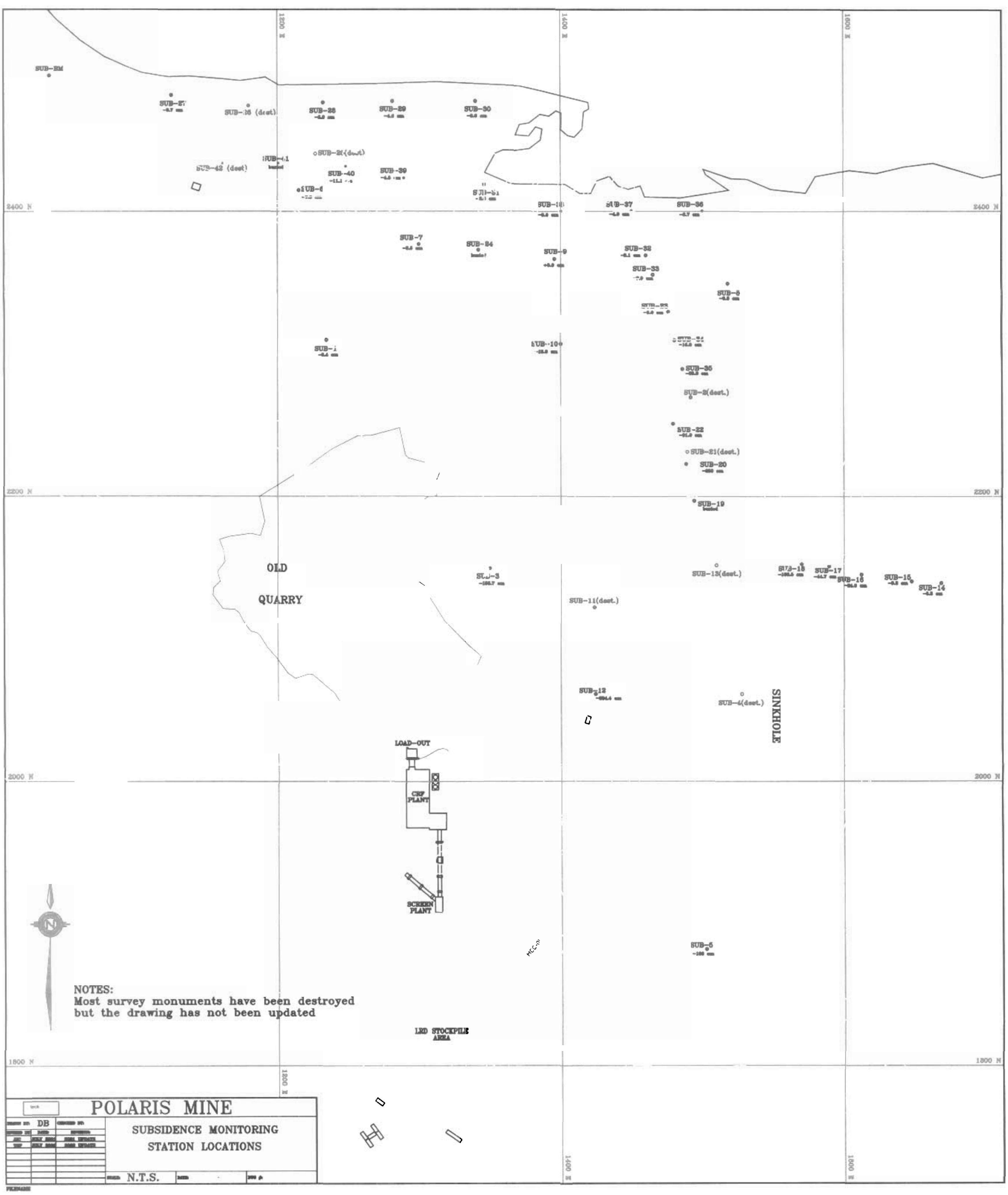
