

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Crustal Deformation near Hanford, Washington

by

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DEFORMATION OF THE HANFORD STRAIN NETWORK

J.C. Savage

ABSTRACT

A new survey (August 1983) of the Hanford strain network indicates only minor deformation since the last survey (October 1981). The 1972-1983 deformation of the main network is adequately described by uniform strain accumulation with principal strain rates -0.016 ± 0.013 $\mu\text{strain/a}$ $N3^\circ W \pm 34^\circ$ and -0.024 ± 0.013 $\mu\text{strain/a}$ $N87^\circ E \pm 34^\circ$. (Extension is reckoned positive.) The deformation of a new 12-line network across the Cold Springs syncline suggests a north-south contraction (-0.27 ± 0.22 $\mu\text{strain/a}$) for the 1981-1983 epoch. That strain rate would be consistent with the long-term geologic evidence from folding, but the observed rate is not above possible errors in measurement. No systematic strain accumulation in the 1981-1983 epoch could be deduced from the four, small-aperture strain networks across the Wallula fault system. However, line-length changes somewhat larger than expected were observed in those networks.

INTRODUCTION

In 1972 the U.S. Geological Survey (USGS) established a trilateration network (Figure 1) near Hanford, Washington, to measure the accumulation of tectonic strain on the Hanford Reservation. The network has been surveyed in 1972, 1973, 1975, 1978, 1979, 1981, and 1983. In 1980 the Basalt Waste Isolation Group (BWIP) of Rockwell Hanford Operations added 15 lines (Figure 1) to the Hanford trilateration network and established three new three-line networks (Figures 2 and 3) along the Wallula fault system. These additional lines were surveyed by the U.S.G.S. in October 1981 and August 1983. All of the measured lengths for lines in the original network are shown in Table 1, and the 1981-1983 changes in length for all lines are shown in Table 2.

THE HANFORD NETWORK

The line lengths in the basic Hanford network (i.e., stations shown by solid triangles in Figure 1) show only minor changes in the 1972-1984 interval, and those changes are generally within the range that might be expected due to measurement error. (Gable to Rattlesnake may be an exception to this statement.) To detect systematic changes in the network it is necessary to average over the network as a whole. This is done most conveniently by computing the strain field required to transform the network from some average configuration to the configuration measured at the time of each survey (see Savage et al., [1981] for a more detailed discussion of the calculation). The tensor strain components so calculated are shown in Figure 4 as a function of time. In that figure the strain field is referred to a geographic coordinate system (i.e., the 1 axis is directed east and the 2 axis north). As can be seen in the figure both extensions (e_{11} and e_{22}) exhibit slight negative trends whereas the shear (e_{12}) is essentially flat. The average strain rates (with standard deviations) computed from those plots are as follows:

$$\begin{aligned} \dot{e}_{11} &= -0.024 \pm 0.013 \mu\text{strain/a} \\ \dot{e}_{12} &= 0.000 \pm 0.005 \mu\text{strain/a} \\ \dot{e}_{22} &= -0.016 \pm 0.013 \mu\text{strain/a} \end{aligned}$$

These are extremely low strain rates, and at the 95% confidence level it is not clear that real deformation has been measured. The results are perhaps best summarized by the statement that the measurements provide marginal evidence for east-west contraction, contraction that might be associated with the subduction of the Juan de Fuca plate beneath the American plate off the Oregon-Washington coast [Savage et al., 1981]. The rate of north-south contraction, if any exists, is below the level of detection in our measuring system ($0.042 \mu\text{strain/a}$ or $4.2\%/Ma$). Thus, no source of continued formation of the prominent east-west anticlines in the Hanford area is evident in the measurements.

The 12-line Cold Creek network (stations Benson, Haven, and 911 through 917 in Figure 1) spans the Cold Creek syncline within the Hanford network (see Figure 3 for greater detail). This network was surveyed only in 1981 and 1983. The observed line length changes are all relatively small (Table 2). The average strain rate for this network over the 1981-1983 interval is given by the tensor components

$$\begin{aligned}\dot{\epsilon}_{11} &= -0.02 \pm 0.26 \mu\text{strain/a} \\ \dot{\epsilon}_{12} &= -0.01 \pm 0.14 \mu\text{strain/a} \\ \dot{\epsilon}_{22} &= -0.27 \pm 0.22 \mu\text{strain/a}\end{aligned}$$

The strain rate corresponds to an essentially uniaxial north-south contraction, but the observed rate of accumulation is within the uncertainties of the measurements. Thus, although the observed north-south contraction is consistent with the folding observed in the Hanford area, the uncertainties in the geodetic observations are such that a coincidence between the geodetic and geologic observations cannot be claimed with confidence.

The geodetic triangle Weller-Bender-Gibbon at the south end of the Hanford network (Figure 1) will be discussed in the next section.

NETWORKS ALONG THE WALLULA FAULT SYSTEM

Four new networks across the Wallula fault system were established in 1980 and surveyed by the USGS in October 1981 and August 1983 (Figure 2). Three of the networks are shown in Figure 3 and the fourth network, the Prosser network, consists of the Weller-Bender-Gibbon triangle shown at the bottom of Figure 1. Each of these networks is simply a small aperture geodetic triangle, which offers no redundancy in measuring either line length change or strain. The observed 1981-1983 changes in line length for these networks are shown in Table 2. Two of the lines (Jigg-Siwash in the Wallula Gap net and Quarry East-Quarry West in the Milton Freewater net) show significant changes in length ($+13.7$ and -16.8 mm) (Table 2), rather large changes considering the very short lengths (3.76 and 2.15 km) of the lines. Because of the absence of redundancy in these networks and the short history of measurement, we are hesitant to attach too much significance to these observed changes, but we are surprised by the magnitude of the changes. The average strain rates for the four networks are shown in Table 3. Significant strain rates are observed for both the Milton-Freewater and Wallula Gap networks as a direct consequence of the large length changes in the two lines discussed above. The strain rate for the Milton-Freewater network is primarily a contraction parallel to the strike of the Wallula fault system with marginal right-lateral shear across the strike.

At the Wallula Gap network the contraction is perpendicular to fault strike and the shear is left lateral across the strike. The strain rates observed at the Prosser and Warm Springs networks are not defined within measurement precision.

In an attempt to define the strain field across the Wallula fault system more precisely we have lumped all four networks (Prosser, Wallula Gap, Warm Springs, and Milton-Freewater) into a single strain adjustment. The result is shown in the last row of Table 3. The strain field is dominated by the along-strike contraction from the Milton-Freewater network and the left-lateral shear from the Wallula Gap network. None of the components of strain for the combined network is significant at the two-standard-deviation level.

CONCLUSION

Marginal deformation in the main network has been detected for the 1972-1983 interval. The deformation is best described by the principal strain rates

$$\begin{aligned} & -0.016 \pm 0.013 \text{ } \mu\text{strain/a N03}^\circ\text{W} \pm 34^\circ \\ & -0.024 \pm 0.013 \text{ } \mu\text{strain/a N87}^\circ\text{E} \pm 34^\circ \end{aligned}$$

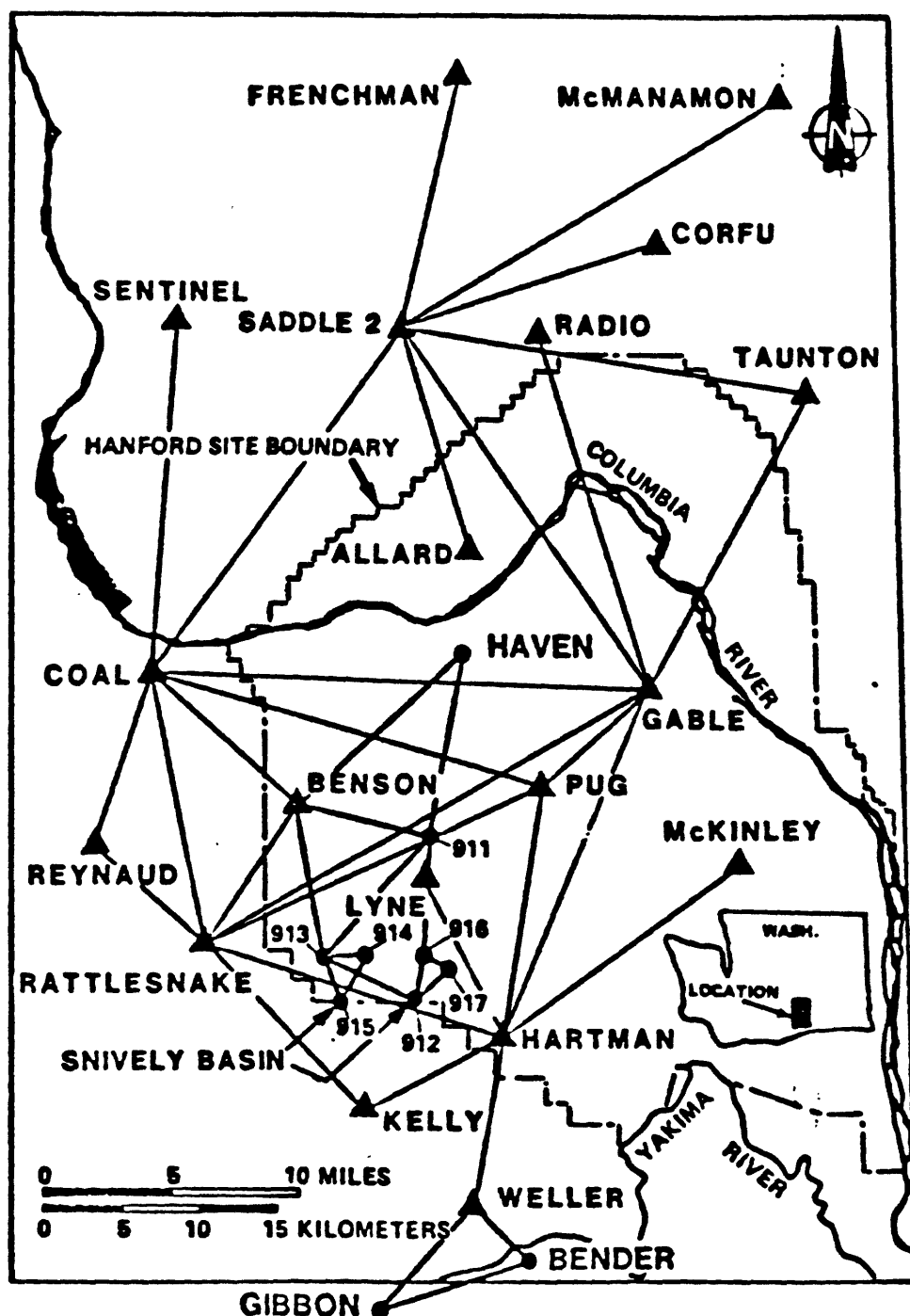
This is the lowest strain rate observed in any of the networks surveyed by the U.S.G.S. The 12 new lines in the Cold Creek syncline area of the Hanford network show no significant changes in length in the 1981-1983 interval, although the deformation is suggestive of north-south contraction.

The four small-aperture networks along the Wallula fault system seem to show larger line-length changes than similar lines measured in the Hanford network. Nevertheless, no well defined pattern of strain accumulation was identified. The average strain rate measured in those four networks is best described by the principal strain rates:

$$\begin{aligned} \dot{\epsilon}_1 &= -0.02 \pm 0.27 \text{ } \mu\text{strain/a S88}^\circ\text{E} \pm 32^\circ \\ \dot{\epsilon}_2 &= -0.27 \pm 0.22 \text{ } \mu\text{strain/a N02}^\circ\text{E} \pm 32^\circ \end{aligned}$$

REFERENCE

Savage, J. C., M. Lisowski, and W. H. Prescott, Geodetic measurements in Washington, Journal of Geophysical Research, 86, 4929-4940, 1981.



- ▲ HANFORD SITE GEODETIC NET EST. PRIOR TO 1980
 ● BWIP-ESTABLISHED GEODETIC MONUMENTS EST. 1980-81

FIGURE 1. Locations of Geodetic Trilateration Survey Lines Within and Immediately Adjacent to the Hanford Site, Washington.

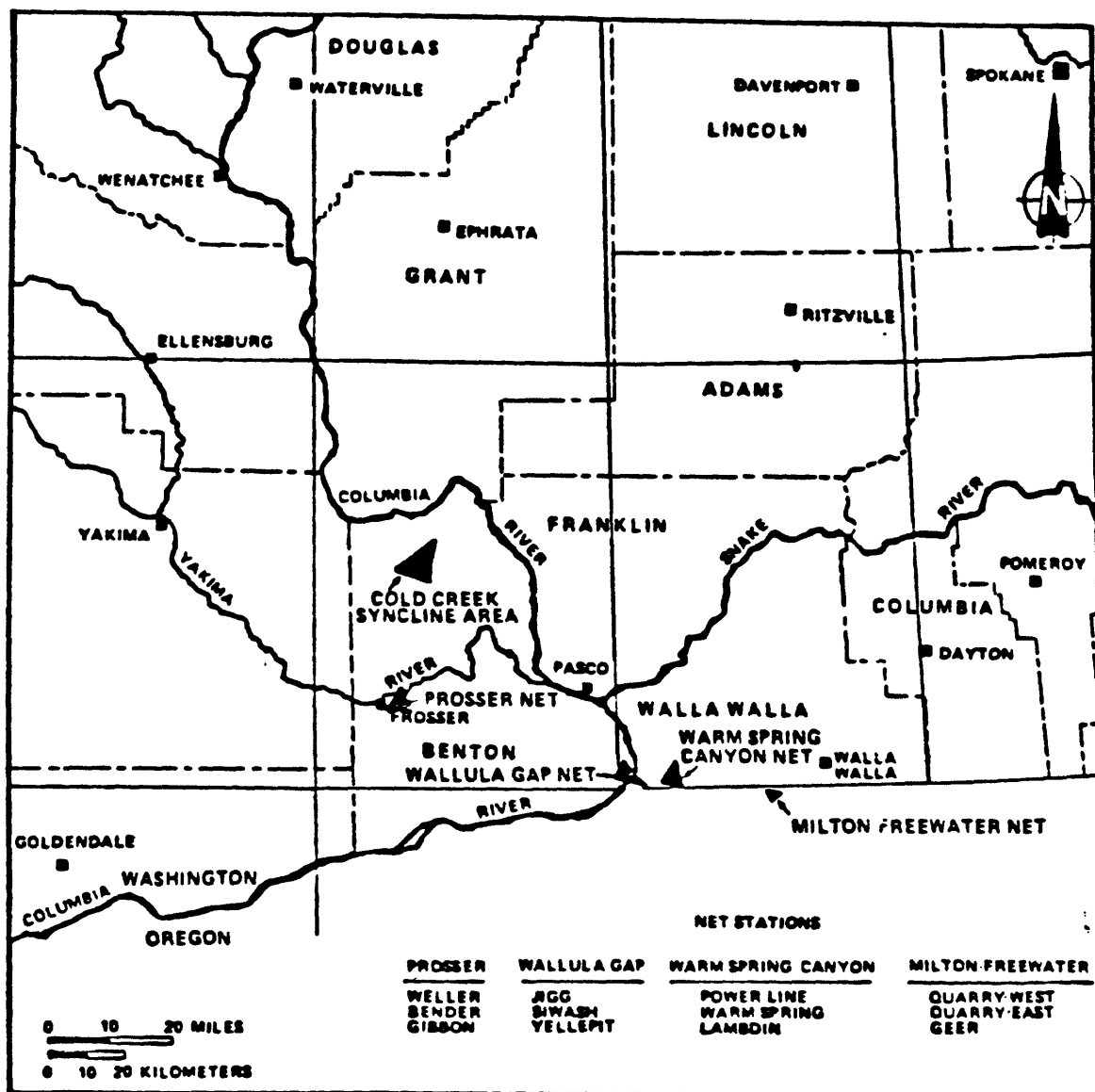


FIGURE 2. Locations of Geodetic Trilateration Survey Lines Along the Wallula Fault System.

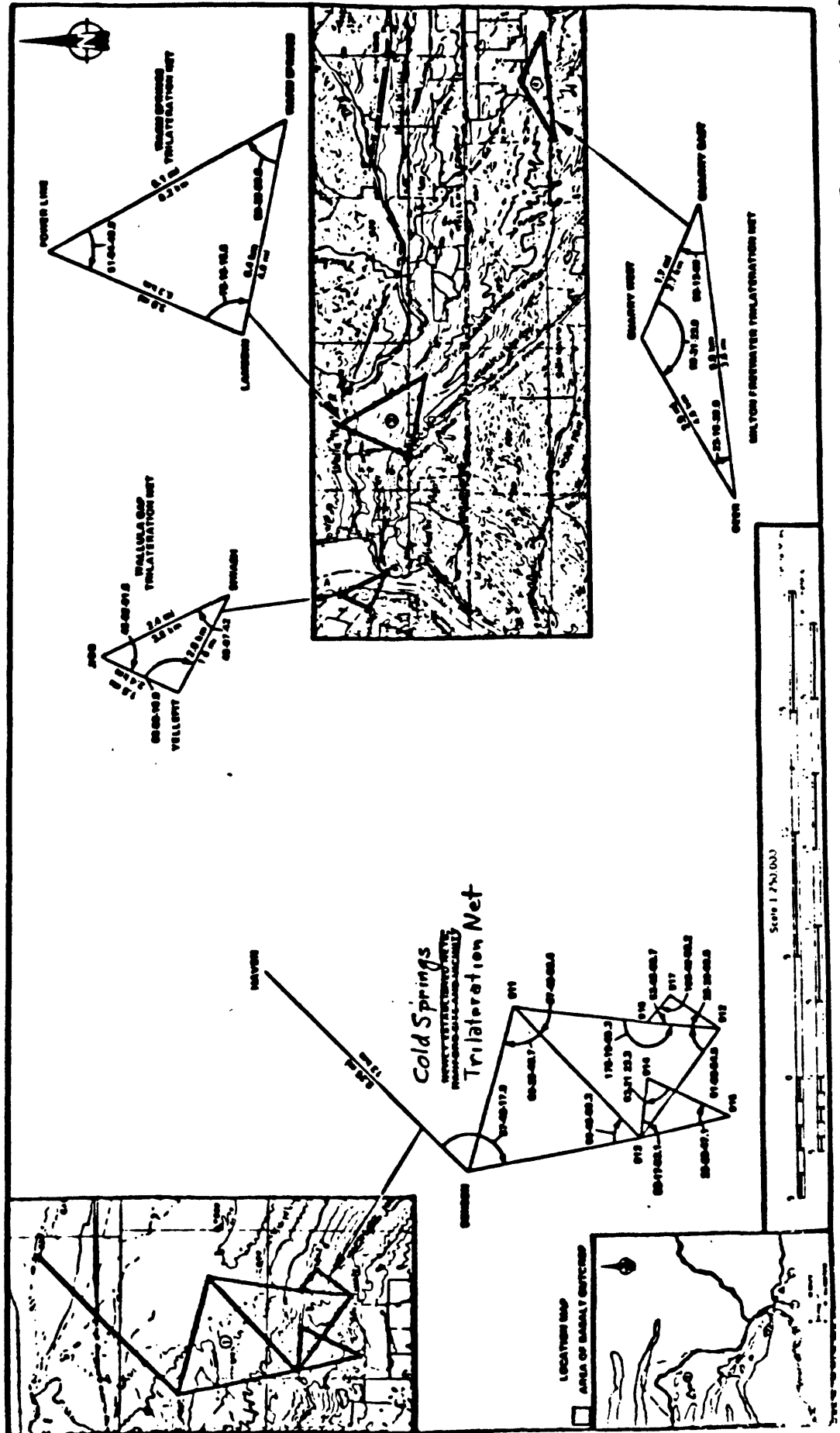


FIGURE 1. Locations of Newly Established Trilateration Networks, Showing Station Names and Internal Angles of Closure (in degrees-minutes-seconds).

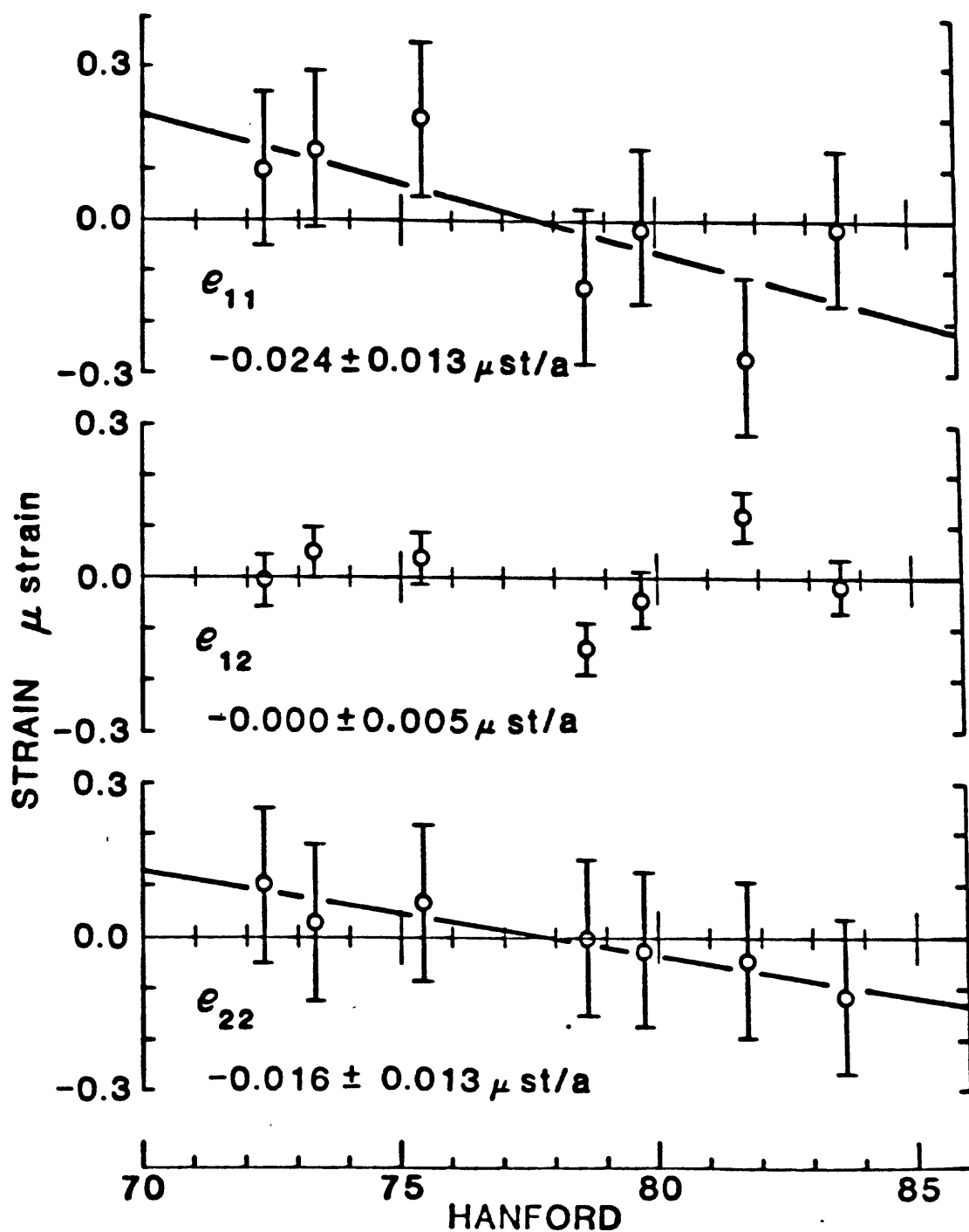


Figure 4.

