12				
Circular				111.66	111.21	111.59	111.37
Drive S.	# 7349 (Asph.)			0.83	0.78	0.40	0.60
					12	50	100
	114.50	114.70	113.13	113.28			
	4.40	5.20	5.77	5.62	Drive N. Gravel		# 7330
	100	50	9				
				113.96	113.88	114.75	115.76
Asp Dr. S. # 7347				4.94	5.02	4.15	2.94
					12	50	100
	112.28	113.40	114.19	114.20			
	6.62	5.50	4.71	4.70	Drive N Asp.		# 7336
	100	50	12				
	105.70	111.20	115.40	115.75			
	13.40	7.70	3.50	3.15	Asp. Dr. N.		# 7350
	100	50	12				
				118.87	118.65	120.77	123.87
Asp. Dr. S. # 7365				6.56	6.80	4.46	1.59
					9	50	100
				120.80	120.80	122.87	124.5
Asp. Dr. S. # 7383				4.65	4.65	2.58	1.00
					10	50	75

Samuel Lord Dr.

Topo N. & S.

+57	Mail Box	13.5		
+52	12" CMP.	16'		
+48			15'	12" CMP
+43	CEZ	29'		
+43	Mail Box	13.5		
+34	Mail Box	12.5		
+29	12" CMP.	16'		
+16	& 10' Gravel Dr.			
3+03	12" CMP.	17'		
+55			17'	12" CMP.
+38				& 9' Asph Dr.
2+28			16'	12" CMP
+63	CE2.	17'		
+51	shrub	20'		
+48	Blue spruce	25'		
+45	10" CMP.			
+31	& 10' Gravel Dr.			
+26	10" CMP.	19.5'		
+23	Blue spruce	26'		
1+20	Mail Box	16.5		
+86			13'	speed sign
+85	shrub	24'		
+61				
+51	stop sign	20'	26.5'	
+32	CEZ	42'		
+31			32'	36" stump
+08	Wing Pavement	58'	34'	Wing Pavement
0+0	& Chagrin		Road	



N. & S.

+50	Guard rail	15.5'	& 16' Asp Dr. (No pipe)
+49			22' CEZ
+40			24' 4" Pine
+29			25' 6" Pine
+15			24' 6" Pine
6+09			16' 12" CMP.
+99	Mail Box	17	& 9' Asp. Dr.
+87			16' 12" CMP.
+41	Beg Guard rail	17'	
+23	Mail Box	15'	
5+05		20'	
+99	rail fence	29'	
+58	& 9' Asp Dr.		
+81		24	
+67	rail fence	21	
+65			26' Bush
+62	Bush	24'	
+45	Bush	24'	
+25	Bush	23'	
4+02	Bush	26	
+93	Bush	24'	23' CEZ.
+83	Light Post & Bush	29'	
+83	12" CMP	18'	
+70	& 9' Asp. Dr.		15' 12" CMP.
3+56			& 9' Asp Dr.

CH&N Bainbridge Rd Sec "D"
Levels Between English Dr & Kenston Lake

10-16-59
H. Patterson
W. Walchock

Cool 36°
Clear

	+	HI	−	Elev			N.	Pavem't ℄	S.		
B.M. #3	5.68	1140.72		1135.04	X Cut on S. Hdwl. Culvt.						
T.P.	6.99	1145.86	1.85	1138.87							
0+0				1144.19				1.67			
+13				1143.83			1141.34 4.52/19	2.03	1141.90 3.96/22		
+50				1142.97			1140.37 5.49/19	2.89	1140.53 5.33/22		
1+00				114183			39.28 6.58/19	4.03	39.46 6.40/22		
+50				1140.93			38.96 6.90/19	4.93	38.46 7.4/22		
2+00				1140.62			37.96 7.9/20	5.84	37.96 7.9/21		
3+00				1138.66		12x19 Conc. Drive Pipe 36.66 outlet 9.20/20	36.96 inlet 8.9/20	7.20	1136.86 9.0/21		
T.P.	2.32	1141.19	6.99	1138.87							
4+00				1137.61			1135.69 5.50/20	3.58	35.79 inlet 5.40/21	35.49 outlet 5.7/21	12"x17" Conc
5+00				1136.87			35.09 6.10/20	4.42	35.19 6.0/21		
6+00				1136.45			34.19 7.00/20	4.74	34.69 6.50/21		
7+00				1136.36			32.59 8.6/21	4.83	33.29 inlet 7.9/21	32.79 outlet 8.4/21	12"x24" CIP covered w/Conc Slab
+28 :	℄ culvt.										

		1141.19			
8+0				1136.63	
T.P.	11.75	1147.41	5.53	1135.66	
9+0				1137.11	
10+0				1137.64	
11+0				1138.29	
12+0				1139.62	
13+0				1141.23	
14+0				1143.75	
15+0				1147.10	
+39	+& Kenston Lake Dr & Bainbridge Rd				
T.P.	1.40	1139.22	9.59	1137.82	
			4.09	1135.13	
BM #3	4.09	1139.13		1135.04	
N 0+0			7.34	1131.79	Inlet
+50			5.00	1134.13	
1+00			4.60	1134.53	Ditch North
+50			4.30	1134.83	
2+00			3.50	1135.33	

N		S
33.09 8.40 20	4.56	34.39 6.8 21
34.71 12.7 18	10.30	35.41 12.0 20
35.81 11.6 15	9.72	35.91 11.5 20
36.21 11.2 15	9.12	36.61 10.8 20
37.61 9.8 15	7.79	38.21 9.2 20
39.11 7.3 15	6.18	39.61 7.8 20
41.01 6.4 15	3.66	41.41 6.0 20
10'x 22' New CIP 43.61 3.8 15	0.31	44.01 3.45 20

Culvt. Sta 131+43.5

		1139.13			
S					
0+0			7.50	1131.63	Outlet
+50			7.10	1132.03	
1+00			7.50	1131.63	
TP	4.35	1137.74	5.74	1133.39	Ditch
1+50			6.60	1131.14	
2+00			6.90	1130.84	
+50			8.60	1129.14	
3+00			9.10	1128.64	
BM #3			2.70	1135.04	

Culvt.

