LEVELS

351(2)

TELEDYNE POST

ALL VOID

EXCEPT BM LEVELS

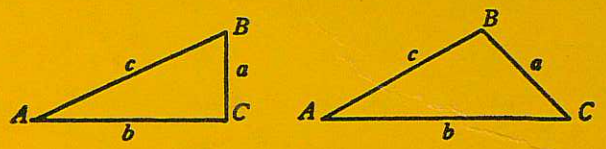
FROM COUNTY COURTHOUSE

COLLEGE

FIELD BOOK

48QC-05B

FORMULAE FOR SOLVING RIGHT TRIANGLES



$$\text{Sin } A = \frac{a}{c} = \text{Cos } B \quad , \text{Cot } A = \frac{b}{a} = \text{Tag } B$$

$$\text{Cos } A = \frac{b}{c} = \text{Sin } B \qquad \text{Sec } A = \frac{c}{b} = \text{Cosec } B$$

$$\text{Tan } A = \frac{a}{b} = \text{Cot } B \qquad \text{Cosec } A = \frac{c}{a} = \text{Sec } B$$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A, a = C \sin A, b = C \cos A.$
A, b	B, a, c	$B = 90° - A, a = b \tan A, C = \frac{b}{\cos A}.$
A, a	B, b, c	$B = 90° - A, b = a \cot A, C = \frac{a}{\sin A}.$
a, c	A, B, b	$\sin A = \frac{a}{c}, \cos B = \frac{a}{c}, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b}, \cot B = \frac{a}{b}, c = \sqrt{a^2 + b^2}$

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a}, c = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C, C = \frac{a \sin C}{\sin A}$
a, b, c	Area	side $\frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