Tensor strain components as a function of time for the main Hanford trilateration network. The 1 axis is directed east and the 2 axis north.

Table 1. Line lengths measured in the Hanford area 1972-1983. The standard error in measurement is given by $(a^2 + b^2 L^2)^{1/2}$ where $a = 3$ mm, $b = 0.2 \cdot 10^{-6}$ (dimensionless), and L is the line length.

station1	elev(m)	station2	elev(m)	date	time	azi	m-m dist(m)	sea arc(m)	
911	193.85	913	632.16	81 9 9		222.7	8448.1290 +	8436.2054	
911	193.85	913	632.16	83 8 19	1118	222.7	8448.1226 +	8436.1990	
911	193.85	916	660.50	81 9 9		188.0	6107.0234 +	6088.7604	
911	193.85	916	660.50	83 8 19	1032	188.0	6107.0210 +	6088.7580	
911	193.85	henson	507.40	81 9 12		286.2	8098.0146 +	8091.4985	
911	193.85	henson	507.40	83 8 19	1047	286.1	8098.0122 +	8091.4961	
912	975.36	913	632.16	81 9 9		314.8	5899.1720 +	5888.4386	
912	975.36	913	632.16	83 8 19	1513	314.8	5899.1719 +	5888.4384	
912	975.36	916	660.50	81 9 9		9.6	3616.6440 +	3602.4498	
912	975.36	916	660.50	83 8 19	1842	9.6	3616.6465 +	3602.4523	
912	975.36	917	593.45	81 9 9		32.5	3013.3417 +	2988.6744	
912	975.36	917	593.45	83 8 19	2006	32.5	3013.3380 +	2988.6707	
913	632.16	914	595.58	81 9 12		98.2	2709.9617 +	2709.4545	
913	632.16	914	595.58	83 8 19	1333	98.2	2709.9604 +	2709.4532	
913	632.16	915	822.96	81 9 12		180.0	1092.4641 +	4087.5471	
913	632.16	915	822.96	83 8 19	1411	180.0	1092.4560 +	4087.5390	
913	632.16	henson	507.40	81 9 12		342.9	8330.9346 +	8329.2560	
913	632.16	henson	507.40	83 8 19	1321	342.9	8330.9310 +	8329.2524	
914	595.58	915	822.96	81 9 12		207.5	4112.0810 +	4505.8468	
914	595.58	915	822.96	83 8 19	1644	207.5	4112.0803 +	4505.8461	
916	660.50	917	593.45	81 9 9		123.3	1411.0467 +	1419.3245	
916	660.50	917	593.45	83 8 19	1159	123.3	1411.0574 +	1419.3353	
allard	165.80	saddle 2	800.70	72 3 8		344.1	15567.0167 /	15552.8882	
allard	0.00	saddle 2	0.00	72 6 4		344.1	15567.0187 /	15552.8902	
allard	0.00	saddle 2	0.00	73 4 13		344.1	15567.0213 /	15552.8928	
allard	165.80	saddle 2	800.70	75 5 16		344.1	15567.0140 /	15552.8855	
allard	165.80	saddle 2	800.70	78 8 18		344.1	15567.0132 /	15552.8848	
allard	165.80	saddle 2	800.70	79 9 6		344.1	15567.0084 /	15552.8800	
allard	165.80	saddle 2	800.70	81 9 14		344.0	15567.0106 +	15552.8822	
allard	165.80	saddle 2	800.70	83 8 18	1621	344.0	15567.0162 +	15552.8878	
bender	623.62	alibon	565.10	81 9 12		247.2	10237.1601 +	10236.0413	
bender	623.62	alibon	565.10	83 8 13	1918	247.2	10237.1530 +	10236.0342	
bender	623.62	weller	403.00	81 9 16		320.6	6330.7412 +	6326.3869	
bender	623.62	weller	403.00	83 8 12	1723	320.6	6330.7432 +	6326.3888	
benson	507.40	coal	753.80	72 3 7		312.7	13210.5079 /	13206.9069	
benson	0.00	coal	0.00	72 6 2		312.7	13210.5147 /	13206.9137	
benson	0.00	coal	0.00	73 4 12		312.7	13210.5198 /	13206.9087	
benson	507.40	coal	753.80	75 5 17		312.7	13210.5168 /	13206.9057	
benson	507.40	coal	753.80	76 8 17		312.7	13210.5090 /	13206.9079	
benson	507.40	coal	753.80	79 9 5		312.7	13210.5014 /	13206.9053	
benson	507.40	coal	753.80	81 9 11		312.7	13210.5012 +	13206.9071	
benson	507.40	coal	753.80	83 8 17	1444	312.7	13210.5088 +	13206.9078	
benson	507.40	haven	224.94	81 9 9		14.5	13059.3152 +	13055.5131	
benson	507.40	haven	224.94	81 9 12		14.6	13059.3132 +	13055.5110	
benson	507.40	haven	224.94	83 8 19	0647	14.5	13059.3146 +	13055.5125	
benson	507.40	pt 5/75	1106.09	75 5 17		215.0	10951.7131 /	10933.9546	
benson	507.40	ratt fm1	1106.09	72 3 4		215.0	0.0000 /	10930.9180	red
benson	507.40	ratt fm1	1106.09	72 6 2		215.0	0.0000 /	10930.9146	red
benson	0.00	ratt fm1	0.00	73 4 12		215.0	10948.6722 /	10930.9096	
benson	0.00	ratt fm1	0.00	75 5 17		215.0	0.0000 /	10930.9162	red
benson	507.40	ratt fm1	1106.09	78 8 17		215.0	10948.6692 /	10930.9066	
benson	507.40	ratt fm1	1106.09	79 9 5		215.0	10948.6666 /	10930.9040	
benson	507.40	ratt fm1	1106.09	81 9 10		215.1	10948.6655 +	10930.9028	
benson	507.40	ratt fm1	1106.09	83 8 16	1308	215.1	10948.6690 +	10930.9063	
benson	507.40	rattle	1106.09	72 3 9		215.1	10951.7519 /	10933.9935	
benson	507.40	rattle	1106.09	72 6 2		215.1	0.0000 /	10933.9901	red
benson	507.40	rattle	1106.09	72 6 2		215.0	10951.7543 /	10933.9959	
coal	753.80	gabier#2	330.80	72 3 4		92.0	32518.9861 /	32513.5105	
coal	0.00	gabier#2	0.00	72 6 2		92.0	32518.9950 /	32513.5103	
coal	0.00	gabier#2	0.00	73 4 11		92.0	32518.9906 /	32513.5150	
coal	753.80	gabier#2	330.80	75 5 15		92.0	32518.9944 /	32513.5188	
coal	753.80	gabier#2	330.80	76 8 16		92.0	32518.9835 /	32513.5078	
coal	753.80	gabier#2	330.80	79 9 5		92.0	32518.9905 /	32513.5148	
coal	753.80	gabier#2	330.80	81 9 11		92.2	32518.9742 +	32513.4986	
coal	753.80	gabier#2	330.80	83 8 17	1540	92.2	32518.9956 +	32513.5200	

station1	elev(m)	station2	elev(m)	date	time	+zi	m-p dist(m)	see arc(m)	
coal	753.90	pt 5/75	1106.09	75	5 17	169.1	18247.0353 /	18240.9775	
coal	753.90	duq	228.40	72	3 7	106.5	16394.8120 /	26387.5724	
coal	0.00	duq	0.00	72	6 2	106.5	16394.8206 /	26387.5811	
coal	0.00	duq	0.00	73	4 12	106.5	16394.8142 /	26387.5747	
coal	753.90	duq	228.40	75	5 17	106.5	16394.8142 /	26387.5747	
coal	753.90	duq	228.40	78	8 17	106.5	16394.8142 /	26387.5746	
coal	753.90	duq	228.40	79	9 5	106.5	21394.8092 /	26387.5696	
coal	753.90	duq	228.40	81	9 11	106.5	21394.8035 +	26387.5640	
coal	753.90	duq	228.40	83	8 17	1756 106.5	21394.8137 +	26387.5741	
coal	753.90	ratt r#1	1106.09	72	3 7	169.1	0.0000 /	18230.6892	red
coal	753.90	ratt r#1	1106.09	72	6 2	169.1	0.0000 /	18230.7001	red
coal	0.00	ratt r#1	0.00	73	4 12	169.1	18136.7488 /	18230.6906	
coal	0.00	ratt r#1	0.00	75	5 17	169.1	0.0000 /	18230.6908	red
coal	753.90	ratt r#1	1106.09	78	8 17	169.1	18216.7520 /	18230.6937	
coal	753.90	ratt r#1	1106.09	79	9 5	169.1	18216.7446 /	18230.6864	
coal	753.90	ratt r#1	1106.09	81	9 10	169.1	18216.7452 +	18230.6868	
coal	753.90	ratt r#1	1106.09	83	8 16	1505 169.1	18216.7441 +	18230.6857	
coal	753.90	rattle	1106.09	72	3 7	169.1	18247.0852 /	18241.0274	
coal	753.90	rattle	1106.09	72	6 2	169.1	18247.0961 /	18241.0383	
coal	753.80	reynaud	780.00	72	3 7	197.2	11991.4945 /	11990.0244	
coal	0.00	reynaud	0.00	72	6 2	197.2	11991.4997 /	11990.0296	
coal	0.00	reynaud	0.00	73	4 12	197.2	11991.4970 /	11990.0269	
coal	753.90	reynaud	780.00	75	5 17	197.2	11991.4151 /	11990.0250	
coal	753.90	reynaud	780.00	78	8 17	197.2	11991.4981 /	11990.0280	
coal	753.90	reynaud	780.00	79	9 5	197.2	11991.4173 /	11990.0172	
coal	753.90	reynaud	780.00	81	9 11	197.2	11991.4919 +	11990.0208	
coal	753.90	reynaud	780.00	83	8 17	1348 197.2	11991.4967 +	11990.0205	
coal	753.80	saddle 2	800.70	72	3 8	35.8	28031.0993 /	28027.6621	
coal	0.00	saddle 2	0.00	72	6 4	35.8	28031.0971 /	28027.6646	
coal	0.00	saddle 2	0.00	73	4 12	35.8	28031.0931 /	28027.6599	
coal	753.90	saddle 2	800.70	75	5 16	35.8	28031.0971 /	28027.6638	
coal	753.90	saddle 2	800.70	78	8 17	35.8	28031.0891 /	28027.6561	
coal	753.90	saddle 2	800.70	79	9 6	35.8	28031.0853 /	28027.6521	
coal	753.90	saddle 2	800.70	81	9 11	35.7	28031.1011 +	28027.6679	
coal	753.90	saddle 2	800.70	83	8 17	1728 35.7	28031.0975 +	28027.6643	
coal	753.90	sent r#4	735.40	72	3 7	4.3	23365.9955 /	23363.2701	
coal	0.00	sent r#4	0.00	72	6 2	4.3	23365.9915 /	23363.2661	
coal	0.00	sent r#4	0.00	73	4 12	4.3	23365.9925 /	23363.2671	
coal	753.90	sent r#4	735.40	75	5 17	4.3	23365.9969 /	23363.2715	
coal	753.90	sent r#4	735.40	78	8 17	4.3	23365.9848 /	23363.2594	
coal	753.90	sent r#4	735.40	79	9 5	4.3	23366.0009 /	23363.2755	
coal	753.90	sent r#4	735.40	81	9 11	4.3	23365.9991 +	23363.2737	
coal	753.90	sent r#4	735.40	83	8 17	1632 4.3	23365.9907 +	23363.2653	
corfu	262.90	saddle 2	800.70	72	3 8	253.4	17345.6873 /	17335.9072	
corfu	0.00	saddle 2	0.00	72	6 4	253.4	17345.6815 /	17335.9014	
corfu	0.00	saddle 2	0.00	73	4 13	253.4	17345.6895 /	17335.9094	
corfu	262.90	saddle 2	800.70	75	5 16	253.4	17345.6808 /	17335.9008	
corfu	262.90	saddle 2	800.70	78	8 18	253.4	17345.6818 /	17335.9017	
corfu	262.90	saddle 2	800.70	79	9 6	253.4	17345.6878 /	17335.9077	
corfu	262.90	saddle 2	800.70	81	9 13	253.4	17345.6799 +	17335.8998	
corfu	262.90	saddle 2	800.70	83	8 13	4041 253.4	17345.6809 +	17335.9008	
french	536.40	saddle 2	800.70	72	3 8	193.0	17057.1140 /	17053.2816	
french	0.00	saddle 2	0.00	72	6 4	193.0	17057.1166 /	17053.2842	
french	0.00	saddle 2	0.00	73	4 13	193.0	17057.1193 /	17053.2869	
french	536.40	saddle 2	800.70	75	5 16	193.0	17057.1105 /	17053.2781	
french	536.40	saddle 2	800.70	78	8 18	193.0	17057.1136 /	17053.2812	
french	536.40	saddle 2	800.70	79	9 5	193.0	17057.1153 /	17053.2829	
french	536.40	saddle 2	800.70	81	9 13	193.1	17057.0977 +	17053.2654	
french	536.40	saddle 2	800.70	83	8 13	1712 193.1	17057.1100 +	17053.2777	
gablers2	330.80	hartman	1074.60	72	3 4	204.4	25020.0105 /	25006.2109	
gablers2	330.80	hartman	1074.60	72	6 1	204.4	25020.0098 /	25006.2102	
gablers2	0.00	hartman	0.00	73	4 11	204.4	25020.0173 /	25006.2176	
gablers2	330.80	hartman	1074.60	75	5 15	204.4	25020.0161 /	25006.2164	
gablers2	330.80	hartman	1074.60	78	8 16	204.4	25020.0138 /	25006.2142	
gablers2	330.80	hartman	1074.60	79	9 4	204.4	25020.0183 /	25006.2186	
gablers2	330.80	hartman	1074.60	81	9 10	203.3	25020.0132 +	25006.2133	
gablers2	330.80	hartman	1074.60	83	8 15	1240 203.3	25020.0083 +	25006.2065	
gablers2	330.80	pt 5/75	1106.09	75	5 17	240.0	33568.3175 /	33555.1261	

station1	elev(m)	station2	elev(m)	date	time	azi	m-a dist(m)	sea arc(m)	
gablerm2	330.80	duq	228.40	72	3 4	228.9	9541.6741 /	9540.7074	
gablerm2	330.80	duq	228.40	72	6 1	228.9	9541.6755 /	9540.7018	
gablerm2	0.00	duq	0.00	73	4 11	228.9	9541.6783 /	9540.7116	
gablerm2	330.80	duq	228.40	75	5 15	228.9	9541.6794 /	9540.7117	
gablerm2	330.80	duq	228.40	78	8 16	228.9	9541.6712 /	9540.7045	
gablerm2	330.80	duq	228.40	79	9 4	228.9	9541.6806 /	9540.7139	
gablerm2	330.80	duq	228.40	81	9 11	228.9	9541.6712 +	9540.7045	
gablerm2	330.80	duq	228.40	83	8 18	1032	9541.6739 +	9540.7072	
gablerm2	330.80	radio	812.90	72	3 4	142.8	24360.2691 /	24353.3271	
gablerm2	330.80	radio	812.90	72	6 1	142.8	24360.2599 /	24353.3179	
gablerm2	0.00	radio	0.00	73	4 11	142.8	24360.2666 /	24353.3246	
gablerm2	330.80	radio	812.90	75	5 15	142.8	24360.2694 /	24353.3274	
gablerm2	330.80	radio	812.90	78	8 16	142.8	24360.2686 /	24353.3266	
gablerm2	330.80	radio	812.90	79	9 4	142.8	24360.2648 /	24353.3228	
gablerm2	330.80	radio	812.90	81	9 11	142.8	24360.2638 +	24353.3218	
gablerm2	330.80	radio	812.90	83	8 18	1246	24360.2645 +	24353.3225	
gablerm2	330.80	ratt fm1	1106.09	72	3 7	241.0	0.0000 /	33557.6732	red
gablerm2	330.80	ratt fm1	1106.09	72	6 2	240.0	0.0000 /	33557.6808	red
gablerm2	0.00	ratt fm1	0.00	73	4 11	240.0	33570.3650 /	33557.6738	
gablerm2	0.00	ratt fm1	0.00	73	4 12	240.0	33570.3654 /	33557.6743	
gablerm2	0.00	ratt fm1	0.00	75	5 17	240.0	0.0000 /	33557.6803	red
gablerm2	330.80	ratt fm1	1106.09	78	8 16	240.1	33570.3598 /	33557.6477	
gablerm2	330.80	ratt fm1	1106.09	79	9 10	240.1	33570.3533 /	33557.6412	
gablerm2	330.80	ratt fm1	1106.09	81	9 10	240.1	33570.3494 +	33557.6582	
gablerm2	330.80	ratt fm1	1106.09	83	8 18	1004	33570.3432 +	33557.6520	
gablerm2	330.80	rattle	1106.09	72	3 7	240.0	33568.3289 /	33555.6375	
gablerm2	330.80	rattle	1106.09	72	6 2	240.0	0.0000 /	33555.6451	red
gablerm2	330.80	rattle a	1106.09	72	6 2	240.0	33568.3408 /	33555.6493	
gablerm2	330.80	saddle 2	800.70	72	3 4	326.1	28864.2671 /	28857.9058	
gablerm2	0.00	saddle 2	0.00	72	6 4	326.1	28864.2575 /	28857.8963	
gablerm2	0.00	saddle 2	0.00	73	4 11	326.1	28864.2582 /	28857.8969	
gablerm2	330.80	saddle 2	800.70	75	5 16	326.1	28864.2594 /	28857.8981	
gablerm2	330.80	saddle 2	800.70	78	8 16	326.1	28864.2620 /	28857.9008	
gablerm2	330.80	saddle 2	800.70	79	9 6	326.1	28864.2600 /	28857.8987	
gablerm2	330.80	saddle 2	800.70	81	9 11	326.0	28864.2527 +	28857.8914	
gablerm2	330.80	saddle 2	800.70	83	8 18	0944	28864.2539 +	28857.8926	
gablerm2	330.80	taunton	579.60	72	3 4	29.7	22366.7614 /	22363.7920	
gablerm2	330.80	taunton	579.60	72	6 1	29.7	22366.7553 /	22363.7859	
gablerm2	0.00	taunton	0.00	73	4 11	29.7	22366.7558 /	22363.7864	
gablerm2	330.80	taunton	579.60	75	5 15	29.7	22366.7609 /	22363.7915	
gablerm2	330.80	taunton	579.60	78	8 16	29.7	22366.7512 /	22363.7818	
gablerm2	330.80	taunton	579.60	79	9 4	29.7	22366.7486 /	22363.7792	
gablerm2	330.80	taunton	579.60	81	9 11	28.7	22366.7560 +	22363.7865	
gablerm2	330.80	taunton	579.60	83	8 18	1343	22366.7536 +	22363.7841	
gibbon	565.10	weller	403.00	81	9 12	31.7	10371.8713 +	10369.8182	
gibbon	565.10	weller	403.00	83	8 12	1737	10371.8676 +	10369.8145	
hartman	1074.60	kelly	619.80	72	3 6	239.6	10162.7042 /	10151.1766	
hartman	1074.60	kelly	619.80	72	6 1	239.6	10162.7026 /	10151.1749	
hartman	0.00	kelly	0.00	72	7 19	239.6	10162.6949 /	10151.1673	
hartman	0.00	kelly	0.00	73	4 11	239.6	10162.7051 /	10151.1774	
hartman	1074.60	kelly	619.80	75	5 15	239.6	10162.7033 /	10151.1756	
hartman	1074.60	kelly	619.80	78	8 16	239.6	10162.7037 /	10151.1761	
hartman	1074.60	kelly	619.80	79	9 4	239.6	10162.7006 /	10151.1730	
hartman	1074.60	kelly	619.80	81	9 10	239.3	10162.7005 /	10151.1728	
hartman	1074.60	kelly	619.80	83	8 15	1302	10162.6992 +	10151.1715	
hartman	1074.60	lyne	209.90	72	3 6	334.2	11288.5078 /	11254.3087	
hartman	1074.60	lyne	209.90	72	6 1	334.2	11288.5023 /	11254.2932	
hartman	0.00	lyne	0.00	73	4 11	334.2	11288.5004 /	11254.2913	
hartman	1074.60	lyne	209.90	75	5 15	334.2	11288.5009 /	11254.2917	
hartman	1074.60	lyne	209.90	78	8 16	334.2	11288.5076 /	11254.2884	
hartman	1074.60	lyne	209.90	79	9 4	334.2	11288.5086 /	11254.2894	
hartman	1074.60	lyne	209.90	81	9 10	334.3	11288.5087 +	11254.2995	
hartman	1074.60	lyne	209.90	83	8 15	1512	11288.5015 +	11254.2913	
hartman	1074.60	mckinley	171.20	72	3 6	52.8	19157.8444 /	19134.6720	
hartman	1074.60	mckinley	171.20	72	6 1	52.8	19157.8393 /	19134.6670	
hartman	0.00	mckinley	0.00	73	4 11	52.8	19157.8384 /	19134.6660	
hartman	1074.60	mckinley	171.20	75	5 15	52.8	19157.8390 /	19134.6667	
hartman	1074.60	mckinley	171.20	78	8 16	52.8	19157.8247 /	19134.6518	
hartman	1074.60	mckinley	171.20	79	9 4	52.8	19157.8427 /	19134.6703	
hartman	1074.60	mckinley	171.20	81	9 10	53.0	19157.8334 +	19134.6610	
hartman	1074.60	mckinley	171.20	83	8 15	1116	19157.8280 +	19134.6556	