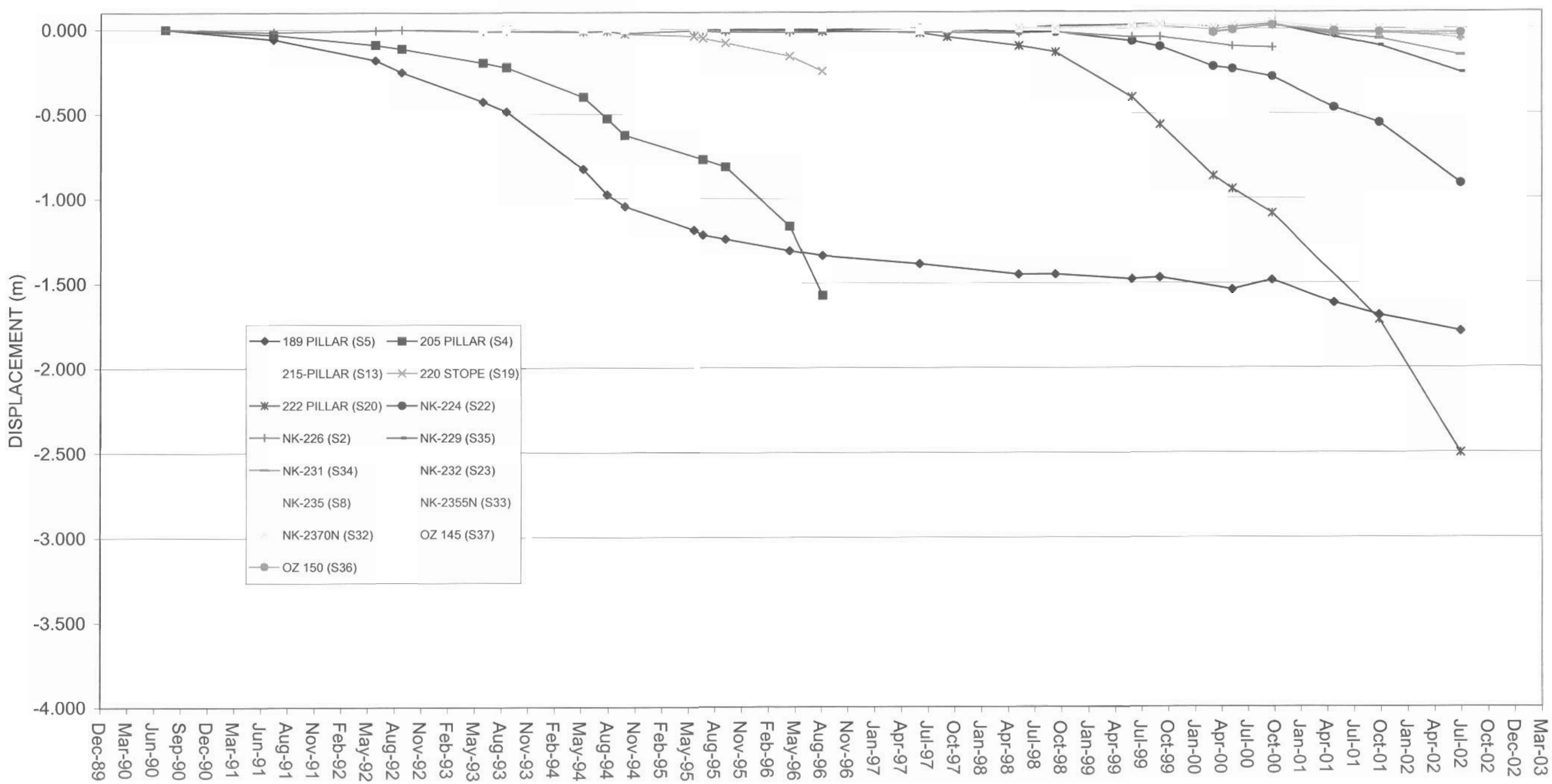
