

PACIFICORP
TECHNICAL SERVICES REPORT
RODGER C. FRY

IW0082

CENTRAL ENGINEERING
ANNUAL SUBSIDENCE MONITORING REPORT
EAST/TRAIL MOUNTAIN PROPERTIES
2000



MARCH 30, 2001

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March 30, 2000

Utah Coal Regulatory Program
 Division of Oil, Gas and Mining
 1594 West North Temple, Suite 121 0
 Box 145801
 Salt Lake City, Utah 84114-5801

Attention: Ms. Pamela Grubaugh-Littig

~~_____~~
~~_____~~
Copy e/015/017
 " e/015/018
 " e/015/019

Re: Submittal of Annual Report for 2000, PacifiCorp, Trail Mountain Mine, C/015/009, Cottonwood Mine, C/015/019, Deer Creek Mine, C/015/018, Des-Bee-Dove, C/015/017, Emery County, Utah.

PacifiCorp, by and through its wholly-owned subsidiary, Energy West Mining Company as mine operator, herewith submits the Annual Report for 2000.

Please find enclosed two copies each of all forms and activities of the above mines related to coal mining and reclamation monitoring during the 2000 year, including the Vegetation, Subsidence and Hydrologic reports.

If there are any questions or concerns please call Dennis Oakley at 687-4825.

Sincerely,

Dennis Oakley
 Charles A. Semborski

for
 Geology/Environmental Supervisor

cc: Carl Pollastro (File)

J:\Environmental\PERMITS\Annualreports\2000Annual\ANNUAL00.wpd

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DIVISION OF OIL, GAS AND MINING

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Date: *03/30/01* For additional information

Huntington Office:
 (801) 687-9821
 Fax # (801) 687-2695

Deer Creek Mine:
 (801) 381-2317
 Fax # (801) 381-2285

Cottonwood Mine:
 (801) 748-2319
 Fax # (801) 748-2380

PACIFICORP
SUBSIDENCE MONITORING PROGRAM
ANNUAL REPORT FOR 2000

March, 2001

Submitted to:

United States Department of the Interior
Office of Surface Mining
Minerals Management Service
Utah Division of Oil, Gas and Mining

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APPENDICES

Subsidence Map

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Deer Creek Mine

Wilberg/Cottonwood Mine

Trail Mountain Mine

Spring Map with 5-Year Mine Plan Showing Subsidence

Cliff Stability Survey Targets & Transects

INTRODUCTION

PacifiCorp's East Mountain/Trail Mountain Subsidence Monitoring Study is an ongoing project designed to detect, observe, and report the effects of mining-induced subsidence above the Deer Creek, Wilberg/Cottonwood, Des-Bee-Dove and Trail Mountain Mines (see Figure 1). This, the nineteenth such annual report submitted, covers the period between August 31, 1999 and August 31, 2000.

The initial report submitted in 1982 details the monitoring methods used in the study; therefore, they are not discussed in depth here. Briefly, PacifiCorp uses aerial photogrammetric survey methods and annual helicopter reconnaissance flights to monitor subsidence. The aerial photogrammetry work is contracted to a mapping company. Contracts for the work are bid and awarded for a three year period. This is the third contractor that has been involved with the project. Between 1982 and 1987 the work was contracted through Intermountain Aerial Surveys. They established reading points on generally a 200 foot grid but adjusted the location of each point to be on easily reproducible locations. Between 1988 and 1990 the work was contracted to Maps Inc. Because of the type of equipment it was better for them to establish uniform grid points on 200 foot spacing. In 1991 the work was contracted to MapCon Mapping Consultants. The owners of this company were previously employed by Intermountain Aerial Surveys and felt that better results could be obtained by using the original grid established by Intermountain Aerial Surveys. Therefore, they reverted back to the original monitoring grid. A change in the method of reading the aerial photographs may result in some slight changes in

measured subsidence in some areas. Also, it is crucial that accurate paneled control be surveyed and recorded on the photographs to enable close subsidence readings. Between 1987 and 1990, some of the survey control in the more difficult to reach areas were not properly paneled and could not be identified on the photographs. It appears that this diminished the precision of the subsidence reading in some of the areas during those years. Using the aerial photographs derived from a flight conducted on September 14, 2000, elevations were measured at 20,859 different points. These elevations were then compared with the baseline survey elevations measured from the aerial photos collected in 1980, 1986, 1987 and 1994. The difference in elevation constitutes the amount of subsidence that has occurred.

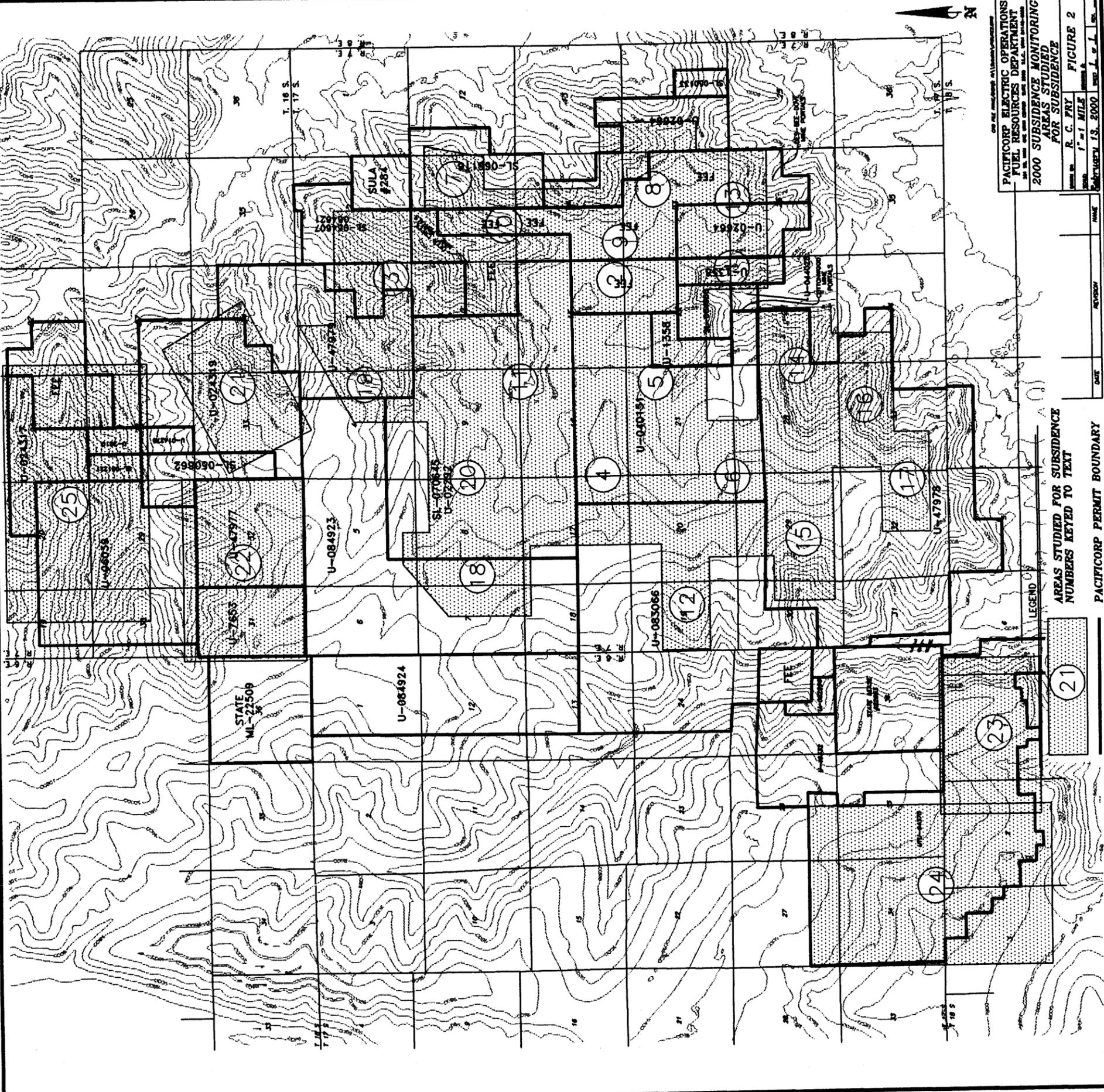
Between 1991 and 1999, the subsidence data were contoured using Exploration Computer Services Minex program. This program was operated on a VAX system and is normally used for geologic modeling and mine planning. It's use was effective for the subsidence monitoring because of the powerful contouring routines that it offered. The VAX system has become obsolete and was retired in mid 2000. In the analysis of the subsidence data from the year 2000, the Surfer program by Golden Software was used to develop the contour maps. The contour maps produced by this software are not as smooth as those produced by the Minex program. A comparison of the maps from 1999 and 2000 showed close agreement between the maps generated with the two software systems. A map of all areas of subsidence is included in the appendix to this report. The raw data is included in the appendix of this report on a 3-1/2 inch disk in an ASCII file called