INDEX

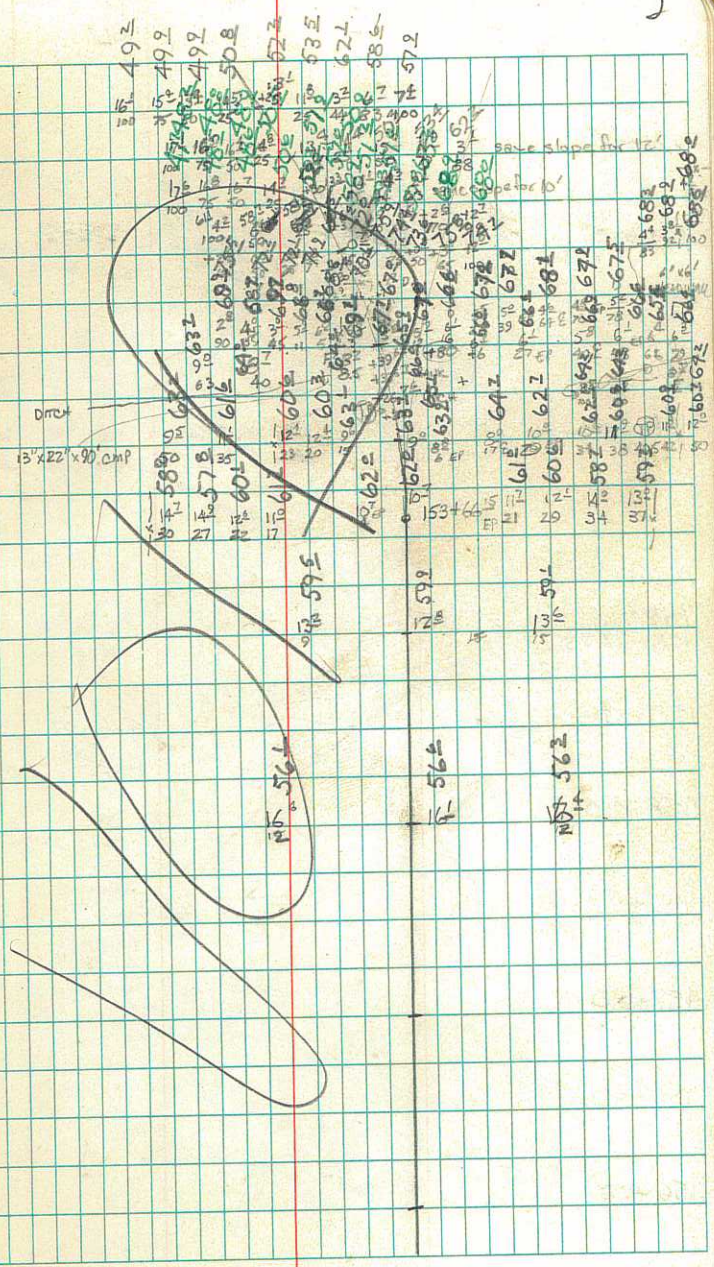
ALL SURVEYS VOIDED

BM LEVELS FROM COUNTY COURTHOUSE TO 1ST SOUTH AND APPROX. 7TH EAST STILL GOOD

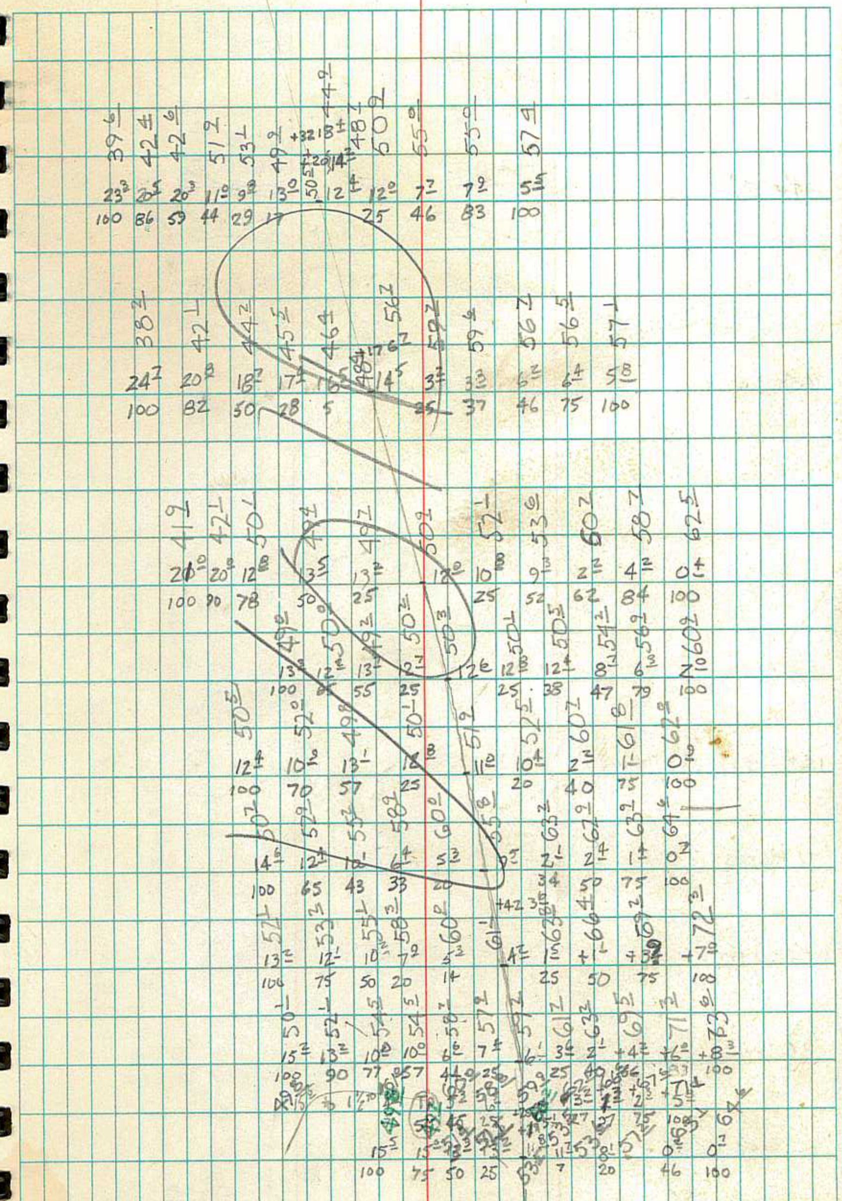
32-34

V = 30 MPH

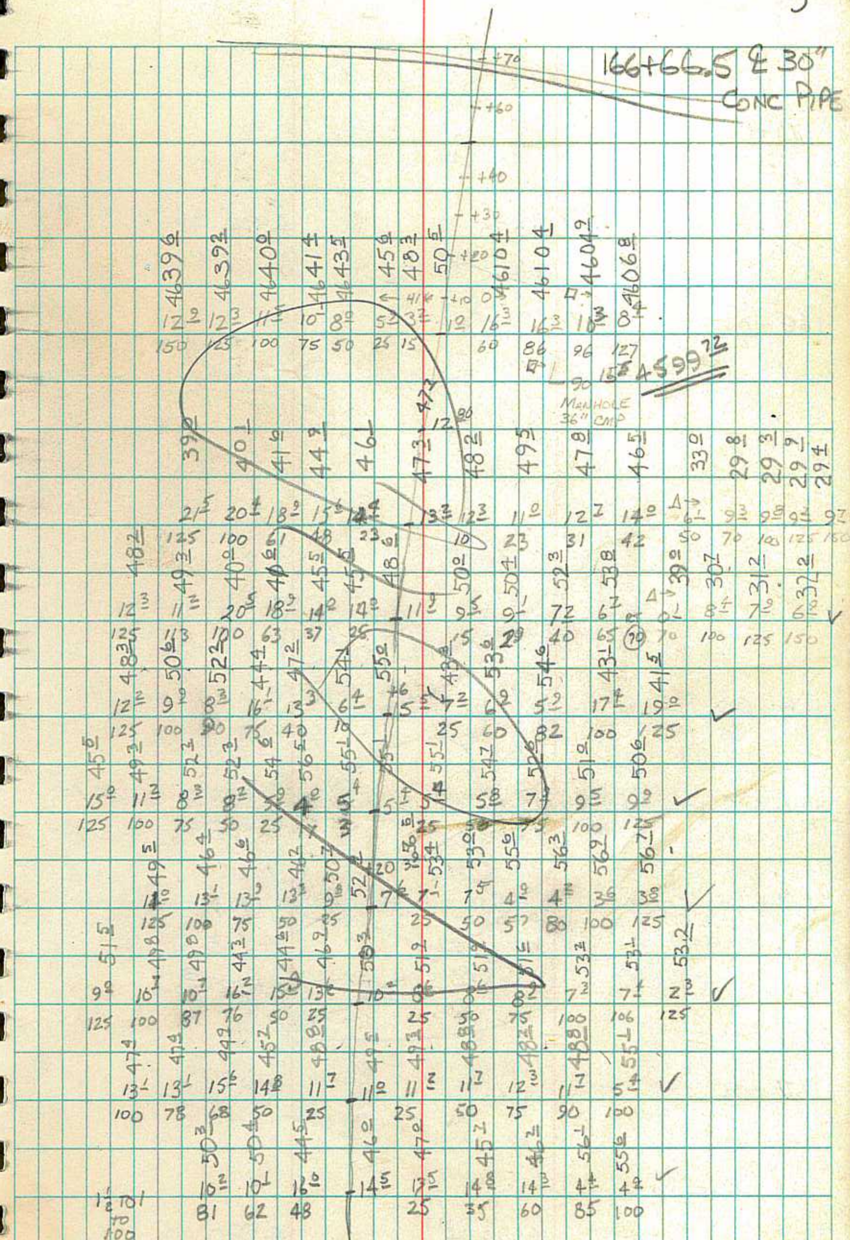
	+	HI	−	EL
155+50				
TP 155+00	5.10	4665.27 ~~4999.59~~	12.48	4660.17 ~~4994.49~~
154+50				
154+00				
153+66.15 BC				
153+00				
152+00				
151+00				
150+00				
	6.97	4672.65 ~~5006.87~~		4665.68 5000.90