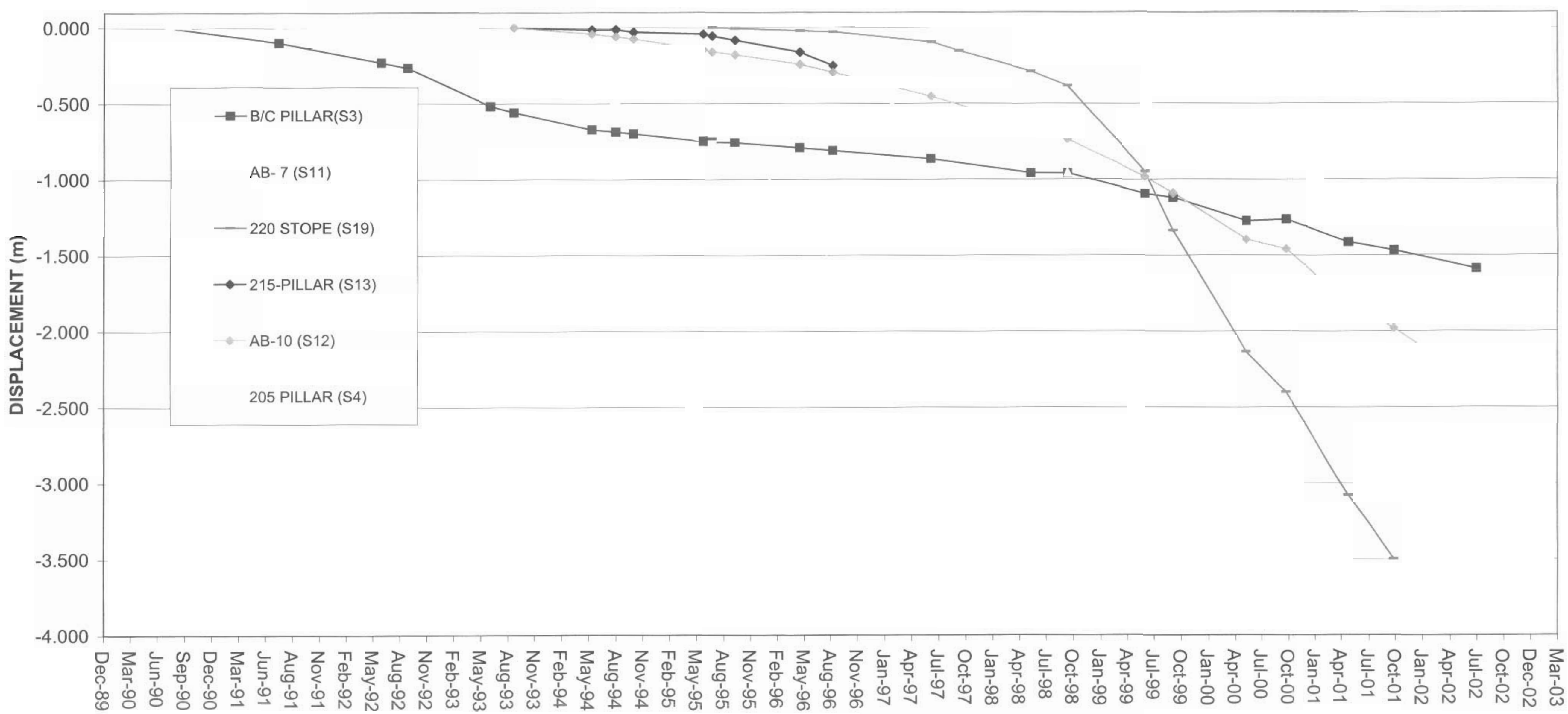