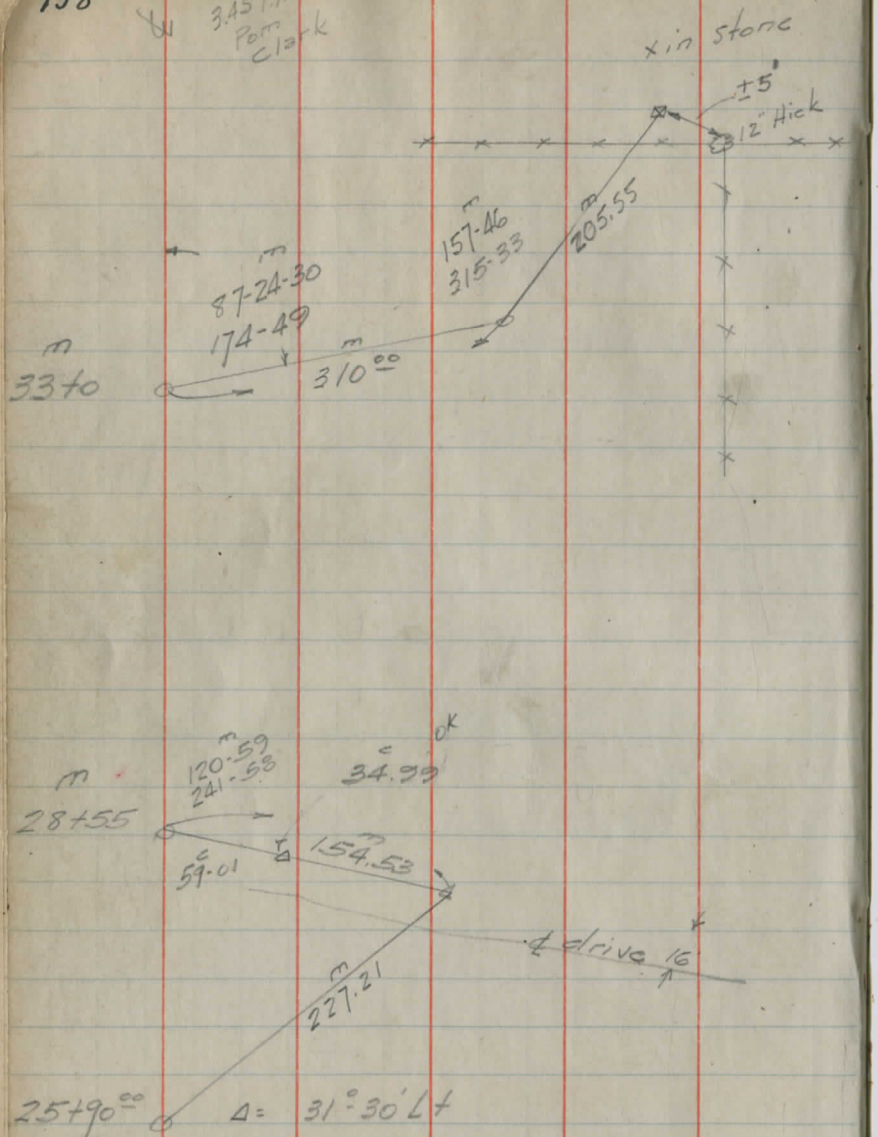
Running South

10-19-59 Check Levels on Bridge Bainbridge Rd & Four Barrell Culvt. on Franklin Rd

H. Patterson
W. Welchack

B.M.	5.30	914.45		909.15 X NW 4	Bridge Abut.
SW 4			5.25		
NE 4			5.36		
SE 4			5.26		
T.P.	1.39	912.62	3.22	911.23	
Outlet N. Barrell			13.90		
" #2			14.30		
" #3			13.90		
" #4			14.20		
Inlet N Barrell			13.70		
" #2			14.2		
" #3			14.0		
" #4			14.0		
TP	2.59	913.82	1.39	911.23	
B.M.			4.61	909.21	

3.45 P.M.
Pom Clark



1	5'	100	02 long.
2		100	01 "
3		100	03 "
4		100	01 "

KEITH'S RAILROAD CURVE TABLES.

w York.

1883,
of Congress,

ES.