2000SUB.TXT. A helicopter reconnaissance flight July 11, 2000 revealed no new fracturing or visible signs of subsidence in any of the monitored areas. Prior to PacifiCorp's acquisition of the Trail Mountain Mine from ARCO Coal Co., they monitored subsidence using on the ground monumentation. Nowhere did that monitoring identify subsidence greater than a few tenths of feet. Substantial longwall mining has now occurred in the Trail Mountain Mine. As a result, subsidence has been detected and is reported herein.

Location

Figure 2 shows all areas above PacifiCorp's coal mines which have potential for mining-induced subsidence. In 2000, twenty-five areas of subsidence were monitored and are reported herein. In areas where subsidence has been detected, data is shown in the form of contour maps and profiles. Both indicate elevation change from pre-mining elevations. The profile figures present data for all years monitored with the exception of the 1990 data. The computer data files from that year were damaged rendering them unreadable. At this time it is felt that enough data exists from the other years and the task of regenerating that data is not warranted. In many areas of subsidence the angle-of-draw has been calculated and reported; however, in some of the cases the angle should not be considered the actual final angle-of-draw due to several factors. For example, the zone of subsidence to date may be small and contained within the underlying mined area, suggesting that the subsidence has not yet reached its maximum extent. Also, many mined

sections are surrounded by other older workings which influence the calculation. In a few areas where the mined-out workings are surrounded by burned coal, the failure of clinker beds promotes subsidence outside the mined area resulting in an angle-of-draw greater than might be expected.



PACIFICORP ELECTRIC OPERATIONS
 FUEL RESOURCES DEPARTMENT
 2000 SUBSIDENCE MONITORING
 AREAS STUDIED
 FOR SUBSIDENCE

DATE: _____ NAME: _____
 DRAWN BY: _____
 CHECKED BY: _____

SCALE: 1" = 1 MILE
 SHEET: J. J. L. 2
 PROJECT: PACIFICORP PERMIT BOUNDARY

LEGEND

AREAS STUDIED FOR SUBSIDENCE
 NUMBERS KEYS TO TEXT

PACIFICORP PERMIT BOUNDARY

21

Area 1

Deer Creek 9th East - Wilberg 1st Right

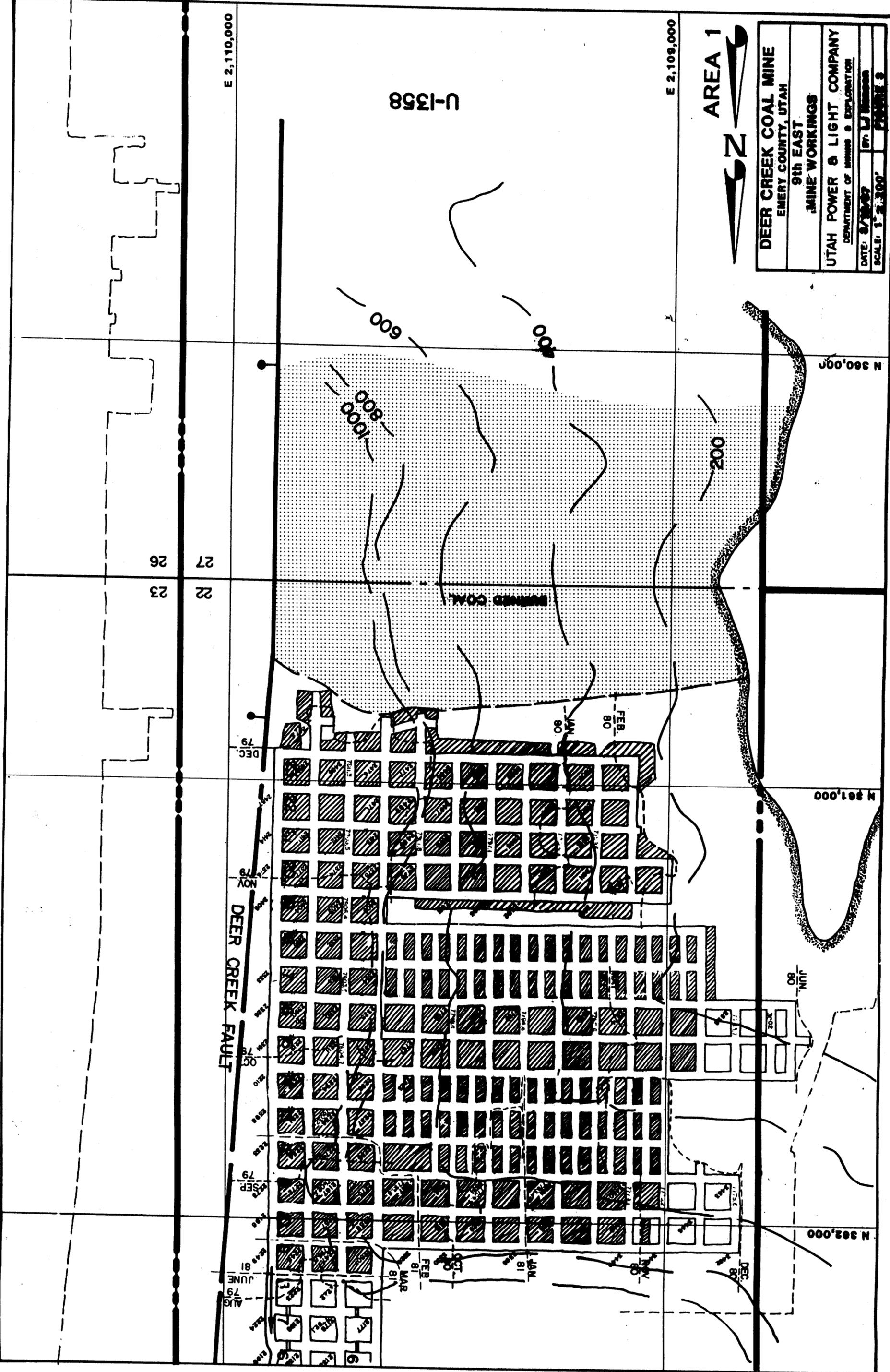
Subsidence in Area 1 was first documented in the 1981 Subsidence Monitoring Report submitted in 1982. The relationship of the subsidence to the underlying Deer Creek and Wilberg mine workings is shown in Figures 3, 4, and 5. Each map covers the same area, Figure 5 being a contour map of subsidence on the surface over the mine workings depicted in the other two figures. The most recent mining in this area occurred in the Wilberg 1st Right section in June 1984.

