Geomatics Canada
Geodetic Survey Division
615 Booth Street
Ottawa, Ontario
K1A 0E9

Géomatique Canada
Division des levés géodésiques
615, rue Booth
Ottawa (Ontario)
K1A 0E9

December 11, 1995

Mr. Morgan Goadsby
Ministry of Natural Resources
Geodetic Services Unit
Land & Resource Information
90 Sheppard Avenue East, 4 th Floor
North York, Ontario
M2N 3A1

Dear Sir:

As a result of the completion of the Conestogo, Ontario Calibration Baseline analyses for the 1993, 1994 and 1995 observations, find enclosed the 1995 adopted values for Conestogo. Should you require further assistance, please feel free to contact us at your convenience.

Yours truly,

Paul Godin
Client Services Section
Phone (613) 995-4421
FAX 995-3215
E-Mail godin@geod.nrcan.gc.ca

Government of Canada | Gouvernement du Canada

MEMORANDUM **NOTE DE SERVICE**

To / À: Paul Godin
Information Services Section

From / De: Larry Hennessey
Field Projects Team

Security Classification - Classification de sécurité	
Our File - Notre référence	2290/ C4
Your file - Votre référence	
Date	December 8, 1995

Subject / Objet: **CONESTOGO, ONTARIO CALIBRATION BASELINE - ADOPTED VALUES - 1995**

We have processed the 1993, 1994 and 1995 measurements of the Conestogo baseline with CALIB/LINCOMP programs and procedures.

There has been movement of about +1.5 mm at pier 1A from 1993 to 1994. There has been no pier movement between the 1994 and 1995 epochs. A remeasurement is not recommended at this time. It should be done only at the request of the controlling agency.

A table of "ADOPTED VALUES" and copies of the report on data processing and recommendations are attached.

Please forward the report to the controlling agency.

Larry Hennessey

L. Hennessey

c.c. S. Crossley
File

Geodetic Survey Division
Earth Science Sector

Conestogo Calibration Baseline
1995 Adopted Values

Authors: L. Hennessey, B. Bresee

Baseline Site

The Conestogo baseline was restructured in 1992 to accommodate a subdivision development. The original pier 1 was destroyed and then relocated close to its original position. A second pier was added (pier 1A) between piers 1 and 2.

This six pier linear baseline has an east/west orientation about 15 metres north of the centerline of Waterloo regional road 17. Pier 1 is located about 20 metres west of the intersection of regional road 17 and Musselman Crescent.

All piers are intervisible and are constructed of 46 cm diameter concrete cylinders, with a brass centering plate cemented into the top. Pier 1 is the most easterly pier and is adjacent to the town of Conestogo. See Appendix A for a plan and profile view of the baseline.

Measurements

The 1995 measurements of this baseline were made by Lafrance from June 23-26 using the Mekometer ME5000 (serial number 357061). See Table 1 for the measurement history on this baseline.

Table 1: Measurement history

Date	Observer	Instrument	Serial Number
Jun. 20-23/1984	Feeny	Mekometer ME3000	218022
Jun. 12-14/1985	Feeny	Mekometer ME3000	218024
Aug. 15-20/1986	Feeny	Geomensor CR204	013
Jun. 26-29/1993	Lafrance	Mekometer ME5000	357061
Jun. 11-15/1994	Hennessey	Mekometer ME5000	357061
Jun. 23-26/1995	Lafrance	Mekometer ME5000	357061

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 scale bias for the May calibration was used for this baseline because the TRANSMET units were calibrated on July 7. This change in the meteorological units would affect the scale determination after this date. The constant bias from the NGBL was used as a gross check on the value determined from the Conestogo baseline adjustment. See Table 2 for the 1995 NGBL biases.

Table 2: Mekometer ME5000 biases derived from 1995 NGBL measurements

Date	Measurement Sets	Constant Bias Value ± Std.Dev. (mm)	Scale Bias Value ± Std.Dev. (ppm)
May 29-31	3	+0.0 ± 0.1	0.0 ± 0.2
Aug.10-15	3	-0.1 ± 0.1	-0.3 ± 0.2

Baseline Adjustment

The 1995 Conestogo baseline measurements were adjusted with the new baseline adjustment program CALIB (version 1.1 March 94). A minimally constrained adjustment was made with pier 1 fixed. A priori standard deviations of 0.1 mm + 0.5 ppm were used for all Mekometer distances and 0.1 mm for the centering errors. The results of this and past adjustments are summarized in Appendix B.

The constant bias from the CALIB adjustment was -0.1 ± 0.1 mm, which agrees with the estimate obtained from the NGBL calibration (see Table 2). The variance factor for the adjustment was 0.972, which passes the Chi-square test. 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 1993, 1994 and 1995 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 1995, the reader is referred to the reports issued for those years. Measurements before 1993 are not analyzed in this report since pier 1 was rebuilt and pier 1A added before the three latest measurements.