	+	HI	−	EL
161+50				
161+00				
160+00				
159+00				
158+97.75 EC				
158+50		4662.93		4661.07
	1.86	~~4997.25~~	−4.20	~~4995.39~~
158+00				
157+50				
157+00				
156+50				
156+00				
		4665.27		



	+	HI	−	EL
		4603.49		
TP ☆	0.83	~~4937.81~~	12.56	4602.66 ~~4936.98~~
167+50		4615.22		4614.25
TP □	0.97	~~4949.39~~	12.42	~~4948.57~~
		4626.67		4626.38
TP ○	0.29	~~4960.99~~	12.73	~~4960.70~~
		4639.41		4638.70
TP △	0.41	~~4973.43~~	12.81	~~4973.02~~
166+00		4651.51		4647.68
TP *	3.83	~~4985.83~~	12.80	~~4982.00~~
165+50.78 EC				
165+00				
164+50				
164+00				
163+50				
163+00				
162+50				
162+00				
161+50.96 BC				
		4660.48		4650.08
	10.40	~~4994.80~~	12.85	~~4984.16~~



	+	HI	−	EL	
170+00					
		4575 ^{90}		4566.48	
	9^{42}	~~4910~~ ^{22}	12^{01}	~~4900~~ ^{80}	
169+00					
168+00	HI El + 533				
	DIS	∀ ∡		HOR DIS.	
166+70	132.48	75°45′46″		128.41	4607^{3}
℄ 36″ PIPE	137.41	76°05′20″		133.38	4607^{7}
166+50	152.91	76°05′20″			11^{5}
MAN HOLE 36″ CMP	226.15	82°02′20″	28°46′00″	LT 223.97	ON 8.33 POLE
		4578 ^{49}		4578.21	
TP	0^{28}	~~4912~~ ^{81}	12^{47}	~~4912~~ ^{33}	
167+00					
		4590.68		4590.60	
TP 2	0^{08}	~~6925~~ ^{80}	12^{89}	~~4924~~ ^{92}	

	67^{3}	72^{3}	72^{6}	69^{2}	63^{9}	64^{5}	63^{8}	63^{6}		
	8^{6}	3^{6}	3^{3}	6^{1}	12^{0}	11^{4}	12^{1}	12^{3}		
	80	67	50	25		25	50	75		

	70^{2}	68^{7}	68^{1}	69	70^{1}	66^{1}	63^{1}	63^{8}	63^{6}	
	8^{3}	9^{8}	10^{3}	9^{4}	8^{1}	12^{1}	15^{4}	14^{7}	14^{9}	
2:1 to 150	61	35	10		5	25	35	50	75	