Figures 6 and 7 are north to south and west to east profiles showing the amount of subsidence in this area during the past sixteen years. The location of each line is shown on Figure 5. The area has seen little change since 1985 and appears to have totally stabilized. Maximum subsidence remains at about twenty-eight (28) feet. A detailed look from a helicopter revealed that the subsidence maximum is located on a steep slope, about 200 feet south of the southernmost mining, where a good-sized rotational slump has occurred. The workings here are also surrounded by burned coal. It is probable that the combination of steep slopes and crushing of clinker beds has allowed subsidence to occur well outside the area of mine workings. An inspection of the area from the ground indicates that many of the open fractures forming the graben-like structure have begun to heal and fill in with soil.

Calculation of the angle-of-draw is complicated because the workings are nearly surrounded by faults, burned coal, and other mine workings. Due to this complexity, angle-of-draw was not determined for Area 1.

In the summer of 1997, some of the fractures in this area were reclaimed per the U. S. Forest Service recommendations. This reclamation consisted of knocking down the abrupt escarpments and filling in the fractures in accessible areas. The top soil was then evenly distributed and the area re-seeded. This reclamation was completed by September 1, 1997 and encompassed 1.5 acres. Visual inspection of the area in the summers of 1999 and 2000 indicated that the vegetation has grown over the disturbed area to where it blends in with the surrounding areas.

There are no springs, and no hydrologic impacts due to mining have been observed at this location.



DEER CREEK COAL MINE
 EMERY COUNTY, UTAH
 9th EAST
 MINE WORKINGS

UTAH POWER & LIGHT COMPANY
 DEPARTMENT OF MINING & EXPLORATION

DATE: 8/19/87 BY: L.J. [unclear]
 SCALE: 1" = 2,000' FIGURE 3

E 2,110,000

E 2,109,000

U-1358

AREA 1

26

27

23

22

N 360,000

N 361,000

N 362,000

DEER CREEK FAULT

MINED COAL

DEC 79

JAN 80

FEB 80

JUN 80

NOV 79

DEC 79

JAN 80

FEB 80

MAR 80

APR 80

MAY 80

JUN 80

JUL 80

AUG 80

SEP 80

OCT 80

NOV 80

DEC 80

JAN 80

FEB 80

MAR 80

APR 80

MAY 80

JUN 80

JUL 80

AUG 80

SEP 80

OCT 80

NOV 80

DEC 80

JAN 81

FEB 81

MAR 81

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AREA 1

MINE WORKINGS UPDATED TO: March 1, 1987



WILBERG COAL-MINE
EMERY COUNTY, UTAH

1st RIGHT
MINE WORKINGS

UTAH POWER & LIGHT COMPANY
DEPARTMENT OF MINING & EXPLORATION

DATE: 2/28/87 BY: LJ MORGAN

SCALE: 1" = 300'

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WATER GAUGE

C.F.M. AT 3
500 H.P. DIESEL BACKUP
RELIANCE 1000 H.P. MOTOR
BLADE SETTING 22°
1175 R.P.M. 1000 H.P.
FULL CAPACITY 118 AMP
4150 VOLTS 40 AMP 3 PHASE
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DEER CREEK FAULT

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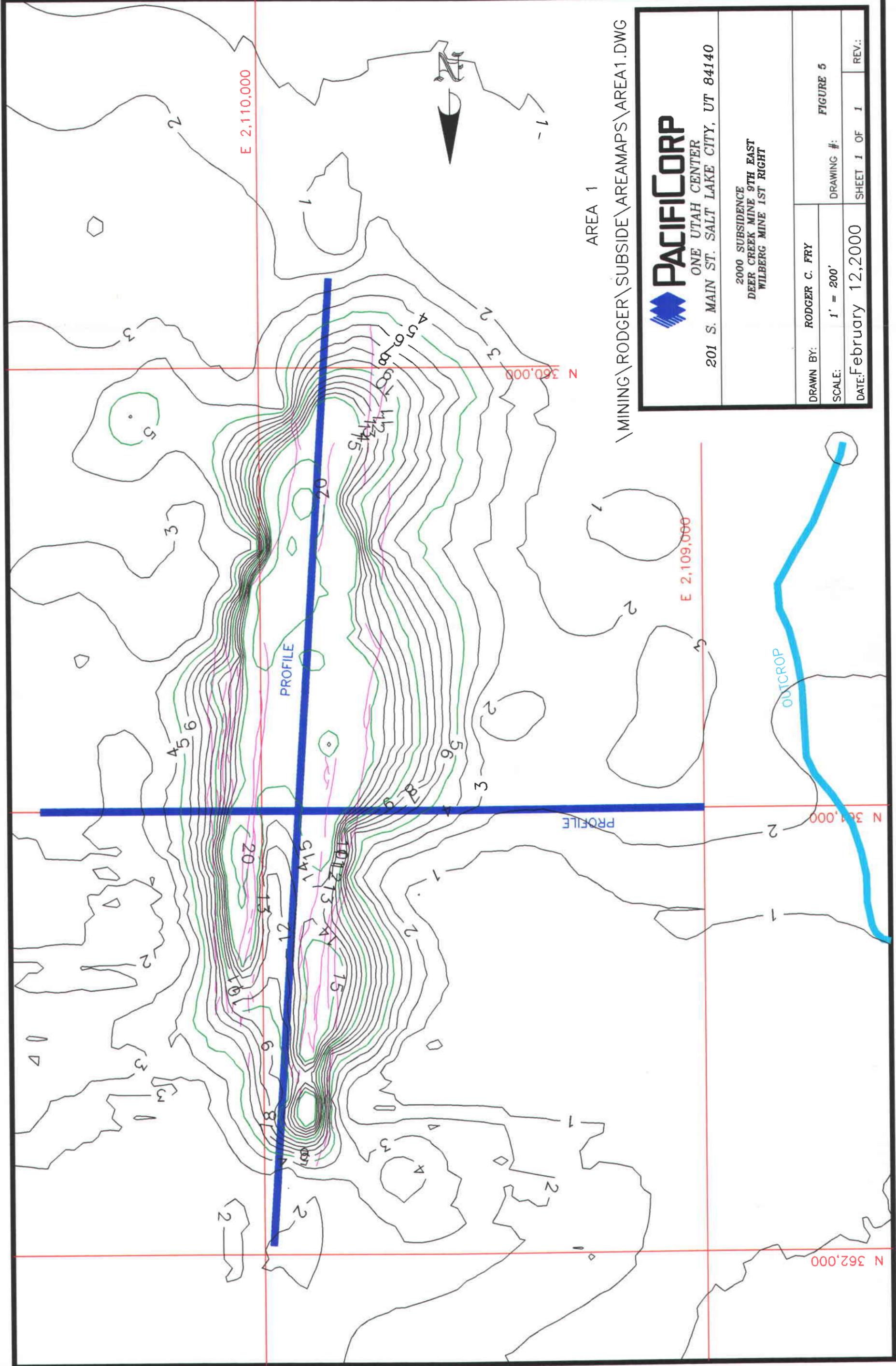
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N 623,000