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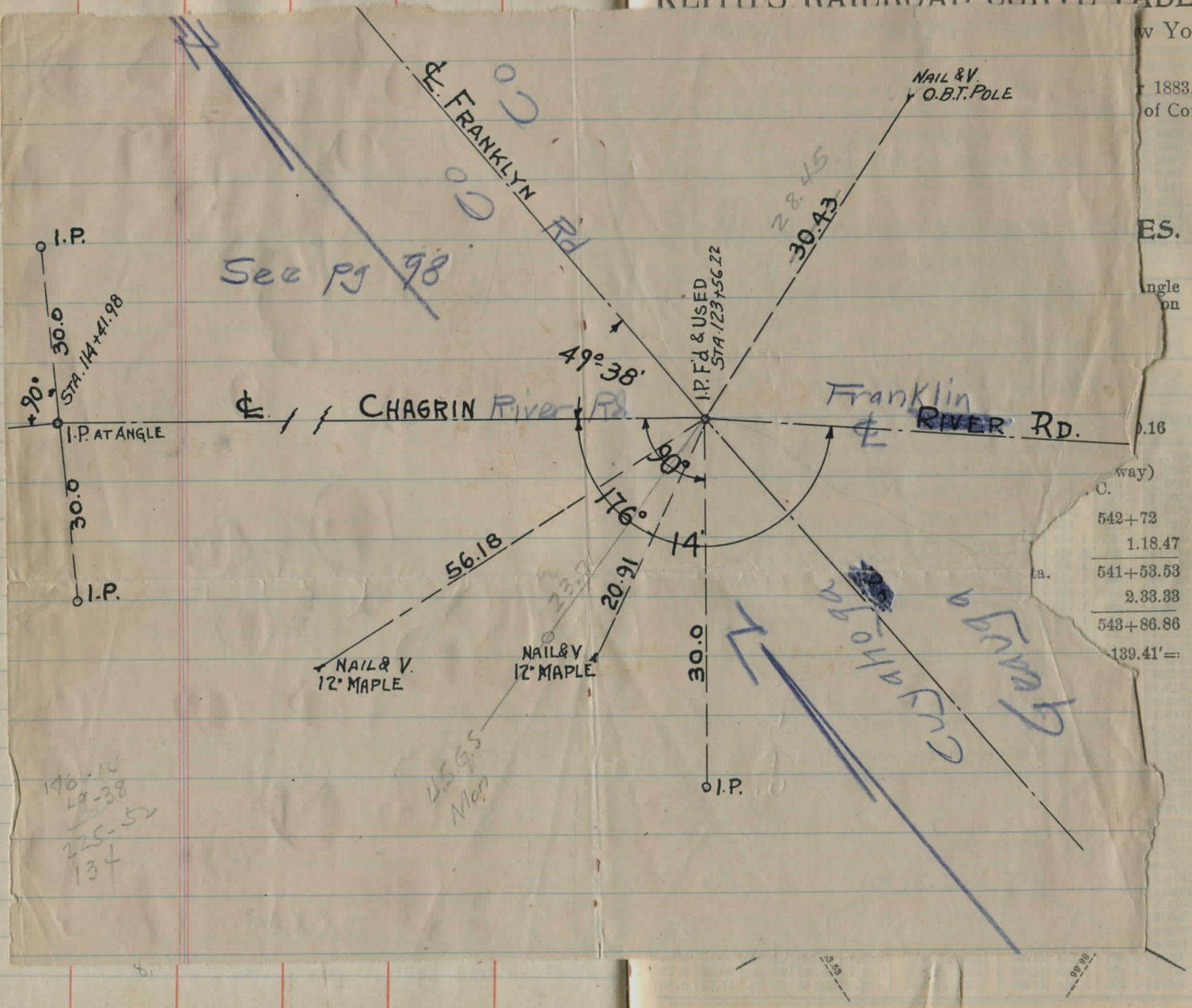
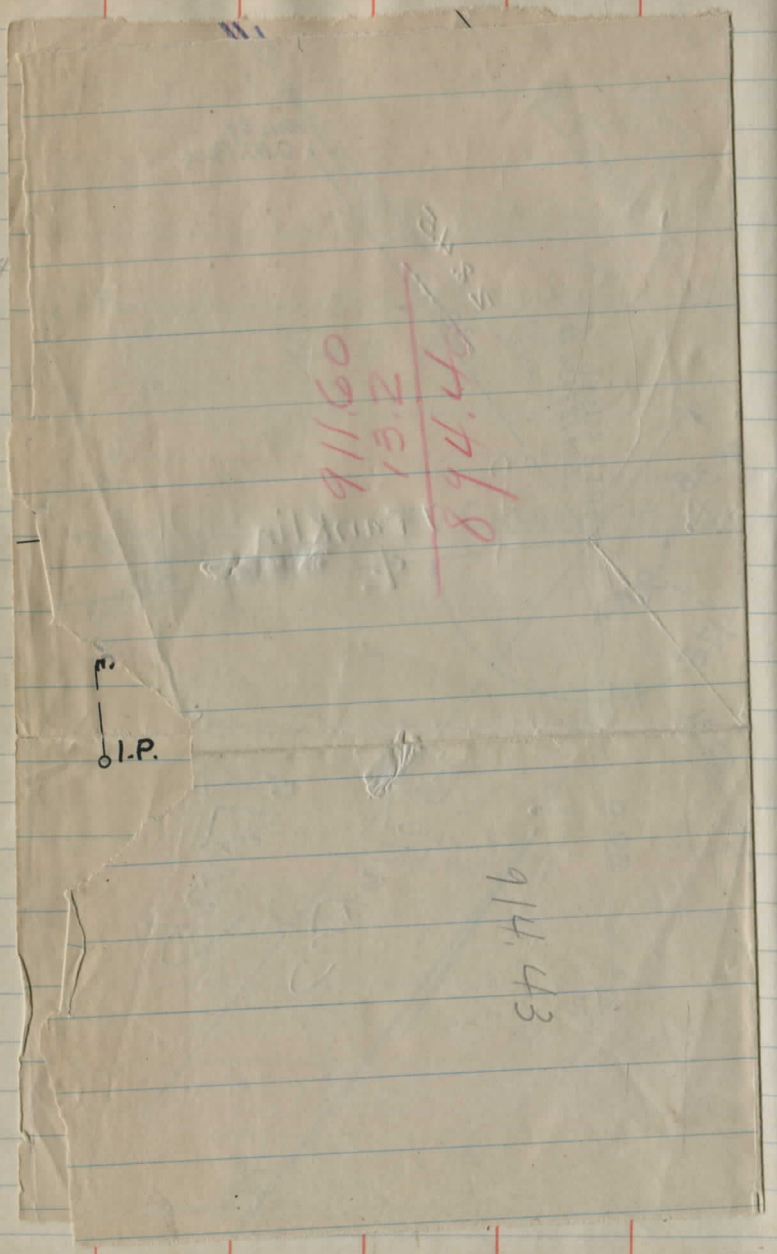


.16

(way)
C.
542+72
1.18.47
ta. 541+53.53
2.33.33
543+86.86
139.41'=

160



KEITH'S RAILROAD CURVE TABLES.

Published by KEUFFEL & ESSER CO., New York.

HOW TO USE KEITH'S TABLES.

EXAMPLE.