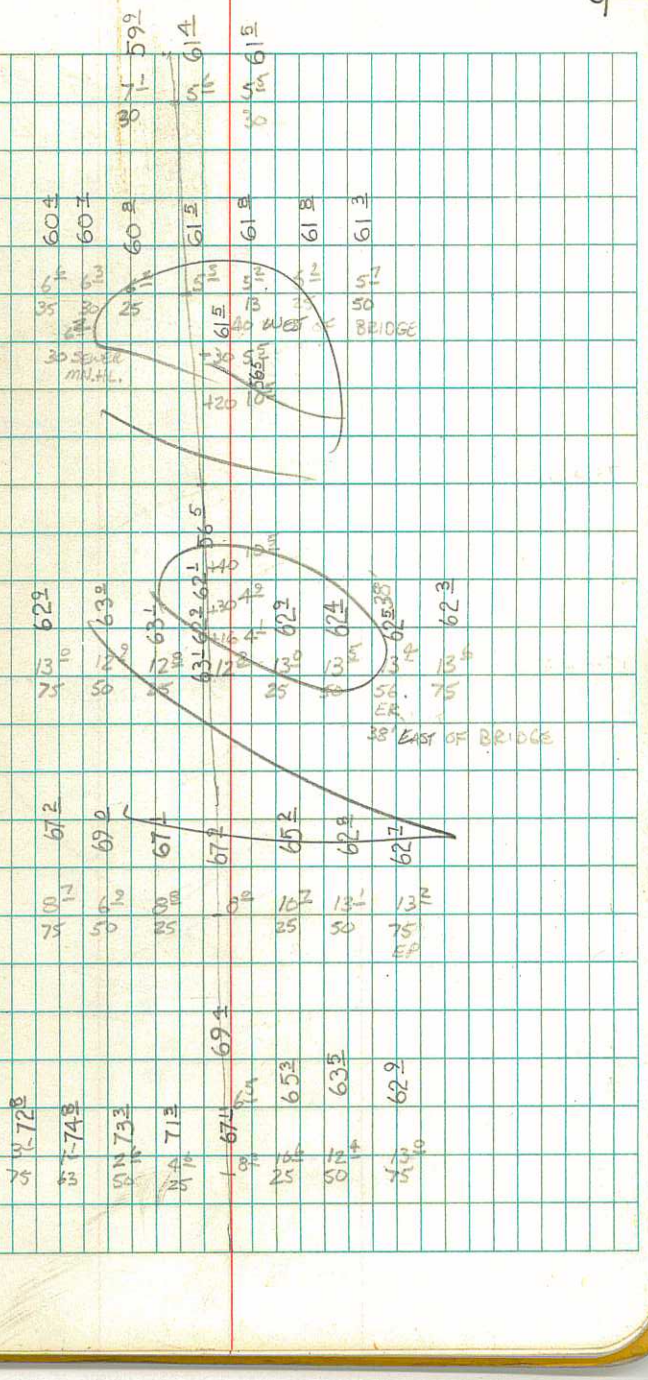
	72^{2}	73^{2}	74^{1}	74^{2}	77^{2}	70^{2}	71^{1}	72^{2}	62^{3}	62^{3}	
	6^{3}	4^{3}	3^{8}	3^{6}	1^{3}	7^{6}	7^{4}	6^{3}	16^{2}	16^{2}	
2:1 to 150	37	22		5	31	43	58	79	97	150	

	4639^{2}	40^{9}	42^{6}	4644^{4} HI	85^{9}	83^{5}	4585^{4}	4561^{5}	4561^{5}
	12^{3}	10^{6}	8^{2}	7^{1}	1^{0}	7^{3}	1^{0}	29^{1}	29^{1}
	150	125	110	100		14 ER	42 ER	80 W	145 W

+90

+80

	+	#1	−	EL
173+00				
172+50				
172+00				
		4566 38		4563.14
	3 84	4901 30	12 76	~~4551 77~~
171+50				
171+00				
170+50				
170+33.15 BC				
4910 23		4575 90		



	+	HI	−	EL	
	13.25	4987.18	0.86	4974.53	
	12.79	4975.81	0.30	4962.62	
	12.86	4962.92	0.81	4950.06	
	13.27	4950.87	0.02	4937.60	
	13.33	4937.62	0.69	4924.29	
	12.85	4924.98	0.58	4912.13	
	12.53	4912.71	6.90	4900.18	B.M. ON BRIDGE
	11.31	~~4907.28~~	5.53	~~4895.78~~	4561.45