station1	elev(m)	station2	elev(m)	date	time	azi	m-m dist(m)	sea arc(m)	
hartman	1074.60	pt 5/75	1106.09	75	5 15	287.9	20238.4840	20235.0140	
hartman	1074.60	bug	228.40	72	3 6	8.9	16941.3885	16918.5166	
hartman	1074.60	bug	228.40	72	6 1	8.9	16941.3830	16918.5111	
hartman	0.00	bug	0.00	73	4 11	8.9	16941.3821	16918.5102	
hartman	1074.60	bug	228.40	75	5 15	8.9	16941.3851	16918.5132	
hartman	1074.60	bug	228.40	76	8 16	1.9	16941.3824	16918.5105	
hartman	1074.60	bug	228.40	79	9 4	1.9	16941.3850	16918.5131	
hartman	1074.60	bug	228.40	81	9 10	1.1	16941.3935	16918.5215	
hartman	1074.60	bug	228.40	83	8 15	9.1	16941.3824	16918.5105	
hartman	1074.60	ratt rm1	1106.09	72	3 7	287.9	0.0000	20244.9969	red
hartman	1074.60	ratt rm1	1106.09	72	6 1	287.9	0.0000	20244.9930	red
hartman	0.00	ratt rm1	0.00	73	4 11	287.9	20248.4649	20244.9932	
hartman	0.00	ratt rm1	0.00	75	5 15	287.9	0.0000	20245.0018	red
hartman	1074.60	ratt rm1	1106.09	78	8 16	287.9	20248.4655	20244.9938	
hartman	1074.60	ratt rm1	1106.09	79	9 4	287.9	20248.4695	20244.9968	
hartman	1074.60	ratt rm1	1106.09	81	9 10	288.1	20248.4666	20244.9948	
hartman	1074.60	ratt rm1	1106.09	83	8 15	1554	20248.4663	20244.9945	
hartman	1074.60	rattle	1106.09	72	3 7	287.9	20238.4557	20234.9857	
hartman	1074.60	rattle	1106.09	72	6 1	287.9	20238.4518	20234.9818	
hartman	1074.60	weller	403.00	72	3 6	190.4	11331.5294	11310.2993	
hartman	1074.60	weller	403.00	72	6 1	190.4	11331.5266	11310.2966	
hartman	0.00	weller	0.00	73	4 11	190.4	11331.5222	11310.2921	
hartman	1074.60	weller	403.00	75	5 15	190.4	11331.5150	11310.2849	
hartman	1074.60	weller	403.00	76	8 16	190.4	11331.5250	11310.2949	
hartman	1074.60	weller	403.00	79	9 4	190.4	11331.5274	11310.2973	
hartman	1074.60	weller	403.00	81	9 10	190.5	11331.5222	11310.2920	
hartman	1074.60	weller	403.00	83	8 15	1134	11331.5216	11310.2914	
kelly	619.80	pt 5/75	1106.09	75	5 17	317.1	15544.2074	15534.5012	
kelly	619.80	ratt rm1	1106.09	72	3 9	317.1	0.0000	15546.2651	red
kelly	619.80	ratt rm1	1106.09	72	6 2	317.1	0.0000	15546.2671	red
kelly	0.00	ratt rm1	0.00	73	4 12	317.1	15555.9661	15546.2649	
kelly	0.00	ratt rm1	0.00	75	5 17	317.1	0.0000	15546.2689	red
kelly	619.80	ratt rm1	1106.09	78	8 17	317.1	15555.9638	15546.2618	
kelly	619.80	ratt rm1	1106.09	79	9 5	317.1	15555.9694	15546.2673	
kelly	619.80	ratt rm1	1106.09	81	9 10	317.4	15555.9523	15546.2502	
kelly	619.80	ratt rm1	1106.09	83	8 16	1052	15555.9587	15546.2566	
kelly	619.80	rattle	1106.09	72	3 9	317.1	15544.1581	15534.4518	
kelly	619.80	rattle	1106.09	72	6 2	317.1	0.0000	15534.4538	red
kelly	619.80	rattle a	1106.09	72	6 2	317.1	15544.1574	15534.4512	
mcmanahan	533.10	saddle 2	800.70	72	3 8	238.2	28848.0498	28843.8200	
mcmanahan	0.00	saddle 2	0.00	72	6 4	238.2	28848.0554	28843.8256	
mcmanahan	533.10	saddle 2	800.70	75	5 16	238.2	28848.0506	28843.8208	
mcmanahan	533.10	saddle 2	800.70	78	8 18	238.2	28848.0545	28843.8248	
mcmanahan	533.10	saddle 2	800.70	79	9 6	238.2	28848.0591	28843.8293	
mcmanahan	533.10	saddle 2	800.70	81	9 13	238.4	28848.0576	28843.8279	
mcmanahan	533.10	saddle 2	800.70	83	8 13	1401	28848.0590	28843.8293	
pt 5/75	1106.09	bug	228.40	75	5 17	64.5	24288.0239	24269.6392	
pt 5/75	1106.09	reynaud	780.00	75	5 17	312.6	9538.8491	9531.8658	
bug	228.40	ratt rm1	1106.09	72	3 7	244.5	0.0000	24272.5770	red
bug	228.40	ratt rm1	1106.09	72	6 2	244.5	0.0000	24272.5923	red
bug	0.00	ratt rm1	0.00	73	4 12	244.5	24290.9534	24272.5702	
bug	0.00	ratt rm1	0.00	75	5 17	244.5	0.0000	24272.5778	red
bug	228.40	ratt rm1	1106.09	76	8 17	244.5	24290.9513	24272.5681	
bug	228.40	ratt rm1	1106.09	79	9 5	244.5	24290.9559	24272.5727	
bug	228.40	ratt rm1	1106.09	81	9 10	244.6	24290.9505	24272.5673	
bug	228.40	ratt rm1	1106.09	83	8 16	1143	24290.9554	24272.5722	
bug	228.40	rattle	1106.09	72	3 7	244.5	24288.0378	24269.6530	
bug	228.40	rattle	1106.09	72	6 2	244.5	0.0000	24269.6683	red
bug	228.40	rattle a	1106.09	72	6 2	244.5	24288.0570	24269.6722	

station1	elev(m)	station2	elev(m)	date	time	azi	m-n dist(m)	see arc(m)	
radio	812.90	saddle 2	800.70	72	3 8	275.2	8593.1165 /	8592.0236	
radio	0.00	saddle 2	0.00	72	6 4	275.2	8593.1118 /	8592.0188	
radio	0.00	saddle 2	0.00	73	4 13	275.2	8593.1192 /	8592.0262	
radio	812.90	saddle 2	800.70	75	5 16	275.2	8593.1128 /	8592.0199	
radio	812.90	saddle 2	800.70	78	8 18	275.2	8593.1103 /	8592.0174	
radio	812.90	saddle 2	800.70	79	9 6	275.2	8593.1150 /	8592.0221	
radio	812.90	saddle 2	800.70	81	9 13	275.2	8593.1141 +	8592.0212	
radio	812.90	saddle 2	800.70	83	8 13	1121 275.2	8593.1139 +	8592.0210	
ratt r1	1106.09	revnaud	780.00	72	3 9	312.6	0.0000 /	9520.1849	red
ratt r1	1106.09	revnaud	780.00	72	6 2	312.6	0.0000 /	9520.1795	red
ratt r1	0.00	revnaud	0.00	73	4 12	312.6	9527.1713 /	9520.1828	
ratt r1	0.00	revnaud	0.00	75	5 17	312.6	0.0000 /	9520.1768	red
ratt r1	1106.09	revnaud	780.00	78	8 17	312.6	9527.1671 /	9520.1786	
ratt r1	1106.09	revnaud	780.00	79	9 5	312.6	9527.1684 /	9520.1799	
ratt r1	1106.09	revnaud	780.00	81	9 10	312.7	9527.1498 +	9520.1612	
ratt r1	1106.09	revnaud	780.00	83	8 16	1401 312.7	9527.1646 +	9520.1761	
rattle	1106.09	revnaud	780.00	72	3 9	312.6	9538.8978 /	9531.9144	
rattle	1106.09	revnaud	780.00	72	6 2	312.6	0.0000 /	9531.9000	red
rattle a	1106.09	revnaud	780.00	72	6 2	312.6	9538.8967 /	9531.9133	
saddle 2	800.70	sent r13	735.40	72	3 8	272.0	14569.7763 /	14567.1820	
saddle 2	0.00	sent r13	0.00	72	6 4	272.0	14569.7755 /	14567.1813	
saddle 2	800.70	taunton	579.60	72	3 8	99.2	27111.1675 /	27107.3482	
saddle 2	0.00	taunton	0.00	72	6 4	99.2	27111.1626 /	27107.3432	
saddle 2	800.70	taunton	579.60	75	5 16	99.2	27111.1668 /	27107.3475	
saddle 2	800.70	taunton	579.60	78	8 18	99.2	27111.1614 /	27107.3420	
saddle 2	800.70	taunton	579.60	79	9 6	99.2	27111.1580 /	27107.3417	
saddle 2	800.70	taunton	579.60	81	9 13	99.3	27111.1552 +	27107.3419	
saddle 2	800.70	taunton	579.60	83	8 13	1443 99.3	27111.1557 +	27107.3414	

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Table 2. 1981-1983 line length changes for the Geodolite lines observed near Hanford, WA.

<u>From</u>	<u>To</u>	<u>Line length</u> <u>km</u>	ΔL <u>mm</u>	σ <u>mm</u>
BASIC HANFORD NETWORK				
Allard	Saddle 2	15.6	5.6	6.1
Benson	Coal	13.2	0.7	5.7
Benson	Rattlesnake	10.9	3.5	5.2
Coal	Gable	32.5	21.4	10.1
	Pug	26.4	10.1	8.6
	Rattlesnake	18.2	-0.9	6.7
	Reynaud	12.0	-0.3	5.4
	Saddle	28.0	-3.6	9.0
	Sentine	23.4	-8.4	7.9
Corfu	Saddle	17.3	1.0	6.5
French	Saddle	17.1	12.3	6.4
Gable	Hartman	25.0	-4.8	8.2
	Pug	9.5	2.7	5.0
	Radio	24.4	0.7	8.1
	Rattlesnake	33.6	-6.2	10.4
	Saddle	28.9	1.2	9.2
	Taunton	22.4	-2.4	7.6
Hartman	Kelly	10.2	-1.3	5.1
	Lyne	11.3	-8.2	5.3
	McKinley	19.1	-11.0	6.4
	Rattlesnake	20.2	-0.3	7.1
	Weller	11.3	-0.6	5.3
Kelly	Rattlesnake	15.5	6.4	6.1
McManamon	Saddle	28.8	1.4	9.2
Pug	Rattlesnake	24.3	4.9	8.1
Radio	Saddle	8.6	-0.2	4.9
Rattlesnake	Reynaud	9.5	14.9	5.0
Saddle	Taunton	27.1	0.5	8.8
COLD CREEK NETWORK				
911	913	8.44	-6.4	4.9
	916	6.09	-2.4	4.6
	Benson	8.09	-2.4	4.8
912	913	5.89	-0.2	4.6
	916	3.60	+2.5	4.4
	917	2.99	-3.7	4.3
913	914	2.71	-1.3	4.3
	915	4.09	-8.1	4.4
	Benson	8.33	-3.6	4.9
914	915	4.51	-0.7	4.4
916	917	14.19	+0.8	5.8
Benson	Haven	13.06	+0.5	5.6

<u>From</u>	<u>To</u>	<u>Line length</u> <u>km</u>	ΔL <u>mm</u>	σ <u>mm</u>
PROSSER NETWORK				
Bender	Gibbon	10.24	-7.1	5.1
	Weller	6.33	+1.9	4.6
Gibbon	Weller	10.37	-3.7	5.2
WALLULA GAP NETWORK				
Jigg	Siwash	3.76	+13.7	4.4
	Yellepit	2.66	-8.3	4.3
Siwash	Yellepit	2.71	4.3	4.3
WARM SPRINGS NETWORK				
Lambdin	Power Line	6.26	9.2	4.6
	Warm Springs	6.30	-4.6	4.6
Power Line	Warm Springs	7.93	-2.9	4.8
MILTON FREEWATER NETWORK				
Geer	Quarry East	5.38	-1.8	4.5
	Quarry West	4.62	+1.5	4.4
Quarry East	Quarry West	2.15	-16.8	4.3

Table 3. Strain rates (with standard deviations) in $\mu\text{strain/a}$ along the Wallula fault system. The coordinate system is oriented so that the 1 axis is parallel to fault strike ($S60^\circ E$) and the 2 axis is perpendicular to strike ($N30^\circ E$).

Network	$\dot{\epsilon}_{11}'$	$\dot{\epsilon}_{12}'$	$\dot{\epsilon}_{22}'$
Milton-Freewater	-3.4 ± 0.9		1.9 ± 0.8 -0.8 ± 1.1
Prosser	0.0 ± 0.4		-0.3 ± 0.3 -0.2 ± 0.3
Wallula Gap	0.9 ± 0.9		-2.4 ± 0.9 -2.1 ± 1.0
Warm Springs	-0.5 ± 0.3		0.1 ± 0.4 0.8 ± 0.4
All 4 Nets	-0.25 ± 0.24		-0.27 ± 0.17 0.9 ± 0.20

COLD CREEK VALLEY LEVEL LINE, HANFORD, WASHINGTON:
SUMMARY OF INITIAL OBSERVATIONS

by

W. H. Prescott

Introduction

As part of a broad investigation into the suitability of a prospective nuclear waste disposal site near Hanford, Washington, the U.S. Geological Survey (USGS), under contract to the Department of Energy, has begun an investigation into the vertical stability of the area. The U.S.G.S. has established a 20 km long level line running north-south across Cold Creek Valley. This level line has been measured twice, in February 1982 and in September and October 1983. These two surveys taken together form a base measurement against which future surveys can be compared for the purpose of detecting crustal motion. The purpose of this report is to discuss these first two surveys and to record the data in an accessible form. In addition to the vertical control discussed here, the USGS has been conducting studies of the horizontal stability of the area since 1972. These measurements are discussed elsewhere (Savage et al., 1981; Prescott and Davis, 1983; Savage, 1984).

Data Set

In February 1982 the U.S. Geological Survey established a level line across Cold Creek Valley. The line extended 19.6 km in a north-south direction from the Rattlesnake Hills to a small unnamed hill just west of Gable Butte (Figure 1). In February 1982 the relative elevations of all bench marks were determined by conducting a first-order spirit level survey along the line. The leveling was repeated in September and October 1983.

There are 20 bench marks along the level line. Two of these, Haven (1947) and Lyne (1947), are old horizontal survey markers that have been in place for nearly 40 years. Two, U.S.G.S. 610 (1915) and U.S.G.S. F322 (1949), are old vertical control marks that have also been in place for many years. 911 and 917 were installed by Rockwell-Hanford personnel and have been used for both horizontal and vertical surveys. One mark, 32 Ensting (1949), was established by Rogers Surveying Co. The remainder of the marks were established by Walters Flying Service (WFS), the subcontractor for both horizontal and vertical surveys in the Hanford area. The marks used in 1982 are numbered "WFS#1" through "WFS#13". In 1983 the field crew determined that the WFS series marks were unsatisfactory and a second set of marks were established nearby. The 1983 marks are stamped "BM 20" through "BM 32". Each 1983 mark is 3 feet south and 3 feet west of the corresponding 1982 mark. Appendix D contains copies of descriptions for all the stations and Appendix E contains a copy of a letter describing the procedures used in installing the 1983 bench marks.

All leveling was done using first-order leveling equipment. A Wild N-3 spirit level (U.S.G.S identification number G-279967) and Wild GPL-3 level rods (serial numbers 1685A, 1685B, 2176A and 2176B) were used. The level uses a parallel plate micrometer to read directly to 0.01 cm with interpolation to 0.001 cm. The rods consist of a wooden frame supporting an invar steel strip. The strip is under tension and graduated every centimeter. The thermal coefficient of invar steel is about $0.0000015 \text{ m/m/}^{\circ}\text{C}$. A copy of a recent calibration is contained in Appendix G.

With minor exceptions, the levels were conducted in accordance with standard procedures for first-order levels. These procedures are summarized briefly in the statement of work contained in Appendix H, and discussed more fully by Phillips (1980). The 1982 survey was double run, to First Order, Class II standards (p. 28, Phillips (1980)). The 1983 survey was single run to First Order, Class II specifications, a category of leveling now referred to as First Order, Class III leveling. It is commonly used for releveling after relatively short time intervals such as was the case at Hanford. The essential requirements of the specifications are:

- Maximum sight lengths of 50 m
- Maximum sight imbalance 2 m per setup
- Maximum sight imbalance 4 m per section
- Minimum rod reading 0.5 m
- Maximum difference between low and high scale reading 0.30 mm
- Maximum line misclosure 5 mm
- Maximum difference between forward and backward running of a section 4 mm K

Where K is section or line length in kilometers.

Discussion

The elevation differences that were obtained in 1982 and 1983 are summarized in Table 1 columns a and c. Because different sets of intermediate bench marks were used during the two surveys, it is not possible to directly compare the observed elevation differences. Columns (b) and (d) contain cumulative elevation differences between the 7 bench marks that were common to both surveys. Rod calibrations, temperature corrections and orthometric height corrections have not been applied to the observations listed in Table 1. The orthometric correction along the level route is only about 1 mm. Assuming no change in gravity this correction is time invariant and will not affect the comparison in Table 2. Since the entire orthometric correction for this line is on the order of 1 mm, even if gravity changed there would be no significant effect on the orthometric height correction. From the plot in Appendix F it is apparent that the worst scale on the rods has a proportional error of about 20 ppm (.006 cm in 300 cm). Since the maximum elevation difference along the Cold Creek level line is less than 400 m, the rod correction is less than 8 mm. Most of the correction is in the single section WFS13/BM32 to 917. Over the remainder of the line the rod correction is less than 1 mm.

The rods were calibrated at 15°C. Air temperature during the leveling varied from -4°C to 24°C (25° to 75°F, Appendices A and B). The coefficient of expansion of invar is 1.5 ppm/°C so the maximum temperature correction is 30 ppm. Over most of the line the temperature correction is less than 1.5 mm. Over the section WFS13/BM32 to 917 the temperature correction would be significant. During the 1982 survey of this section the temperature averaged 30°F or 0°C during the 1983 survey the temperature was 55°F or 13°C. Consequently, the elevation difference obtained in 1982 should be decreased by 5 mm and the elevation difference obtained in 1983 by 0.7 mm. This correction would reduce the observed change in elevation (Table 2) of the section Lyne to 917 from -5.79 mm to about -2 mm. Temperature correcting the other sections would have no affect.

Not all of the specifications were adhered to rigorously during the surveys. As an examination of the field notes from 1982 will reveal, the sight lengths frequently exceeded 50 m and the minimum reading was often less than 0.5 m. In 1983 one section elevation difference, F322 to 32 Ensting, exceeded the allowed line divergence.

Neither the 1982 nor the 1983 field crew recorded the identification of the rods and levels used. Only one level could have been used. During the 1982 survey either of the rod pairs may have been used. 1685A and B were lost in shipping in June 1982 so 2176A and B were used in 1983.

Summary and Suggestions for Future Work

Initial measurements have been completed along a 20 km long level line across Cold Creek Valley. In a number of ways these measurements were not conducted the way they should have been. Some of the procedures for first-order leveling were not followed. Bench marks were replaced with no tie made between the old and new bench marks. In spite of these shortcomings in the methods, the results appear satisfactory. We now have a baseline against which future surveys can be compared.

In light of the low rates of movement in the vicinity of the Hanford site, we suggest a 3 year interval between observations. Since both the horizontal and vertical arrays were surveyed in mid-1983, they will be due in 1986. Measurements more often than once in 3 years are probably not cost effective when the deformation rates are below 0.1 ppm/yr as they appear to be at Hanford. The observed horizontal compression rate of 0.27 ppm/yr across the Cold Spring syncline (Savage, 1984) is higher and an earlier survey of this area might be indicated. However, there will be no serious loss of information incurred by leaving this area until 1986 also; by then we will have a 5 year record in the area and the strain rates should be well defined. Consequently, we suggest a complete resurvey of both the horizontal and vertical arrays in 1986.

References

- Phillips, John O, 1980, Specifications to support classification, standards of accuracy and general specifications of geodetic control surveys, Federal Geodetic Control Committee, U.S. Dept. of Commerce, National Ocean Survey, Rockville, Md.
- Prescott, W. H. and J. D. Davis, 1983, Geodolite observations near Hanford, Washington, Tech. Mem. RHO-BW-CR-132P Rockwell Hanford Operations, Richland, WA.
- Savage, J. C., M. Lisowski, and W. H. Prescott, 1981, Geodetic strain measurements in Washington, J. Geophys. Res., 86(B6), 4929-4940.
- Savage, J. C., 1984, Deformation of the Hanford Strain Network, unpublished report.