1200 E
1400 E
1600 E
2400 N
2200 N
2000 N
1800 N
SUB-28
SUB-29
SUB-30
SUB-42 (dest)
SUB-40
SUB-39
SUB-37
SUB-36
SUB-7
SUB-34
SUB-9
SUB-32
SUB-33
SUB-35
SUB-2(dest.)
SUB-22
SUB-21(dest.)
SUB-20
SUB-19
OLD
QUARRY
SUB-13(dest.)
SUB-17
SUB-16
SUB-15
SUB-14
SUB-11(dest.)
SUB-4(dest.)
SINKHOLE
LOAD-OUT
CRF PLANT
SCREEN PLANT
SUB-5
NOTES:
Most survey monuments have been destroyed
but the drawing has not been updated
LED STOCKPILE AREA
POLARIS MINE
DB
SUBSIDENCE MONITORING
STATION LOCATIONS
N.T.S.

SUBSIDENCE DISPLACEMENT
NORTH - SOUTH THROUGH SINKHOLE AREA
AT 1500 E SECTION

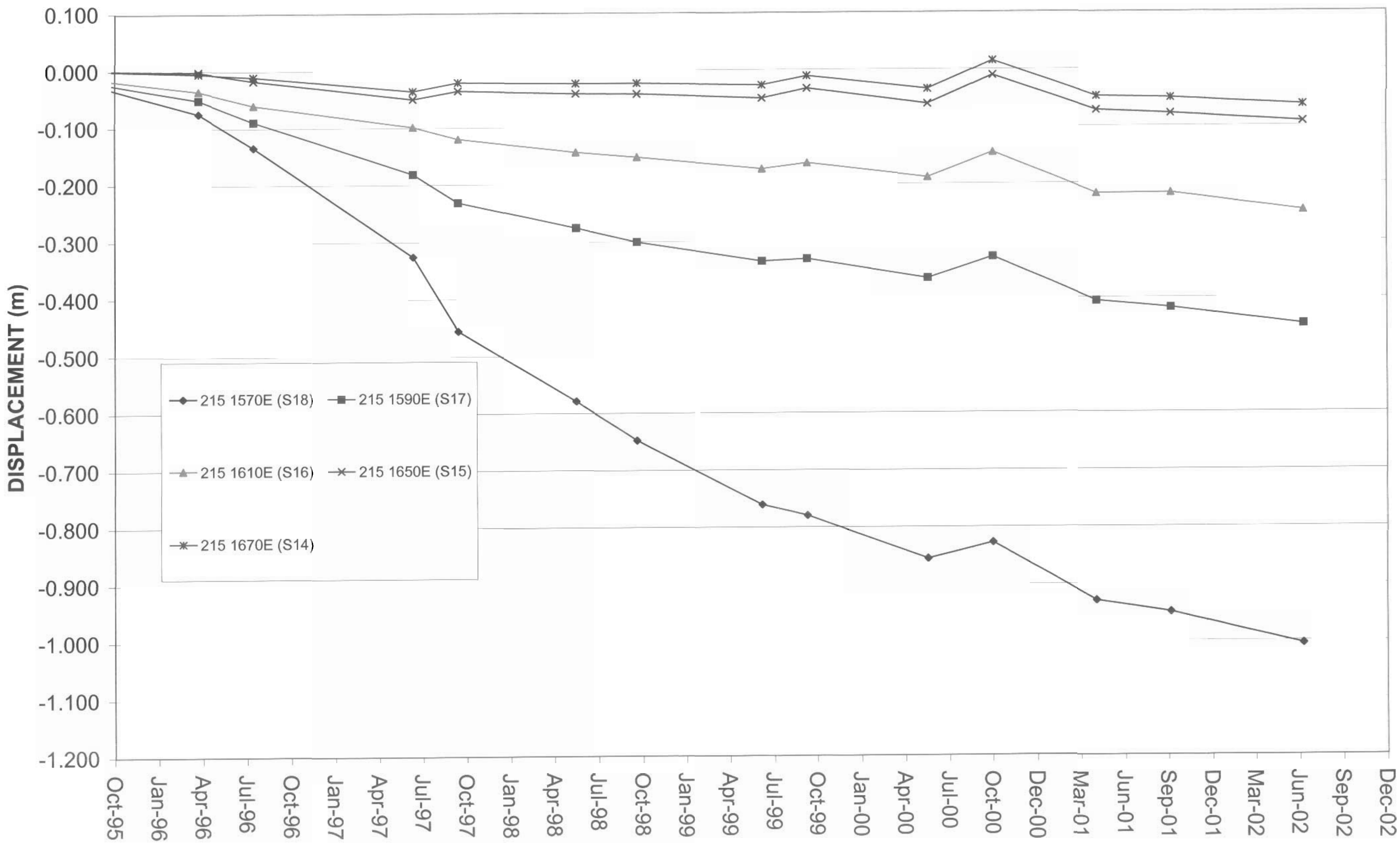


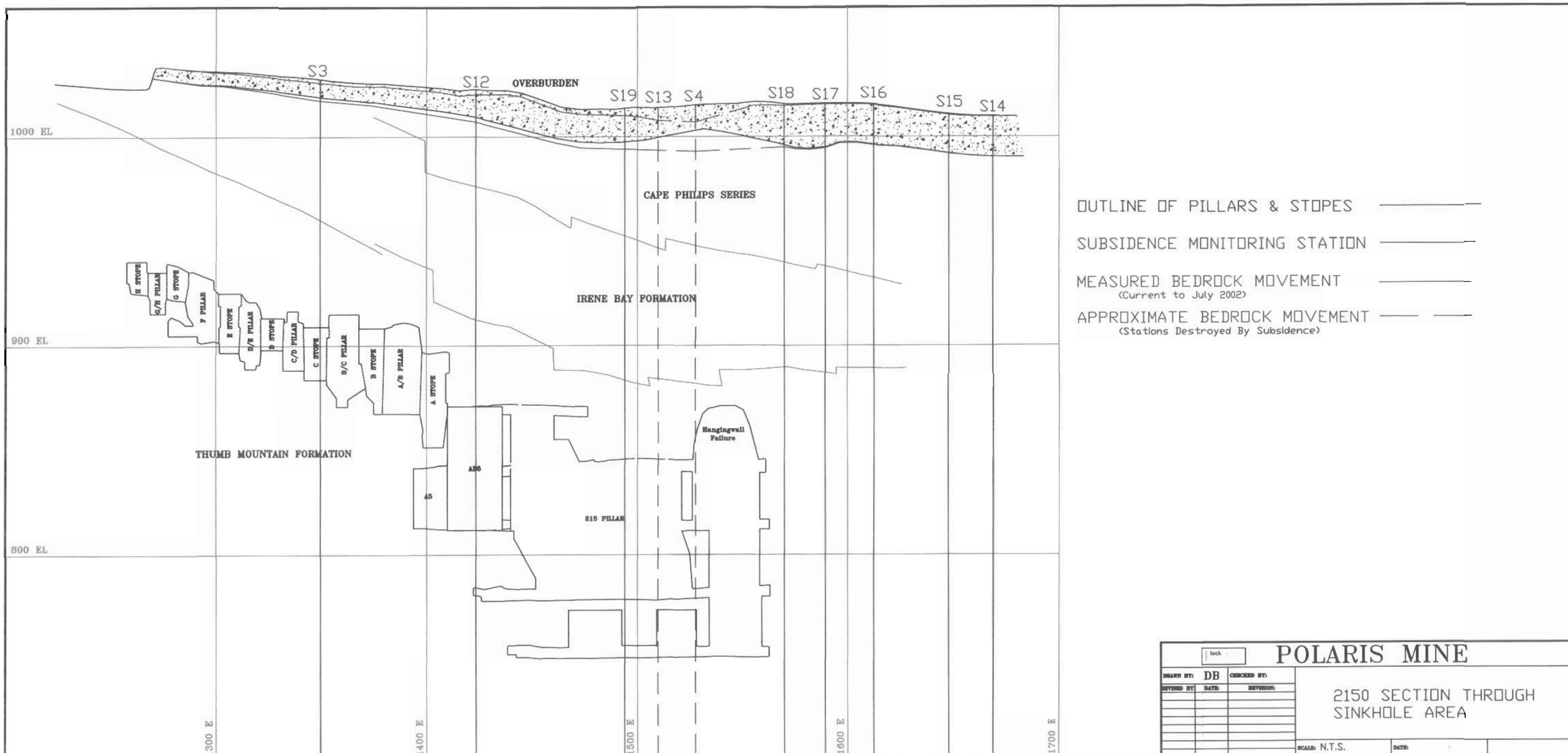
teckcominco