175+00

174+50

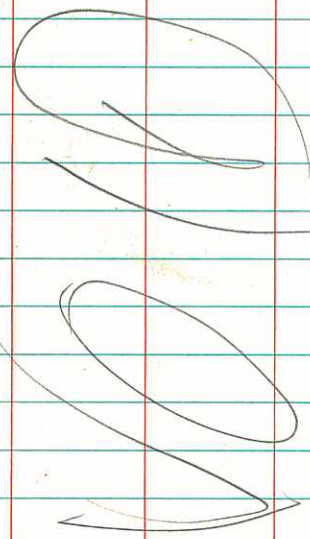
174+23.08 EC

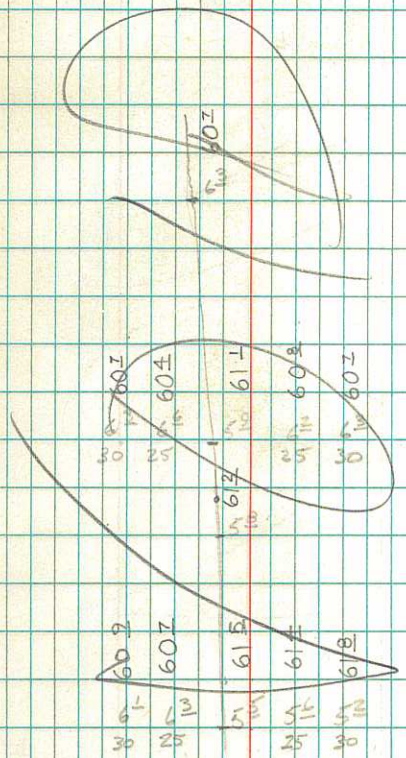
174+00

173+50

17

4566.98

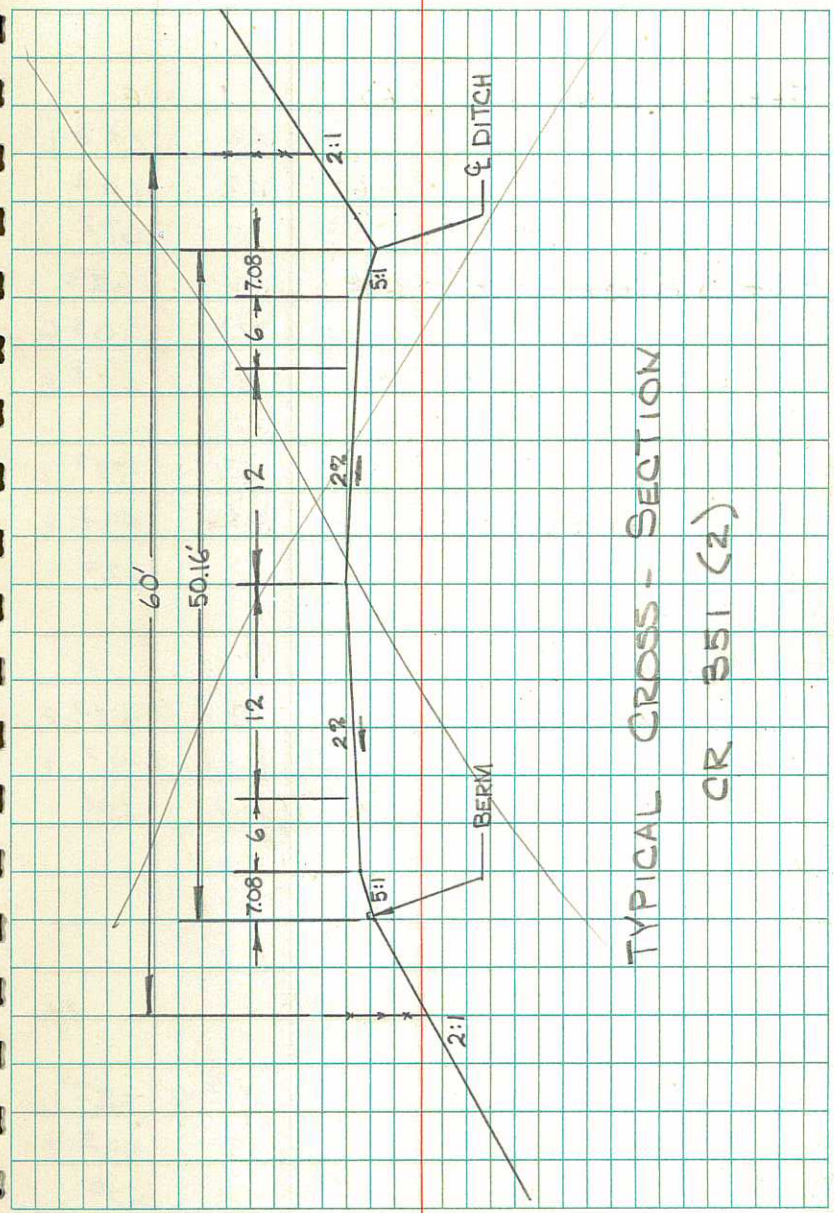




	+	HI	−	EL
			10^{50}	5001^{30}
	5^{24}	5011^{80}	0^{19}	5006^{56}
	11^{44}	5006^{75}	0^{85}	4995^{81}
	8^{58}	4996^{16}	0^{20}	4987^{58}

THE FOLLOWING SURVEY NOTES ARE FOR THE SLOPE STAKES ALONG THE APPROXIMATE RIGHT-OF-WAY LINE FOR PROJECT 851 (2).

NOTE: ELEVATIONS OF DITCH ARE AT A DISTANCE OF 25.08' FROM ℄, EXCEPT ON THE CURVES.



TYPICAL CROSS-SECTION
CR 851 (2)

ST.	DIST TO DITCH	+	HI	−	EL
154+50	21.8 L ~~23.80~~				
	R 37.20			3.2	69.5 L
				4.2	68.1
		5.3	73.2		67.2
154+00	L 22.85	5.6	67.6		62.0
	R 31.25			7.3	60.3 L
				5.4	62.2 R
153+66.15	BC L 24.10				
	R 28.75			9.7	57.9 L
				8.4	59.2 R
		5.6	67.6		62.0
153+00	L 25.08				
	R 25.08			9.9	57.7 R
				11.3	56.3 L
		5.6	67.6		62.0
152+00	L 25.08				
	R 25.08			12.9	54.7 L
				12.6	55.0 R
		5.6	67.6		62.0
					BM 466568

SLOPE DISTANCE	V	H	HOR. DIS.