Table 1. Summary of Observed Elevation Differences

Station 1	Station 2	(a) 1982 Individual Sections (M)	(b) 1982 Preexisting Sections (M)	(c) 1983 Individual Sections (M)	(d) 1983 Preexisting Sections (M)
Haven	WFS 1/BM 20	-43.68253		-44.02852	
WFS 1/BM 20	WFS 2/BM 21	-3.46373		-3.42489	
WFS 2/BM 21	WFS 3/BM 22	3.15636		3.48710	
WFS 3/BM 22	WFS 4/BM 23	14.53972		14.49985	
WFS 4/BM 23	WFS 5/BM 24	31.04737		31.04468	
WFS 5/BM 24	USGS F322	15.03964	16.63683	15.06437	16.64259
USGS F322	WFS 6/BM25	-47.25877		-42.35641	
WFS 6/BM25	WFS 7/BM 26	-1.04732		-6.11416	
WFS 7/BM 26	WFS 8/BM 27	-1.69814		-1.59334	
WFS 8/BM 27	Ensting 32	-1.69924	-51.70347	-1.62677	-51.69068
Ensting 32	WFS 9/BM 28	1.77572		1.66201	
WFS 9/BM 28	Rockwell 911	6.12241	7.89813	6.23681	7.89882
Rockwell 911	USGS 610	-12.15454	-12.15454	-12.15187	-12.15187
USGS 610	WFS 10/BM 29	2.01434		1.89247	
WFS 10/BM 29	Lyne	22.32757	24.34191	22.44761	24.34008
Lyne	WFS 11/BM 30	43.25491		43.46137	
WFS 11/BM 30	WFS 12/BM 31	56.97773		56.80882	
WFS 12/BM 31	WFS 13/BM 32	68.80900		68.67120	
WFS 13/BM 32	Rockwell 917	222.69564	391.73728	222.79016	391.73155

Table 2. Summary of Observed Changes in Elevation Difference

Station 1	Station 2	Section Length (Km)	Elev. Diff. 1983-1982 (mm)	Divergence Allowed ($= 5\text{mm}/\sqrt{\text{Km}}$) (mm)
Haven	F322	5.9	+5.67	12.1
F322	32 Ensting	4.7	+12.65	10.8
32 Ensting	Rockwell 911	1.7	+0.48	6.5
Rockwell 911	USGS 610	1.2	+2.78	5.5
USGS 610	Lyne	1.7	+1.87	6.5
Lyne	Rockwell 917	4.4	-5.79	10.5
Cumulative		<u>19.6</u>	<u>13.92</u>	<u>18.7</u>

28

(A) Haven

△ WFS 1 / BM 20

△ WFS 2 / BM 21

△ WFS 3 / BM 22

△ WFS 4 / BM 23

△ WFS 5 / BM 24

△ F 322

△ WFS 6 / BM 25

△ WFS 7 / BM 26

△ WFS 8 / BM 27

△ Rogers Ensting 32

△ WFS 9 / BM 28

△ Rockwell 911

△ USGS 610

△ WFS 10 / BM 29

△ Lyne

△ WFS 11 / BM 30

△ WFS 12 / BM 31

△ WFS 13 / BM 32

△ Rockwell 917

APPENDIX A:

February 1982 Field Notes

[illegible][illegible]

DATE 2/9/82

TIME 2:00

DIRECTION FW

BW

PARTY 5 E3E3

ROD 100

LOCATION KICKLAND CEM

FROM BM HAVEN

TO BM WFS 1

WEATHER CLEAR

COORDINATES X

Y

EMP	STA	BACKSIGHT				FORESIGHT				REMARKS		
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA		DIST	R-L
	1	301550	4				2	301550	3			
5084	028	508687E	508687E					9434341	9434341			
	2	111938	1450	662			1	1522469	166E			
		301550	3	413452				301550	4	933448		
530158		5500084	5500084					9668380	9668380			
	1	301550	4				2	301550	3			
	2	301550	3				1	301550	4			
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DATE 2/11/82 TIME 10:30 DIRECTION FW ☐ BW ☒ PARTY 5 EYES ROD 222
LOCATION Rock Land WA. FROM BM WEST TO BM HAYEN ☒ DL ROD 3m
WEATHER cloudy COORDINATES X Y ☒ SE

[illegible]

DATE 4/19/62 TIME 1600 DIRECTION FIN ☒ DNV ☐
LOCATION _____ FROM BM WES 2 TO BM WES 3
WEATHER CLEAR 2060 41° COORDINATES X _____ Y _____
MARKING 5. ESTES ROD WA
" SLATE ROD SP
" SL

[illegible]

DATE 2/10/62 TIME 12:45 DIRECTION FW ☐ BW ☒ PARTY SURVEY ROD 210
LOCATION FROM BM WES 3 TO BM WES 2 N DL ROD IM
WEATHER CLEAR 60.0 31.0 COORDINATES X Y SE

MP	STA	BACKSIGHT						FORESIGHT						REMARKS
		RIGHT	LEFT	STADIA	DIST	R-L		RIGHT	LEFT	STADIA	DIST	R-L		
	1	132539			55.6		2	094638			61.0			
		301550	4	437032		+7		301550	3	395685		-2		
		437039						395683						
	2	171522		196	50		1	137240		181.6	48.8			
		301550	3	473135				301550	4	438836				
		910221				+4		634473				-48		
	1	145129		168	50		2	179496		203.7	48.6			
		301550	4	445497				301550	3	481100				
		1353200				+14		131559				-102		
	2	134737		168.1	48.4		1	152070						
		301550	3	441215				301550	4	457642		50		
		1796987				-2		147334				-124		
	1	121460		141.0	49.2		2	173769		192.1	46.8			
		301550	4	422938				301550	3	475333				
		2249497				+70		225058				-138		
	2	134110		158.9	49.6		1	164530		187	45			
		301550	3	435700				301550	4	466069				
		4575659				+30		2716538				-127		
	1	093831		117.1			2	145246		168.1	45.8			
		301550	4	395287				301550	3	446835				
		30157038				+124		3163334			4	-166		
	2	132098		157	50		1	149467		175.9	53			
		301550	3	433700				301550	4	451060				
		3484686				+70		3614357				-209		
	1	116239		140.5	48.6		2	188200		211.2	46			
		301550	4	417772				301550	3	489779				
		3402475				+89		4104101				-258		
(UB) TOTAL														37

DATE 2/10/82 TIME 2:15

DIRECTION FW ☐ BW ☒

PARTY

ROD

LOCATION

FROM BM 2253 TO BM 2252

κ

ROD

WEATHER CLEAR COLD 37°

COORDINATES X

Y

⊠

EMP	STA	BACKSIGHT				FORESIGHT				REMARKS	
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA		DIST
		3902475	3902386			189	4124101	4124339			
	1	301550				2	301550	3			
	2	294318		119	50	1	161466		141	60	
		301550	395860				301550	4	463241	-263 - 265	
		4298343	4298246			197	4571117	4587360			
	1	115061		1325	35	2	161192		174.8	574	
		301550	416605				301550	3	462777		
		4714934	4714851			103	4824837	5030157		-298	
	2	301550					1	5024859			
		301550					301550	4			
	1	301550				2	445546				
		301550					301550	3			
	2	301550					1				
		301550					301550	4			
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DATE 2/11/82 TIME 12:00
LOCATION _____
WEATHER clear 1060 42°
DIRECTION FW ☒ BW ☐ RETURN to BM
FROM BM 12FS 1 12FS 2
COORDINATES X _____ Y _____
PARTY 955/25 ROD 144
PARTY 1 ROD 5M

[illegible]

DATE 2/10 TIME 8:45 DIRECTION FW ☒ BW ☐
LOCATION _____ FROM BM WFS 1 TO BM WFS 2
WEATHER CLD 22° COORDINATES X Y _____

[illegible]

DATE 2/10/82 TIME 10:20 DIRECTION FW ☒ BW ☐
LOCATION _____ FROM BM WES 2 TO BM WFA 2
WEATHER CLEAR 66-60 28" COORDINATES X _____ Y _____
PARTY S. E. SHER ROD 42
P. J. A. ROD JDA

[illegible]

[illegible][illegible]

MP	STA	BACKSIGHT					FORESIGHT					REMARKS
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA	DIST	R-L	
	1	301550 4	4032266	217		2	301550 3	3786175				
	2	261303				1	208091		22.2			
		301550 3	562906				301550 4	309635				
		4595019	4595766			2157	4095749	4095810			-61	
	1	301550 4				2	301550 3					
	2											
		301550 3				1	301550 4					
	1	301550 4				2	301550 3					
	2											
		301550 3					301550 4					
	1	301550 4										
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		301550 3					301550 4					
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	2											
		301550 3					301550 4					
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	2					1	301550 3					
		301550 3					301550 4					
	1	301550 4				2	301550 3					
	2											
		45950125					40957795					
		499270	499356									
(B) TOTAL			499313									43

[illegible]

DATE 2/11/82 TIME 2:40 DIRECTION FW ☒ BW ☐ PARTY 3 ESTB ROD W
LOCATION Substance WFR FROM BM WFS 3 TO BM WFS 4 K DL ROD JM
WEATHER cloudy cool 39° COORDINATES X Y 05

[illegible]

[illegible]

FOPI 1100

DATE 2/11/82 TIME 3:25 DIRECTION FW ☒ BW ☐ PARTY 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462

[illegible]

DATE 2/11/82 TIME 4:30 DIRECTION FW ☒ BW ☐
LOCATION _____ FROM BM 4154 TO BM WES 5 PARTY SESTES ROD _____
WEATHER cleary cold 52° COORDINATES X _____ Y _____ ☐ _____

[illegible]

[illegible]

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516740-20058

[illegible]

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13

DATE <u>2/15/02</u> TIME <u>9:00</u> DIRECTION <u>FW</u> ☒ <u>BW</u> ☐		WATERS		PARTY'S		PAGE		
LOCATION <u>RESEARCH</u>		FROM <u>BM 4563</u>		TO <u>BM 4563</u>		ROD <u>50</u>		
WEATHER <u>Partly cloudy</u>		COORDINATES <u>X</u>		<u>Y</u>		<u>SE</u>		
TEMP	STA	BACKSIGHT				FORESIGHT		REMARKS
53	TR	RIGHT	LEFT	STADIA	DIST	R-L	LEFT	R-L
	1	5449352	5949490			162	5473424	443
	2	019002	432556	43.6	49.6		243431	50.4
	3	301550	577004				301550	
	4	0253053	577004	52.8	59.6	558	10218405	28.4
	5	301550	354650				1 221241	
	6	6124701	6124696			11	301550	6.0
	7	071505	96				10741196	425
	8	301550	373059				2 190343	58
	9	6477102	647755			407	301550	
	10	114239	425414	136	43.6		11233131	497
	11	301550	373059				1 109822	
	12	6913551	6413574			423	301550	43
	13	301550	4				11639470	4101
	14	2					2	
	15	301550	3				301550	
	16	1					2	
	17	301550	4				301550	
	18	2					1	
	19	301550	3				301550	
	20	1					2	
	21	301550	4				301550	
	22	2					1	
	23	301550	3				301550	
	24	1					2	
	25	301550	4				301550	
	26	2					1	
	27	301550	3				301550	
	28	1					2	
	29	301550	4				301550	
	30	2					1	
	31	301550	3				301550	
	32	1					2	
	33	301550	4				301550	
	34	2					1	
	35	301550	3				301550	
	36	1					2	
	37	301550	4				301550	
	38	2					1	
	39	301550	3				301550	
	40	1					2	
	41	301550	4				301550	
	42	2					1	
	43	301550	3				301550	
	44	1					2	
	45	301550	4				301550	
	46	2					1	
	47	301550	3				301550	
	48	1					2	
	49	301550	4				301550	
	50	2					1	
	51	301550	3				301550	
	52	1					2	
	53	301550	4				301550	
	54							

[illegible]

[illegible][illegible]

[illegible][illegible]

BW ☒

MF

LECTION

$$\frac{D_1}{D_2}$$

10:5

2. TIME

2/15/8

DATE _____

LOCATION REXLAND 4119 FROM BM WES 7 TO BM WFS 6 PL ROD IN
WEATHER partly cloudy windy 15° COORDINATES X Y SE

[illegible]

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[illegible]

EMP	STA	BACKSIGHT						FORESIGHT					
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA	DIST	R-L	REMARKS	
		3889257	3889349			+83	3956445	3956455			-10		
	1	138062		164	52	2							
		301550	429591				301550	3					
		A32891H	4328940			+H							
	2						196302		76.8	53			
		301550	3				301550	4					
							4404297				-19		
	- 1	124676		48.7	502	2	145429		70.1	46.4			
		301550	426231				301550	3					
		4755195	4755171			+24	4851276				-35		
	2	122870		48.5	514	1	160387		87	54			
		301550	3174387				301550	4					
		5179615	5179558			+57	5313213		183.5		-67		
	1	122889		46	48	2	159052			49			
		301550	424416				301550	3					
		5604054	5603974			+80	5773815				-35		
	2					1							
		301550	3				301550	4					
	1					2							
		301550	4				301550	3					
	2					1							
		301550	3				301550	4					
	1					2							
		301550	4				301550	3					

DATE <u>2/17/2015</u> DIRECTION <u>FW</u> ☐ <u>BW</u> ☒										WALERS FLING SERVICE PAGE <u>3</u> OF <u>42</u>									
LOCATION <u>RICHARD WEA</u> FROM <u>BM WES B</u> TO <u>BM WES 2</u> <u>N</u> <u>06</u> <u>ROD 50</u>																			
WEATHER <u>partly cloudy cool</u> COORDINATES <u>X</u> <u>Y</u> <u>00</u> <u>50</u>																			
BACKSIGHT					FORESIGHT														
EMP	STA	RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA	DIST	R-L	REMARKS							
	580																		
1	158808			82.8	48		2	123671		146	48								
	301550	4	460351			42	301550	3	424738										
	46358						424221												
2	162810				51.6		1	136789		52.2									
	301550	3	464339				301550	4	428348										
	924718		924690			428	852560				116								
1	147128			72.1	50		2	134612		49.8	50.4								
	301550	4	448700				301550	3	426143										
	1373396		1373390			36	1278722				153								
2	142844			62.5	51.4		1	135090		61.1	52.2								
	301550	3	444373				301550	4	436635										
	1817790		1817763			427	1715362				118								
1	137082						2	139679		45.8	52.4								
	301550	4	438616		51.9		301550	3	441238										
	2256422		2256379			443	2156591				19								
2	147006			72.1	50.2		1	134535		59	49								
	301550	3	448561				301550	4	436080										
	2704978		2704940			158	2592677				15								
1	144862			70	50.4		2	141281		66.6	50.8								
	301550	4	446401				301550	3	446819										
	3157390		3157341			149	3235208				42.7								
2	150480			74.9	49		1	136849		161	48.4								
	301550	3	452015				301550	4	438361										
	3603420		3603356			464	3473907				465								
1	145570			67.1	43.2		2	146452		72	51.2								
	301550	4	447062				301550	3	447978										
	4050480		4050413			462	3924909				189								
SUB) TOTAL																			
-																			
63																			

DATE <u>2/17/82</u> TIME <u>10:50</u> DIRECTION <u>FW</u> ☐ <u>BW</u> ☒		LOCATION <u>FROM BM WFS 8</u>		WEATHER <u>COORDINATES X</u>					
MP	STA	BACKSIGHT				FORESIGHT			
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	
		4050480	4050418			462	3921909	3921	
1	147139			725	50.8		2 1283328		
		301550 4	448701				301550 3	429	
		4499219	4499119			7100	4351787	4351	
2	1288971			531	48.4		1 124358		
		301550 3	430501				301550 4	425	
		4929740	4929620			7120	4717695	4717	
1	1401522			651	50		2 122978		
		301550 4	441676				301550 3	424	
		5371447	5371296			7146	5202223	5202	
2	731891			58.2			1 131263		
		301550 3	433428				301550 4	4322	
		5804883	5804724			7159	5035026	5035	
1							2		
		301550 4					301550 3		
2									
		301550 3					301550 4		
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DATE 3/1/82 TIME 12:35 DIRECTION FW ☒ BW ☐ PARTY SLESTES ROD W2
LOCATION Richmond WPA FROM BM W2'S B TO BM BM #32 ^{EXISTING} PL ROD iron
WEATHER cloudy cool windy 62° COORDINATES X Y 58

[illegible]

DATE 2/16/82 TIME 1:38 DIRECTION FW ☒ BW ☐ EXTRINSIC BMS PARTY 3 ESTERS ROD 420
LOCATION NEILSON WET FROM BM WFS B TO BM 623.405 N DL ROD 50
WEATHER cloudy cool windy 63° COORDINATES X Y DL SE

[illegible]

[illegible]

[illegible]

[illegible]

DATE 3/17/82 TIME 8:10 DIRECTION FW ☐ BW ☒ PARTY 5-53-6-3 ROD 42m
LOCATION Quiland rtr FROM BM 42-3-9 TO BM 43-2-6 10 10 ROD 50m
WEATHER clear 53° COORDINATES X Y 0 25

EMP	STA	BACKSIGHT						FORESIGHT					
		RIGHT	LEFT	STADIA	DIST	R-L		RIGHT	LEFT	STADIA	DIST	R-L	REMARKS
	1	095839						2	724278				
		301550	4	391356		-33			301550	3	535776		+52
		397989							525858				
	2	134850						1	083261				
		301550	3	436402					301550	4	384813		52.6
		8333789							910639				+45
	1	027962						2	197767				
		301550	4	774500					301550	3	499700		52.6
		1213201							1409956				46.2
	2	111062						1	148962				
		301550	3	412633					301550	4	450501		
		1625913							1860468				+73
	1	101982						2	155480				
		301550	4	403531					301550	3	457041		
		2039445							2317498				+42
	2	184474						1	109719				
		301550	3	486010					301550	4	411388		
		2515464							2728724				+93
	1	116385						2	080756				
		301550	4	417475					301550	3	382270		
		24333404							311073				+78
	2							1					
		301550	3						301550	4			
	1							2					
		301550	4						301550	3			
									127669				
									127587				
(SUB) TOTAL													
									127628				70

FOIA b 7(D)

[illegible][illegible]

[illegible][illegible]

[illegible]

[illegible]

DATE 2/19/82 TIME 10:50

DIRECTION FWD ☒ BW ☐

WALLERS FLYING SERVICE

PAGE 2.01

LOCATION Richland WA

FROM BM 911

PARTY SEBES

ROD 48

WEATHER sunny windy

COORDINATES X

Y

OD 585

TO BM WES 9

R

DL

ROD 12

EMP	STA	BACKSIGHT				FORESIGHT				REMARKS			
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA		DIST	R-L	
1	115774			41.7	52		2	173576					
	301550	4	417368					301550	3	475093			
	3916643		3916700			-77		4528994		4528905			489
2							1						
	301550	3						301550	4				
1							2						
	301550	4						301550	3				
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	301550	3						301550	4				
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DATE 03/26/92

TIME 10:15

DIRECTION FW ☐ BW ☒

WALKERS FLYING SERVICE

PAGE 3 OF 3

LOCATION RICHMOND WA

FROM BM WES 11

TO BM 455496

PARTY SEATES

ROD 30

WEATHER SUNNY CLEAR COOL

COORDINATES X

Y

DL

545

EMP	STA	BACKSIGHT				FORESIGHT				REMARKS	
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA		DIST
	1	092951		116	29.8		2	348253			
		301550	4	394522				301550	3	600776	53.2
		621720		621722		-22		1068904		1068905	
	2	012160		99	54		1	193575		20.1	53.2
		301550	3	373114				301550	4	44541	
		638010		638016				1182922		1184096	
	1	390283			88.9	11.8	2	013412			
		301550	4	532650				301550	3	34850	
		717318		717316				149154		1498896	
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DATE 2/21/82 TIME 2000
LOCATION RUBBANK WY
WEATHER CLOUDY CAL

DIRECTION FWD ☒ BW ☐
FROM BM BANKS 11 TO BM WFS 12
COORDINATES X Y

WALTERS FLYING SERVICE PARTY SCHLES ROD WA
PAGE 3 OF 3 PAGE 3 OF 3

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DATE 2/24/EZ TIME 12:35
LOCATION RICHMOND WA
WEATHER SUNNY CBL 50"

EMP	STA	BACKSIGHT						FORESIGHT						REMARKS
		RIGHT	LEFT	STADIA	DIST	R-L		RIGHT	LEFT	STADIA	DIST	R-L		
	1	265018		12.4	26.8			2	109332		12.4	27.4		
		301550	4	566569					301550	3	410912			
		18162788		18182827		-39			9431520					
	2	285300		52.9	19.2			1	133615		14.3	17.4		
		301550	3	5849850					301550	4	435167			
		16747638		16747677		-39			9866745					
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DATE 3/14/02 TIME 4:05

DIRECTION FW ☐ BW ☒

WALLERS FLYING SERVICE PARTY SCOTT'S ROD 42

LOCATION RICHMOND WA

FROM BM 13 TO BM 12

PARTY SCOTT'S ROD 42

WEATHER CLEAR 42°

COORDINATES X Y

OK SEE

EMP	STA	BACKSIGHT				FORESIGHT				REMARKS		
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA		DIST	R-L
1	079293			92.4	22.4		2 248884					
	301550	4	300848				301550	3	531440			
	955088		205048			58	16199532		16199482			750
2	082440			73	21.2		1 301701			89.3	26.2	
	301550	3	383970				301550	4	581256			
	991428		8914850			178	16195783		16195738			45
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11

DATE 2/25/82

TIME 1624

DIRECTION FW ☒ BW ☐

WALKERS FILING SERVICE

PAGE 7 OF 20

LOCATION R. C. C. L. A. N. D.

FROM BM 205513

TO BM C

PARTY S. C. S. T. O. N. S.

ROD 1.00

WEATHER CLOUDY

36°

COORDINATES X

Y

D.C.