AREA 1

\\MINING\RODGER\SUBSIDE\AREAMAPS\AREA1.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
DEER CREEK MINE 9TH EAST
WILBERG MINE 1ST RIGHT

DRAWN BY: RODGER C. FRY

SCALE: 1' = 200'

DATE: February 12, 2000

FIGURE 5

DRAWING #:

SHEET 1 OF 1

REV.:

Area 1 Subsidence Profile South - North

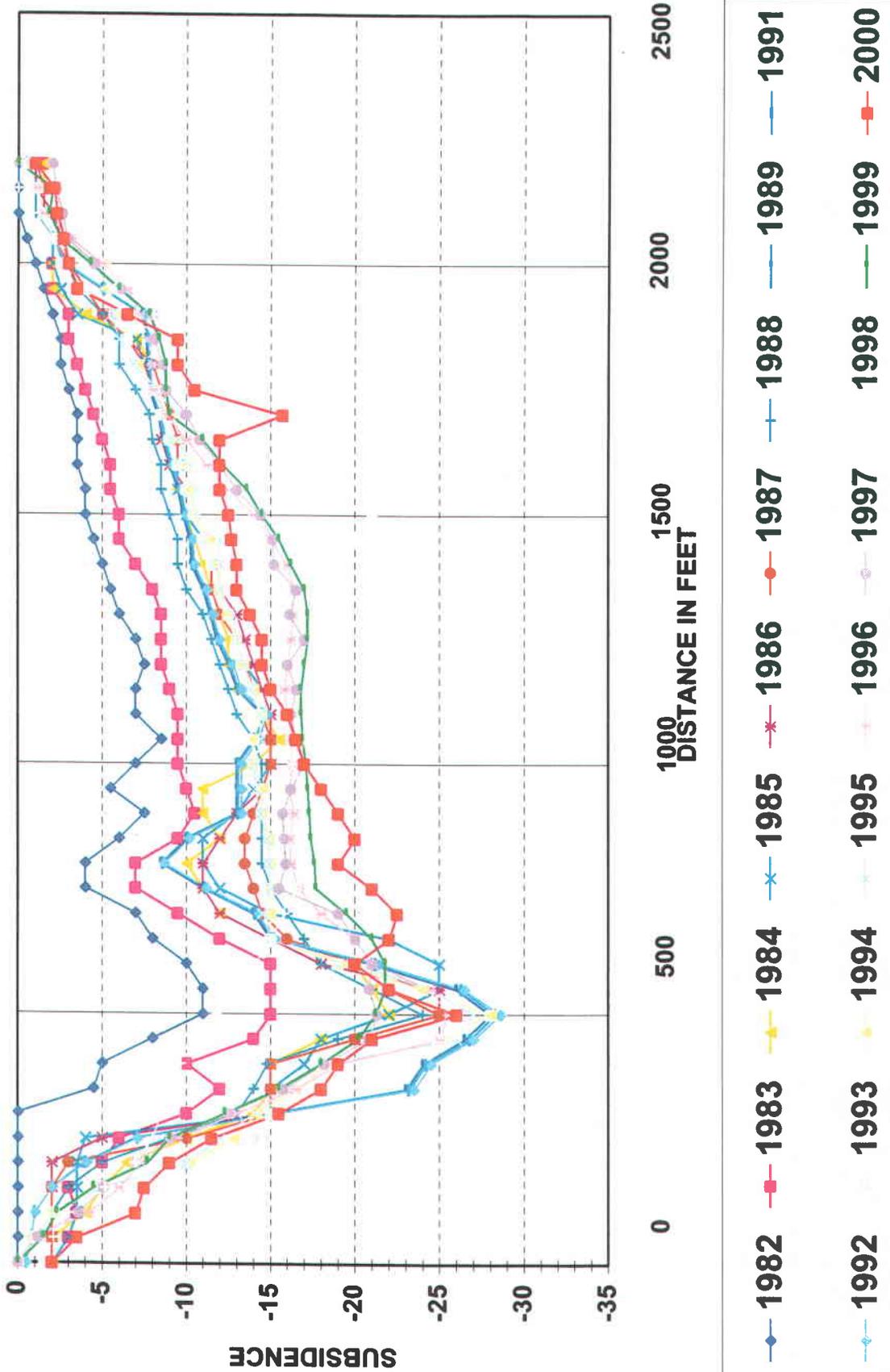


Figure 6

Area 1 Subsidence Profile West - East

