Cranbrook Calibration Baseline
1996 Adopted Values

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Baseline Site

The Cranbrook baseline is located on the north side of Highway #95, about 10 km NE of Cranbrook.

This linear baseline consists of 5 concrete piers whose tops are about 1.5 meters above ground level. The piers are about 20 meters from the centerline of the highway and are accessible by vehicle. Some line clearing may be needed on a yearly basis.

See Appendix A for a plan and profile view of the baseline.

Measurements

The 1996 measurements of this baseline were made by Hennessey from July 6-9, using the Mekometer ME5000 (serial number 357061). See Table 1 for the measurement history of this baseline.

Table 1: Measurement history

Date	Observer	Instrument	Serial Number
July 23-26/1990	Lafrance	Mekometer ME5000	357061
Sept. 7-10/1991	Lafrance	Mekometer ME5000	357061
July 06-09/1996	Hennessey	Mekometer ME5000	357061

Currently, each baseline measurement for a year consists of at least three double (forward and backward) distance measurements between all intervisible piers using either the Geomensor CR204 or Mekometer ME5000 EDM instruments.

NGBL Calibration

The scale bias for the Mekometer ME5000 was determined from calibration surveys on the National Geodetic Baseline (NGBL). The constant bias from the NGBL was used as a gross check on the value determined from the Cranbrook baseline adjustment. The average scale bias from the two NGBL calibrations was applied to all distance observations. See Table 2 for the 1996 NGBL biases.

Table 2: Mekometer ME5000 biases derived from 1996 NGBL measurements

Date	Measurement Sets	Constant Bias Value ± Std.Dev. (mm)	Scale Bias Value ± Std.Dev. (ppm)
May 15-22	3	0.0 ± 0.1	-0.07 ± 0.16
July 17-18	3	0.0 ± 0.1	-0.27 ± 0.13
Average			-0.17 ± 0.15

Baseline Adjustment

The 1996 Cranbrook baseline measurements were processed with the new baseline adjustment program CALIB (version 1.1, May 95). A minimally constrained adjustment was made with pier 1 fixed. An a priori standard deviation of 0.1 mm + 0.5 ppm was used for all Mekometer distances, and 0.1 mm for the centering errors. The results of the 1990, 1991 and 1996 adjustments are summarized in Appendix B.

The constant bias from the CALIB adjustment was -0.1 ± 0.1 mm, which is consistent with the estimate obtained from the NGBL calibration (see Table 2). The variance factor for the 1996 adjustment was 1.035, which passes the Chi-square test. There were no residual outliers in the adjustment using all the observations. All residuals passed the Chi-square goodness-of-fit test for normal distribution. All tests were performed at the 95% confidence level.

Comparison with Previous Epochs

The results of the 1990, 1991 and 1996 adjustments were compared to check for any scale differences and pier movements between epochs. The analysis was performed with the new baseline comparison program LINCOMP (version 1.3, May 95). For the adjustments and analyses of the measurements prior to 1996, the reader is referred to the reports issued for those years.

<u>Pier Movement Analysis</u>

The pier movement analysis performed by program LINCOMP uses the "least absolute sum" (L1-norm) solution. Piers that are identified as having statistically significant coordinate differences are removed from the analysis by renaming them. The process is iterated until no outliers remain. The comparison of the 1990, 1991 and 1996 epochs shows no pier movement at this baseline.

<u>Scale Difference Analysis</u>

Any scale difference between epochs is estimated with program LINCOMP using the least squares (L2-norm) solution with suspected pier movements removed. The estimated scale differences between the epochs are given in Table 3.