MP	STA	BACKSIGHT				FORESIGHT				REMARKS	
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA		DIST
	1	271136		285							
		301550	4	572680							
		42614053		42613479							
	2	29619411		876	18						
		301550	3	548490							
		43212544		43212069							
	1	2861960		426	11.4						
		301550	4	5725712							
		43212544		43212069							
	2	2401254		281.5	11.6						
		301550	3	542180							
		43212544		43212069							
	1	271531		271.9	12.8						
		301550	4	572107							
		43212544		43212069							
	2	2401254		281.9	12.8						
		301550	3	542180							
		43212544		43212069							
	1	271522		296.2	9.4						
		301550	4	573058							
		43212544		43212069							
	2	2401254		277.5	15.2						
		301550	3	571511							
		43212544		43212069							
	1	285341		276	21.4						
		301550	4	572680							
		43212544		43212069							
	2	2401254		277.5	15.2						
		301550	3	571511							
		43212544		43212069							
	1	285341		276	21.4						
		301550	4	572680							
		43212544		43212069							
	2	2401254		277.5	15.2						
		301550	3	571511							
		43212544		43212069							
	1	285341		276	21.4						
		301550	4	572680							
		43212544		43212069							
	2	2401254		277.5	15.2						
		301550	3	571511							
		43212544		43212069							
	1	285341		276	21.4						
		301550	4								

DATE 2/26/82

TIME 0815

DIRECTION FW

BW

WALLERS FLYING SERVICE

PAGE 20 OF 20

LOCATION Richland

FROM BM wfs 13

TO BM 817

PARTY S E S T A S

ROD w w

WEATHER clouds cold

COORDINATES X

Y

DATA

P S E S T A S

ROD J M

MP	STA	BACKSIGHT				FORESIGHT				REMARKS	
		RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA	DIST	R-L
	1	247048		300.2	26.4		2	005674			
		301550	4				301550	3		18.8	
		47907021	4			4118	26180807				4111
	2	279132		296	33.8		1	009372		25.8	33
		301550	3				301550	4			
		48487253				4132	26491229				4115
	1	276460		292.5	22.2		2	002892		15.3	25
		301550	4				301550	3			
		49065763				4140	26796171				4103
	2						1				
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		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
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	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
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		301550	3				1				
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	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4				301550	3			
	2										
		301550	3				1				
							301550	4			
	1						2				
		301550	4								

DATE 2/26/92 TIME 0833 DIRECTION FW ☐ BW ☒

LOCATION Richland FROM BM G (912) TO BM WMS 13 PARTY S E S ROD 5 m

WEATHER clouds cold 82.000 COORDINATES X Y DATA

MP STA

RIGHT

LEFT

STADIA

DIST

R-L

RIGHT

LEFT

STADIA

DIST

R-L

REMARKS

BACKSIGHT

FORESIGHT

1	009218		220	25.6		2	292401														
	301550	4	310764				301550	3	584328			294	22.4								
	310768					4	584351														
2	018595		36	35		1	278141					294	31.8								
	301550	3	320141				301550	4	579692												
	630913					18	1164042														
1	018465		23.2	9.6		2	285265					291	11.6								
	301550	4	320010				301550	3	586818												
	950928					113	1750857														
2	017400		20.5	6.2		1	278701					82.5	7.6								
	301550	3	318938				301550	4	580258												
	1269978					125	2331108														
1	012389		16	7.4		2	292833					96.5	7.4								
	301550	4	313942				301550	3	574324												
	1583917					122	2925491														
2	011998		14	4.2		1	294545					294	7.0								
	301550	3	313532				301550	4	596092												
	1897365					138	3521596														
1	006730		8.95	5.6		2	295442					298.5	6.2								
	301550	4	309285				301550	3	2985690												
	2205612					138	4118578														
2	013168		16.2	6.2		1	278665					281	4.8								
	301550	3	318210				301550	4	580212												
	2520368					146	4698793														
1	026280		29	5.6		2	294710					296	2.2								
	301550	4	327832				301550	3	596452												

116

[illegible]

DATE <u>2/26/82</u> TIME <u>1053</u> DIRECTION <u>FW</u> ☐ <u>BW</u> ☒										WALERS FLYING SERVICE PARTY <u>565763</u> ROD <u>3m</u>									
LOCATION <u>Richland</u> FROM BM <u>G(917)</u> TO BM <u>WFS 13</u> ☒ <u>SC</u> ROD <u>ww</u>																			
WEATHER <u>clouds Burec</u> COORDINATES <u>X</u> <u>Y</u> <u>64724</u>																			
BACKSIGHT					FORESIGHT														
MP	STA	RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA	DIST	R-L	REMARKS							
1	011272			13	3.6		2 272565		74.5	4									
	301550	4 312811					301550	3 574118											
	9834263	9834116				147	1690684	16490590			198								
2	013164			17	7.8		1 272332		296	7.4									
	301550	3 314223					301550	4 573823											
	9148981	9148839				442	17084520	17084463			4107								
1	009601			15	10.8		2 288764		293	8.6									
	301550	4 311132					301550	3 570320											
	9460172	9459971				716	17624884	17624283			4101								
2	004950			8	6.2		1 274343		278	7.4									
	301550	3 306508					301550	4 575884											
	9766632	9766479				4153	18250222	18250667			4110								
1	005472			13	15.2		2 292558		298.2	11.4									
	301550	4 309013					301550	3 574108											
	10073654	10073492				4162	18844885	18844725			4110								
2	004801			10.2	10.8		1 287605		293.4	11.6									
	301550	3 306354					301550	4 587458											
	10380005	10379846				4159	19424040	19423933			4107								
1	016021			21.5	11		2 291900		96.5	9.2									
	301550	4 317558					301550	3 573449											
	10697576	10697404				4172	20027490	20027382			4101								
2	013462			19.2	11.6		1 292430		298	11.2									
	301550	3 315023					301550	4 573978											
	11012588	11012427				4161	20621470	20621360											
1	009090			15	12		2 296038		302	12									
	301550	4 310648					301550	3 577631											
	11323228	11323075				4153	2121908	21218991			4117								
B) TOTAL																			
- 118																			

[illegible]

122

[illegible]

MP STA	BACKSIGHT					FORESIGHT					REMARKS
	RIGHT	LEFT	STADIA	DIST	R-L	RIGHT	LEFT	STADIA	DIST	R-L	
1	02/01/1		101			2	32/60/3				
	30/550	4	30/447				30/550	3	32/60/3		
	30/550		30/447		61"		42/24/51			152	
2	02/05/4		24.9			1	30/550				
	30/550	3	30/401				30/550	4	53/22/4		
	30/550		30/401		145		42/24/51			149	
1						2					
	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
1						2					
	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
1						2					
	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
1						2					
	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
1						2					
	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
1						2					
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2						1					
	30/550	3					30/550	4			
1						2					
	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
1						2					
	30/550	4					30/550	3			
2						1					
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1						2					
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	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
1						2					
	30/550	4					30/550	3			
2						1					
	30/550	3					30/550	4			
							</				

APPENDIX B:

September, October 1983 Field Notes

ROD.

5

971

100

PODRZ
B

CF

[illegible]

DATE 9-17-83 TIME 0915
LOCATION HANFORD
WEATHER OVERCAST, COLD, LIGHT BREEZE
DIRECTION FW ☒ BW ☐ PAK 11 PG ROD_H
FROM BM^{#32} ENSTINE BM 27 π PG ROD_B
PG-5 CF

TEMP

TEMP OF	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
60°	5932.549	5932.591		593.0	+033	5975.785	5975.770		592.4	+015	
	2132.62		2384	502	-008	140440		1655	503		ROD-B @ TBM-1
	301550	514820				301550	442015			-025	
	514812			6332		441990			6326		
	301550					301550					
	185211										
CHK.	301550	486758			+003	301550					ROD-B @ CHK PT. 18- DIFF. ELEV. = 39.056 CM.
	486761										
	301550					301550					
	161386		1916	204	-012	144948		1547	200	+008	
15	301550	462948		6536		301550	446290				
	462936					446298			6526		
	164949		1863	428	-002	148526		1700	428		ROD-A @ BM#27 A 5" ALL THREAD, GALV. ROD DRIVEN TO REFUSAL (12') INCREASED IN 8" PVC 35. X 3/4. OF WFS 8
16	301550	466501		6964		301550	450068				
	466499					450076			6954		
	301550					301550					
	301550					301550					(M) DIST = 1391.8 METERS
	301550					301550					
	7376.795	7376.850		696.4	+055	7214.149	7214.143		695.4	+006	
TOTALS											
	Σ B.S. = 7376.823	Σ F.S. = 7214.146				B.S. - F.S. = +162.676 CM.					
						ELEV. METERS = 191.66476			(BM#27)		128

OCCASION HANDLED										LOCATION										DATE									
FROM BM 27										TO BM 26										PG									
WEATHER WIND, HAZ, CLOUDS, LIGHT, BREEZE										F-108										C-1									
BACKSIGHT										FORESIGHT										REMARKS									
LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R																				
1859.147	1859.139	1770	1504	0.008	1760.498	1760.472	1669	1496	0.026	ROD-A WIND IN SHADE																			
301550 (3)	458900	1770	354	-0.002	301550 (4)	450952		350	-0.03																				
459.117			1858		450.939			1846																					
1499.770		1670	540		150.404		1680	352																					
301550 (4)	451553			-0.033	301550 (3)	451949																							
451550			2197		451954			2198																					
1499.997		1670	340	0.002	150.389		1670	352	0.009																				
301550 (4)	451524				301550 (3)	451930																							
451549			2197		451939			2198																					
1609.901		1858	502	0.003	156.619		1847	502		LEVEL MAILED BEFORE LAST READINGS																			
301550 (3)	462248				301550 (4)																								
462251			2700		458.149			2700																					
1606.997		1858	502	0.009	156.599		1817	502	-0.003	DIST. CHANGED TO 50 M.																			
301550 (3)	462229				301550 (4)	458152																							
462248			2700		458.149			2700																					
1644.471		1896	502	0.001	157.637		1827	502	0.028																				
301550 (4)	461622				301550 (3)	459159																							
461621			3202		459.187			3202																					
1525.477		1777	502	-0.001	142.990		1670	500	-0.006																				
301550 (3)	454130				301550 (4)	444540																							
454129			3704		444.540			3702																					
1623.146		1893	500	0.002	152.296		1793	500	-0.007																				
301550 (4)	463714				301550 (3)	453893																							
463714			4204		453.822			4202																					
1623.355		1773	498	-0.003	152.323		1774	502	-0.027																				
301550 (1)	463702				301550 (3)	453880																							
463705			4202		453.853			4204																					
4615.894	4615.852		420.2	0.042	447.105	447.071		420.4	0.014																				
TOTALS																				- 130									

TIME 11:52 AM
 LOCATION HANESOP
 WEATHER WARM LIGHT BREEZE CLEAR
 VISION F.W. 10 W
 FROM BM 27 TO BM 26
 PAKIT 25
 ROD 26
 CF

BACKSIGHT					FORESIGHT						
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
12	5541552	5541544		5208	008	5396228	5396237		5206	009	
13	1163212		1933	402	007	156710	156710	1768	400	012	ROD A AT TBN-2
	301550	464770				301550	458352				
	4047102			5610		458352			5606		
HK. PT.	1156309		1756	386		156711		1768	400		ROD A AT REF. PT. 2-A
	301550	457870			011	301550	458399			006	6.9015 EL DIFF. CAL
	451857					458391					(6.902 EL. DIFF.) RF
	166246		1937	328	013	148970		1665	350		FEAR RECORDING
	301550	466783				301550	458488				
	464794					458527			5956		
14	165324		1827	348		148942		1666	354		
	301550	466896			012	301550	458504			008	
	466774			5958		458496			5960		
	158929		1709	282		143020		1606	352		SHORTEND SIGHTS DUE TO HEAT WAVES
	301550	454824			026	301550			6342		
	454749			6310		444570			300		
15	160567		1757	302		152583		1676			
	301550	462119			001	301550	454122			011	
	462117			6260		454133			6260		
	159173		1665	146		160626		1679	146		SHORTEND SIGHTS TO
16	301550	460725			008	301550	462187			001	FEARLESS CHKS IN T2
	460723			6406		462186			6406		MON 26
	151680		1589	144		152710		1600	146		
17	301550	453229			001	301550	454125			009	
	453230			6550		454126			6552		
	156772		1644	152		171022		1788	156		ROD-A AT MON. 26
18	301550	454931			010	301550	472578			008	A 5/8" ALL THREAD. GALV.
	454932			6702		472570			6708		ROD. DRIVEN TO REFUSAL
											(6") INCREASED IN 8" PVC
TOTALS	8307.581	8307.585		670.2	004	8148.243	8148.245		670.8	002	3'S. X 3' W. OF LINES 7
											* MON. 26 FIVE' CR
Σ BS =	8307.583	Σ F.S. = 8148.244		BS - FS =		+159.339	C.M.				NET 7' 11" - 2' 10" OFF
											MON 26
											1.46 mm
											133

DATE 9-17-82 TIME 1530
LOCATION HANDFORD
WEATHER COOL, ^{BARELY} WINDY, CLEAR
DIRECTION FWK ☐ BW ☐ PARTY PS ROD^AEE
FROM BM 26 TO BM 25 π PS ROD^BW
PG. 12 ☒ CF

[illegible]

DATE 9-19-73 TIME 1155 DIRECTION FWL BW 12 REV
 LOCATION HANFORD FROM BM 26 TO BM 25 7 PG RODRW
 WEATHER COOL, CLEAR, CALM P6.13 CF 8

TEMP. F.	BACKSIGHT					FORESIGHT					
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
	② 145730		1711	2178		④ 146047	58		2178		
	301550 4			504		301550 ③	7645	1711	503		↑ POST 100
	445480					447622	446651		2678		CLOSE TO T
	② 145637		1708	2672		① 145799		1708	500		
	301550 ④	447203		504	-06	301550 ③	447332		500	+019	
	447187			2682		447349			2678		
57°	① 165616		1806	300		② 160643		1757	302		ROD-B @ TBM-3
	301550 ③	467179			-03	301550 ④	462208		302	-007	SET (2x2)
	467166			2982		462193			2990		
CHK PT 3a	① 165616		1805			② 155702					ROD-B @ CHK. PT. 3a
	301550 ③	467194			-05	301550 ④	457242			+010	SET STEEL TURNING PIN
	467189					457252					ELEV. DIFF. = 4.949 CM.
	301550					301550					
	301550					301550					
	301550					301550					
	301550					301550					
	301550					301550					
	301550					301550					
SUB	301550					301550					
TOTALS	4140465	4140179		2182	+014	4075269	4075312		298.0	+043	
Σ BS. =	4140472	Σ FS. =	4075391			BS-FS =	065.181 CM				135

DATE 9-21-83 TIME 17:05 DIRECTION FWN BW 11
 LOCATION HANFORD FROM BM 26 TO BM 25 7 PG RODRW
 WEATHER CLEAR, CALM, WISEM PG. 17 CF

TEMP OF	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
	13090.764	13090.984		7016	000	12650.308	12650.314		7014	006	
	1) 206744		2157	176	008	119154		1291	178		
70°	301550	507498				301550	420111			009	
	507490			7192		420104			7192		
	2) 206757		2671	204		123693		1338	202		ROD-A AT BM #25
68°	301550	507407			000	301550	425238			005	A 5/8" ALL THREAD GALV.
	507405			7396		425242			7394		ROD. DRIVEN TO REFUSAL
	301550					301550					(12") INCASED IN 8" PVC
											3.5" X 3' W. OF WFS 6
	301550					301550					END: 1830 68°F
	301550					301550					
	301550					301550					
	301550					301550					(M) DIST = 1479.0 METERS
	301550					301550					
	301550					301550					
	14107.661	14107.689			008	13496.355	13496.362			008	
	9967496.0	9967410		7396	004	9420986	9420951		7394	035	
				BS - FS = 611.416 CM							
											ELEV. METER S' = 197.37231 BM #25 - 139

BACKSIGHT										FORESIGHT									
EMP.	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS								
72°	1) 2541413 301550 4) 556302 556293		2647	204	-007	070153 301550 3) 582299 382203		0908	200	+006	ROD-A AT PM. #25 3" ALL THROUGH ROD DRIVEN 12' TO REFUGAL 3'5X3' W. OF WES 6								
	2) 232142 301550 3) 539700 239600		2471	200	-007	1) 214192 301550 4) 395748 375142		0844	204	+002	ROD'S INST. ON E. SIDE OF ASPHALT RD.								
	1) 262757 301550 4) 564512 564508		2731	202	-004	2) 059494 301550 3) 359022 359044		0675	200	+022									
	2) 274277 301550 3) 575993 575999		2827	128	+003	1) 056350 301550 4) 359780 357900		0656	184	+018									
	1) 279512 301550 4) 581113 581112		2883	174	-001	2) 050630 301550 3) 352129 352180		0597	182	+001									
	2) 270759 301550 3) 562313 562208		2694	172	-001	1) 059094 301550 4) 352444 352444		0596	970		ROD-A BEARING TO LAKE								
	1) 211159 301550 3) 572710 572707		2298	172	-008	1) 059500 301550 4) 361054 361050		0681	172	-004									
76°	1) 270543 301550 4) 582274 572303		2897	178	+019	2) 051388 301550 3) 352945 352937		0597	166	-009									
	2) 260387 301550 3) 562128 562139		2677	142	+011	1) 055713 301550 4) 357263 357263		0633	152	000									
				1460					1460										
	4534755	4534151			+004	2898420				+028	- 140								

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A RODRIGUEZ

Д

[illegible]

DATE 11/11/11 TIME 10:42 DIRECTION FROM BM 25 TO BM USEGS-322 PAGE PG 2 ROD # CF
 LOCATION FAIRVIEW FROM BM 25 TO BM USEGS-322 π
 WEATHER CLEAR, BFTLY WARM PS. 20 ☐

BACKSIGHT					FORESIGHT					REMARKS
LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
8608903	8608871	2730	2408	.032	5384085	5384076	1026	2412	.009	
2 2667766			124	.034	1 0761720			116		TURNING PTS. IN SOFT
301550 ③	567312		2532		301550 ④	377312	446		+009	DIRT SET 16"2x2's
567316					397350		0700	2528		
298838		2890	196		2 059232		0847	204		
301550 ④	600373			1015	301550 ③	307373			+009	
600378			2728		361382			2732		
295622		2912	112		1 062777		0682	108		
301550 ③	587159			+003	301550 ④	364334			-007	
587172			2840		364327			2840		
266533		2717	104							
301550 ④					3 301550 ③					
568080			2944							
266055		2712	104		2 059252					
301550 ④	567612			-005	301550 ③	367296		102		
567607			2944		361302			2942		
274442		2806	124		1 101757		1080	124		ROD-A AT USEGS
301550 ③	575995			-003	301550 ④	403300			+007	MON. BM
575992			3067		403307			3066		STAMPED F322
301550										1949
					301550					STD. BR. DISC.
										MRKD. WITH -
301550										CONC. FOOTING CRACKED
					301550					END: TIME 1845 70°F
										SPUR
301550										
										(M) DIST = 613.4 METERS
11508378	11508322		3068	+056	7272723	7272690		+0	033	
Σ BS = 11508.350	Σ F.S. = 7272.707				BS - F.S. =	4235.643 CM				
					ELEV. METERS =	241.72874 (M)	F322		-	142

[illegible]

1.

[illegible]

DATE 9-24-23

TIME 1720

DIRECTION FW ☒ BW ☐

PARTY

RQDEE

LOCATION HANFORD

FROM BM 27 TO BM 911

P

RODRW

WEATHER HOT, CALM, HAZY

PG 26

 CF

BACKSIGHT

FORESIGHT

	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
	7437.011	7437.037		349.6	-036	7291.103	7291.439		349.6	-036	
	1169.124		1808	252	-033	1444.397		1570	252	-009	
85°	301550	41469257			-033	301550	4145940			-009	
	469134			3748		445931			3748		
	179249		1913	240	-008	129253		1423	262	-033	SIGHTS TO UNBALANCED
	301550	41480828			-008	301550	41430836			-033	
	480819			3982		430803			4010		
	181512		1940	250	+003	131532		1441	252	-008	SHOTS ARE ACROSS A
	301550	41483089			+003	301550	41433090			-008	DRY, GRASS FIELD TO MON.
	483092			3998		433082			4000		
	153518		1661	252	-012	144227		1568	252	-002	
80°	301550	41455080			-012	301550	41445779			-002	
	455068			4250		445111			4252		
	200503		2132	254	+003	057879		0703	248	+008	
78°	301550	41502091			+003	301550	41359421			+008	
	502053			4504		359429			4500		
	202972		2093	146	-005	121583		1344	136	+002	
	301550	41504432			-005	301550	41429131			+002	
	504422			4650		429133			4636		
	221440		2293	118	-008	064392		0716	144	-009	ROD-A ON BM 911
72°	301550	41522998			-008	301550	41345951			-009	AT 1 1/2" ER. DISC. ANSWER O
	522990			4768		365942			4780		STAMPED 911
											IMBEDDED IN A ROCK
	301550					301550					(M) DIST = 954.8 METERS
	301550					301550					END 1845 72° E
	10374370	10374439			-009	9750.697	9750.751			-054	
	Σ B.S. = 10374.404	Σ F.S. = 9750.724				-9750.724					
	BS - FS = 623.680 CM										
						EL. BM 911 = 197.93672 METERS					- 148

RODENT

411 RODRW

2

FORESIGHT

[illegible]

RODENT

RC. RADN

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[illegible]

TE 9-25-83 TIME 1622 DIRECTION FW BW PARTY PG ROD
LOCATION HANFORD FROM BM 911 TO BM USGS - WASH T PG ROD
ATHER HOT LIGHT HART BREEZY PG 30 CF

STATION	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
24° (23)	7634.090 (1) 0714.87 301550 (4) 3412.57 3430.27	9634.107 0801 3412.57		419.4 172 4366	-019 -002	10579.569 (2) 209105.4 301550 (3) 5086.15 5086.01	10579.569 2155 5086.15	419.4 170 4364	-001 -008		
(24)	1123.57 301550 (3) 4139.21 4139.02	1230 4139.21		212 4578	-013	(1) 201450 301550 (4) 503003 503000	2121 4578	214 4578	-003		
(25)	1537.00 301550 (4) 4553.48 4553.50	1648 4553.48		220 4298	+006	(2) 154407 301550 (3) 4559.62 4559.58	1655 4559.62	222 4800	-004		
26° (26)	1661.54 301550 (3) 4607.18 4607.04	1777 4607.18		230 5028	-014	(1) 162661 301550 (4) 464203 464211	1743 464203	232 5032	+008		
(27)	1393.11 301550 (4) 4408.73 4408.61	1510 4408.73		234 5262	-002	(2) 201576 301550 (3) 503104 503126	2130 503104	228 5260	+022		
(28)	1907.74 301550 (3) 4824.33 4824.34	1925 4824.33		232 5494	+001	(1) 163468 301550 (4) 4765021 465018	1751 4765021	232 5492	-003		
25° (29)	1480.56 301550 (4) 1116.628 1116.606	1566 1116.628		232 5726	-022	(2) 160129 301550 (3) 4761686 461697	1718 4761686	234 5726	-009		
(30)	1616.69 301550 (3) 4632.23 4632.19	1717 4632.23		200 5926	-004	(1) 14706.72 301550 (4) 4426.28 4426.11	1512 4426.28	202 5928	-017		
(31)	1799.69 301550 (4) 4915.03 4915.14	1971 4915.03		142 6067	+011	(2) 11875.4 301550 (3) 420302 420304	1258 420302	140 6068	+002		
(32)	127.19 301550 (3) 4286.68 4286.69	1357 4286.68		172 6240	+001	(1) 208001 301550 (4) 508560 508551	2157 508560	174 6242	-009	ROD-A @ BM USGS BR CAP (3 3/4") CNTR. KUNCHED A. STAMPED 1915, WASH, ELEV. 110. FT.	
Σ BS = 14097.428	Σ FS = 15312.617	Σ FS = 15312.617			BS - FS = -1215.189 CM						

USGS LYNE-210.12487

(30) 253.58625

(31) 310.39506

(32) 379.06620

917 NCER 601.85639 M.

* ASSUMED ELEV. HAVEN = 225.10435m	
Date	19
ELEVATION	BM
225.10435 M.	HAVEN
-44.02850	
181.07585 M.	(20)
3.42489	
187.65096 M.	(21)
+3.48710	
181.13906 M.	(22)
+14.49990	
195.63796 M.	(23)
31.04468	
226.68264 M.	(24)
15.06436	
241.74700 M.	F-322-1949
* ASSUMED ELEV. HAYE = 190.03800	
88 190.03800 M	32 ENSTING
+1.66192	
191.69992 M	(29)
+6.23680	
197.93672 M	(31)
-12.15189	
185.78483 M	USGS (10) (WASH)
+1.89244	
187.67727 M	(29)
+22.44760 = ELEV CYNE = 210.12487	

[illegible]

[illegible]

LOCATION	HANDLED	FROM BM ^{USC 9-65} F 322	TO BM # 24	T	P _C	RÖD _{rw} ^A
WEATHER	WARM, PARTIALLY CLOUDY, GUSTY WINDS	PG. 34			CF	RÖD _{rw} ^B

Dr. L. RODRIGUEZ

8

FORESIGHT

159

Handwritten: R^2D^2

3

[illegible]

100

7

161

5. 6. 1971

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FORFEIT

[illegible]

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1. 2000

'EATHER WARM, CLEAR, PRETTY

PG: 41.