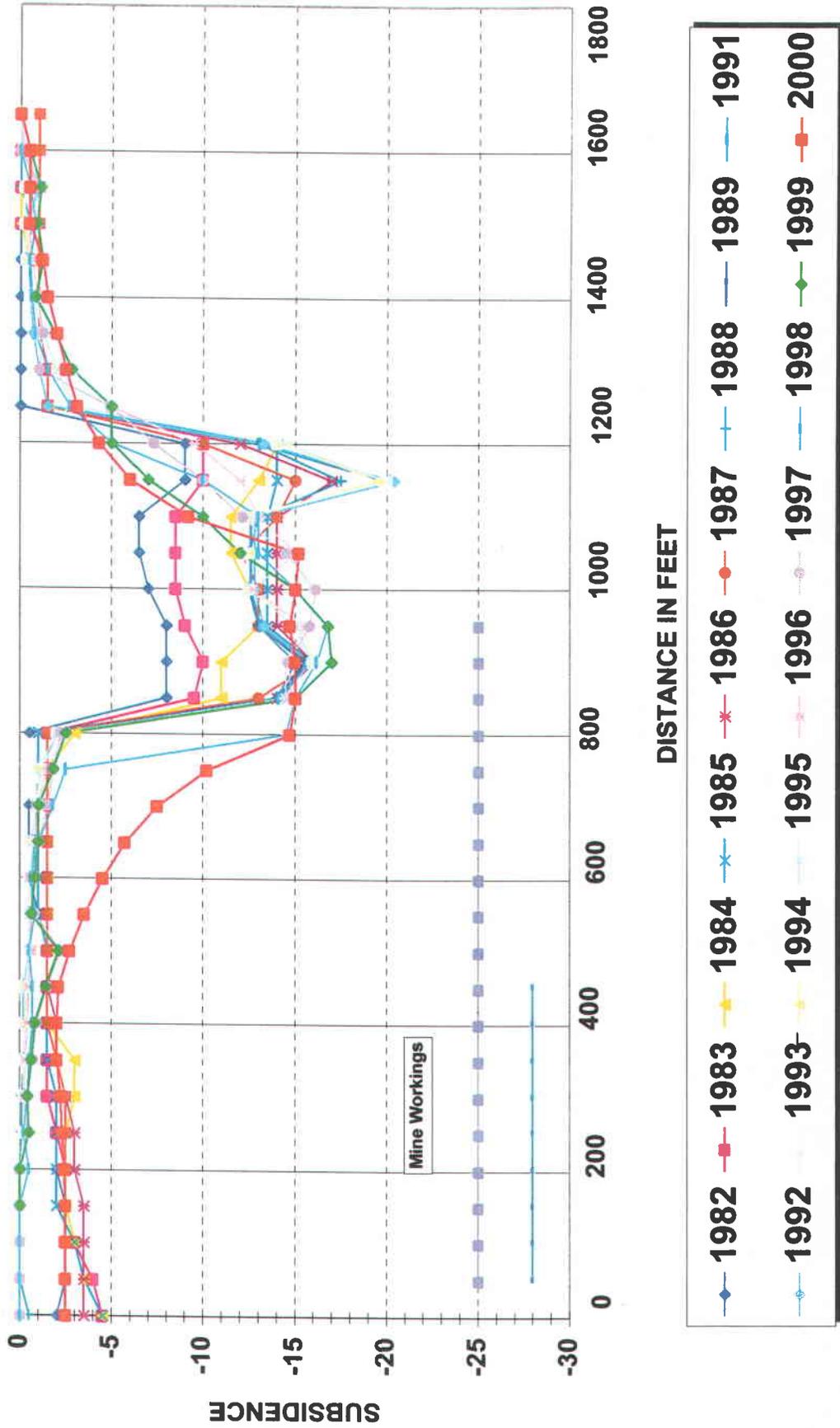


Figure 7

Area 2

Deer Creek 5th, 6th, 7th, and 8th East Longwall Panels

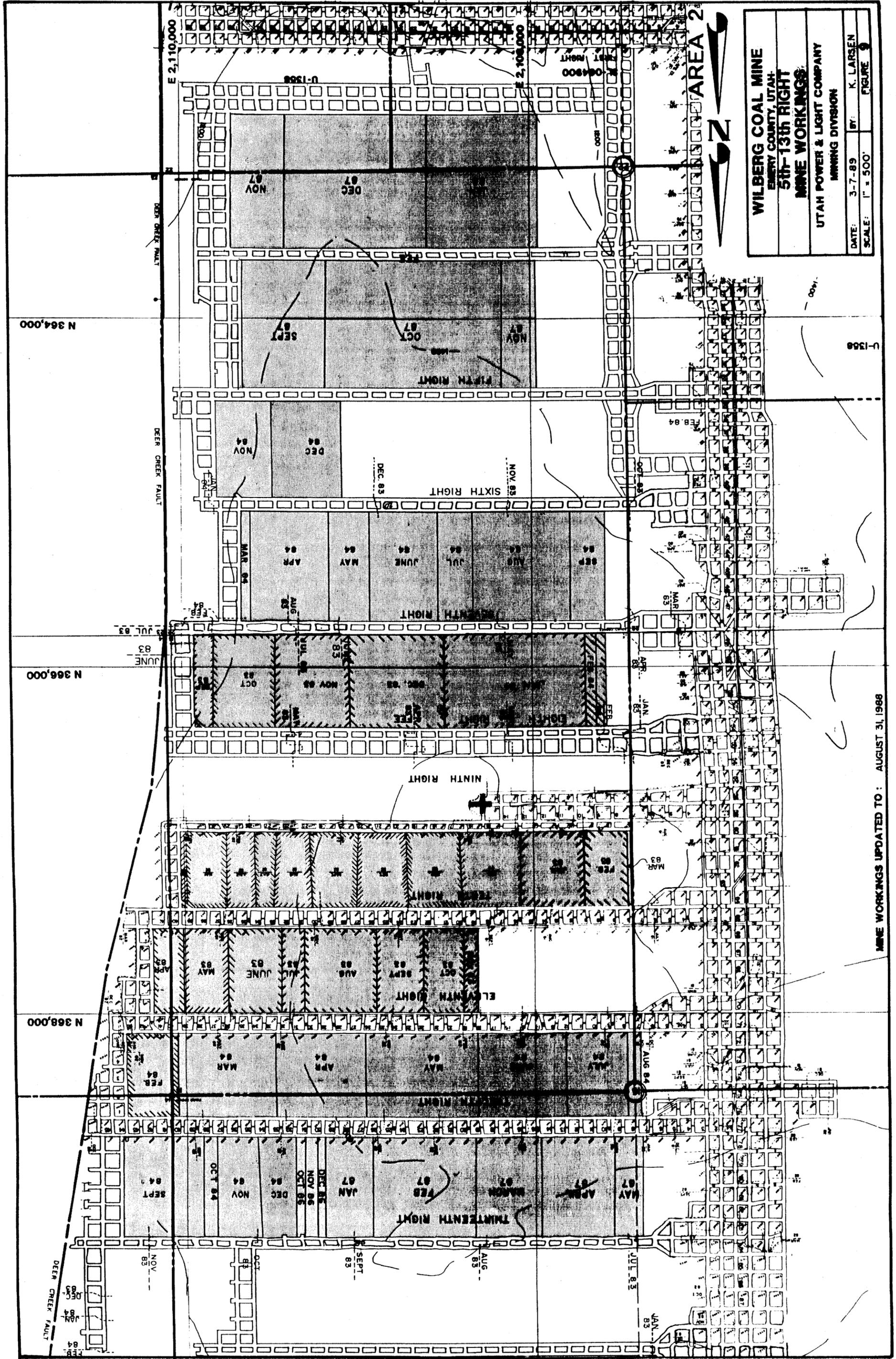
Wilberg 3rd through 13th Right Panels

Mining in the Deer Creek Mine in Area 2 was completed by February 1985 (Figure 8). Coal extraction in the underlying Wilberg Mine 3rd and 4th Right panels was completed between September 1987 and the end of January 1988 (Figure 9).

