NORTH WEST SURVEY CORPORATION INTERNATIONAL LTD.
Land, Aerial And Photogrammetric Surveyors

AREA CODE 403
TELEPHONE 667-6258

BOX 4418
WHITEHORSE, YUKON Y1A 3T5

REPORT ON THE

CYPRUS ANVIL OPEN PIT CONTROL SURVEY

ANVIL AREA

MAP SHEETS 105 K/5 & 6, Y.T.

JULY-SEPTEMBER, 1979

TABLE OF CONTENTS

INTRODUCTION

In 1979 North West Survey Corporation Yukon Ltd. was engaged by the Exploration Department of Cyprus Anvil Mining Corporation to consolidate all the various control surveys in the Anvil—Faro—Vangorda—Swim Area for a major photogrammetric mapping program. During the course of the larger control survey an additional survey control was completed within and around the vicinity of the Anvil Open Pit. This control survey was on the Cyprus Anvil Mine Diamond Drill Hole Grid and Mine Datum.

FIELD PROCEDURES

An initial familiarization meeting was held with Dan Perrin, Cyprus Anvil Chief Surveyor and J.F. Welter of North West Survey. Three stations were already established in bedrock immediately around the pit area and designated as Pri 4, Tri 18 and Pri 6. It was decided to accept the existing coordinates and elevation for Tri 18 and accept the azimuth as computed from existing coordinates Tri 18 to Pri 4 of 115°37'52.9". One additional station was to be established to the immediate east of the pit on a side hill forming a permanent backsight to pit control stations Pri 4, Tri 18 and Tri 6. In addition it was felt that existing stations to the south of the mine haulage road and on top of the ridges be surveyed common to the pit control to serve as additional check azimuths or stations utilized for three point resection. A unique four digit identifying number was given to each station. A circular yellow plastic tag indicating the station number has been attached to its respective monument. The survey monument is usually a 5/8"x30" iron bar with a 4"x4"x4' red wooden post placed over it. The list of the stations with their identifying numbers and previous identifier are as follows: 1485—Tri 18, 1487—Pri 4, 1486—Pri 6, 1483, 1481—HIW 2, 1463—RC 2, 1477, 1475—HIW 8, 1417—WHI 1-71.

All horizontal and vertical angles were measured with Wild T2 transits to second order specifications. All distances were measured with an AGA 78 Laser Geodimeter. Simultaneous reciprocal trigonometric levelling procedures were used to determine elevation differences. All field work was observed and recorded in metric values.

PRELIMINARY REDUCTIONS

All horizontal angles were reduced in the field to ensure that they met second or third order specifications. All distances were corrected for observed meteorological conditions and reduced to the horizontal. All distances were further reduced to the elevation of 1485—Tri 18 at 4356.34'. Distances were not reduced for scale factor. When extending or working within the control net all measured distances must be reduced to the horizontal and corrected for datum of Tri 18 - 4356.34 as follows:

$$S = \left[D - \left[\frac{DH}{2.095 \times 10^7} \right] - \left[\frac{h^2}{2D} + \frac{h^4}{8D^3} \right] \right] \times 1.000208$$

Where S = sea level distance in feet.

D = slope length of line in feet.

H = mean elevation of line in feet.

h = elevation difference of line in feet.

1.000208 = factor to adjust sea level distance to datum elevation of Tri 18 - 4356.34'.

When using electromagnetic measuring equipment care must be taken to ensure H and h values are to measuring device electrical centre and reflector.

Preliminary horizontal coordinate checks in the field indicated

satisfactory results. The simultaneous reciprocal trigonometric levels were reduced to elevation differences between stations and again that indicated satisfactory field results.