Pier Movement Analysis

The pier movement analysis performed by program LINCOMP uses the "least absolute sum" (L1) solution. Piers which are identified as having statistically significant coordinate differences are removed from the analysis by renaming them. The process is iterated until no outliers remain. For the comparison between the 1993 and 1994 epochs, the pier in Table 3 was found to have moved. The comparison between the 1994 and 1995 epochs showed no significant pier movements. The coordinate difference is estimated from a combined CALIB adjustment of the two applicable epochs. A positive sign for the movement implies that the pier has moved away from the first pier (the distance has lengthened over time).

Table 3: Pier movement on the Conestogo baseline

Comparison		Pier	Coordinate Differences	
From	To		Value ± Std.Dev. (mm)	95% Confidence Interval (mm)
1993	1994	1A	+1.5 ± 0.1	+1.3 to +1.7

Scale Difference Analysis

Any scale difference between epochs is estimated with program LINCOMP using the least squares (L2) solution with suspected pier movements removed. The estimated scale difference between the 1993, 1994 and 1995 epochs is given in Table 4.

Table 4: Scale difference between epochs

Comparison		Piers Used	Scale Change	
From	To		Value ± Std.Dev. (ppm)	95% Confidence Interval (ppm)
1993	1994	1,2,3,4,5	-0.02 ± 0.38	-0.77 to +0.73
1994	1995	1.1A,2,3,4,5	-0.33 ± 0.41	-1.13 to +0.47

The estimated scale differences are not statistically significant at the 95% confidence level. The large standard deviation and confidence interval reflect the fact that the scale difference estimate is primarily based on the longer (less precise) distances.