Table 3: Scale difference between epochs

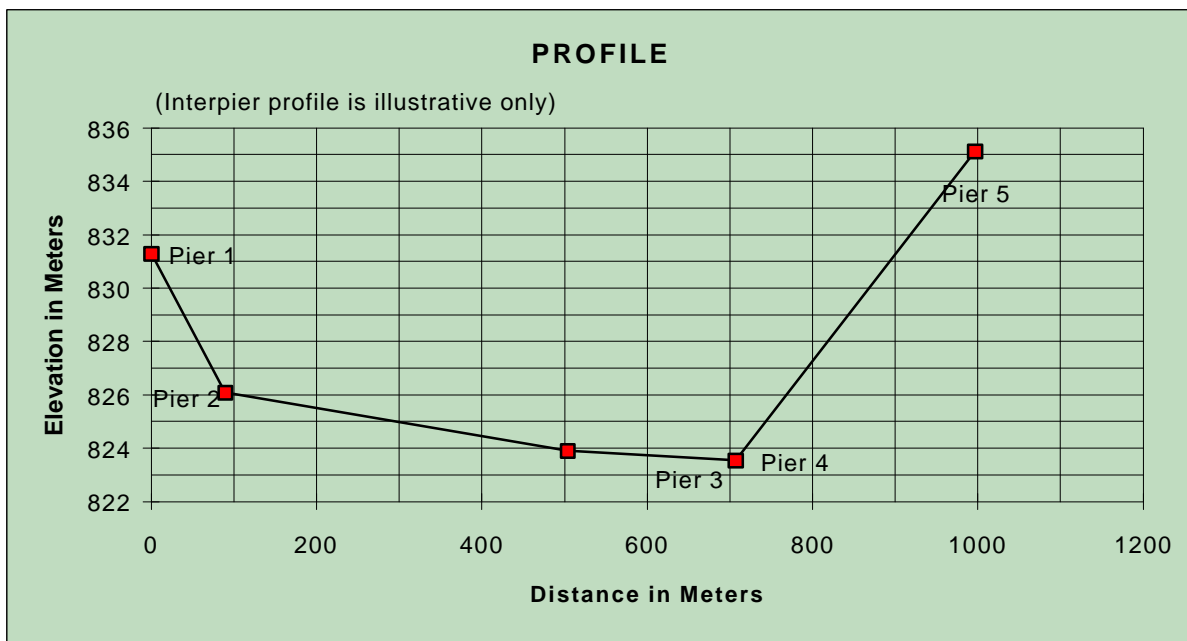| Comparison			Scale Change	
From	To	Piers Used	Value ± Std.Dev. (ppm)	95% Confidence Interval (ppm)
1990	1991	1,2,3,4,5	-0.21 ± 0.47	-1.12 to +0.70
1991	1996	1,2,3,4,5	-0.21 ± 0.44	-1.07 to +0.65

Adopted Distances

The Adopted Distances for the Cranbrook baseline are given in Appendix C and are based on the 1996 measurements. This appendix gives the adjusted interpier slope distances, estimated standard deviations and elevation differences.

Recommendations

Since there is adequate redundancy provided by 5 stable piers to derive the constant and scale biases, a remeasurement is not necessary at this time and should be done only at the request of the controlling agency.

Hennessey/Bresee
February 1997

PLAN VIEW

Pier 1   Pier 2   Pier 3   Pier 4   Pier 5

0   200   400   600   800   1000

Distance in Meters

PROFILE

(Interpier profile is illustrative only)