FINAL ADJUSTMENT

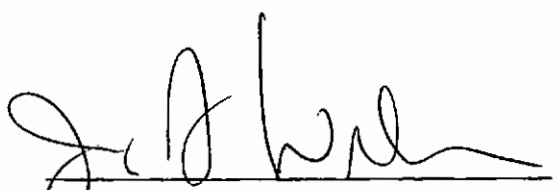
The horizontal field data was prepared for a least squares plane grid coordinate adjustment by assigning apriori standard deviations to all observed values. Horizontal angles observed as either 3 sets or 6 sets were given standard deviations of 2.5" or 2.0", respectively. All distances had standard deviations computed on the basis of 1 cm + 2 ppm of length. The coordinates for Station 1485—Tri 18 were held fixed as was the bearing $115^{\circ}37'52.9"$ to 1487—Pri 4. The resulting adjustment and 95% relative confidence ellipses indicated all stations were of better than second order accuracy and approaching first order accuracy. The results of the horizontal adjustment is enclosed in Appendix A.

The vertical adjustment was completed on program LEVELOB being a least squares adjustment for level nets. Elevation differences were assigned link weights calculated by an estimated angle error of 2.0" and a height of instrument error of 0.02 m. The adjusted elevation matrix indicated maximum standard deviations of 0.03 m. Again the adjustment indicated satisfactory results as obtained by the reciprocal simultaneous trigonometric levelling procedure. The results of the LEVELOB adjustment is enclosed in Appendix B.

Both the horizontal and vertical adjustments were completed by our associated company A.E. Peterson Consulting Ltd. on our minicomputer at our Edmonton office.

CONCLUSION

The open pit control survey was most successfully adjusted using the least squares plane coordinate adjustment and program LEVELOB. From the relative precisions of the interstation error ellipses the network can be classified as second order in accordance with Geodetic Survey of Canada 1973 specifications. The final coordinates and elevations follow in Figure 1.



J.F. Welter, A.L.S., C.L.S.

FIGURE 1

As all of the field measurements and subsequent reduction and adjustments were in metres and the Cyprus Anvil Mine still operates on imperial measure the final coordinates and elevations in feet are as follows:

Station Number	Station Name	Mine Coordinates Northings	Mine Coordinates Eastings	Mine Elevations
1485	Tri 18	10,701.191	12,298.091	4356.34
1487	Pri 4	8,769.331	16,324.534	4233.29
1486	Pri 6	6,062.556	14,763.205	4014.26
1483		9,656.207	17,886.093	4772.45
1481	HIW 2	17,398.848	10,361.811	5519.59
1463	RC 2	-198.661	-912.710	5080.01
1477		-8,766.339	8,867.851	4851.71
1475	HIW 8	-7,888.835	15,488.196	4693.21
1417	WHI 1-71	402.097	15,019.800	3663.13

Coordinates and elevations have been derived from published values of 1485—Tri 18 with assumed bearing of 115°37'52.9" to 1487—Pri 4. Measured distances have been reduced to the datum elevation of Tri 18 being 4356.34'. Coordinates have not been corrected for scale factor.

APPENDIX A

LEAST SQUARES PLANE ADJUSTMENT

CYPRUS ANVIL OPEN PIT CONTROL SURVEY - 1979

L.S. ADJUSTMENT - PLANE COORDINATES

A. E. PETERSON CONSULTING LTD.
EDMONTON ALTA.

DATE 18 12 1979 TIME 10 15 29

CYPRUS

APPROX. COORDINATES

WARNING--S.D. SET EQUAL TO 0.1 SEC.

UPDATED COORDINATES AND CORRECTIONS

	NORTHING	CORR.	EASTING	CORR.
1485	3261.723	.000	3748.458	.000
1487	2672.892	.000	4975.718	.000
1486	1847.867	.000	4499.825	.000
1483	2943.212	.000	5451.681	.000
1481	5303.169	-.000	3158.280	-.000
1463	-60.552	-.000	-278.194	.000
1477	-2671.980	-.000	2702.921	.000
1475	-2404.517	-.000	4720.802	.000
1417	122.559	-.000	4578.035	.000

95% C.L. ON SO= 1.122 1.751 EXPECTED VALUE=1.

SO= 1.368 MEAN RES= .026 D.F.= 40.

WARNING--S.D. SET EQUAL TO 0.1 SEC.