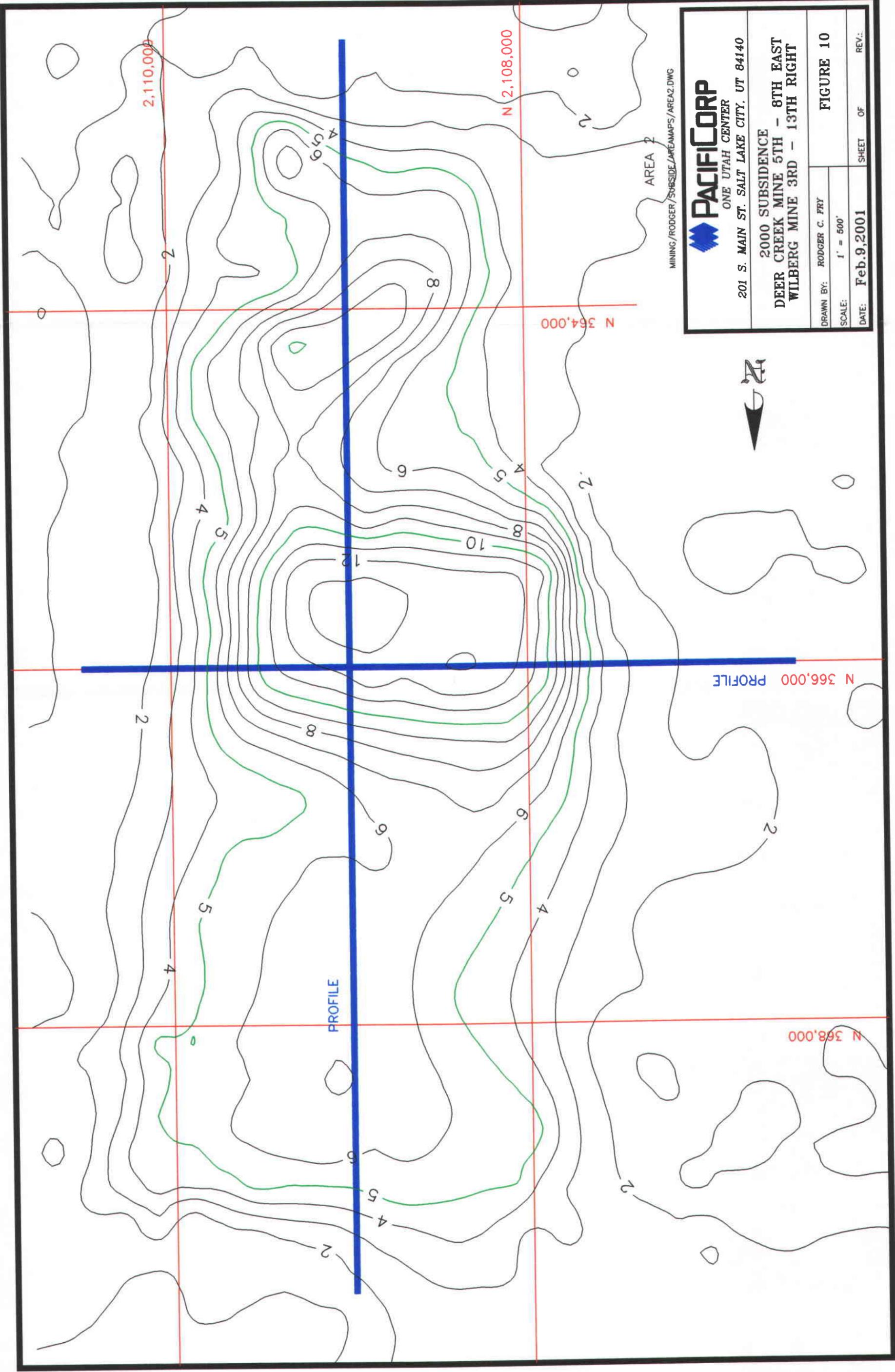
Maximum subsidence in Area 2 has stabilized at <13 feet in one area above the center of the multiple seam mining area (Figure 10). The subsidence profiles (Figures 11 and 12) indicate that the subsidence has been stable for the past 7 years or more. Neither PacifiCorp nor other contracted personnel have detected any surface fissures or other visible disturbance in the area.

Angle-of-draw has been calculated where possible. On the eastern side of Area 2 the angle is influenced by the Deer Creek Fault and the adjacent Little Dove Mine workings across the fault; thus, no angle was calculated. On other sides it ranges from less than zero to 11 degrees.

No springs have been identified over the subsidence area but two springs, one-fourth to one-third mile to the west, show no effects from mining (see Hydrologic Monitoring Report, 2000).



MINE WORKINGS UPDATED TO : AUGUST 31, 1988



MINING/RODGER/SUBSIDE/AREAMAPS/AREA2.DWG

PACIFIC CORP
 ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
 DEER CREEK MINE 5TH - 8TH EAST
 WILBERG MINE 3RD - 13TH RIGHT

DRAWN BY: RODGER C. FRY	FIGURE 10
SCALE: 1" = 500'	
DATE: Feb.9,2001	SHEET OF
	REV.:

Area 2 Subsidence Profile

North - South

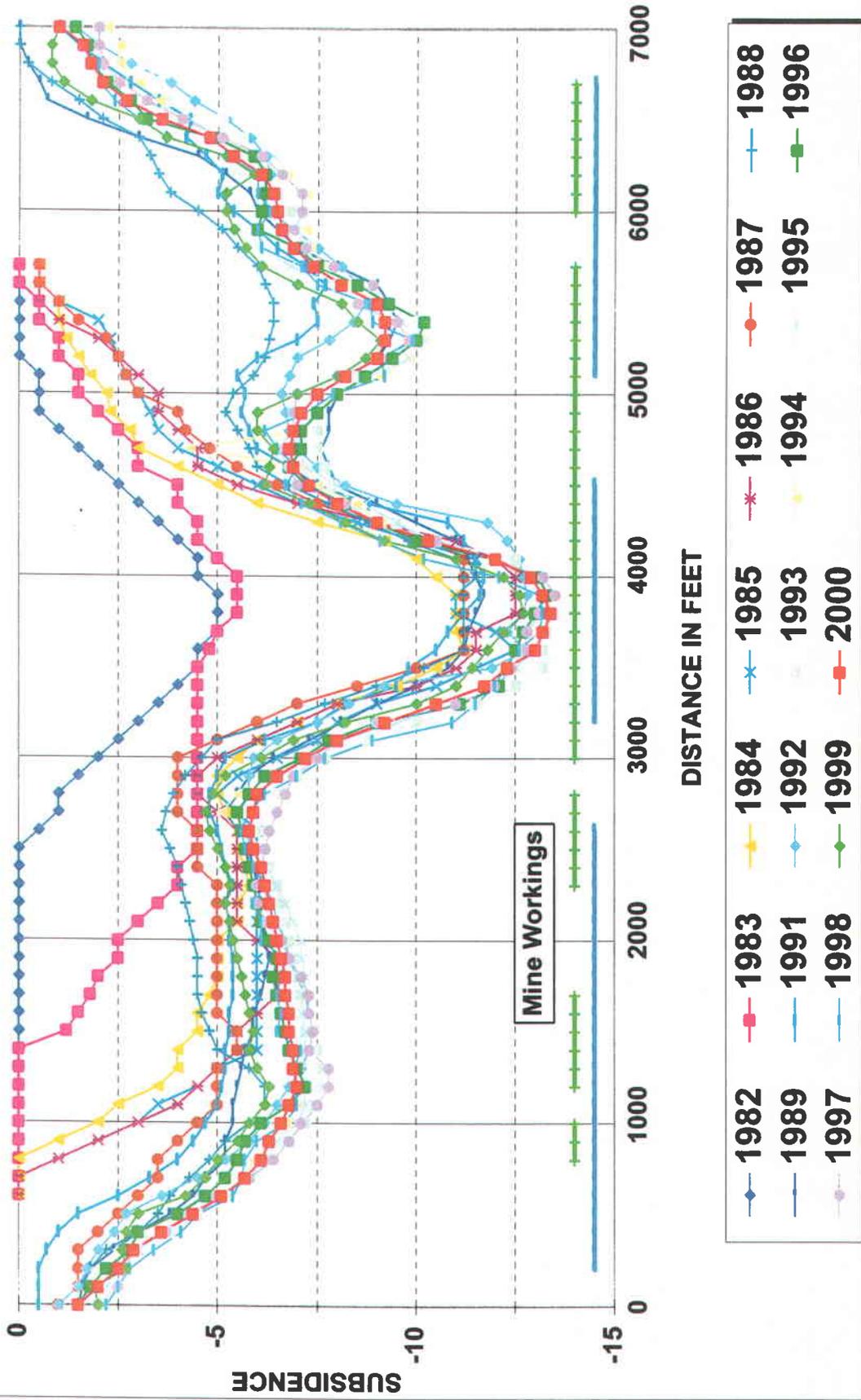


Figure 11

Area 2 Subsidence Profile

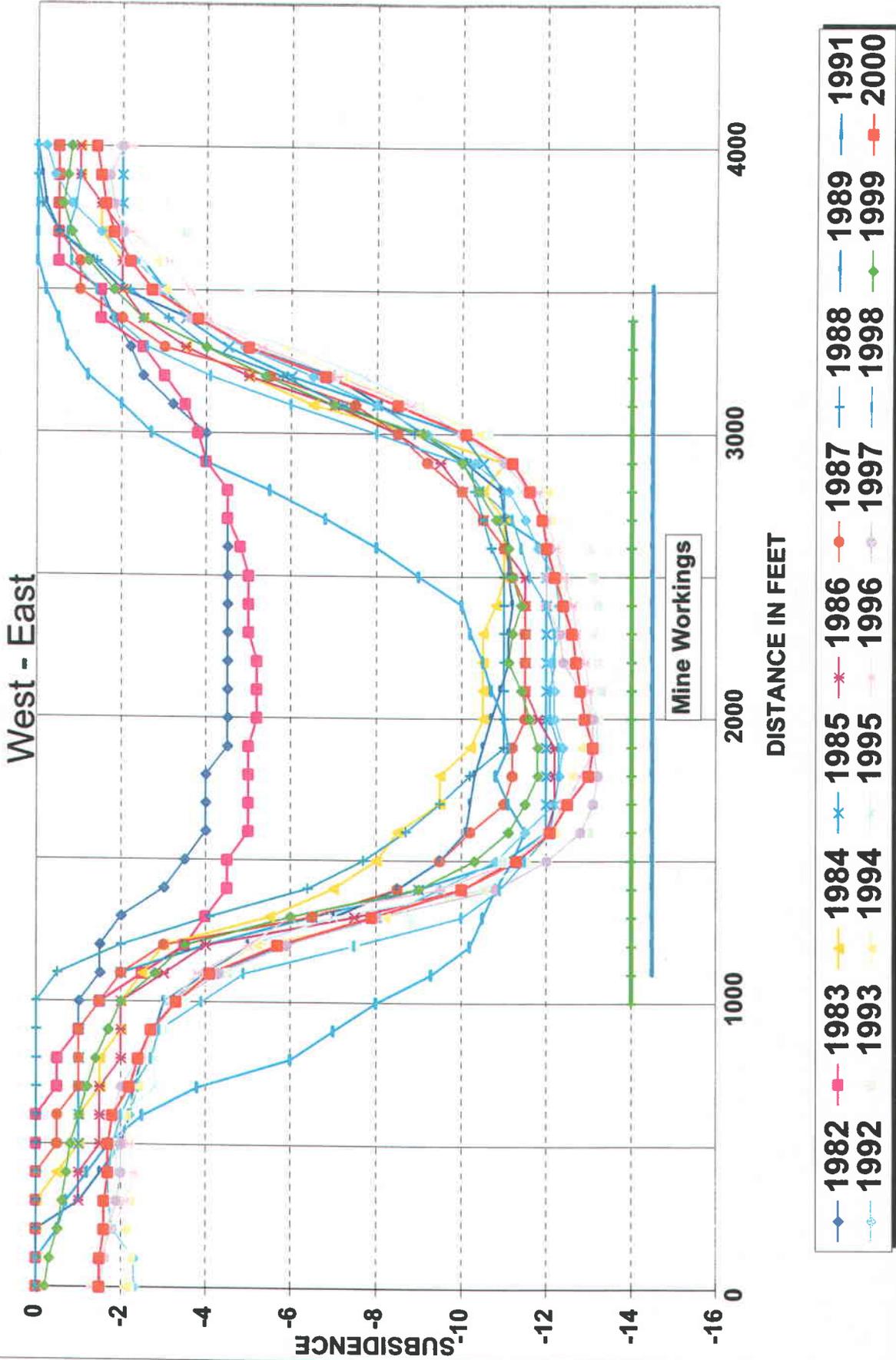


Figure 12

Area 3

Deer Creek 1st North Area

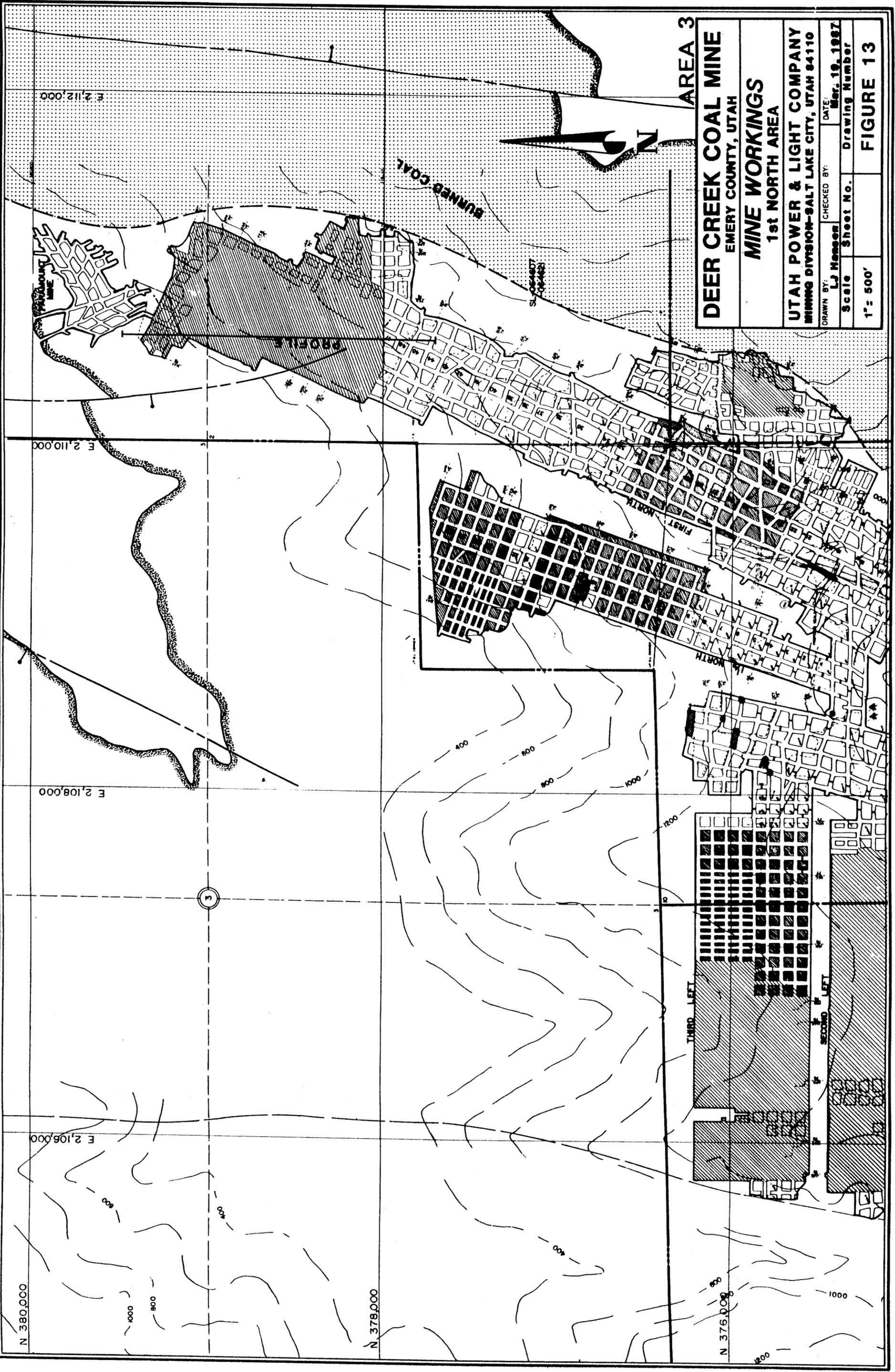
Most of the 1st North section of the Deer Creek Mine was abandoned and sealed in 1978 after being mined out. The southern portion is still open and may be used for access to a block of coal which lies to the west. Pillar extraction in the 3rd Left and 1-1/2 North sections was completed early in 1980 (Figure 13).