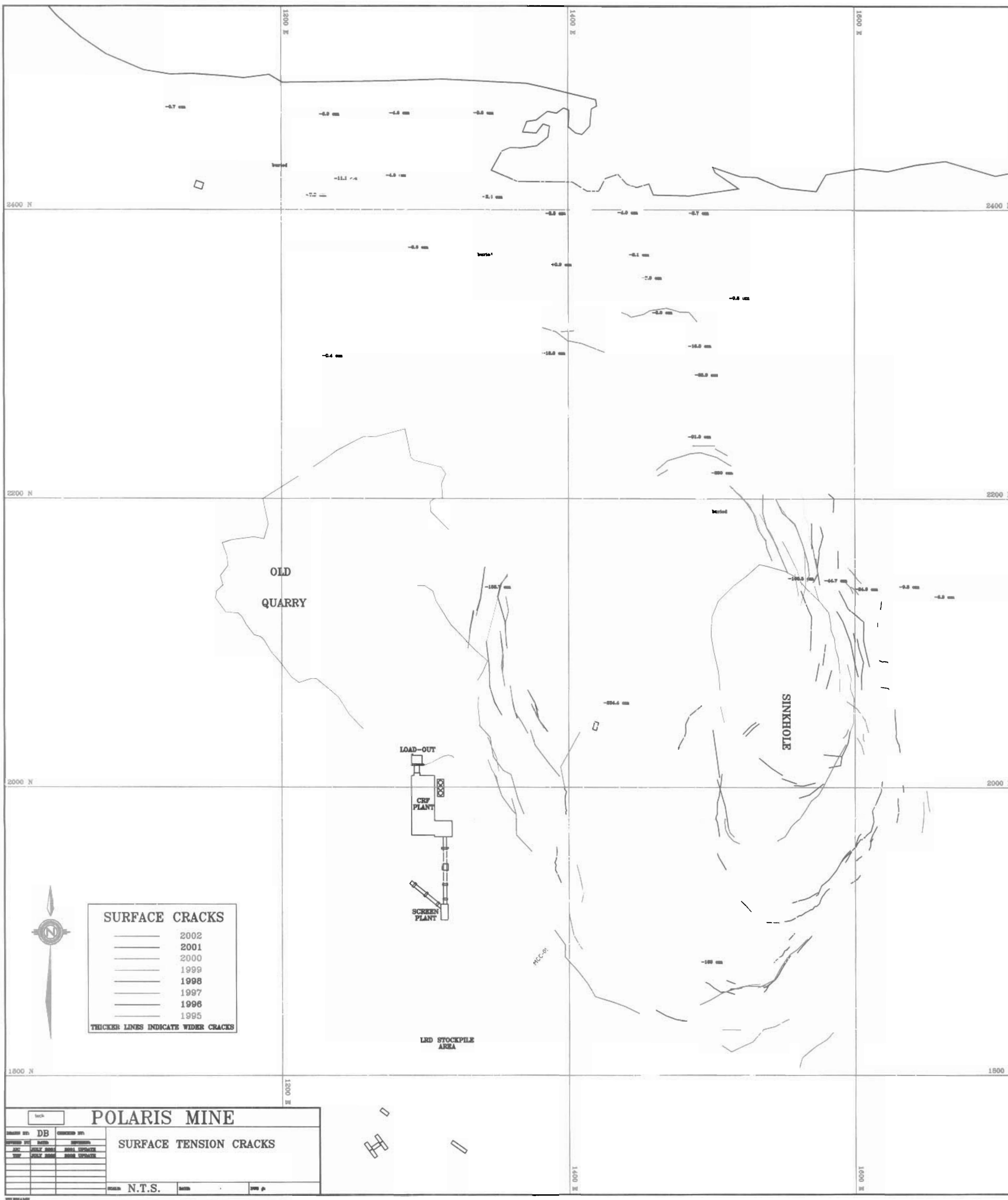
SUBSIDENCE DISPLACEMENT
WEST OF SINKHOLE AREA
AT 2150 N SECTION



SUBSIDENCE DISPLACEMENT
EAST OF SINKHOLE AREA
AT 2150 N SECTION




S3
S12
OVERBURDEN
S19 S13 S4
S18 S17 S16
S15 S14
1000 EL
900 EL
800 EL
CAPE PHILIPS SERIES
IRENE BAY FORMATION
THUMB MOUNTAIN FORMATION
H STOPE
G/H PILLAR
G STOPE
F PILLAR
E STOPE
D/E PILLAR
D STOPE
C/D PILLAR
C STOPE
B/C PILLAR
B STOPE
A/B PILLAR
A STOPE
AB6
A5
215 PILLAR
Hangingwall Failure
1300 E
1400 E
1500 E
1600 E
1700 E
OUTLINE OF PILLARS & STOPES
SUBSIDENCE MONITORING STATION
MEASURED BEDROCK MOVEMENT
(Current to July 2002)
APPROXIMATE BEDROCK MOVEMENT
(Stations Destroyed By Subsidence)
POLARIS MINE
DRAWN BY: DB
CHECKED BY:
REVISED BY
DATE:
REVISION:
2150 SECTION THROUGH
SINKHOLE AREA
SCALE: N.T.S.
DATE:



POLARIS MINE
SURFACE TENSION CRACKS
DB
N.T.S.
SURFACE CRACKS
2002
2001
2000
1999
1998
1997
1996
1995
THICKER LINES INDICATE WIDER CRACKS
OLD QUARRY
SINKHOLE
LOAD-OUT
CRF PLANT
SCREEN PLANT
LRD STOCKPILE AREA
1200 E
1400 E
1600 E
2400 N
2200 N
2000 N
1800 N

APPENDIX C

1. Excerpts from Report on 'Site visit to Cominco Ltd.'s Polaris Mine' by Golder Associates Ltd., February 1994

2. Excerpts from Report on 'Visit to Polaris Mine November and December 1995' by Golder Associates Ltd., May 31, 1996

Golder Associates Ltd.