UPDATED COORDINATES AND CORRECTIONS

	NORTHING	CORR.	EASTING	CORR.
1485	3261.723	.000	3748.458	-.000
1487	2672.892	-.000	4975.718	.000
1486	1847.867	-.000	4499.825	-.000
1483	2943.212	-.000	5451.681	-.000
1481	5303.169	.000	3158.280	.000
1463	-60.552	.000	-278.194	-.000
1477	-2671.980	.000	2702.921	-.000
1475	-2404.517	.000	4720.802	-.000
1417	122.559	.000	4578.035	-.000

95% C.L. ON SO= 1.122 1.751 EXPECTED VALUE=1.

SO= 1.368 MEAN RES= .026 D.F.= 40.

OBSERVATIONS

CODE	FROM	TO	OBS.	S.D.	RES. (ADJ-OBS)	STAND. RES.
N-CO	1485	1485	3261.723	.0001	-.000	.000
E-CO	1485	1485	3748.458	.0001	.000	.000
DIR.	1485	1463	.000	2.0000	-.363	.182
DIR.	1485	1483	2300701.800	2.5000	.202	.081
DIR.	1485	1487	2450924.000	2.0000	-1.229	.615
DIR.	1485	1486	2813213.200	2.0000	1.463	.732
DIR.	1487	1463	.000	2.0000	1.451	.725
DIR.	1487	1485	530705.900	2.0000	-.007	.004
DIR.	1487	1481	825038.000	2.5000	-.678	.271
DIR.	1487	1483	1775333.700	2.5000	.674	.270
DIR.	1487	1486	3272752.800	2.0000	-1.441	.721
DIR.	1486	1463	.000	2.0000	-2.399	1.200
DIR.	1486	1485	834705.200	2.0000	-1.502	.751
DIR.	1486	1481	903310.200	2.5000	.159	.064
DIR.	1486	1487	1414456.100	2.0000	1.172	.586
DIR.	1486	1483	1524541.300	2.5000	4.105	1.642
DIR.	1483	1463	.000	2.5000	.754	.302
DIR.	1483	1485	381521.800	2.5000	4.412	1.765
DIR.	1483	1481	732905.000	2.5000	-.920	.368
DIR.	1483	1417	3145224.200	2.5000	3.784	1.513
DIR.	1483	1477	3234453.500	2.5000	-1.469	.588