8

CE

2

[illegible]

A. R. D. 86

8

[illegible]

191

FE ^A RODRIG ^B
CE

FE ^A RODRIG ^B
CE

3

TEMP °F	BACKSIGHT					FORESIGHT					
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
75°		3261.811		156.7	-000		3253.974		157.0	-007	
	2)	1528.91	1640	202		1)	1636412	1736	200		
	3)	301550	455421		+020	4)	301550	465199		-001	
		455441		1770			1165172		1770		
	1)	170555	1809	202		2)	125842	1359	202		
	9)	301550	472083		+023	3)	301550	421398		-006	
		412105		1972			421392		1972		
	2)	235649	2458	204		1)	020740	0810	203		
	10)	301550	537186		+013	4)	301550	372480		+010	
		537199		2176			372490		2174		
70°	1)	198921	2100	222		2)	180351	1915	222		
	11)	301550	500482		-011	3)	301550	481904		-003	
		500471		2398			481901		2396		
	2)	190977	1930	240		1)	214818	2269	242		
	12)	301550	482521		+006		301550	516382		-0154	
		472529		2638			516368		2638		
	1)	166785	1774	212		2)	144822	1554	212		
	13)	301550	468352		-017	3)	301550	446351		+021	
		468335		2850			446372		2850		
	2)	159450	1705	222		1)	160263	1714	222		
14)	301550	460998		+002	4)	301550	461824		-011		
	461000		3072			461813		3072			
1)	142658	1532	212		2)	158402	1690	212			
15)	301550	444223		-015	3)	301550	459960		-008		
	444208		3284			459952		3284			
2)	163096	1725	188		1)	151441	1614	200		ROD-A @ BM 29. A.F. ALL	
70°	16)	301550	444646		000	4)	301550	458001		-010	THIRD GALV. ROD. DRIVEN
		444646		3472			452991		3494		TO REFRESH (24") INCASED
TOTALS		7947.167	7547.923	347.2	-046		7358.438	7358.473	348.4	-035	IN 18" OF 8" PVC
	ΣBS = 7847.700	ΣFS = 7358.456					BS - FS =	+ 189.244	GM.		REPLACED W.F.S 10
											168
											END: 1514 70°F
											(M) DIST. = 695.6 METERS

ROD

2

[illegible]

4

8

[illegible]

TEMP. °F.	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
	8190.928	8190.958		397.2	7.030	7582.172	7582.819		397.4	7.037	
	2) 194553		1946	200	1	1) 056935		0669	200		SUN IN CLOUDS
65°	301550	2) 486100			7.003	301550	4) 358478			7.007	
	486103			4172		358485			4174		
	1) 264613		2757	232	7.007	2) 114399		1254	220		
19)	301550	4) 566170				301550	3) 415944			7.015	
	566163			4394		415929			4394		
	2) 212034		2246	252		1) 133553		1461	250		
20)	301550	3) 513581			7.003	301550	4) 435099			7.004	
	513584			4646		435103			4644		
	1) 220316		2329	252		2) 118185		1308	252		
21)	301550	4) 521872			7.006	301550	3) 419745			7.010	
	521866			4898		419735			4896		
	2) 210220		2227	250		1) 050450		0632	256		
22)	301550	3) 511770			0.000	301550	4) 351995			7.005	
	511770			5148		352000			5152		
	1) 276638		2838	144		2) 056051		0631	142		LIGHT RAIN, GOLD FRONT
23)	301550	4) 578182			1.006	301550	3) 357603			7.002	ROD-A IN DIRT. ROD-B
	578188			5292		357601			5294		ON RD. IN DIRT
	2) 297517		2905	140		1) 070963		0778	136		SHOTS ACROSS
24)	301550	3) 599053			7.014	301550	4) 372519			7.006	
	599067			5432		372513			5730		
	1) 295588		2903	106		2) 055298		0601	096		
25)	301550	4) 597125			7.013	301550	3) 356848			0.000	
	597139			5538		356848			5526		
	2) 299462		2939	112		1) 048497		0534	098		ROD-A @ BM-LYNE
26)	301550	3) 601015			7.003	301550	4) 350031			7.006	A USCEGS 2 1/2" BR. DISC.
	601012			5650		350037			5624		IMBEDDED IN ROCK. CNTR.
											PUNCHED A. STAMPED
TOTALS	13165.819	13165.826		565.0	7.007	10921.043	10921.081		562.4	7.038	LYNE 1947
Σ BS =	13165.822	Σ FS = 10921.062				BS-FS = +2244.760 CM.					
											END: 1802 57° E.
											(M) DIST. = 1127.4 METERS

DATE 10-10-83 TIME 0910 DIRECTION FW ☒ BW ☐ PARTY PG ROD
 LOCATION HANFORD 56° FROM BM HAVEN TO BM #20 PG ROD
 WEATHER HAZEY, COOL, LIGHT BREEZE PG. 48 CF

TEMP °F	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
56°	1) 058662		0630	086		2) 240375		2646	084		ROD-A @ BM-HAVEN
	301550 4) 360222				010	301550 3) 561928				003	A USCEGS 2 1/2" GR. DISC.
	360212					561925					SET IN CEMENT IN A ROCK OUTCROP
	2) 053602		0574	076		1) 244002		2479	078		CNTR. MKRD. Δ
	301550 3) 355152				000	301550 4) 545557				005	STAMPED HAVEN 1947
	355152			162		545552			162		
	1) 060159		0629	054		2) 242595		2452	052		SHOTS DOWN STEEP HILL
	301550 4) 361715				006	301550 3) 544141				004	ROCKY, DRY GRASS
	361709			216		544145			214		
	2) 065313		0680	054		1) 267652		2703	054		
	301550 3) 366867				004	301550 4) 569197				005	
	366863			270		569202			268		
	1) 055484		0580	052		2) 247372		2499	050		
	301550 4) 356983				001	301550 3) 548923				001	
	356984			322		548922			318		
	2) 052263		0546	046		1) 278670		2813	052		
	301550 3) 353824				011	301550 4) 580218				002	
	353813			368		580220			370		
61°	1) 052088		0547	052		2) 252989		2555	050		
	301550 4) 353636				001	301550 3) 554533				006	
	353635			420		554539			420		
	2) 067650		0700	048		1) 247139		2494	046		
	301550 3) 369199				001	301550 4) 548693				004	
	369200			468		548689			466		
	1) 059076		0626	070		2) 270923		2745	072		
64°	301550 4) 360631				005	301550 3) 572473				000	
	360626			538		572473			538		

E 10-10-83

TIME 1115

DIRECTION FW ☒ BW ☐

PARTY PG

RODEE

ATION HANFORD

FROM BM HAVEN TO BM #20

PG

RODRW

THER WARM, BREEZY, LIGHT HAZE

PG 49



CF

FIX UMBRELLA

BACKSIGHT

FORESIGHT

	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
	3238.194	3238.229		53.8	003	5025.667	5025.663		53.8	004	
2)	050453		0528	48	001	1) 222831		2352	48		
10)	301550	352002				301550	4) 524381			000	SHOTS ON STEEP HILL
	352003			586		524381			586		ROCKY, DRY GRASS
1)	051981		0549	58	004	2) 285903		2892	66	007	
11)	301550	353527				301550	3) 587446				
	353531			644		587446			652		
2)	054406		0572	56	003	1) 275020		2774	48	008	
12)	301550	355959				301550	4) 576578				
	355956			700		576578			700		
1)	056320		0590	54	001	2) 292042		2947	54	006	
13)	301550	357871				301550	3) 593598				
	357870			754		593598			754		
2)	055048		0580	60	000	1) 285269		2882	58	001	
14)	301550	356598				301550	4) 596820				
	356598			814		596819			812		
1)	059818		0616	56	006	2) 290441		2933	58	002	
15)	301550	360362				301550	3) 591989				
	360368			870		591991			870		
2)	051901		0552	66	001	1) 298424		3017	66	007	
16)	301550	353450				301550	4) 599981				
	353451			936		599974			936		
1)	076049		0776	72	003	2) 299564		2960	72	004	
17)	301550	372596				301550	3) 601110				
	372599			1008		601114			1008		
2)	054551		0586	90	010	1) 297505		2916	82	010	
18)	301550	356096				301550	4) 599045				
	356101			1088		599055			1090		

E 10-10-83 TIME 1346 DIRECTION FW ☒ BW ☐ PARTY PG RODDE
 ATION HANFORD FROM BM HAVEN TO BM #20 T PG RODRW
 EITHER WARM, LIGHTHAZE, BREEZY PG. 50  CF

BACKSIGHT						FORESIGHT					
STATION	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
	6461.671	6461.685		108.8	7019	10276.616	10276.611		109.0	7005	
19)	1) 060790		0649	78	7007	2) 2983332		2946	74	000	STEEP HILL
	301550 4)	362333				301550 3)	599882	7			
	362340					599882					
20)	2) 051962		0572	104		1) 293033		2984	108		TERRAIN LEVELING OUT
	301550 3)	353513			7015	301550 4)	594593			000	
	353512			1270		594583			1272		
21)	1) 104985		1150	208		2) 146570		1565	198		
	301550 4)	406520			7015	301550 3)	448101			7019	
	406535			1470		448120			1470		
22)	2) 092232		1084	184		1) 292077		3012	182		
	301550 3)	400772			7010	301550 4)	593642			7015	
	400782			1654		593627			1652		
23)	1) 052259		0595	146		2) 299058		2918	144		
	301550 4)	353809			7001	301550 3)	600601			7007	
	353808			1800		600608			1796		
24)	2) 057613		0668	184		1) 243809		2533	190		
	301550 3)	359151			7012	301550 4)	545367			7008	
	359163			1988		545357			1986		
25)	1) 216986		2234	128		2) 058872		0644	110	7003	
	301550 4)	518539			7003	301550 3)	360419				
	518536			2112		360422			2096		
26)	2) 294349		2858	170		1) 060829		0701	186	7007	
	301550 3)	595908			7009	301550 4)	362372				
	595899			2282		362379			2282		
27)	1) 299502		2913	144		2) 101955		1071	142		
	301550 4)	600041			7011	301550 3)	403506			7001	
	600052			2426		403505			2424		

TE 10-11-73 TIME 0955 DIRECTION FW ☒ BW ☐ PARTY P₂ ROD EE-
 CATION HANFOLD FROM BM#20 TO BM#21 P₂ P₂ ROD W
 ATHER WARM LIGHTHAZE, BREEZY PG. 52  CF

TEMP °F	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
53°	1) 073663		0848	222	±003	2) 242222		2574	222		ROD-A @ BM#20 SEE
	301550	4) 375210				301550	3) 547834			±001	PG. 51 FOR DESC.
	395713					549823					
	2) 090231		1028	252		1) 077602		0923	252		SHOTS ACROSS SOFT DIRT
	301550	3) 391803			±022	301550	4) 381139			±014	SHORT BRUSH, SLIGHT
	391781			474		381153			474		ROLLING TERRAIN
	1) 163908		1765	252		2) 189639		2022	252		
56°	301550	4) 465448			±010	301550	3) 491175			±014	
	465458			726		491189			726		
	2) 212618		2253	254		1) 116107		1288	254		
	301550	3) 514170			±002	301550	4) 476680			±023	
	514168			980		476657			980		
	1) 227590		2403	254		2) 169346		1819	252		SUN ON BS. INVAR
	301550	4) 529138			±002	301550	3) 470881			±015	FS. INVAR SHADED
	529140			1234		470896			1232		
	2) 073923		0764	252		1) 240460		2531	252		
59°	301550	3) 395397			±004	301550	4) 542008			±002	
	395393			1486		542010			1484		
	1) 153419		1661	254		2) 137972		1505	254		
	301550	4) 454980			±011	301550	3) 439318			±004	
	454969			1740		439322			1738		
	2) 202685		2154	254		1) 128915		1387	256		
	301550	3) 504254			±019	301550	4) 427491			±026	
	504235					428465			1994		
	2) 202698		2154	254		1) 125945		1389	256		
63°	301550	3) 504249			±001	301550	4) 427476			±019	
	504248			1994		427495			1974		

TE 10-11-83 TIME 1140 DIRECTION FW BW PARTY LS RODER
CATION HANFORD FROM BM 20 TO BM 21 T FS RODRW
ATHER WALL LIGHT HAZARD ELEV PG. 53 CF

BACKSIGHT						FORESIGHT					
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
	3610.350	3610.215		199.4	005	3119.555	3117.511		199.4	004	
	1) 170239		1830	254	005	2) 098733		1115	252		
63° 9)	301550 4)	471893			005	301550 3)	400409			016	
	471828			2248		400483			2246		
	2) 133199		1456	248		1) 202812		2153	250		
10)	301550 3)	434733			004	301550 4)	504352			010	
	4134737			2496		5011362			2496		
	1) 210502		2228	246		2) 227194		2395	246		
11)	301550 4)	512032			020	301550 3)	528738			006	
	512052			2742		528744			2742		
	2) 066362		0791	254		1) 289006		3018	256		
12)	301550 3)	367921			009	301550 4)	590558			002	
	367912			2996		590556			2998		
	1) 210392		2230	252		2) 101100		1138	254		
13)	301550 4)	511940			018	301550 3)	402652			002	
	511922			3248		402650			3252		
	2) 134651		1472	252		1) 185842		1982	248		
65° 14)	301550 3)	436206			005	301550 4)	487403			011	
	436201			3500		487392			3500		
	1) 130487		1431	252		2) 166951		1796	252		
15)	301550 4)	432042			005	301550 3)	468492			009	
	432037			3752		468501			3752		
	2) 154089		1667	252		1) 163698		1763	252		
16)	301550 3)	455623			016	301550 4)	465246			002	
	455639			4004		465248			4004		
	1) 157974		1706	252		2) 162869		1755	250		
69° 17)	301550 4)	459528			004	301550 3)	464412			023	
	459524			4256		464419			4254		

TE 10-11-83 TIME 1331 DIRECTION FW ☒ BW ☐ PARTY PG ROD
CATION HANFORD FROM BM #20 TO BM #21 T PG ROD
ATHER WARM, LIGHT HAZE, BREEZY PG. 54  CF

		BACKSIGHT					FORESIGHT					
		LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
		7692.262	7692.292		425.6	7031	8031.910	8031.893		425.4	7019	
	2)	163975		1760	240	703	1) 1426425		1549	246	7006	
68° 18'	18)	301550 ③	465548			703	301550 ④	444201				
		465525			4496		1444195			4500		
	1)	129984		1391	142		2) 157068		1640	138		
19'	19)	301550 ④	431536			700	301550 ③	458620			7002	
		431534			4638		458618			4638		
	2)	218212		2263	162		1) 215331		2234	162		ROD-A @ BM #21 A 5"
68° 20'	20)	301550 ③	519759			7003	301550 ④	516880			7001	ALL THREAD, GALV. ROD.
		519762			4800		516881			4800		DRIVEN TO REFUSAL (6')
		301550					301550					INCREASED IN 18" OF 8" PVC.
												REPLACED W/FS 2
		301550										
							301550					END: 1406 68°F
		301550										(M) DIST = 960.0 METERS
		301550					301550					
		301550					301550					
		301550					301550					
TOTALS		9109.083	9109.136		480.0	7053	9451.604	9451.594		480.0	7010	
Σ BS = 9109.110			Σ FS = 9451.599				BS - FS =	-342.489 CM.				

[illegible]

61
11
D
C
D

LOCATION HANFORD

LOCATION Hanford

FROM BM #21

TO BM # 22

55

1. 0

WEATHER WISEM HEEF WILLY
LIGHT

PG. 57

3

5

07

DO NOT TAKE THESE: ALL SOLID EVIDENCE

BACKSIGHT

[illegible]

ROSE,

4- RODR

7

SAHIB ZADEH (H-2)

[illegible]

DATE 10-3-83 TEMP 51°F OBSERVER PG PRECISE LEVELING - METRIC RODS
 WEATHER COOL, BREEZY, CLOUDY RECORDER CF LINE DIR. FORW/BACK ROD CONST. - KERN 301.50/WKD 301.55
 FROM BM CONCRETE ON TPO TO BM PAGE 35 ORDER

BACKSIGHT						FORESIGHT						DESCRIPTION
STADIA THREAD READING	STADIA A/I	ROD READING				STADIA THREAD READING	STADIA A/I	ROD READING				
		LEFT		RIGHT				LEFT		RIGHT		
1555	102	3015		15554		16653	105	502				
		3015			3015							
1627	102	3015		15768		14660	105	500				
	504	3015		31322		31313		1002				
				31330				204				
				13		31309		499				
		3015			3015							
		3015			3015		79712	200				

	3015	7	3015
	3015	8	3015
	3015	9	3015
	3015	10	3015
	3015	11	3015
	3015	12	3015
	3015	13	3015
	3015	14	3015

ELEV. FROM PAIR _____
 B.S. _____ I.F.S. _____
 B.S. - I.F.S. _____
 Elev. Meters _____ Feet _____
 Miles From _____
 Miles _____
 Total Miles _____

0753

ROD-AN-FE
ROD-3-3-10

PAGE 38

ORDER

PRECISE LEVELING - METRIC RODS

DATE 10-6-83 TEMP 55°F OBSERVER PG

WEATHER OVERCAST, CLOUDY, CALM RECORDED CF

LINE DR. FORM/BACK

FROM BENCH MARK TO BM

ROD CONST. - KERN 301.50/WID 301.55

DESCRIPTION

PAIX

BACKSIGHT				FORESIGHT			
STADIA THREAD READING	STADIA M/L	ROD READING		STADIA THREAD READING	STADIA M/L	ROD READING	
		LEFT	RIGHT			LEFT	RIGHT
1500				1864			
1450	1003015	14495	13015	1614	1015	500	
	3015						
1568				1603			
1517	1023015	15169	13015	13525	1352	500	
	3015						
	202						
	3015	29644	3015	29665		1000	
		29641					
		3		29641			
	3015						
	3015			3024			
	3015			3003	300		

3015				73015			
3015				63015			
3015				93015			
3015				103015			
3015				113015			
3015				123015			
3015				133015			
3015				143015			

11.5. _____ ELEV. FROM PAGE _____
B.S. - F.S. _____
Elev. Meters _____ Feet _____
Miles From _____
B.M. _____
Miles _____
Total miles _____

10-16-73 TIME 1011 DIRECTION FWD B.W. PG
 STATION HANFORD FROM BM #32 TO BM #31 PG
 WEATHER HAZY, COOL, CLEAR PG. 58 CF

54	1) 050242	0566	128	009	2) 296525	3028	126	1005	ROD-A @ BM #32. A 5" ALL THREAD, GALV. ROD. DRIVEN (18") TO REFUSAL. INCASED IN 18" OF 8" PVC
	3) 351792	351801			598095	3) 598090		1013	REPLACED WFS 13
55	2) 094673	1058	1222	006	1) 1200978	2122	224	1002	SHOTS ACROSS ROCKY, DRY GRASS, ROLLING TERRAIN MODERATELY SLOPING
	3) 396223	0750	350	001	502528	4) 502515	1350		
	1) 060694		146		2) 285510	2927	144		
	2) 392244		496		587060	3) 587058	1194		
	3) 053130	0593	124	007	1) 222541	2287	124	1004	
	354680		620		524091	2803	130		
56	1) 052038	0586	132	003	2) 273806	3) 575348	748	1008	
	353588		752		575356		124		
	2) 063793	0698	120	002	1) 253138	2593	872	010	
	365343		872		321550	4) 554688	98		
	1) 060172	0652	100	010	554678	2336	970	1002	
	361722		972		822866	530218	100		
	2) 079170	0841	98	001	530216	2576	1070	1002	
	380920		1070		1) 253505	4) 554057	166		
	1) 054620	0628	164	005	301550	554055	2997	1001	
57	301550		1234		2) 291414	592963	1236		
	356120				301550	592964			

TELETYPE UNIT TIME 1200
 CATION 1200
 A THER HELLER, THIN CLOVE

[illegible]

BACKSIGHT					FORESIGHT						
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
19)	1525.72	1525.76	2200	200	0.04	2205.72	2205.72	2200	200	0.00	1525.76
20)	301550	301550			0.00	301550	301550			0.00	301550
21)	301550	301550	1430	200	0.00	301550	301550	2000	200	0.00	301550
22)	301550	301550	1639	230	0.00	301550	301550	2051	242	0.00	301550
23)	301550	301550	2077	252	0.00	301550	301550	2051	246	0.00	301550
24)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
25)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
26)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
27)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
28)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
29)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
30)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
31)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
32)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
33)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
34)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
35)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
36)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
37)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
38)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
39)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
40)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
41)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
42)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
43)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
44)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
45)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
46)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
47)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00	301550
48)	301550	301550	2077	252	0.00	301550	301550	2077	252	0.00</	

TE 10-16-72 TIME 1:22

DIRECTION FW [] BW []

PARTY P. RODER

P. RODER

CATION HALLFORD

FROM BM 32 TO BM 31

T

P. RODER

ATHER COAL, DILLON, CALK

PG 61

CF

BACKSIGHT						FORESIGHT					
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
	255955	1052298			100		1006552		412.7	102	
	255972		0608	156	100	301550		579	183	105	
30	301550	353421			100	301550	597493		490.7	105	
	353430				100	301550		299.9			
31	301550	354264			100	301550	5971262		500	105	
	354271		0608	156	100	301550		259.4	158		
32	301550	356002			100	301550	553031			100	
	355990				100	301550			523.0		
33	301550	357268	0597	160	100	301550		283.9	160		
	357275				100	301550			539.0	106	
34	301550	363512			100	301550	597597			101	
	363520				100	301550		284.0			
35	301550	365235	0585	150	100	301550		285.2	148		
	365240				100	301550	579372			105	
36	301550	367983	0608	152	100	301550			56.98		
	367991				100	301550	576731	282.8	152	102	
37	301550	369735	0630	152	100	301550			585.0		
	369731				100	301550	572366	279.0	152	103	
38	301550	371479			100	301550			600.2		
	371486				100	301550		274.4	234	106	
39	301550	373222	0754	234	100	301550	504236				
	373219				100	301550			123.6		

CATION HEPFL

FROM BM⁴ 20 TO BM^{#31}

FIG RODRIGUEZ

FIG RODRIGUEZ

ATHER COLLEGE, CHICAGO, ILL.