500 - 4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone (604) 298-6623
Fax (604) 298-5253

Golder Associates

REPORT ON

SITE VISIT
TO
COMINCO LTD.'S
POLARIS MINE

1994

Submitted to:

Cominco Ltd.
Polaris Operations
Polaris, NWT
X0E 0Y0

DISTRIBUTION:

3 copies -	Cominco Ltd. Little Cornwallis Island, NWT
3 copies -	Cominco Ltd. Vancouver, B.C.
2 copies -	Golder Associates Ltd. Vancouver, B.C.

February 1994

932-1510

- Movements on the 880 level were difficult to interpret due to erratic results.

Due to problems with maintaining convergence stations, the program was discontinued and is being replaced by a qualitative visual monitoring program.

4.3 Subsidence

Surface subsidence measurements continue over the Keel and Panhandle Zones. In 1993, an additional eight stations were added to the existing five. The locations of the monitoring points are shown in Figure 1. The new stations will provide information above the abutment pillar and northern stoping areas

Two measurements have been made since the December 1992 visit. Only three stations, B/C, 189 and 205 are showing significant movement. The movement recorded at these three stations is summarized in Table 1 and graphed in Figure 2.

Table 1

Summary of Subsidence 1990-1993 for B/C, 189 and 205 Stations

Station	Total Movement (mm)	1990-1991 Movement (mm)	1991-1992 Movement (mm)	1992-1993 Movement (mm)
B/C	558	97	167	294
189	486	58	195	233
205	224	30	84	110

Table 1 shows a yearly trend of increasing subsidence at the B/C and 189 stations. This corresponds to the nearly 100% extraction of the ore beneath these stations. The station above 205 is beginning to show the effects of the northward advance of the mining front.

4.4 Surface Extensometer

The two surface extensometer installations adjacent to the B/C and 189 surface subsidence stations have been monitored since 1988. Plots of cumulative movement of these two extensometers are presented in Figures 3 and 4. Total movement recorded for the B/C extensometer is 19 millimetres and for the 189 extensometer, 77 millimetres. These values are approximately 4% and 16% of total subsidence measured at that point.

Both extensometers record some minor separation at 40-60 metres depth. The disparity between the measured surface subsidence and the movement indicated by the extensometers indicates that the hangingwall may be moving as a relatively cohesive mass (or as a series of large blocks).

5.0 KEEL PILLAR MINING

Pillar mining in the Keel Zone has rapidly become the primary source of ore at the Polaris Mine. Pillar ore now forms 72% of production tonnes versus 14% in 1988.

5.1 Review of Pillar Mining Experience

A considerable amount of information has been collected on the pillar mining carried out to date. This information was reviewed and will be applied to the analysis of future pillar mining operations.

5.1.1 Pillar Recovery

Table 2 presents experience with pillar mining to date. The percentage extraction of both tonnes and metal are included as well as comments on stability related issues.

Table 2

Summary of Keel Pillar Mining Experience

Pillar	% Tonnage Recovery	% Metal Recovery	Comments
180	-	60	Backfill problems
182	-	100	Back failure in Stage II
185	85	75	Backfill problems in Stage I, back failure in Stages II and III
189	105	95	
192	92	85	Backfill problems in Stage I Back failure in Stage IV
195 *	100	85	Back/hangingwall failure in Stage III, 90 metre high fill exposure
199 *	72	70	Significant ore loss in Stages I and III. Major back/hangingwall failure in Stage III
202-I	88	81	
202-II	102	99	Major failure of 820/850 block in Stage II

* Pillar not complete

The first pillars to be recovered tended to encounter problems with fill wall stability. However, with improved fill quality these problems appear to be resolved (for the fill wall dimensions currently being exposed). Recently there has been an increased incidence of back failures. These failures appear, in part, to be influenced by the various faults that traverse the orebody.