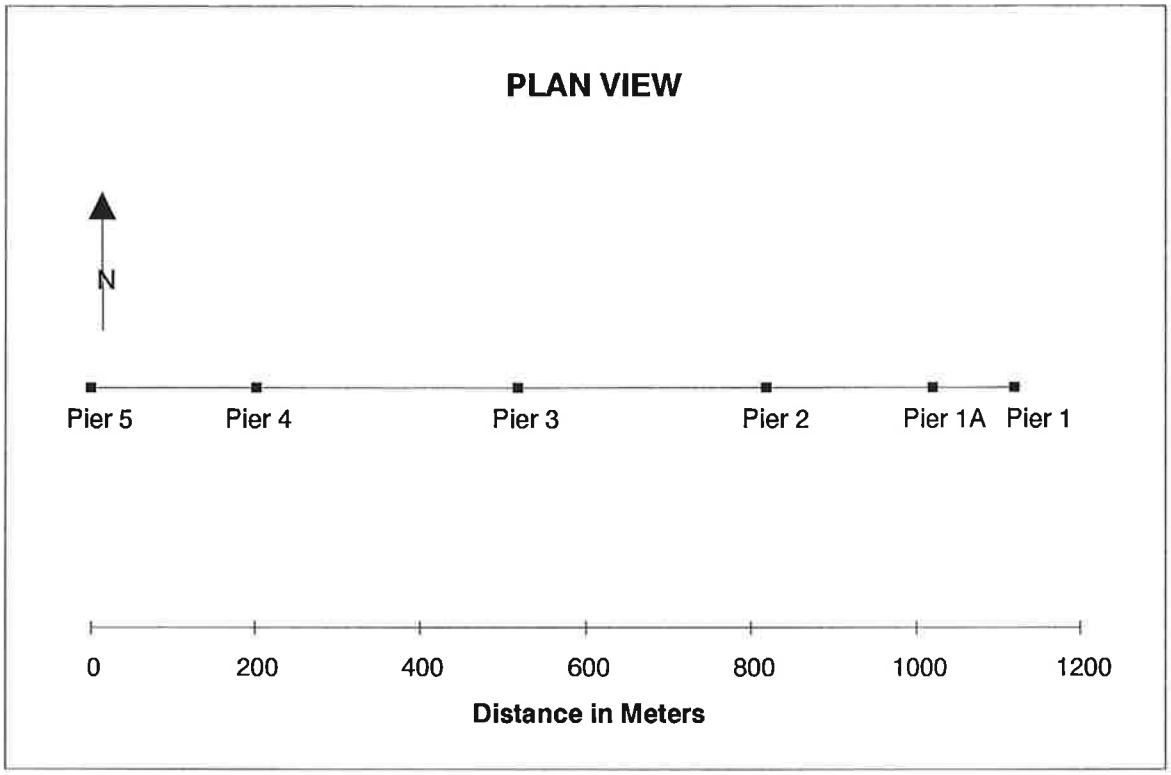
Adopted Distances

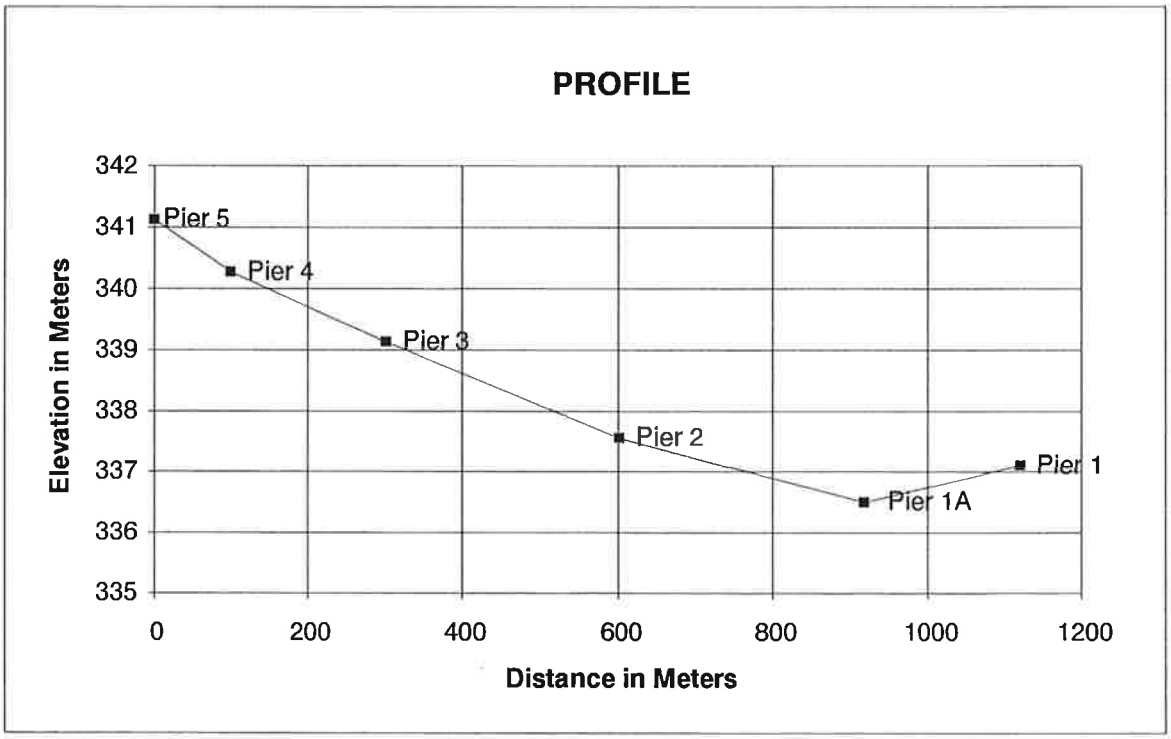
The Adopted Distances for this baseline are given in Appendix C and are based on the 1995 measurements. This table gives the adjusted inter-pier slope distances, estimated standard deviations and elevation differences.

Recommendations

The six piers on the baseline were stable between the 1994 and 1995 epochs. A remeasurement of the baseline is not recommended at this time.

Hennessey, Bresee
December, 1995


PLAN VIEW
N
Pier 5
Pier 4
Pier 3
Pier 2
Pier 1A
Pier 1
0
200
400
600
800
1000
1200
Distance in Meters


PROFILE
342
341
340
339
338
337
336
335
Elevation in Meters
Pier 5
Pier 4
Pier 3
Pier 2
Pier 1A
Pier 1
0
200
400
600
800
1000
1200
Distance in Meters

CALIB LEAST SQUARES ADJUSTMENT SUMMARY APPENDIX B

BASELINE NAME: CONESTOGO, ONTARIO

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.	
Jun.26-29 1993	113	0.811	Pass	Pass	-0.0 ± 0.1	+0.0 ± 0.1	No outliers
Jun.11-15 1994	86	2.090	Fail	Pass	-0.0 ± 0.1	-0.5 ± 0.2	Five lines removed
Jun.23-26 1995	88	0.972	Pass	Pass	-0.1 ± 0.1	+0.0 ± 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.

1995 ADOPTED BASELINE DISTANCES

APPENDIX C

BASELINE NAME: **CONESTOGO, ONTARIO**

Calib Version 1.1 1995 Epoch December, 1995

Geodetic Survey Division, Geomatics Canada

From Pier	To Pier	Elevation Difference Metres (m)	Slope Distance Metres (m)	Std Dev (mm)
1	1A	-0.600	202.5241	0.1
	2	0.456	517.9824	0.1
	3	2.037	818.6501	0.2
	4	3.173	1020.2365	0.2
	5	4.023	1120.2119	0.3
1A	1	0.600	202.5241	0.1
	2	1.056	315.4607	0.1
	3	2.637	616.1299	0.1
	4	3.773	817.7170	0.2
	5	4.623	917.6930	0.2
2	1	-0.456	517.9824	0.1
	1A	-1.056	315.4607	0.1
	3	1.581	300.6694	0.1
	4	2.717	502.2567	0.1
	5	3.567	602.2329	0.2
3	1	-2.037	818.6501	0.2
	1A	-2.637	616.1299	0.1
	2	-1.581	300.6694	0.1
	4	1.136	201.5872	0.1
	5	1.986	301.5636	0.1
4	1	-3.173	1020.2365	0.2
	1A	-3.773	817.7170	0.2
	2	-2.717	502.2567	0.1
	3	-1.136	201.5872	0.1
	5	0.850	99.9766	0.1
5	1	-4.023	1120.2119	0.3
	1A	-4.623	917.6930	0.2
	2	-3.567	602.2329	0.2
	3	-1.986	301.5636	0.1
	4	-0.850	99.9766	0.1