DISTANCE FROM ℄	EL LEFT DITCH (BBM)	EL RIGHT DITCH (BBM)
℄ 10.5 L 47.80	59.0	59.2
℄ 9.1 R 49.40		
℄ 3.0 L 28.2	57.3	57.3
℄ 4.9 R 41.1		
℄ 1.9 L 27.9	56.2	56.2
℄ 3.2 R 35.15		
℄ 1.7 L 28.48	54.6	54.6
℄ 3.7 R 31.28		
E 25.08 L	54.7	54.7
℄ 0.2 R 25.68		

ST	DIST TO DITCH	+	HI	−	EL
157+50	L 21.80			7 4	58 7
	R 31.20			3 3	62 8
			66 1		
157+00	L 21.80			8 4	57 7
	R 31.20			3 2	62 9
		5 0	66 1		61 1
156+50	L 21 80			6 3	58 3
	R 31.20			1 8	62 8
		5 4	64 6		59 2
156+00	L 21 80			5 3	53 0
	R 31.20			+ 3 2	61 5
		4 8	58 3		53 5
155+50	L 21 80			8 5	47 8 L
	R 31.20			6 8	49 5 R
		5 3	56 3		51 0
155+00	L 21.80				
	R 31.20			2 0	75 5 R
				11 2	66 3
		5 5	77 5		72 0

STOPE DIST.	V &	HOR DIST	DIST FROM ℄	EL LFT DTCH (Berm)	EL RIGHT DITCH (Berm)
			C 3 2 L 28 3 C 7 1 R 45 8	55 5	58 5
			9 L 21.80 C 5 2 R 41 6	57 7	57 7
			F 1 0 L 23 8 C 3 2 R 38 2	59 3	59 3
			F 7 5 L 36.8 C 1 5 R 33.2	60 5	60 5
			F 3 9 L 47 8 1 F 1 3 R 53 8	60 8	60 8
			C 6 3 1 L 34 1 C 1 5 3 R 62 3	60 9	60 0

ST	DIST TO DITCH	+	HI	-	EL
160+00	L 25.08				
	R 25.08			$5\frac{2}{}$	$56\frac{8}{}$ R
		$13\frac{6}{}$	62^{0}		$48\frac{4}{}$
				8^{0}	$45\frac{1}{}$ L
		$4\frac{7}{}$	$53\frac{1}{}$		$48\frac{4}{}$
159+00	L 25.10			$7\frac{3}{}$	$49\frac{4}{}$ L
158+97.75	EC R 29.70			$3\frac{6}{}$	$53\frac{1}{}$ R
		$5\frac{8}{}$	$56\frac{7}{}$		50^{2}
158+50	L 21.80			$6\frac{1}{}$	$50\frac{6}{}$ L
	R 31.20			7^{0}	49^{2} R
		$6\frac{4}{}$	$56\frac{7}{}$		$50\frac{3}{}$
158+00	L 21.80	6^{0}	$57\frac{9}{}$		$51\frac{9}{}$
	R 31.20			$4\frac{6}{}$	$53\frac{3}{}$ R
				$4\frac{4}{}$	$53\frac{5}{}$

SLPE DIST	V &	HOR. DIST.	DIST FRM ℄	EL 46 LEFT DITCH	EL 46 RIGHT DITCH
			C $6\frac{3}{}$ L $37\frac{7}{}$ C 18^{0} R $61\frac{1}{}$	$38\frac{8}{}$	$38\frac{8}{}$
			C $3\frac{2}{}$ L $32\frac{7}{}$ C $7\frac{3}{}$ R $44\frac{7}{}$	$45\frac{6}{}$	$45\frac{6}{}$
			C $1\frac{3}{}$ L $24\frac{8}{}$ C $0\frac{6}{}$ R $3\frac{4}{}$	$49\frac{1}{}$	$49\frac{1}{}$
			C $1\frac{3}{}$ L $24\frac{4}{}$ C $1\frac{1}{}$ R $3\frac{0}{}$	$52\frac{2}{}$	$52\frac{2}{}$

ST	DIST TO DITCH	+	HI	−	EL
163+50	L 29.20			8.5	52.7
	R 24.80	6.1	61.2		55.1
				13.5	44.4 L
		2.8	57.9		55.1
163+00	L 29.20			6.2	49.8 L
	R 24.80	2.4	55.8		53.4
				5.3	57.7 R
		9.5	62.9		53.4
162+50	L 29.20			8.7	52.1 R
	R 24.80	8.3	60.8		51.2
				7.9	46.0 L
		2.0	53.9		51.9
162+00	L 29.10			11.0	47.6 R
	R 24.80	9.3	58.6		49.3
				7.5	47.2 L
		5.5	54.5		49.3
161+50.96 BC	L 27.65			7.3	50.8 L
	R 25.08			1.9	56.8 R
		11.7	58.7		47.0
161+00	L 25.20			9.8	44.3 L
	R 25.08	3.6	54.1		50.5
				5.7	55.0 R
		10.2	60.7		50.5