DIR.	1483	1486	3383924.000	2.5000	-3.422	1.369	
DIR.	1483	1487	3580418.600	2.5000	-3.138	1.255	
DIR.	1481	1483	.000	2.5000	-3.227	1.291	
DIR.	1481	1487	93211.500	2.5000	-.397	.159	
DIR.	1481	1486	225736.400	2.5000	1.827	.731	
DIR.	1481	1463	764935.600	2.0000	1.151	.575	
DIR.	1463	1475	.000	2.5000	7.860	3.144	**
DIR.	1463	1477	160549.800	2.5000	6.453	2.581	**
DIR.	1463	1481	2773142.500	2.5000	-1.263	.505	
DIR.	1463	1485	2952125.500	2.5000	-4.474	1.790	
DIR.	1463	1483	3071300.300	2.5000	-2.366	.946	
DIR.	1463	1487	3072344.000	2.5000	-4.282	1.713	
DIR.	1463	1486	3130629.500	2.5000	.455	.182	
DIR.	1463	1417	3324319.800	2.5000	-2.381	.952	
DIR.	1477	1463	.000	2.5000	-1.083	.433	
DIR.	1477	1483	745155.000	2.5000	-3.125	1.250	
DIR.	1477	1475	1311348.500	2.5000	4.208	1.683	
DIR.	1475	1477	.000	2.5000	-.977	.391	
DIR.	1475	1463	324017.300	2.5000	-.461	.184	
DIR.	1475	1417	941858.200	2.5000	1.438	.575	
DIR.	1417	1475	.000	2.5000	-2.922	1.169	
DIR.	1417	1463	910427.000	2.5000	-3.161	1.264	
DIR.	1417	1483	2002625.500	2.5000	6.083	2.433	**
WARNING--S.D. SET EQUAL TO 0.1 SEC.							
AZI.	1485	1487	1153752.900	.0100	.000	.000	
LEN.	1485	1486	1601.111	.0130	-.005	.413	
LEN.	1486	1487	952.438	.0120	.001	.110	
LEN.	1487	1485	1361.214	.0120	-.006	.482	
LEN.	1485	1486	1601.106	.0120	-.000	.031	
LEN.	1486	1487	952.438	.0120	.001	.110	
LEN.	1487	1485	1361.210	.0120	-.002	.149	
LEN.	1485	1463	5220.302	.0200	-.011	.568	
LEN.	1486	1463	5145.059	.0200	-.011	.535	
LEN.	1487	1463	5922.443	.0200	-.002	.119	
LEN.	1485	1483	1732.745	.0140	.003	.230	
LEN.	1486	1483	1451.152	.0130	-.011	.879	
LEN.	1487	1483	547.367	.0110	.002	.204	
LEN.	1486	1481	3706.573	.0170	.022	1.318	
LEN.	1487	1481	3197.109	.0160	-.011	.712	
LEN.	1481	1483	3290.763	.0160	-.006	.364	
LEN.	1481	1463	6370.040	.0930	.113	1.219	
LEN.	1483	1417	2952.860	.0160	-.008	.478	
LEN.	1463	1417	4859.639	.0190	.040	2.120	**
LEN.	1417	1475	2531.129	.0150	-.023	1.530	
LEN.	1475	1477	2035.534	.0140	-.004	.276	
LEN.	1483	1477	6251.796	.0930	.098	1.058	
LEN.	1475	1463	5521.101	.0850	.143	1.680	

UPDATED COORDINATES AND CORRECTIONS

	NORTHING	CORR.	EASTING	CORR.
1485	3261.723	-.000	3748.458	-.000
1487	2672.892	.000	4975.718	-.000
1486	1947.867	.000	4499.925	.000

1483	2943.212	-.000	5451.681	.000
1481	5303.169	-.000	3158.280	-.000
1463	-60.552	-.000	-278.194	.000
1477	-2671.980	.000	2702.921	-.000
1475	-2404.517	-.000	4720.802	-.000
1417	122.559	-.000	4578.035	-.000

95% C.L. ON SO= 1.122 1.751 EXPECTED VALUE=1.

SO= 1.368 MEAN RES= .026 D.F.= 40.

****ADJUSTED COORDINATES AND STANDARD DEVIATIONS****

STA.	NORTHING	S.D. (NORTH)	EASTING	S.D. (EAST)
1485	3261.7230	.0001	3748.4580	.0001
1487	2672.8925	.0038	4975.7177	.0077
1486	1847.8674	.0078	4499.8245	.0117
1483	2943.2117	.0101	5451.6805	.0108
1481	5303.1689	.0223	3158.2802	.0324
1463	-60.5520	.0444	-278.1936	.0294
1477	-2671.9800	.0381	2702.9207	.0658
1475	-2404.5171	.0280	4720.8024	.0614
1417	122.5593	.0218	4578.0347	.0327

ERROR ELLIPSE MULTIPLIER= 2.542

95% CONFIDENCE ELLIPSES

STATION	SEMI-MAJOR AXIS	SEMI-MINOR AXIS	AZIMUTH OF MAJOR AXIS (DEG)
1485	.000	.000	.00
1487	.022	.002	-64.37
1486	.030	.020	-87.99

1483	.027	.026	-89.01
1481	.093	.037	59.72
1463	.130	.039	-31.00
1477	.177	.078	-68.71
1475	.156	.071	88.06
1417	.084	.055	-80.81

95% RELATIVE CONFIDENCE ELLIPSES

*ACC. FACTOR UNDER: 2=FIRST; 5=2ND.; 12=3RD.; 30=4TH. ORDER.