Recovered metal range from a low of 60% to a high of 100% with an average of 80%. Recovered tons range from a low of 72% to a high of 105%. The ratio of % metal to % tonnage is an average 0.92.

5.1.2 Backfill Performance

Backfill performance during pillar extraction is summarized in Table 3

Table 3
Summary of Exposed Backfill Stability*

Pillar	Stage	Maximum Height of Backfill Exposure (m)	Maximum E-W Span of Backfill (m)	Comments
185	II	50	24	
189	II	66	34	
192	I	65	33	Fail
192	II	65	25	
195	II	69	25	
195	III	71	26	
195	IV	95	22	
199	I	80	37	Fail
199	II	83	10	
199	III	87	28	Fail
199	IV	95	25	
202	I	51	26	

* Note: This table does not include early failures that were attributed to poor quality backfill.

Backfill stability would appear to be controlled by the following factors:

- The content and distribution of water in the fill;
- The time allowed for the fill to freeze;
- The height and width of exposed fill wall;

- The length of time between exposing a fill wall and backfilling of the pillar;

A reasonable amount of information is available on the water content and distribution within specific fill blocks. Where low moisture fill is anticipated, a "skin" of ore may be left to reduce the potential for fill dilution. The time required for the fill to freeze is also relatively well established and blocks are scheduled to allow sufficient time for ice formation. Stable exposure heights and widths have yet to be established. The data in the above table and in Figure 5 would indicate that the exposed width may play as big a role as the exposed height. This may be a result of the surfaces formed during fill deposition as shown in Figure 5.

5.2 Current Status of Pillar Mining in the Keel Zone

Active pillars in the Keel Zone are:

- 192 Stage III
  - Good recovery, no major problems to date.
- 195 Stage V
  - Mining block adjacent to major back failure, cable bolted back next to failure in good condition.

  199 Stage IV
  - Mining block adjacent to major back failure, some drilling problems on 850 level.
- 202 Stage II
  - Good recovery in 760/790 block, severe problems in 820/850 block with large ground displacements (see Section 5.3).
- 205 Stage I
  - Initial block development in place at eastern end.

5.3 202 Pillar Mining

The following outlines the sequence of events in mining of Stage II:

Mine and fill 760 to 790 level;

- Observed horizontal cracking and difficulty in maintaining blasthole integrity;

Mass blast 820 to 790 level;

- Continuous movement of the 850 to 820 block after the mass blast.

The block is bounded on the west by a steeply dipping structure and appears to be bounded by a similar structure on the eastern side. The top of the block is between 6 and 12 metres above the 850 Level. Figure 6 shows the approximate size of the block and the associated structures.

Total downward movement of the block is in excess of 3.5 metres on the 850 level (see Photographs 14 and 15). The block appears to be moving as a large mass and not rubblizing internally. **It is important to note that the total void space above the level must be equal to 3.5 metres.**

Important considerations in developing a plan to recover the block are as follows:

- 17,000 tonnes of ore from the 820/790 block remains on the 790 level;
- The 35,000 tonnes of ore in the 820/850 block is primarily from the high grade P1 horizon;
- Material above and to the east of the failure will be low grade or barren rock;
- The ultimate hangingwall on the 880 level has not been cable bolted;
- Significant back failures had occurred in both the 195 and 199 pillars.

From a geotechnical point of view it is important that any mining plan incorporate the following:

- Test holes towards the 199 pillar to establish the north-south extent of the back failure;
- Cable bolt the ultimate hangingwall on the 880 Level and, dependent upon the condition of the block below 880, cable bolt downwards to secure the ground above the sliding block. It must be recognized that due to the magnitude of the movements which have occurred that cable bolting may not be successful;
- Ensure that the drawpoint on 790 level is kept full to minimize the impact of any potential air blast should the sliding block fail suddenly;
- Development of a plan to fill the void should it become necessary;
- If an option is to mine Block III to induce failure of Block II then the size of Block III should be kept to minimum. This will reduce the size of the backfill exposure when both blocks are empty.

In evaluating a recovery plan it is very important to consider the risks associated with the plan and the consequences of both success and failure. The problem is 202 cannot be analyzed in isolation from the other stoping areas.

A number of controls exist that influence the course of action. These include:

- backfill disrupts float circuit and causes metal losses