PG 62

1

25

[illegible]

TE 10-17-72 TIME 1020 DIRECTION FW ☐ BW ☐ PARTY ROD RW
 CATION HANDICAL FROM BM 32 TO BM 31 T PG PG ROD RW
 ATER OVERCAST AND BREEZY PG 63 ☐ PG

BACKSIGHT						FORESIGHT					
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
58°	14113.674	14113.200		614.6		20283.774	20283.739		644.4	-043	
	1) 0703.22										ROD B @ CORNER PT. 5a
	301550 2	312479			+00	301550					DIFF. ELEV. = 5.4300
	3724.92										
	301550					301550					
	1) 2500.00										ROD B @ CORNER PT. 5b
	301550 3	251822			-003	301550					
	3518.19										DIFF. ELEV. = 15.230
	301550					301550					
1)	301550 3	0137		164		259782	2677		178	-006	ROD B @ CORNER PT. 5c
	0526.16		0632	192		1610.82			6622		
2)	301550 1	355178			-00	301550 1	561338		2758		DIFF. ELEV. = 15.230
	3551.66			6803		1610.82			6798		
	1) 172350		1769	90		172350			2269		
3)	301550 3	473871			+002	301550 3	523967			+004	
54°	172350			6892		523967			6882		
4)	15710		217	178		15710			2250		
	301550 1	314000			+002	301550 1	517795			000	
	15710			7070		517795			7064		
2)	2000.38		0986	88		2000.38			2345		ROD A @ BM #31 @ 5/8"
5)	301550 3	15710			000	301550 3	531623			-005	ALL THREAD GALV. ROD
				9158		531618			9156		DRIVEN (13') TO NEUTRAL
											AND INCREASED IN
											18" OF 8" P.V.C.
TOTALS	16119.937	16119.954		715.8	-017	22972.039	22972.081		715.6	-042	(M) DIST. = 1431.4 METERS
	11110 and		5 FCS	72982.060		BS-FS =	-6867.114 CM				

LOCATION HEAVY FROM BM 11 TO BM 30 7 ROD 1
WEATHER COOL PG 64 1

BACKSIGHT					FORESIGHT						
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
53	1) 250150		2530	2411		2) 272150		1705	240		100-100 01-03 51-74
	301550	355313			013	301550	594141			010	15-03 For DECC.
	352202					301551					
	2) 053800		0635	170		1) 251470		2209	189		SHOTS ALONG A DIRT
2)	301550	355385			004	301550	573052			013	EGG LVL.
	355279			434		552007			428		
	1) 0522012		0620	182		2) 290295		2111	192		
3)	301550	354200			002	301550	591641			004	
	350102			622		591641			620		
	2) 056009		0611	162		301550		2427	161		
4)	301550	351578			011	301550	539111			021	
	351557			784		539111			124		
	1) 053870		0617	220		2) 262701		2702	218		
5)	301550	355440			020	301550	569970			016	
	355420			1004		569954			1002		
	1) 053457		0633	198		1) 266179		2261	112		
6)	301550	355000			007	301550	565739			010	
	355009			1202		565727			1200		
	1) 052755		0628	219		2) 261805		2722	219		
7)	301550	354290			025	301550	563351			004	
	354115			1420		563355			1418		
	2) 061500		0757	214		1) 269747		2805	216		
8)	301550	366557			002	301550	571317			023	
	366554			1634		571297			1634		
	1) 057050		0664	188		2) 291008		3036	188		
56	301550	351639			009	301550	592539			019	
	358600			1722		592552					

197

891

PARTY DE ROD

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Д

FORESIGHT

TE 10-10-22 TIME 1600 DIRECTION FW BW ☐ PARTY PC ROD EE
 CATION HFN FOLL FROM BM# 30 TO BM LINE T PC ROD PLW
 ATER COOL SW FCEST. 2011 EY PG 69 ☐ CF

TIME OF	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
	2557902	2557902		2020	000	2557902	2557902		2020	000	
	2557902	2557902	0677	206	000	2557902	2557902	2728	206	002	
10)	301550	301550			000	301550	301550			002	
	301550	301550			000	301550	301550			002	
	301550	301550	3618	192	000	301550	301550	2729	187	009	
11)	301550	301550			000	301550	301550			009	
	301550	301550			000	301550	301550			009	
	301550	301550	0516	2457	000	301550	301550	2534	2454	004	
12)	301550	301550			000	301550	301550			004	
	301550	301550			000	301550	301550			004	
	301550	301550	0647	2827	000	301550	301550	2569	2828	010	SUN IN CLOUDS
13)	301550	301550			000	301550	301550			010	
	301550	301550			000	301550	301550			010	
	301550	301550			000	301550	301550			010	
14)	301550	301550			000	301550	301550			010	
	301550	301550			000	301550	301550			010	
	301550	301550	0667	3060	000	301550	301550	2890	3060	009	
15)	301550	301550			000	301550	301550			009	
	301550	301550			000	301550	301550			009	
	301550	301550	0667	3344	000	301550	301550	2579	3344	002	
16)	301550	301550			000	301550	301550			002	
	301550	301550			000	301550	301550			002	
	301550	301550	0679	3522	000	301550	301550	2578	3520	003	
17)	301550	301550			000	301550	301550			003	
	301550	301550			000	301550	301550			003	
	301550	301550	0699	3752	000	301550	301550	2590	3752	003	
18)	301550	301550			000	301550	301550			003	
	301550	301550			000	301550	301550			003	
	301550	301550			000	301550	301550			003	

201
-

TIME	BACKSIGHT					FORESIGHT				
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R
	96.00	96.00		434.2	0.00	117.00	117.00		434.2	0.00
50°	301550	4122.120			0.00	301550				
	4122.135									
	301550					301550				
	1167.11									
	301550	4183.75			0.00	301550				
	4183.71									
	301550					301550				
22)	1159.43		1331	344	0.00	1) 2019.98		2191	342	
	301550	3) 4174.86				301550	4) 5035.51			0.03
	1114.70					5035.48			468.8	
23)	0705.20		0798	344	0.00	1) 1562.00		1735	344	
	301550	4) 3720.76				301550	3) 457.150			0.00
	0533.37					457.150			503.4	
24)	301550	3) 3548.99	0675	284	0.00	1) 264.987		2793	286	
	0533.37					301550	2) 5665.33			0.06
	301550	4) 372.770				5665.33			532.0	
25)	0914.20		1074	320	0.00	2) 0513.22		0673	320	
	301550	4) 372.770				301550	3) 3528.82			0.09
	372.770					3528.82			564.0	
26)	301550	3) 5340.45	2314	102	0.00	1) 0577.42		2628	102	
	5340.47					301550	4) 3572.92			0.00
						3572.92			574.2	
27)	9681.414	9681.403			0.01	14027.563	14027.528		574.2	0.035
						14027.563				

ST

TEMP. OF	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
50°	1) 056128		0641	160		2) 213918		2218	158		ROD-A @ BM-UNDER 917
	301550 4)	357686			008	301550 3)	515460			1008	1 1/2" BR. DISC. SET IN CMT
	357678					515468					IN A ROCK. CNTR. PUNCH
	2) 301550 3)					1) 300303		2953	100		⊙ STAMPED 917
						301550 4)					NOTE: ROD ON VERY WESTERLY
	2) 050641		0554	96		601853					LIP OF BR. DISC. THIS IS THE
	301550 3)	352180			1011	1) 295566		3004	96		ONLY ACCESS TO BR. DISC.
	352191			256		301550 4)	597112			1004	THE REMAINING PORTION IS
48°	1) 050495		0563	116		597116		2913	116		COUNTERSUNK IN CMT.
	301550 4)	352047			002	2) 297112				000	RAIN STOPED
	352045			372		301550 3)	598662				
	2) 064345		0692	98		5981162		2939	98		RAINING AGAIN
	301550 3)	365900			005	1) 298846				1005	
	365895			470		301550 4)	600391				
	1) 066582		0710	88		600396			468		
	301550 4)	368129			003	2) 296901		3013	88		RAIN STOPED
	368132			558		301550 3)	598443			1008	
	2) 053254		0578	92		598451					SHOTS ACROSS SOFT
	301550 3)	354816			006	1) 297791		2931	94		SANDY SOIL, DRY GRASS
	354804			650		301550 4)	599326			1005	STEEP TERRAIN.
	1) 056531		0610	90		599341			650		
	301550 4)	358076			005	2) 296965		3013	86		
	358081			740		301550 3)	599507			1008	
	2) 056429		0620	112		598515			736		
50°	301550 3)	357980			001	1) 293327		2991	116		
	357979			852		301550 4)	594876			1001	
						594877			952		

TE 10-19-83 TIME 1236 DIRECTION FW ☒ BW ☐ PARTY PG RODER
 CATION HANFORD FROM BM ^{NCR} 917 TO BM #32 PG RODER
 ATHER COLD, CLOUDY, BREEZY PG 73 CF

TEMP	BACKSIGHT					FORESIGHT					REMARKS
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
	2866.805	2866.808		85.2	003	4702.826	4702.787		85.2	009	
	1) 0595.11		0642	134	001	2) 2776.92		2844	134	002	SUN CAME OUT
50	9) 301550	4) 359062				301550	3) 599240				
	359061			986		599242			986		
	2) 053189		0598	132		1) 279109		2859	136		SUN BACK IN CLOUDS
	301550	3) 354741			002	301550	4) 580670			011	
	354739			1118		580659					
	1) 065414		0713	118		2) 290931		2965	114		
112	301550	4) 366971			007	301550	3) 592378			003	
	366964			1236		592381			1236		
	2) 052852		0593	130		1) 282228		2887	130		
50	12) 301550	3) 354403			001	301550	4) 583780			002	
	354402			1366		583778			1366		
	1) 058882		0655	132		2) 286398		2930	132		
13	301550	4) 360438			006	301550	3) 587948			000	
	360432			1498		587948			1498		
	2) 068595		0750	128		1) 294867		3013	128		
14	301550	3) 370141			004	301550	4) 596410			007	
	370145			1626		596417			1626		
	1) 056889		0633	128		2) 292559		2989	126		
15	301550	4) 358436			003	301550	3) 594113			004	
	358439			1754		594109			1752		
	2) 068331		0738	110		1) 290297		2958	110		
16	301550	3) 369884			005	301550	4) 591845			002	
	369881			1864		591847			1862		
	1) 067524		0733	116		2) 282108		2878	114		
55	17) 301550	4) 369078			004	301550	3) 583663			005	
	369074			1900		583658			1976		

E 10-19-83 TIME 1423 DIRECTION FW ☒ BW ☐ PARTY PG RODDEE
ATION HANFORD FROM BM ^{NGER} 917 TO BM #32 PG 7 PG RODRW
THER SOLD BREEZY, CLOUDY PG 74  CF

BACKSIGHT					FORESIGHT					REMARKS	
	LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	
	6129.942	6129.964		198.0	022	9992.865	9992.834		197.6	031	
2)	055849		0491	134		1) 299193		2921	142	005	SUN CAME OUT
2)	301550	3) 357396			009	301550	4) 600738				
	357399					600743					
1)	057104		0630	214		2) 294298		2999	112		
1)	301550	4) 358661			007	301550	3) 595828			000	
	358654			2232		595828			2230		
2)	066196		0718	112		1) 297211		2916	112	007	
20)	301550	3) 367750			004	301550	4) 598768				
	367746			2344		598761			2342		
1)	060999		0669	118		2) 294447		3003	118	005	
21)	301550	4) 362550			001	301550	3) 595992				
	362549			2462		595997			2460		
2)	066851		0722	108		1) 295363		3007	106	006	
22)	301550	3) 368403			002	301550	4) 596919				
	368401			2570		596913			2566		
1)	057513		0626	102		2) 294153		2994	104		
23)	301550	4) 359064			001	301550	3) 595704			001	
	359063			2672		595703			2670		
2)	062573		0673	94		1) 290425		2953	98		
24)	301550	3) 364122			001	301550	4) 591981			006	
	364123			2766		591975			2768		
1)	062200		0673	102		2) 296999		3018	96		
25)	301550	4) 363760			010	301550	3) 598541			008	
	363750			2868		598549			2864		
2)	066798		0741	146		1) 290421		2979	150		
26)	301550	3) 368346			002	301550	4) 591972			001	
	368348			3014		591971			3014		

NOVA
B

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TE 10-20-83 TIME 0850 DIRECTION FW ☒ BW ☐ PARTY PG ROD EE
 CATION HANFORD FROM BM ^{NEAR} 912 TO BM #32 T PG RODRW
 ATHER HAZE, CALM, WARM PG 77  CF B

TEMP. °F	BACKSIGHT				FORESIGHT				REMARKS
	LEFT	RIGHT	STA	DIST L-R	LEFT	RIGHT	STA	DIST L-R	
	12324.311	12324.341		390.0	20131.142	30131.118		389.8	7024
53°	050120								RED-A @ CHK PT 7a
	301550	351671		001	301550				
	351670								
	301550				301550				
	049683								RED-A @ CHK PT 7a
	301550	351236		003	301550				
	351233								
	301550				301550				
	1) 053030		0572	84	2) 297920		2938	82	RED-A @ TBM-7
35)	301550 4	354579		001	301550 3	599464		7006	
	354580			3984	599470			3980	
	2) 059096		0636	90	1) 299361		2948	92	SHOTS ACROSS SOFT
36)	301550 3	360649		003	301550 4	600918		007	SANDY SOIL, DRY GRASS
	360646			4074	600911				VERY STEEP TERRAIN
	1) 063638		0688	104	2) 297830		2926	104	
37)	301550 4	365195		007	301550 3	599377		7003	
	365188			4178	599380			4176	
	2) 057688		0629		1) 294010		2992	104	
37)	301550 3	359241		003	301550 4				
	359238				598560			4280	
	2) 051488		0566	102	1) 287810		2928	100	
39)	301550 3	353033		7005	301550 4	589356		7004	
	353038			4280	599360			4276	

TE 10-20-93 TIME 1029 DIRECTION FW ☒ BW ☐ PARTY PG A E
 CATION HANFORD FROM BM ^{NGER} 917 TO BM #32 T PG A RW
 ATHER WARM, CALM, HAZY PG 78 Y CF B

BACKSIGHT				FORESIGHT			
LEFT	RIGHT	STA	DIST L-R	LEFT	RIGHT	STA	DIST L-R
13752.703	13757.797	0610	428.0	25520.263	22520.233	422.6	7.030
17055549		0610	110	2) 297513	2970	110	
301550 4) 357109		0610		301550 3) 599063			7.001
352099			4390	599062		4386	
2) 056371		0621	114	1) 296739		2909	116
301550 3) 357918				301550 4) 598291			7.002
357921			4504	598289		4502	
1) 054243		0604	124	2) 299419		2933	122
301550 4) 355803				301550 3) 600967			7.002
355793			4628	600969		4624	
2) 062520		0692	134	1) 293308		3001	136
301550 3) 364069				301550 4) 594859			7.001
364070			4762	594858		4760	
1) 059541		0666	142	2) 300079		2930	142
301550 4) 361096				301550 3) 601624			7.005
361091			4904	601629		4902	
2) 050672		0590	166	1) 286229		2947	170
301550 3) 352212				301550 4) 587779			7.001
352222			5070	587778		5072	
1) 060137		0688	174	2) 283729		2923	172
301550 4) 361701				301550 3) 585297			7.001
361687			5244	585298		5244	
2) 054555		0622	152	1) 298338		2907	152
301550 3) 356101				301550 4) 599887			7.001
356105			5396	599888		5396	
1) 057211		0638	134	2) 294668		3012	180
301550 4) 358769				301550 3) 596214			7.004
358761			5530	596218		5526	

BREEZE CAME UP

TE 10-20-93 TIME 1154

DIRECTION FW ☒ BW ☐

PARTY PG EE

CATION HANFORD

FROM BM ^{NCEP} 917 TO BM # 32

PG

A

RW

ATHER COOL, BREEZY, HAZY

PG 79

CF

B

TIME	BACKSIGHT				FORESIGHT			
	LEFT	RIGHT	STA	DIST	LEFT	RIGHT	STA	DIST
	16982512	16982574		553.0	27984232	27984194	552.6	4038
	2) 052993		0592	124	1) 294051		3003	126
50	354543	354538		5654	301550 4) 595608			507
	1) 055398		0615	122	2) 295642		3018	124
49	301550 4) 356963			5776	301550 3) 597190			5002
	356948			5776	597192			5776
	2) 051893		0573	108	1) 299171		2943	98
50	301550 3) 353432			5884	301550 4) 600720			5001
	353443			5884	600721			5874
	1) 051571		0587	142	2) 388836		3965	154
51	301550 4) 353119			6026	301550 3) 590380			5006
	353121			6026	590386			6028
52	058330		0640	114	1) 296729		2911	112
	301550 3) 359880			6140	301550 4) 598275			5004
	359880			6140	598279			6140
	1) 058703		0640	118	2) 293851		2997	118
53	301550 4) 359655			6258	301550 3) 595397			5002
	359653			6258	595401			6258
	2) 055805		0627	138	1) 290449		2973	138
54	301550 3) 357345			6396	301550 4) 592000			5001
	357355			6396	591999			6396
	1) 052981		0595	130	2) 298901		2924	130
55	301550 4) 354536			6526	301550 3) 600444			5007
	354531			6526	600451			6526
	2) 054947		0617	136	1) 296208		2895	134
56	301550 3) 356494			6662	301550 4) 597768			5010
	356497			6662	597758			6660

WIND CAME UP

TE 10-20-83 TIME 1325

DIRECTION FWD BW

PARTY PG

EE

CATION HANFORD

FROM BM ^{NCER} 917 TO BM #32

PG

RW

ATHER WARM, BREEZY, CLEAR

PG 80

B

CF



TEMP	BACKSIGHT				FORESIGHT			
	LEFT	RIGHT	STA	DIST L-R	LEFT	RIGHT	STA	DIST L-R
59°	20188.403	20188.536	0594	646.2	33252.020	33251.978	666.0	649.2
	1) 052037			148	2) 297109		2899	148
	30155.4	353586		603	301550.3	598652		6007
	353589			6810	598659		6808	
	2) 062609		0703	154	1) 298338		2906	154
58°	301550.3	364153		606	301550.4	599891		603
	364159			6964	599888		6962	
	1) 051590		0593	154	2) 299149		2918	146
	301550.4	353503			301550.3	600694		6005
	353140			7118	600699			
	1) 051964		0593	146	2) 299153		2919	148
59°	301550.4	353510		604	301550.3	600706		603
	353511			7110	600703		7110	
62°	2) 053719		0608	142	1) 299221		2963	142
	301550.3	355265		604	301550.4	590785		6014
	355269			7252	590771		7252	
	1) 061501		0689	148	2) 299158		2903	146
61°	301550.4	362061		610	301550.3	599200		6008
	362061			7400	599208		7398	
	2) 052741		0646	138	1) 292720		2986	138
62°	301550.3	359282		609	301550.4	594270		6000
	359291			7538	594220		7536	
	1) 059781		0666	136	2) 292760		2996	136
63°	301550.4	361321		610	301550.3	594299		6011
	361331			7674	594310		7672	
	2) 050005		0569	138	1) 297784		2908	140
62°	301550.3	351561		606	301550.4	599333		6001
	351555			7812	599334		7812	

CF

213.