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

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

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

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

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

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

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

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

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

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

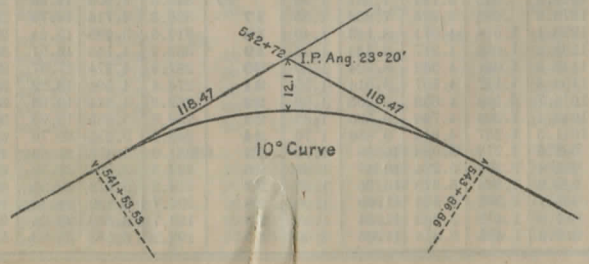


Table I. — Minutes in Decimals of a Degree.

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

Table II. — Inches in Decimals of a Foot.

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

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

Table III. — Radii, Ordinates and Deflections.

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

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
1°	50.00	.22	11°	551.70	26.50	21°	1061.9	97.57
10′	58.34	.30	10′	560.11	27.31	10′	1070.6	99.16
20	66.67	.39	20	568.53	28.14	20	1079.2	100.75
30	75.01	.49	30	576.95	28.97	30	1087.8	102.35
40	83.34	.61	40	585.36	29.82	40	1096.4	103.97
50	91.68	.73	50	593.79	30.68	50	1105.1	105.60
2	100.01	.87	12	602.21	31.56	22	1113.7	107.24
10	108.35	1.02	10	610.64	32.45	10	1122.4	108.90
20	116.68	1.19	20	619.07	33.35	20	1131.0	110.57
30	125.02	1.36	30	627.50	34.26	30	1139.7	112.25
40	133.36	1.55	40	635.93	35.18	40	1148.4	113.95
50	141.70	1.75	50	644.37	36.12	50	1157.0	115.66
3	150.04	1.96	13	652.81	37.07	23	1165.7	117.38
10	158.38	2.19	10	661.25	38.03	10	1174.4	119.12
20	166.72	2.43	20	669.70	39.01	20	1183.1	120.87
30	175.06	2.67	30	678.15	39.99	30	1191.8	122.63
40	183.40	2.93	40	686.60	40.99	40	1200.5	124.41
50	191.74	3.21	50	695.06	42.00	50	1209.2	126.20
4	200.08	3.49	14	703.51	43.03	24	1217.9	128.00
10	208.43	3.79	10	711.97	44.07	10	1226.6	129.82
20	216.77	4.10	20	720.44	45.12	20	1235.3	131.65
30	225.12	4.42	30	728.90	46.18	30	1244.0	133.50
40	233.47	4.76	40	737.37	47.25	40	1252.8	135.35
50	241.81	5.10	50	745.85	48.34	50	1261.5	137.23
5	250.16	5.46	15	754.32	49.44	25	1270.2	139.11
10	258.51	5.83	10	762.80	50.55	10	1279.0	141.01
20	266.86	6.21	20	771.29	51.68	20	1287.7	142.93
30	275.21	6.61	30	779.77	52.89	30	1296.5	144.85
40	283.57	7.01	40	788.26	53.97	40	1305.3	146.79
50	291.92	7.43	50	796.75	55.13	50	1314.0	148.75
6	300.28	7.86	16	805.25	56.31	26	1322.8	150.71
10	308.64	8.31	10	813.75	57.50	10	1331.6	152.69
20	316.99	8.76	20	822.25	58.70	20	1340.4	154.69
30	325.35	9.23	30	830.76	59.91	30	1349.2	156.70
40	333.71	9.71	40	839.27	61.14	40	1358.0	158.72
50	342.08	10.20	50	847.78	62.38	50	1366.8	160.76
7	350.44	10.71	17	856.30	63.63	27	1375.6	162.81
10	358.81	11.22	10	864.82	64.90	10	1384.4	164.86
20	367.17	11.75	20	873.35	66.18	20	1393.2	166.95
30	375.54	12.29	30	881.88	67.47	30	1402.0	169.04
40	383.91	12.85	40	890.41	68.77	40	1410.9	171.15
50	392.28	13.41	50	898.95	70.09	50	1419.7	173.27
8	400.66	13.99	18	907.49	71.42	28	1428.6	175.41
10	409.03	14.58	10	916.03	72.76	10	1437.4	177.55
20	417.41	15.18	20	924.58	74.12	20	1446.3	179.72
30	425.79	15.80	30	933.13	75.49	30	1455.1	181.89
40	434.17	16.43	40	941.69	76.86	40	1464.0	184.08
50	442.55	17.07	50	950.25	78.26	50	1472.9	186.29
9	450.93	17.72	19	958.81	79.67	29	1481.8	188.51
10	459.32	18.38	10	967.38	81.09	10	1490.7	190.74
20	467.71	19.06	20	975.96	82.53	20	1499.6	192.99
30	476.10	19.75	30	984.53	83.97	30	1508.5	195.25
40	484.49	20.45	40	993.12	85.43	40	1517.4	197.53
50	492.88	21.16	50	1001.7	86.90	50	1526.3	199.82
10	501.28	21.89	20	1010.3	88.39	30	1535.3	202.12
10	509.68	22.62	10	1018.9	89.89	10	1544.2	204.44
20	518.08	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	483.4	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	2225.5
10	3876.8	1188.4	10	4653.6	1651.7	10	5549.2	2246.7
20	3889.0	1195.2	20	4667.4	1660.5	20	5565.4	2258.0
30	3901.2	1202.0	30	4681.3	1669.2	30	5581.6	2269.3
40	3913.4	1208.9	40	4695.2	1678.1	40	5597.8	2280.6
50	3925.6	1215.8	50	4709.2	1686.9	50	5614.2	2292.0
69	3937.9	1222.7	**79**	4723.2	1695.8	**89**	5630.5	2303.5
10	3950.2	1229.7	10	4737.2	1704.7	10	5646.9	2315.0
20	3962.5	1236.7	20	4751.2	1713.7	20	5663.4	2326.6
30	3974.8	1243.7	30	4765.3	1722.7	30	5679.9	2338.2
40	3987.2	1250.8	40	4779.4	1731.7	40	5696.4	2349.8
50	3999.5	1257.9	50	4793.6	1740.8	50	5713.0	2361.5
70	4011.9	1265.0	**80**	4807.7	1749.9	**90**	5729.7	2373.3
10	4024.4	1272.1	10	4822.0	1759.0	10	5746.3	2385.1
20	4036.8	1279.3	20	4836.2	1768.2	20	5763.1	2397.0
30	4049.3	1286.5	30	4850.5	1777.4	30	5779.9	2408.9
40	4061.8	1293.6	40	4864.8	1786.7	40	5796.7	2420.9
50	4074.4	1300.9	50	4879.2	1796.0	50	5813.6	2432.9