Pier 1

Pier 2

Pier 3

Pier 4

Pier 5

Elevation in Meters

836
834
832
830
828
826
824
822

0   200   400   600   800   1000   1200

Distance in Meters
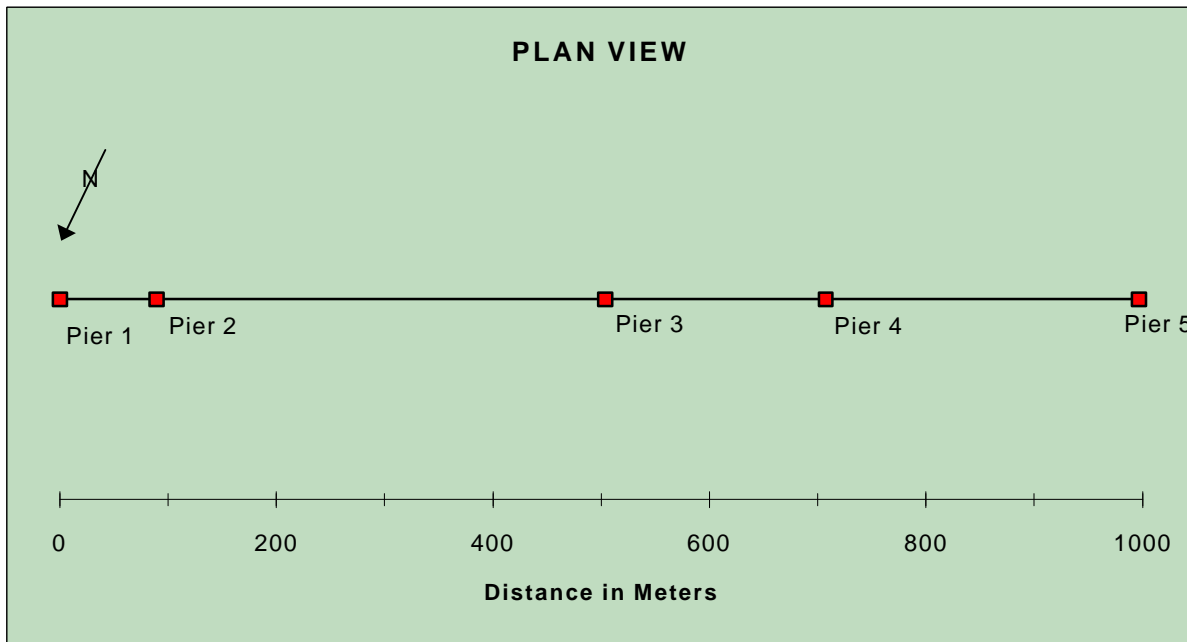
CALIB LEAST SQUARES ADJUSTMENT SUMMARY   **APPENDIX B**

BASELINE NAME: CRANBROOK, B.C.

Epoch Dates	Degrees of Freedom	Variance Factor	Statistical Tests		Derived Constant	Input Scale	Comments
			V.F.	G.O.F.	mm ± S.D.	ppm ± S.D.	
July 23-26 1990	55	1.388	Pass	Fail	-0.1 ± 0.1	-0.4 ± 0.2	Two lines taken out
Sept. 7-10 1991	55	1.157	Pass	Pass	-0.0 ± 0.1	-0.6 ± 0.3	No Outliers
July 6-9 1996	55	1.035	Pass	Pass	-0.1± 0.1	-0.2 ± 0.2	No Outliers

LEGEND: V.F.   -   Variance Factor Test
            G.O.F.   -   Goodness of Fit Test

NOTE: All statistical and outlier tests
             performed with a 95% Confidence Level.

1996 ADOPTED BASELINE DISTANCES   **APPENDIX C**

BASELINE NAME: CRANBROOK, B.C.

Calib Version 1.1   1996 Epoch
        February, 1997

Geodetic Survey Division, Geomatics Canada

From	To	Elevation Difference	Slope Distance	Std Dev
Pier	Pier	Metres (m)	Metres (m)	(mm)
1	2	-5.208	89.4126	0.1
	3	-7.400	503.8104	0.2
	4	-7.755	707.1095	0.2
	5	3.828	996.6949	0.3
2	1	5.208	89.4126	0.1
	3	-2.192	414.5009	0.1
	4	-2.547	617.8112	0.2
	5	9.036	907.4713	0.2
3	1	7.400	503.8104	0.2
	2	2.192	414.5009	0.1
	4	-0.355	203.3111	0.1
	5	11.228	493.0587	0.2
4	1	7.755	707.1095	0.2
	2	2.547	617.8112	0.2
	3	0.355	203.3111	0.1
	5	11.583	289.8513	0.1
5	1	-3.828	996.6949	0.3
	2	-9.036	907.4713	0.2
	3	-11.228	493.0587	0.2
	4	-11.583	289.8513	0.1