SLP DIST.	V &	HOR. DIST.	DIST FRM ℄	EL. 46 LEFT DITCH	EL. 46 RIGHT DITCH
			C 29.3 L 87.2	15.1	15.1
			C 37.3 R 99.4		
			C 31.1 L 91.4	18.7	18.7
			C 39.0 R 102.8		
			C 24.0 L 77.3	22.0	22.0
			C 30.1 R 85.0		
			C 21.6 L 72.3	25.4	25.4
			C 22.2 R 69.2		
			C 22.0 L 71.7	28.8	28.8
			C 28.0 R 81.1		
			C 12.1 L 49.4	32.2	32.2
			C 22.8 R 70.7		

ST	DIST TO DITCH	+	HI	−	EL
166+00	L 25.45			2 1	110 1 R
	R 25.08	12 5	11 2 2		99 72
				13 6	41 8 L
		4 2	55 1	~~41 8~~	50 5
165+50 78	L 27.65 EC			2 9	19 7 R
	R 25.08	22 9	12 2 6		99 7
				8 7	40 6 L
		1 1	48 8		47 7
165+00	L 29 20			7 6	40 4 L
	R 24 80	0 7	48 0		47 3
				12 0	28 6 R
		-8 0	40 6		48 6
164+50	L 29 20			6 9	33 7 R
	R 24 80	-8 0	40 6	6	48 6
				12 2	41 3 L
		4 2	53 5		48 6
164+00	L 29 20			10 8	47 3 R
	R 24 80	3 1	58 1		
				7 8	49 3 L
		2 1	57 1		55 0

SLP DIST	V ∠	HOR DIST	DIST FRM ℄	EL. LEFT DITCH	EL. RIGHT DITCH
			℄ 43 3		
			L 112 1	4598 5	4598 5
			R ℄ 1 6 48 3		
			℄ 38 7		
			L 105 1	4601 9	4601 9
			R ℄ 17 8 60 7		
			℄ 35 1		
			L 99 4	4605 3	4605 3
			R ℄ 23 2 71 4		
			℄ 32 5		
			L 94 4	4608 7	4608 7
			R ℄ 25 0 74 8		
			℄ 37 3		
			L 103 8	12 0	12 0
			R ℄ 35 1 95 4		

ST.	DIST TO DITCH	+	HI	−	EL	SLP DIST	V ∠	HOR DIST	DIST FRM ℄	EL LEFT DITCH	EL RIGHT DITCH
169+00	L 25.08			8^{7}	63^{9} R				F 8^{6} L 42^{3} F 14^{5} R 54^{1}	78^{4}	78^{4}
	R 25.08	3^{5}	72^{6}		69^{1}						
				4^{8}	69^{8} L						
		5^{5}	74^{6}		69^{1}						
168+00	L 25.08			4^{2}	76^{0} L				F 9^{4} L 43^{3} F 14^{4} R 53^{9}	85^{10}	85^{10}
	R 25.08	5^{5}	80^{2}		74^{7}						
				8^{2}	70^{7} R						
		4^{2}	78^{9}		74^{7}						
167+00	L 25.08			1^{9}	85^{6} R				C 48^{7} L 122^{5} F 6^{1} R 37^{3}	91^{7}	91^{7}
	R 25.08	12^{8}	87^{5}		~~91^{7}~~ 74^{7}						
				15^{0}	40^{4} L						
		4^{9}	55^{4}		50^{5}						

ST	DIST TO DITCH	+	HI	−	EL
172+50	L 23.15				
	R 30.85				
172+00	L 23.15	IN THE LOGAN RIVER			
	R 30.85				
171+50	L 23.15			5^{7}	62^{9} L
	R 30.85			6^{0}	62^{6} R
		5^{5}	68^{6}		63^{1}
171+00	L 23.15			7^{3}	66^{7} L
	R 30.85			10^{2}	63^{1} R
		6^{1}	74^{0}		67^{2}
170+50					
$170+33^{15}$	BC L 24.95			7^{2}	65^{5} R
	R 28.65			2^{0}	71^{2} L
		6^{1}	73^{2}		67^{1}
170+00	L 25.08				
	R 26.00			9^{6}	61^{2} R
				2^{7}	68^{1} L
		6^{9}	70^{8}		63^{2}

SLP DIST	V ∢	HOR DIST	DIST. FRM ℄	EL LEFT DITCH	EL RIGHT DITCH
			L	61^{1}	61^{1}
			R		
			L	62^{0}	62^{0}
			R		
			F 0^{2} L 23^{6}	63^{1}	63^{1}
			F 0^{5} R 31^{2}		
			C 1^{0} L 25^{2}	65^{7}	65^{7}
			F 2^{6} R 33^{5}		
			C 1^{1} L 28^{2}	69^{6}	69^{6}
			F 4^{1} R 36^{9}		
			F 3^{8} L 32^{7}	71^{20}	71^{20}
			F 10^{7} R 47^{4}		

ST	DIST TO DITCH	+	HI	−	EL	SLP DIST	V ∡	HOR. DIST	DIST FROM ℄	EL LEFT DITCH	EL RIGHT DITCH
175+00											
174+50											
$174+23^{08}$	EC L								L		
	R								R		
174+00	L								L		
	R								R		
173+50	L								L		
	R								R		
173+00	L 23.15								L	59^{8}	59^{8}
	R 30.85								R		