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
91°	5830.5	2444.9	**101°**	6950.6	3278.1	**111°**	8336.7	4386.1
10′	5847.5	2457.1	10′	6971.3	3294.1	10′	8362.7	4407.6
20	5864.6	2469.3	20	6992.0	3310.1	20	8388.9	4429.2
30	5881.7	2481.5	30	7012.7	3326.1	30	8415.1	4450.9
40	5898.8	2493.8	40	7033.6	3342.3	40	8441.5	4472.7
50	5916.0	2506.1	50	7054.5	3358.5	50	8468.0	4494.6
92	5933.2	2518.5	**102**	7075.5	3374.9	**112**	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
93	6037.8	2594.0	**103**	7203.2	3474.4	**113**	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
94	6144.3	2671.6	**104**	7333.6	3576.8	**114**	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
95	6252.8	2751.3	**105**	7467.0	3682.3	**115**	8993.8	4934.1
10	6271.1	2764.8	10	7489 6	3700.2	10	9022.7	4958.6
20	6289.4	2778.3	20	7512.2	3718.2	20	9051.7	4983.1
30	6307.9	2792.0	30	7534.9	3736.2	30	9080.9	5007.8
40	6326.3	2805.6	40	7557.7	3754.4	40	9110.3	5032.6
50	6344.8	2819.4	50	7580.5	3772.6	50	9139.8	5057.6
96	6363.4	2833.2	**106**	7603.5	3791.0	**116**	9169.4	5082.7
10	6382.1	2847.0	10	7626.6	3809.4	10	9199.1	5107.9
20	6400.8	2861.0	20	7649.7	3827.9	20	9229.0	5133.3
30	6419.5	2875.0	30	7672.9	3846.5	30	9259.0	5158.8
40	6438.4	2889.0	40	7696.3	3865.2	40	9289.2	5184.5
50	6457.3	2903.1	50	7719.7	3884.0	50	9319.5	5210.3
97	6476.2	2917.3	**107**	7743.2	3902.9	**117**	9349.9	5236.2
10	6495.2	2931.6	10	7766.8	3921.9	10	9380.5	5262.3
20	6514.3	2945.9	20	7790.5	3940.9	20	9411.3	5288.6
30	6533.4	2960.3	30	7814.3	3960.1	30	9442.2	5315.0
40	6552.6	2974.7	40	7838.1	3979.4	40	9473.2	5341.5
50	6571.9	2989.2	50	7862.1	3998.7	50	9504.4	5368.2
98	6591.2	3003.8	**108**	7886.2	4018.2	**118**	9535.7	5395.1
10	6610.6	3018.4	10	7910.4	4037.8	10	9567.2	5422.1
20	6630.1	3033.1	20	7934.6	4057.4	20	9598.9	5449.2
30	6649.6	3047.9	30	7959.0	4077.2	30	9630.7	5476.5
40	6669.2	3062.8	40	7983.5	4097.1	40	9662.6	5504.0
50	6688.8	3077.7	50	8008.0	4117.0	50	9694.7	5531.7
99	6708.6	3092.7	**109**	8032.7	4137.1	**119**	9727.0	5559.4
10	6728.4	3107.7	10	8057.4	4157.3	10	9759.4	5587.4
20	6748.2	3122.9	20	8082.3	4177.5	20	9792.0	5615.5
30	6768.1	3138.1	30	8107.3	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	6808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
100	6828.3	3184.1	**110**	8182.8	4259.7	**120**	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

Table V. Corrections for use with table IV,

For Tangents Add

△ ANGLE / CURVE	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46
15°	.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.53	.58	.63	.68
20°	.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90
25°	.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14
30°	.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39
35°	.11	.22	.34	.47	.58	.69	.70	.81	.92	1 04	1.29	1.42	1.54	1.66
40°	.13	.26	.40	.53	.67	.80	.93	1.06	1.20	1.34	1.49	1.64	1.79	1.94
45°	.15	.30	.44	.60	.76	.91	1.06	1.21	1.37	1.52	1.70	1.87	2 04	2.21
50°	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.54	1.72	1.91	2.10	2.29	2.48
55°	.19	.38	.57	.76	.95	1.14	1.32	1.52	1.72	1 92	2.14	2.35	2.56	2.77
60°	.21	.42	.63	.84	1.05	1.27	1.49	1.71	1.94	2.17	2 38	2 60	2.83	3.07
65°	.23	.46	.69	.93	1.16	1.40	1.64	1.88	2.13	2.38	2 63	2.88	3.13	3.39
70°	.25	.51	.76	1.02	1 28	1.54	1.80	2.06	2.33	2.60	2.88	3.16	3.44	3.72
75°	.27	.56	.83	1.12	1.40	1.69	1.98	2.27	2.57	2 87	3.16	3.47	3.78	4.09
80°	.30	.61	.91	1.22	1.53	1.84	2.15	2.46	2.78	3.10	3.44	3.78	4.12	4.46
85°	.33	.66	1.00	1.33	1.68	2.02	2.36	2.70	3.05	3 40	3.77	4.14	4.55	4.89
90°	.36	.72	1.09	1.45	1.83	2.20	2.57	2.94	3.32	3.70	4.10	4.50	4.91	5.32
95°	.39	.79	1.19	1.55	2.00	2.40	2.80	3.20	3.61	4.02	4 49	4.98	5.38	5.83
100°	.43	.86	1.30	1.74	2.18	2.62	3.06	3.50	3.95	4.40	4 88	5 37	5.85	6 34