LINE	SEMI-MAJ. AXIS	SEMI-MIN. AXIS	AZIMUTH OF MAJOR AXIS (DEG)	LINE AZIMUTH (DEG)	AZIMUTH ACCURACY (SEC)	LENGTH ACCURACY	ACC. FACTOR
*	1485	1487					
	.022	.002	-64.4	115.6	.3	.022	1.39
*	1485	1486					
	.030	.020	-88.0	152.0	3.5	.023	1.65
*	1485	1483					
	.027	.026	-89.0	100.6	3.1	.027	1.42
*	1485	1481					
	.093	.037	59.7	343.9	8.8	.042	3.99
*	1485	1463					
	.130	.039	-31.0	230.5	5.1	.043	2.39
*	1485	1477					
	.177	.078	-68.7	190.0	6.0	.084	2.84
*	1485	1475					
	.156	.071	88.1	170.3	5.6	.073	2.62
*	1485	1417					
	.084	.055	-80.8	165.2	5.1	.060	2.43
*	1487	1486					
	.020	.019	86.8	210.0	5.6	.022	2.44
*	1487	1483					
	.027	.019	45.5	60.4	7.5	.026	3.57
*	1487	1481					
	.091	.034	57.4	325.4	5.9	.034	2.69
*	1487	1463					
	.131	.038	-31.1	242.5	4.5	.039	2.13
*	1487	1477					
	.178	.078	-68.8	203.0	6.3	.078	2.96
*	1487	1475					
	.157	.070	88.1	182.9	6.3	.071	2.97
*	1487	1417					
	.084	.054	-81.8	188.9	6.7	.054	3.02
*	1486	1483					
	.034	.027	-65.0	41.0	4.7	.028	2.05
*	1486	1481					
	.103	.036	63.3	338.8	5.7	.037	2.63
*	1486	1463					
	.123	.040	-24.4	248.2	4.9	.040	2.31
*	1486	1477					
	.167	.079	-67.1	201.7	7.1	.079	3.30
*	1486	1475					

	.146	.072	87.3	177.0	7.1	.072	3.27
*	1486	1417					
	.074	.056	-77.8	177.4	8.7	.057	3.86
*	1483	1481					
	.097	.035	51.3	315.8	6.1	.036	2.78
*	1483	1463					
	.141	.042	-28.3	242.3	4.5	.042	2.11
*	1483	1477					
	.182	.077	-65.2	206.1	6.0	.077	2.81
*	1483	1475					
	.157	.070	-87.1	187.8	6.0	.071	2.80
*	1483	1417					
	.086	.050	-71.3	197.2	6.0	.050	2.74
*	1481	1463					
	.145	.081	-60.1	212.6	4.7	.081	2.20
*	1481	1477					
	.214	.098	-84.0	183.3	5.5	.098	2.61
*	1481	1475					
	.206	.080	78.1	168.5	5.4	.080	2.56
*	1481	1417					
	.141	.067	72.8	164.7	5.4	.067	2.52
*	1463	1477					
	.129	.110	-84.9	131.2	6.1	.123	3.09
*	1463	1475					
	.146	.097	36.4	115.1	5.4	.099	2.55
*	1463	1417					
	.121	.054	-5.1	87.8	5.1	.054	2.38
*	1477	1475					
	.089	.047	-10.4	82.4	9.0	.047	3.96
*	1477	1417					
	.133	.069	-59.2	33.9	8.2	.069	3.74
*	1475	1417					
	.106	.049	85.2	356.8	8.7	.049	3.89

TIME USED= 47.00 SECONDS

APPENDIX B

LEVELOB VERTICAL ADJUSTMENT

CYPRUS ANVIL OPEN PIT CONTROL SURVEY - 1979

PROGRAM LEVELOB--A.E. PETERSON CONSULTING LTD.
EDMONTON, ALTA.