BM LEVELS

Φ & NOTES - WILLIAMS 9/28/76

T - WARD COOL, CLEAR

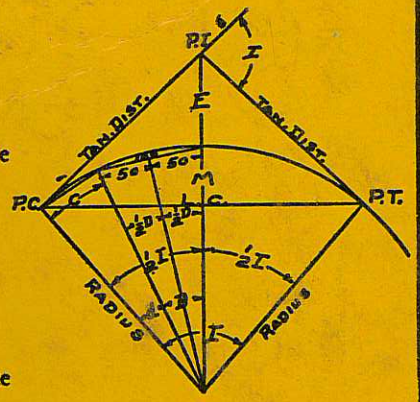
+	HI	−	EL	
		5 37	4555 96	BM P.C. JOHN. AT BR.
5 65	4561 33	2 46	4555 68	TP
		4 78	4553 36	BM TEL POLE LR-9. ST-30 NORTH SIDE
7 18	4558 14	2 93	4550 96	TP
		5 33	4548 36	SEWER M.H. 560E 100S
		6 84	4547 05	EAST RIM SEWER M.H. 533E 100S NORTH EDGE OF ROAD
7 14	4553 89	2 45	4546 75	TP
		4 85	4544 35	EAST RIM SEWER M.H 500E 100S
6 67	4549 73	3 39	4542 53	EAST RIM SEWER M.H. 450E 100S
		5 51	4540 41	EAST RIM SEWER M.H. 400E 100S
6 88	4545 92	4 67	4539 04	TP
		4 88	4538 85	EAST RIM SEWER MAN H. 350E 200S
6 46	4543 71	1 71	4537 25	EAST RIM SEW MANHOLE 200S 300E.
4 82	4533 96	5 08	4534 14	TP
0 34	4539 22	4 84	4538 38	TP
0 34	5483 72	6 70	4543 18	TP
6 22	4550 88	0 29	4543 80	TP
6 72	4544 15	2 55	4537 43	TP
6 63	4539 98	3 75	4533 35	TP
3 86	4537 10	3 06	4533 21	TP
1 96	4536 27		4534 31	USGS BM COUNTY COURTHOUSE

	+	HI	−	EL	
BM →			6 31	4556 37	2" PIPE NEAR FENCE
	6 72	4562 68		4555 96	BM COR OF BRIDGE
		ERROR OF CLOSURE = +.03			
			1 52	4534 34	USGS BM MARKED 4534 31
	2 62	4535 36	4 04	4533 24	TP
	3 89	4537 28	6 76	4533 39	TP
	2 31	4540 15	7 09	4537 84	TP
	0 70	4544 93	7 14	4544 23	TP
	5 63	4561 31	0 20	4545 74	TP
	7 06	4545 94	0 10	4538 88	TP
	4 83	4538 98	4 24	4534 15	TP
	1 32	4538 39	6 50	4537 07	TP
	4 07	4543 66	6 87	4539 59	TP
	3 46	4546 46	6 30	4543 00	TP
	2 80	4549 30	6 97	4546 44	TP
	3 77	4553 41	7 08	4549 64	TP
	2 52	4556 72	7 13	4554 20	TP

~~WCP 3-10~~					
TP TO	P13	35.4			
N					
TP WET TO	P13	93.5			

CURVE FORMULAE

D=Degree of Curve
1°=1-Degree of Curve
2°=2-Degree of Curve
P.C.=Point of Curve
P.T.=Point of Tangent
P.I.=Point of Intersection
I=Intersection of Angle, Angle Between Two Tangents
L=Length of Curve, from P.C. to P.T.
T=Tangent Distance
E=External Distance
R=Radius
L.C.=Length of Chord
M=Length of Middle Ordinate
c=Length of Sub-Chord
d=Angle of Sub-Chord



$$R = \frac{L.C.}{2 \sin \frac{1}{2} I} \quad T = R \tan \tfrac{1}{2} I = \frac{L.C.}{2 \cos \frac{1}{2} I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, \; D\,1° = R = 5730, \; D\,2° = \frac{5730}{2}, \; D = \frac{5730}{R}$$

$$M = R\,(1 - \cos \tfrac{1}{2} I), = R - R \cos \frac{I}{2}$$

$$\frac{E + R}{R} = \sec \frac{I}{2}, \; \frac{R - M}{R} = \cos \frac{I}{2}$$

$$c = 2R \sin \tfrac{1}{2} d, \; d = \frac{c}{2R}$$

$$L.C. = 2R \sin \tfrac{1}{2} I, \; E = R\,(\sec \tfrac{1}{2} I - 1), = R \sec \frac{I}{2} - R$$

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	.8657
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

Inches in Decimals of a Foot.

1/16 .0052	3/32 .0078	1/8 .0104	3/16 .0156	1/4 .0208	5/16 .0260	3/8 .0313	1/2 .0417	5/8 .0521	3/4 .0625	7/8 .0729
1 .0823	2 .1667	3 .2500	4 .3333	5 .4167	6 .5000	7 .5833	8 .6667	9 .7500	10 .8333	11 .9167