TE 10-20-83 TIME 1736
STATION HANFORD
ATHER COOL, CALM, THIN CLOUDS

[illegible]



215

TE 10-21-83 TIME 1049 DIRECTION FW ☒ BW ☐ PARTY PG A EE
 CATION HANFORD FROM BM ^{NGER} 917 TO BM 32 PG B RW
 ATHER COOL, BREEZY, PARTIAL CLOUDS PG 85 ☒ CF B

TEMP °F	BACKSIGHT				FORESIGHT			
	LEAST	HIGHT	STA	DIST	LEFT	RIGHT	STA	DIST
	30212.656	30212.744		1032.2	49769.215	49769.215	1032.2	1068
52° 85)	1) 057374		0662	176	2) 299259	2905	174	1014
	3) 301550	4) 358932		008	301550	3) 600795		
	358924			10498	600809		10496	
86)	2) 056453		0666	204	1) 296512	2963	204	
	301550	3) 358006		003	301550	4) 598073		1011
	358003			10702	598062		10700	
87)	1) 058268		0660	154	2) 292130	2999	156	
	301550	4) 357809		1009	301550	3) 593681		1001
	357818			10856	593680		10856	
88)	2) 056050		0630	140	1) 297614	2906	140	
	301550	3) 357607		007	301550	4) 599165		1001
	357600			10996	599164		10996	
89)	1) 050370		0576	144	2) 296044	2988	144	
	301550	4) 351927		007	301550	3) 597599		1005
	351920			11140	597594		11140	
57° 90)	2) 055832		0632	148	1) 293810	3011	146	
	301550	3) 357378		1004	301550	4) 595357		1003
	357382			11288	595360		11286	
	1) 063708		0722	176	2) 294680	2961	172	
91)	301550	4) 365271		013	301550	3) 596221		1009
	365258			11458	596236		11458	
92)	2) 055600		0662	212	1) 294295	2837	212	
	301550	3) 357152		002	301550	4) 595843		1002
	357150			11670	595845		11670	
	1) 064673		0727	160	2) 299166	2912	160	
59° 93)	301550	4) 366233		010	301550	3) 600708		1008
	366223			11830	600716		11830	

10-21-83 TIME 1254 DIRECTION FW ☒ BW ☐ PARTY PG ROD EE
 'ON HANFORD FROM BM ^{NCER} 917 TO BM #32 T PG ROD RW
 EX PARTIAL CLOUDS WINDY COOL PG 86  CF

BACKSIGHT					FORESIGHT					
LEFT	RIGHT	STA	DIST	L-R	LEFT	RIGHT	STA	DIST	L-R	REMARKS
33444.934	33445.059		1183.0	725	55146.743	55146.657		1183.0	7086	
2) 053385		0610			1) 298413		2908	152		GUSTING WIND
301550 3) 354					301550 4)					
					599963			11982		
2) 053381		0610	152		1) 298413		2908	152		
301550 3) 354946				015	301550 4)	599978			015	
354931			11982		599963			11982		
1) 051162		0578	132		2) 284709		2913	132		
301550 4) 352725				013	301550 3)	586254			7005	
352712			12114		586259			12114		
2) 202730		2083	112		1) 301480		2960	110		ROD-A @ BM #33
301550 3) 504271				609	301550 4)	603012			7018	SEE PG 58 FOR DISC.
504280			12226		603030			12224		
301550					301550					
301550										
					301550					
301550										
					301550					END: 1325 6PF
301550										
07A5 34656.857	34657.001		1222.6	7144	56935.995	56935.901		1222.4	7094	(M) DIST. = 2445.0 METERS
2 85 = 34656.929	5 FS = 56935.948	5 FS =	56935.948		BS - FS =	- 22279.019			CM.	

PRECISE LEVELING - METRIC RODS

LINE DIR.	FORM/BACK
FROM BM	Coll 11/4 Top 7.

[illegible][illegible]

APPENDIX C:

Bench Mark Descriptions

- 221

DESCRIPTION OF BENCH MARKS

Hanford Area

Station Haven (1947) State Washington County Benton Date 2/17/82Nearest Town Benson Ranch County BentonDistance and direction from nearest town 8.5 miles northCharacter of mark Brass disk Stamping Haven 19Established by: USGS

Detailed description:

From intersection of 240 E. and 240 W. in Richland go west on State Route 240 for 24 miles then proceed through locked gate (N.) 7.0 miles to a power line access road. Turn right on to power line access road and proceed approximately 1.2 miles, turn left up to top of hill and station.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station ~~WFS 1~~ BM 20 State Washington County Benton Date 2/17/82Nearest Town Benson Ranch County BentonDistance and direction from nearest town 8 miles northCharacter of mark Brass disk Stamping ~~WFS 1~~ BM 20Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland go west on State Route 240 for 24 miles then proceed through N. locked gate 7.0 miles to a power line access road. Turn right onto power line access road and proceed approximately 1.05 miles to WFS 1. Station is approximately 104 feet N. of road and 9 feet S.E. of witness post.

DESCRIPTION OF BENCH MARKS

223

Hanford Area

Station ~~WFS-2~~ ^{BM 21} State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 7.6 miles north
 Character of mark Brass disk Stamping ~~WFS-2~~ BM 21
 Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles then proceed through N. locked gate 6.5 miles to Railroad Grade Rd. Turn right and proceed 0.6 miles to WFS 2. Station is approximately 18 feet S. of centerline road, and 3 feet W. of witness post.

(RD 5900)

DESCRIPTION OF BENCH MARKS

Hanford Area

Station ~~WFS-3~~ ^{BM 22} State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 7.2 miles north
 Character of mark Brass disk Stamping ~~WFS-3~~ BM 22
 Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles then proceed through N. locked gate 6.0 miles to WFS 3. Station is approx. 54 feet E. of paved road and 3 feet W. of witness post.

DESCRIPTION OF BENCH MARKS

224

Hanford Area

Station Bm 23
~~WFS 4~~ State Washington County Benton Date 2/17/82
Nearest Town Benson Ranch County Benton
Distance and direction from nearest town 6.4 miles south
Character of mark Brass disk Stamping ~~WFS 4~~ Bm 23
Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 mi then proceed through N. locked gate 5.2 miles to WFS 4. Station is approx. 51 feet E. of paved road and 3 feet W. of witness post.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station Bm 24
~~WFS 5~~ State Washington County Benton Date 2/17/82
Nearest Town Benson Ranch County Benton
Distance and direction from nearest town 5.6 miles north
Character of mark Brass disk Stamping ~~WFS 5~~ Bm 24
Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go west on State Route 240 for 24 miles, then proceed through N. locked gate 4.5 miles to WFS 5. Station is approx. 48 feet E. of paved road and 3 feet W. of witness post. Station is also 60 feet N.E. of anchor pole and 60 feet N.W. of most N. edge of elect. towers.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station USGS F 322 (1949) State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 4.9 miles north
 Character of mark Brass disk Stamping F 322 1949
 Established by: USGS

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles, then proceed N. through N. locked gate 3.7 miles to (F322, 1949). Station is approx. 45 feet W. of paved road at top of cut bank.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station ~~WFS-6~~ BM25 State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 4.3 miles north
 Character of mark Brass disk Stamping ~~WFS-6~~ BM25
 Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland go west on State Route 240 for 24 miles, then proceed N. through N. locked gate for 3.1 miles to WFS 6. Station is approx. 24 feet E. of centerline of paved road, and approx. 5 feet W. of a 4 x 4 witness post.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station Bm 26
~~WFS 7~~ State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 3.5 miles north
 Character of mark Brass disk Stamping ~~WFS 7~~ Bm 26
 Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go west on State Route 240 for 24 miles, then proceed N. through N. locked gate 2.4 miles to WFS 7. Station is approx. 30 feet E. of centerline of paved road and 3 feet W. of witness post.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station Bm 27
~~WFS 8~~ State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 2.7 miles north
 Character of mark Brass disk Stamping ~~WFS 8~~ Bm 27
 Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go west on State Route 240 for 24 miles then proceed N. through N. locked gate for 1.6 miles to WFS 8. Station is approx. 60 feet E. of centerline of paved road, and 7 feet W. of witness post.

6 + 3' 5"

DESCRIPTION OF BENCH MARKS

Hanford Area

Station No. 32 (1949) State Washington County Benton Date 2/17/82Nearest Town Benson Ranch County BentonDistance and direction from nearest town 1.9 miles northCharacter of mark Brass disk Stamping BM No. 32 Elev. 623.405Established by: Rogers Surveying Co.

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go west on State Route 240 for 24 miles, then proceed N. through N. locked gate 0.8 miles to station No. 32. Station is approx. 45 feet E. of a paved road, also approx. 188 feet N.E. of a P. P. and on the prod of a graded road to the E. of station. There is a 4 x 4 witness post present that is 2 feet high and 2 feet east of station.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station ~~WFS-9~~ ^{BM 28} State Washington County Benton Date 2/17/82Nearest Town Benson Ranch County BentonDistance and direction from nearest town 1.4 miles northCharacter of mark Brass disk Stamping ~~WFS-9~~Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go west on State Route 240 for 24 miles, then proceed N. through N. locked gate 0.3 miles to WFS 9. Station is approx. 35 feet E. of centerline of graded road and 3 feet S.W. of witness post. Station is also 2 1/2 feet above centerline of road.

DESCRIPTION OF BENCH MARKS

228

Hanford Area

Station 911 (A) State Washington County Benton Date 2/17/82Nearest Town Benson Ranch County BentonDistance and direction from nearest town 0.85 miles northCharacter of mark 1 1/2" Brass disk Stamping 911Established by: Rockwell

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go west on State Route 240 for 24 miles, then proceed through S. locked gate 0.1 miles. Then E. cross country 0.1 miles to N.E. edge of Rock Quarry Pit.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station USGS 610 (1915) State Washington County Benton Date 2/17/82
Datum, WashNearest Town Benson Ranch County Benton

Distance and direction from nearest town _____

Character of mark Brass disk Stamping USGS 1915 610 feet DatumEstablished by: USGS

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles, then proceed through S. locked gate 0.95 miles to station (USGS 1915). Station is approximately 18 feet W. of graded rd. and in between two graded roads and 2 feet S.W. of witness post. Station is also among the first three trees you come to.

DESCRIPTION OF BENCH MARKS

229

Hanford Area

Station ~~WFS 10~~ ^{BM 29} State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 0.4 miles south
 Character of mark Brass disk Stamping WFS 10 BM 29
 Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles, then proceed through S. locked gate 1.35 miles to WFS 10. Station is approximately 78 feet N. of graded rd. and 3 feet W. of witness post.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station USGS
Lyne (1947) State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 1.1 miles south
 Character of mark Brass disk Stamping Lyne 1947
 Established by: USGS

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles, then proceed through S. locked gate 2 miles to Station (Lyne 1947). Station is located on top of a small hill approximately 200 feet to the E. of the center of graded rd. and 3 feet E. of witness post. Station is cemented to a large rock.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station Bm 30
~~HFS-11~~ State Washington County Benton Date 2/17/82

Nearest Town Benson Ranch - County Benton

Distance and direction from nearest town 1.8 miles south

Character of mark Rod in cement square Stamping None Bm 30

Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles, then proceed through S. gate 2.7 miles to station 11. Station is approximately 78 feet E. of center of graded rd. and 3.5 feet S.W. of witness post.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station Bm 31
~~HFS-12~~ State Washington County Benton Date 2/17/82

Nearest Town Benson Ranch - County Benton

Distance and direction from nearest town 7.6 miles south

Character of mark Rod in cement square Stamping None Bm 31

Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles, then proceed through S. gate 3.45 miles to Station 12. Station is approximately 57 feet E. of center of graded road. Station is also at intersection of a road going W. from graded road. Station is also 6 feet S.W. of witness post.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station Bm 32
WFS 13 State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 3.3 miles south
 Character of mark Rod in cement square Stamping None- B M 32
 Established by: Walters Flying Service

Detailed description:

From intersection of 240 E. and 240 W. in Richland, go W. on State Route 240 for 24 miles, then proceed through S. locked gate 4.2 miles to a "T" intersection, bear right and proceed another 0.25 miles to Station 13. Station is approximately 50 feet W. of centerline of graded road and 3.5 feet N.W. of witness post.

DESCRIPTION OF BENCH MARKS

Hanford Area

Station 917 (G) State Washington County Benton Date 2/17/82
 Nearest Town Benson Ranch County Benton
 Distance and direction from nearest town 5.5 miles south
 Character of mark 1 1/2: Brass disk Stamping 917
 Established by: Rockwell

Detailed description:

From the entrance to Richland Municipal Airport go N. 0.8 mi to State Route 240, turn left on 240, and go W. 21.5 miles to a locked gate on left (S.). Proceed through the gate on main bladed rd. 3.9 miles to a "T" intersection, turn right and go 1.3 miles to a top of saddle and turn right on a faint jeep track 0.3 miles to top of rocky knoll and station.

APPENDIX D:

Note on Station Installation

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233

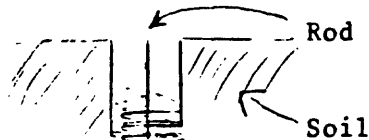
P.O. Box 2123 • Ridgecrest, CA 93555
24 Hours Phone: (818)375-4688

January 14, 1984

Dear Wil:

Thanks for a copy of the letter.

1. All "new" B.B.M's are 3' south and 3' west of "old" W.F.S.'s rods.
2. All Bench marks are encased in 18" (L) X 8" (D) white PVC pipe.



3. All Rods are 5/16 galvanized, all thread driven to refusal with 65 lb. air hammer.
4. Gate number to north stations is 117A.
Gatr number to south stations is 117.
5. If road between 911 and 610 is blocked (drainage area) use the description I wrote in September, 1983:

U.S.G.S. 610 to reach: From the interesection of 240 E and 240 W in Richland go W on 240 for 24.6 mi. to gate 118, proceed through gate (SW) along power-line 0.9 mi. Y go left, 0.9 mi. Y go left, 1.4 mi. Y go left, 0.4 mi. to station on left.

Walt
Floyd Walters

Leveling Field Procedures

Statement of Work

1983 Hanford Site Releveling

I. INTRODUCTION: The USGS requires releveling of a 19 km long level line on the Hanford site across Cold Creek Valley. The following statement of work sets out the procedures to be followed by the level crew.

II. REQUIREMENTS: (A) The contractor shall provide the necessary personnel, vehicles, and equipment required for the surveying and as specified herein.

(B) Surveys - (1) All field work shall be performed to first-order Class III (Class I, double-simultaneous) standards of accuracy, as specified in this statement of work.

(2) In the event of an earthquake or an abnormal situation requiring a redirection of effort, the COTR may modify the instructions to the contractor and the contractor will respond as expeditiously as possible to redirect the field operations.

(C) Field Procedures: Observing order: rod A low scale, rod A lower stadia, rod B low scale, rod B lower stadia, rod B high scale, rod A high scale, with rod A always observed first. (This procedure minimizes effects of rod and tripod settlement during setups and errors caused by refraction changes with changing temperature). Start and end each station with rod A on the bench mark for an even number of setups. (If this is not done, rod index errors from sections with an uneven number of setups can accumulate over long distances.) After a setup is completed, the instrument and back rod are moved forward "leap-frogging" to eliminate accumulation of systematic error caused by index errors, refraction, etc. Level the instrument with telescope pointing opposite directions at alternate instrument stations (that is, always

pointed toward rod A) to prevent accumulation of small compensation error on compensator levels, caused by hysteresis. This is not required on the Ni 002 when the compensator is reversed between left and right scale readings. Maximum disagreement between left and right scale elevation differences is 0.30 mm for each setup. The length of site should be adjusted so setup observations will not have to be repeated frequently to meet this requirement. Maximum length of site shall be 50 m. The direction of running will be reversed on alternate sections when practical to avoid accumulation of small systematic errors from refraction; movement of the forward turning pin while the instrument is moved to the next setup, etc. Backward and forward stadia distances can differ by no more than 2 meters per setup and 4 meters accumulated along a section. The line of sight between instrument and rod should always be higher than 0.5 meters above the ground. This may be relaxed only when checking into a wall-mounted BM. In this case, a TBM will be set and tied to the vertical BM with a single setup, using the vertical BM rods supplied by the contractor. Turning pins with driving cap will be used when they can be driven. Turning pins will be driven vertically into the ground to provide a firm support for the rods. (Tests show that the turning plate settles up to five times as much as the turning pin.) Turning plates, however, will be acceptable. Rod supports will be used at all times. Allow 20 seconds for the tripod feet and turning pins (with rod on pin) to stabilize before making observations. (Tests show that most of the displacement occurs during the first 20 seconds after the tripod and pin are forced into the ground.) The "C" factor will be checked daily on the Ni 1, Ni 2, and N3. Compensators will be checked weekly for automatic levels only.

(D) Circuit lag and re-monumentation: All level lines are presently monumented. Bench mark spacing shall be 1 BM/km (horizontal distance) except where gradients are steep, where 1BM/40m (vertical distance) supercedes horizontal spacing criteria. Continuous circuit lag (net time between initial and final occupation of a BM) must not exceed four days. The COTR will provide an abstract of BM's to be leveled and their elevations for the previous leveling. Destroyed or damaged BMs are to be remonumented at the expense of the COTR and documented for future recovery, at a rate of \$75/BM.

(E) Instruments: Provided by the USGS and must include:

(1) a spirit micrometer level of the highest precision: Wild N3, Wild NA2, N1002, or Ni A31.

(2) Wild matched rods with double invar scales, 1 cm graduation must be calibrated at every graduation by the National Bureau of Standards Lab prior to use.

(3) Field tape recording devices for storing all field measurements and verifying field procedure. The calculator device must: (a) not accept sights in excess of 50 m; (b) not accept rod readings below 50 cm from the ground; (c) not accept left and right scale differences greater than 0.30 mm; (d) not accept stadia mis-balance of more than 2 m per section (4 m for entire line); (e) accept only the prescribed order for reading rods; (f) accept the daily C-factor.

(F) Section re-run: Sections shall be rerun if the difference between three consecutive BM's differs from the previous leveling by 3 mm or more. Otherwise each section shall be run in only one direction. This value may be altered by the COTR as a function of terrain, after notification.

(G) Reports: Level abstracts, with cumulative observed elevation differences from previous leveling (supplied by COTR), instrument and rod make and serial numbers, 2 weeks after the completion of the field work on each line. Personnel changes, remonumentation reports, and schedule changes, all of which require COTR approval, shall be submitted during the course of field work.

(H) Crew Experience: (a) Party Chief: Licensed California Surveyor and extensive previous experience as Party Chief of a 1st-Order level crew. (b) Remainder of crew: previous experience on a 1st-Order level crew. (c) For the entire crew: competence with complete operation of the field tape recording instruments.

(I) Right-of-way: The contractor will obtain right-of-way permission from appropriate persons or agencies with cover statements and assistance as needed, provided by the COTR.

DEPARTMENT OF THE NAVY
NAVAL AIR REWORK FACILITY
ALAMEDA, CALIFORNIA 94501

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-NAVY STANDARDS LABORATORY-
CALIBRATION REPORT

for
3 METER LEVELING ROD SET
Manufacturer: WILD Heerbrugg
Model: 1685 Serial No.: A&B

submitted by
US GEOLOGICAL SURVEY
345 Middlefield Road
Mail Stop 77
Robert Castle
Menlo Park, CA.94025

This set of leveling rods was calibrated using standards traceable to the National Bureau of Standards and the results are listed below.

The measurements were made from the base of the footplate to the centers of the graduations on the metallic strip.

The assumed coefficient of thermal expansion of the metallic (invar) strip is .0000015 m/m/degree celsius.

INTERVAL	S/N:A (CM)	S/N:B (CM)
4	3.99739	3.99704
100	99.99473	99.99723
150	149.99862	149.99909
200	199.99857	199.99983
300	299.99896	300.00090
306	4.44898	4.44663
400	98.45039	98.44760
450	148.45241	148.44945
500	198.45252	198.44882
600	298.45454	298.45204

AMBIENT TEMP.: 19.2 Deg c
REL. HUMIDITY: 45%
REPORT # J6-6
DATE: 6/3/82

PREPARED BY: Ken Rossi
APPROVED BY: W. Gordon
RESUBMISSION DATE: 6/3/84

APPENDIX F:

Level Rod Calibration

240

Rm

Navy Standards Laboratory Report of Calibration

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FOR

(2) 3-Meter Leveling Rods
Wild Heerbrugg Instr. Inc.
Serial Nos. 2176A and 2176B

SUBMITTED BY:

U. S. Geological Warehouse, Menlo Park, CA

The above leveling rods have been compared to N.B.S. traceable standards. The horizontal straight line distance between the terminal points of the indicated intervals have the following lengths under the environmental conditions listed below:

INTERVAL UNITS	LENGTH	
	No. 2176A (1)	No. 2176B (2)
Bottom Plane of footpiece to 60 cm	.59988 Meter	.60002 Meter
to 80 cm	.79987 Meter	.80001 Meter
to 100 cm	.99987 Meter	1.00001 Meter
to 200 cm	1.99984 Meters	1.99999 Meters
to 300 cm	2.99986 Meters	2.99999 Meters
Rod Constant	5.50 and 4.50 mm	5.50 and 4.50 mm

The rod constant factor is the average offset distance between terminal points of the right and left scales of the invar strip measured from each of the above intervals to the first graduation below and above the interval.

The length values shown above are not in error by more than 0.00005 meter. This accuracy is based upon the limits imposed by the standards used, the length of the intervals and the quality of the interval points.

The terminal points of the intervals are defined as the centers of the graduations at their ends nearest the middle of the rod and the point on the bottom plane of the footpiece coincident with the normal projection of a straight line through the ends of the graduations. The coefficient of thermal expansion is assumed to be 1.0 micron per meter per degree celsius.

AMBIENT TEMP 20°C
RELATIVE HUMIDITY 40%
REPORT NO. 6873 & 6877
DATE May 21, 1980
PAGE 1 of 1

PREPARED BY: B. Overcash
B. Overcash
APPROVED BY: A. M. Luis
A. M. Luis
RESUBMISSION DATE May 21, 1981