For Externals Add

ANGLE / CURVE	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.001	.003	.004	.006	.007	.008	.009	.011	.012	014	.015	.017	.018	.020
15°	.003	.007	.010	.014	.018	.023	.027	.029	.032	.035	.039	.043	.047	.051
20°	.006	.011	.017	.022	028	.034	038	.045	.051	.057	.063	.070	.076	.083
25°	.009	.018	.027	.036	.046	.056	.065	.074	.083	.093	.106	120	.127	.135
30°	.013	.025	.038	.051	.065	.078	.090	.103	.116	.129	.149	.170	.179	.188
35°	.018	.035	054	.072	.086	.109	.131	.153	.175	.197	.213	.230	.247	.264
40°	.023	.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

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

Degree of Curve	Radius $\frac{50}{\text{sin. def. ang.}}$	$\frac{\frac{1}{2}\text{ sub chord}}{R}$ = sin of def. angle				Length of arc for 100 ft.
		12.5 Ft.	15 Ft.	20 Ft.	25 Ft.	
30°	193.18	1° 51′	2° 17′	2° 58′	3° 43′	101.15
32°	181.39	1° 59′	2° 25′	3° 10′	3° 58′	101.33
34°	171.01	2° 06′	2° 33′	3° 21′	4° 12′	101.48
36°	161.80	2° 13′	2° 41′	3° 33′	4° 26′	101.66
38°	153.58	2° 20′	2° 49′	3° 44′	4° 40′	101.85
40°	146.19	2° 27′	2° 57′	3° 55′	4° 54′	102.06
42°	139.52	2° 34′	3° 05′	4° 07′	5° 08′	102.29
44°	133.47	2° 41′	3° 13′	4° 18′	5° 22′	102.53
46°	127.97	2° 48′	3° 21′	4° 29′	5° 36′	102.76
48°	122.92	2° 55′	3° 29′	4° 40′	5° 50′	103.00
50°	118.31	3° 02′	3° 38′	4° 51′	6° 04′	103.24
52°	114.06	3° 09′	3° 46′	5° 02′	6° 17′	103.54
54°	110.11	3° 16′	3° 54′	5° 13′	6° 31′	103.84
56°	106.50	3° 22′	4° 02′	5° 23′	6° 44′	104.14
58°	103.14	3° 29′	4° 10′	5° 34′	6° 57′	104.43
60°	100.00	3° 35′	4° 18′	5° 44′	7° 11′	104.72

CURVE FORMULAS.

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

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

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

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

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

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

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

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

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

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

Tan. def. = ½ chord def.

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

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

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

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

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

To find angle for a given distance and deflection.

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

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

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

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

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

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

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

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

Natural Sines

DEG.	0′	10′	20′	30′	40′	50′	DEG.	DEG.	0′	10′	20′	30′	40′	50′	DEG.
0	0000	0029	0058	0087	0116	0145	89	40	6428	6450	6472	6494	6517	6539	49
1	0175	0204	0233	0262	0291	0320	88	41	6561	6583	6604	6626	6648	6670	48
2	0349	0378	0407	0436	0465	0494	87	42	6691	6713	6734	6756	6777	6799	47
3	0523	0552	0581	0610	0640	0669	86	43	6820	6841	6862	6884	6905	6926	46
4	0698	0727	0756	0785	0814	0843	85	44	6947	6967	6988	7009	7030	7050	45
5	0872	0901	0929	0958	0987	1016	84	45	7071	7092	7112	7133	7153	7173	44
6	1045	1074	1103	1132	1161	1190	83	46	7193	7214	7234	7254	7274	7294	43
7	1219	1248	1276	1305	1334	1363	82	47	7314	7333	7353	7373	7392	7412	42
8	1392	1421	1449	1478	1507	1536	81	48	7431	7451	7470	7490	7509	7528	41
9	1564	1593	1622	1650	1679	1708	80	49	7547	7566	7585	7604	7623	7642	40
10	1736	1765	1794	1822	1851	1880	79	50	7660	7679	7698	7716	7735	7753	39
11	1908	1937	1965	1994	2022	2051	78	51	7771	7790	7808	7826	7844	7862	38
12	2079	2108	2136	2164	2193	2221	77	52	7880	7898	7916	7934	7951	7969	37
13	2250	2278	2306	2334	2363	2391	76	53	7986	8004	8021	8039	8056	8073	36
14	2419	2447	2476	2504	2532	2560	75	54	8090	8107	8124	8141	8158	8175	35
15	2588	2616	2644	2672	2700	2728	74	55	8192	8208	8225	8241	8258	8274	34
16	2756	2784	2812	2840	2868	2896	73	56	8290	8307	8323	8339	8355	8371	33
17	2924	2952	2979	3007	3035	3062	72	57	8387	8403	8418	8434	8450	8465	32
18	3090	3118	3145	3173	3201	3228	71	58	8480	8496	8511	8526	8542	8557	31
19	3256	3283	3311	3338	3365	3393	70	59	8572	8587	8601	8616	8631	8646	30
20	3420	3448	3475	3502	3529	3557	69	60	8660	8675	8689	8704	8718	8732	29
21	3584	3611	3638	3665	3692	3719	68	61	8746	8760	8774	8788	8802	8816	28
22	3746	3773	3800	3827	3854	3881	67	62	8829	8843	8857	8870	8884	8897	27
23	3907	3934	3961	3987	4014	4041	66	63	8910	8923	8936	8949	8962	8975	26
24	4067	4094	4120	4147	4173	4200	65	64	8988	9001	9013	9026	9038	9051	25
25	4226	4253	4279	4305	4331	4358	64	65	9063	9075	9088	9100	9112	9124	24
26	4384	4410	4436	4462	4488	4514	63	66	9135	9147	9159	9171	9182	9194	23
27	4540	4566	4592	4617	4643	4669	62	67	9205	9216	9228	9239	9250	9261	22
28	4695	4720	4746	4772	4797	4823	61	68	9272	9283	9293	9304	9315	9325	21
29	4848	4874	4899	4924	4950	4975	60	69	9336	9346	9356	9367	9377	9387	20
30	5000	5025	5050	5075	5100	5125	59	70	9397	9407	9417	9426	9436	9446	19
31	5150	5175	5200	5225	5250	5275	58	71	9455	9465	9474	9483	9492	9502	18
32	5299	5324	5348	5373	5398	5422	57	72	9511	9520	9528	9537	9546	9555	17
33	5446	5471	5495	5519	5544	5568	56	73	9563	9572	9580	9588	9596	9605	16
34	5592	5616	5640	5664	5688	5712	55	74	9613	9621	9628	9636	9644	9652	15
35	5736	5760	5783	5807	5831	5854	54	75	9659	9667	9674	9681	9689	9696	14
36	5878	5901	5925	5948	5972	5995	53	76	9703	9710	9717	9724	9730	9737	13
37	6018	6041	6065	6088	6111	6134	52	77	9744	9750	9757	9763	9769	9775	12
38	6157	6180	6202	6225	6248	6271	51	78	9781	9787	9793	9799	9805	9811	11
39	6293	6316	6338	6361	6383	6406	50	79	9816	9822	9827	9833	9838	9843	10
DEG.	60′	50′	40′	30′	20′	10′	DEG.	DEG.	60′	50′	40′	30′	20′	10′	DEG.