DATE 20 12 1979 TIME 11 31 4

LEVDAT

23 9 1

NOTE LINK WEIGHTS CALCULATED BY ANGLE ERROR OF 2 SECONDS
AND HI ERROR OF .020 HEIGHT UNITS

INPUT DATA

1	1487		1290.300	
2	1486		1223.500	
3	1483		1454.700	
4	1481		1682.300	
5	1463		1548.300	
6	1477		1478.800	
7	1475		1430.400	
8	1417		1116.500	
9	1485		1327.812	
1	1485	1486	-104.2730	.0003
2	1486	1487	66.7700	.0002
3	1487	1485	37.4730	.0003
4	1485	1486	-104.2920	.0003
5	1486	1487	-66.7300	.0002
6	1487	1485	37.5170	.0003
7	1485	1463	220.5250	.0015
8	1486	1463	324.8010	.0014
9	1487	1463	258.0161	.0010
10	1485	1483	126.8580	.0003
11	1486	1483	231.1010	.0003
12	1487	1483	164.3330	.0002
13	1486	1481	458.8010	.0008
14	1487	1481	392.0820	.0007
15	1481	1483	-227.7570	.0007
16	1481	1463	-133.8890	.0021
17	1483	1417	-338.1101	.0006
18	1463	1417	-431.8821	.0013
19	1417	1475	313.9719	.0005
20	1475	1477	48.3180	.0004
21	1483	1477	24.2310	.0020
22	1477	1463	69.6270	.0008
23	1475	1463	117.8780	.0016

SOLUTION TO NORMALS

.743E-02 .476E-01 -.577E-01 .701E-01 .876E-01 .264E-02
.913E-01 .217E-01

SOLUTION TO NORMALS

.107E-03 .238E-03 .127E-03 .242E-04 .201E-03 .199E-03
.241E-03 .208E-03

ADJUSTED ELEVATION MATRIX

			S.D.
1	1487	1290.307	.012
2	1486	1223.547	.013
3	1483	1454.642	.015
4	1481	1682.370	.024
5	1463	1548.387	.026
6	1477	1478.802	.033
7	1475	1430.491	.033
8	1417	1116.521	.029
9	1485	1327.812	.000

LINE NO.	FROM STA.	TO STA.	ADJ.ELEV. DIFF.	OBS.ELEV. DIFF.	RESIDUAL (OBS-ADJ)	SIGMA (INPUT)	LINK S.D.
1	1485	1486	-104.265	-104.273	-.008	.0179	.013
2	1486	1487	66.760	66.770	.010	.0156	.012
3	1487	1485	37.505	37.473	-.032	.0169	.012
4	1485	1486	-104.265	-104.292	-.027	.0179	.013
5	1486	1487	66.760	66.730	-.030	.0156	.012
6	1487	1485	37.505	37.517	.012	.0169	.012
7	1485	1463	220.575	220.525	-.050	.0385	.026
8	1486	1463	324.840	324.801	-.039	.0379	.026
9	1487	1463	258.080	258.016	-.064	.0430	.025
10	1485	1483	126.830	126.858	.028	.0184	.015
11	1486	1483	231.095	231.101	.006	.0172	.014
12	1487	1483	164.335	164.333	-.002	.0146	.014
13	1486	1481	458.823	458.801	-.022	.0289	.022
14	1487	1481	392.063	392.082	.019	.0259	.022
15	1481	1483	-227.728	-227.757	-.029	.0266	.023
16	1481	1463	-133.983	-133.889	.094**	.0459	.030
17	1483	1417	-338.121	-338.110	.010	.0246	.027
18	1463	1417	-431.866	-431.882	-.016	.0361	.028
19	1417	1475	313.970	313.972	.002	.0223	.026
20	1475	1477	48.312	48.318	.006	.0199	.024
21	1483	1477	24.160	24.231	.071	.0451	.032
22	1477	1463	69.585	69.627	.042	.0288	.028
23	1475	1463	117.897	117.879	-.018	.0404	.029
	MEAN RESIDUAL				-.0032		
	STD.ERROR OF OBS.OF UNIT WT.				1.4120		

**INDICATES RESIDUALS> 2*SIGMA SET BY A-PRIORI INPUT FACTORS