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

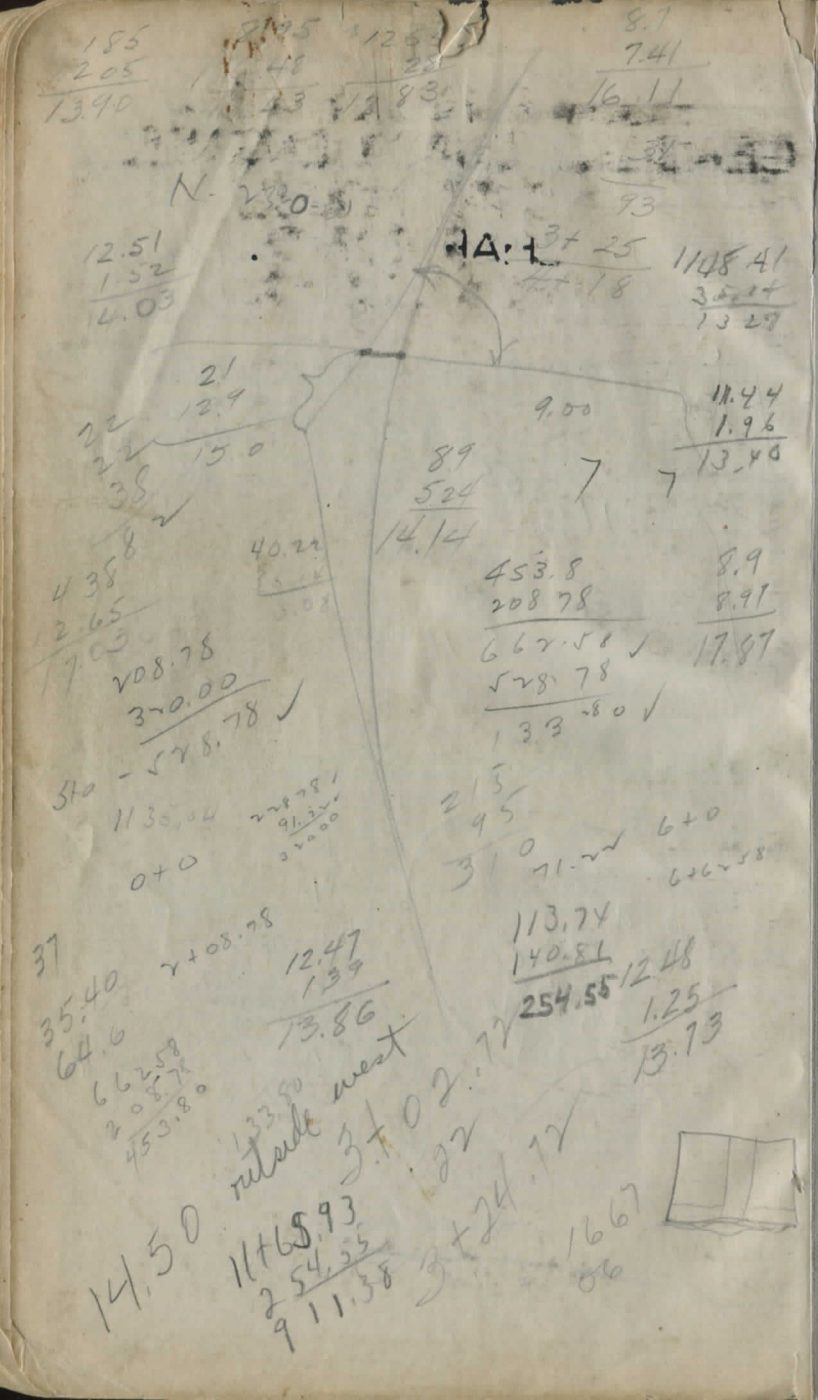
Natural Cosines

Natural Tangents

deg.	0′	10′	20′	30′	40′	50′	deg.	deg.	0′	10′	20′	30′	40′	50′	deg.
0	0000	0029	0058	0087	0116	0145	89	40	8391	8441	8491	8541	8591	8642	49
1	0175	0204	0233	0262	0291	0320	88	41	8693	8744	8796	8847	8899	8952	48
2	0349	0378	0407	0437	0466	0495	87	42	9004	9057	9110	9163	9217	9271	47
3	0524	0553	0582	0612	0641	0670	86	43	9325	9380	9435	9490	9545	9601	46
4	0699	0729	0758	0787	0816	0846	85	44	9657	9713	9770	9827	9884	9942	45
5	0875	0904	0934	0963	0992	1022	84	45	1.0000	1.0058	1.0117	1.0176	1.0235	1.0295	44
6	1051	1080	1110	1139	1169	1198	83	46	1.0355	1.0416	1.0477	1.0533	1.0599	1.0661	43
7	1228	1257	1287	1317	1346	1376	82	47	1.0724	1.0786	1.0850	1.0913	1.0977	1.1041	42
8	1405	1435	1465	1495	1524	1554	81	48	1.1106	1.1171	1.1237	1.1303	1.1369	1.1436	41
9	1584	1614	1644	1673	1703	1733	80	49	1.1504	1.1571	1.1640	1.1708	1.1778	1.1847	40
10	1763	1793	1823	1853	1883	1914	79	50	1.1918	1 1988	1.2059	1.2131	1.2203	1.2276	39
11	1944	1974	2004	2035	2065	2095	78	51	1.2349	1.2423	1.2497	1.2572	1.2647	1.2723	38
12	2126	2156	2186	2217	2247	2278	77	52	1.2799	1.2876	1.2954	1.3032	1.3111	1.3190	37
13	2309	2339	2370	2401	2432	2462	76	53	1.3270	1.3351	1.3432	1.3514	1.3597	1.3680	36
14	2493	2524	2555	2586	2617	2648	75	54	1.3764	1.3848	1,3934	1.4019	1.4106	1.4193	35
15	2679	2711	2742	2773	2805	2836	74	55	1.4281	1.4370	1.4460	1.4550	1.4641	1.4733	34
16	2867	2899	2931	2962	2994	3026	73	56	1.4826	1.4919	1.5013	1.5108	1.5204	1.5301	33
17	3057	3089	3121	3153	3185	3217	72	57	1.5399	1.5497	1.5597	1.5697	1.5798	1.5900	32
18	3249	3281	3314	3346	3378	3411	71	58	1,6003	1.6107	1.6212	1.6319	1.6426	1.6534	31
19	3443	3476	3508	3541	3574	3607	70	59	1.6643	1 6753	1.6864	1.6977	1.7090	1.7205	30
20	3640	3673	3706	3739	3772	3805	69	60	1.7321	1.7437	1.7556	1.7675	1.7797	1.7917	29
21	3839	3872	3906	3939	3973	4006	68	61	1.8040	1.8165	1.8291	1.8418	1.8546	1.8676	28
22	4040	4074	4108	4142	4176	4210	67	62	1.8807	1.8940	1.9074	1.9210	1.9347	1.9486	27
23	4245	4279	4314	4348	4383	4417	66	63	1.9626	1.9768	1.9912	2.0057	2.0204	2.0353	26
24	4452	4487	4522	4557	4592	4628	65	64	2.0503	2.0655	2.0809	2.0965	2,1123	2.1283	25
25	4663	4699	4734	4770	4806	4841	64	65	2.1445	2.1609	2.1775	2.1943	2.2113	2.2286	24
26	4877	4913	4950	4986	5022	5059	63	66	2.2460	2.2637	2.2817	2.2998	2.3183	2.3369	23
27	5095	5132	5169	5206	5243	5280	62	67	2.3559	2.3750	2.3945	2.4142	2.4342	2.4545	22
28	5317	5354	5392	5430	5467	5505	61	68	2.4751	2.4960	2.5172	2.5386	2.5605	2.5826	21
29	5543	5581	5619	5658	5696	5735	60	69	2.6051	2 6279	2.6511	2.6746	2.6985	2.7228	20
30	5774	5812	5851	5890	5930	5969	59	70	2.7475	2.7725	2.7980	2.8239	2.8502	2.8770	19
31	6009	6048	6088	6128	6168	6208	58	71	2.9042	2.9319	2.9600	2.9887	3.0178	3.0475	18
32	6249	6289	6330	6371	6412	6453	57	72	3,0777	3.1084	3.1397	3.1716	3.2041	3.2371	17
33	6494	6536	6577	6619	6661	6703	56	73	3.2709	3.3052	3.3402	3.3759	3.4124	3.4495	16
34	6745	6787	6830	6873	6916	6959	55	74	3.4874	3.5261	3.5656	3.6059	3.6470	3.6891	15
35	7002	7046	7089	7133	7177	7221	54	75	3.7321	3.7760	3.8208	3.8667	3.9136	3.9617	14
36	7265	7310	7355	7400	7445	7490	53	76	4.0108	4.0611	4.1126	4.1653	4.2193	4.2747	13
37	7536	7581	7627	7673	7720	7766	52	77	4.3315	4.3897	4.4494	4.5107	4.5736	4.6382	12
38	7813	7860	7907	7954	8002	8050	51	78	4.7046	4.7729	4.8430	4.9152	4.9894	5.0658	11
39	8098	8146	8195	8243	8292	8342	50	79	5.1446	5.2257	5,3093	5.3955	5.4845	5.5764	10
deg.	60′	50′	40′	30	20′	10′	deg.	deg.	60′	50′	40′	30′	20′	10′	deg.

deg.	0′	10′	20′	30′	40′	50′	deg.
80	5.6713	5.7694	5.8708	5.9758	6.0844	6.1970	9
81	6.3138	6.4348	6.5606	6.6912	6.8269	6.9682	8
82	7.1154	7.2687	7.4287	7.5958	7.7704	7.9530	7
83	8.1443	8.3450	8.5555	8.7769	9.0098	9.2553	6
84	9.5144	9.7882	10.078	10.385	10.711	11.059	5
85	11.430	11.826	12.250	12.706	13.197	13.727	4
86	14.300	14.924	15.605	16.350	17.169	18.075	3
87	19.081	20.206	21.470	22.903	24.542	26.432	2
88	28.636	31.242	34.368	38.189	42.964	49.104	1
89	57.290	68.750	85.940	114.588	171.885	343.77	0
deg.	60′	50′	40′	30′	20′	10′	deg.

Natural Cotangents



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DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 14 FEET WIDE. SIDE SLOPES 1½ TO 1.

FOR SINGLE TRACK UNDER EMBANKMENT.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
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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