The subsidence above 1st North occurs on a narrow ridge capped by a highly fractured sandstone. The subsidence measured is depicted in Figure 13A. Figure 14 is a profile of total subsidence as it occurred along a line of points above the workings. The subsidence in area 3 has shown no significant change in the past 7 years.

A Helicopter survey in 2000 did not reveal any new surface cracks or new areas of cliff failure.

No angle-of-draw was determined due to the steep slopes, burned coal, and mode of subsidence.

The strata surrounding and above the 1st North workings are generally dry; therefore, mining has not adversely affected the groundwater.



AREA 3

DEER CREEK COAL MINE
 EMERY COUNTY, UTAH

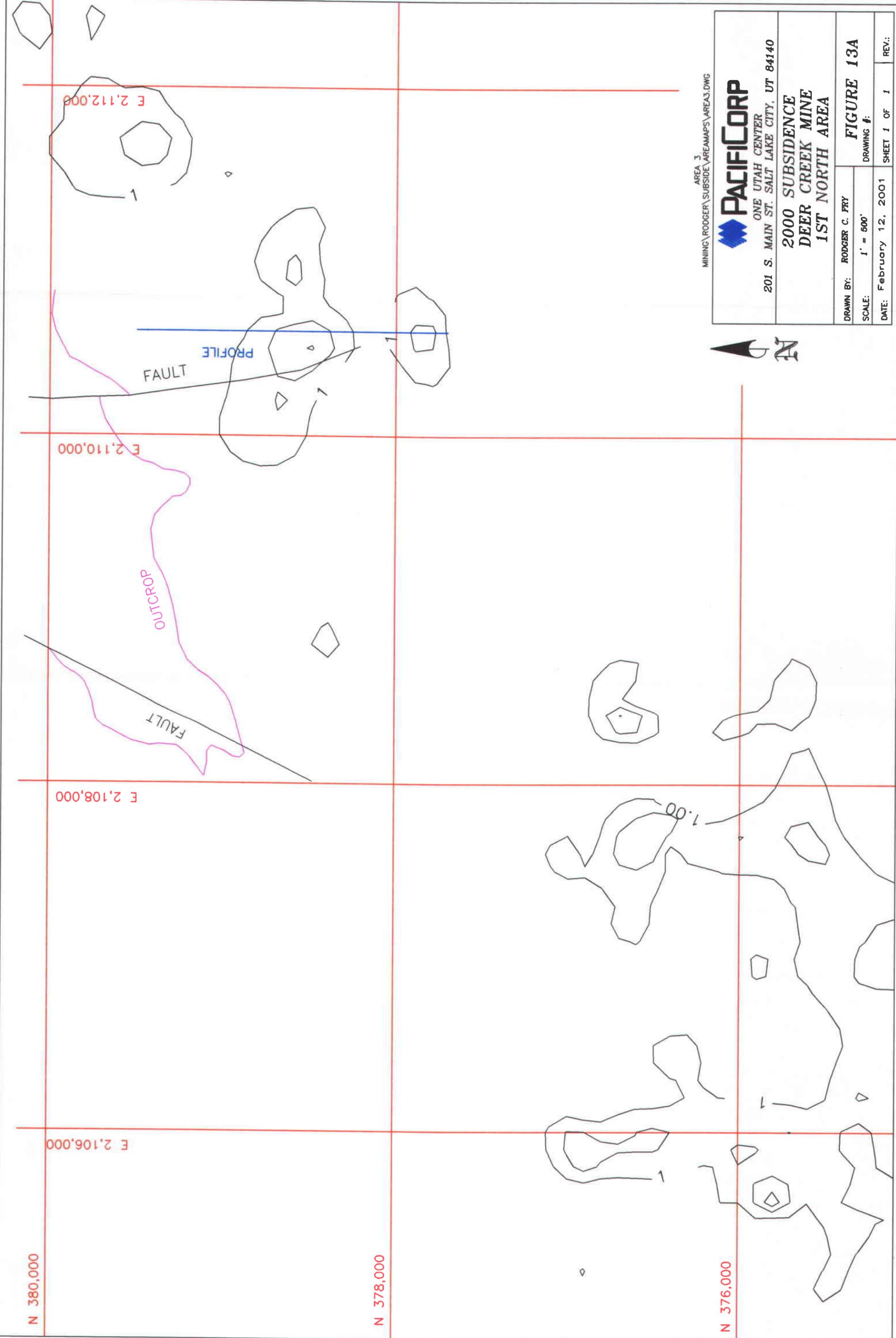
MINE WORKINGS
 1st NORTH AREA

UTAH POWER & LIGHT COMPANY
 MINING DIVISION-SALT LAKE CITY, UTAH 84110

DRAWN BY: LJ Manges
 CHECKED BY: _____
 DATE: Mar. 19, 1987

Scale Sheet No. _____
 Drawing Number _____

1" = 500'
FIGURE 13



MINING\RODGER\SUBSIDE\AREAMAPS\AREA3.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
DEER CREEK MINE
1ST NORTH AREA

DRAWN BY: RODGER C. FRY

SCALE: 1" = 500'

DATE: February 12, 2001

FIGURE 13A

DRAWING #:

SHEET 1 OF 1

REV.:

Area 3 Subsidence Profile

North - South

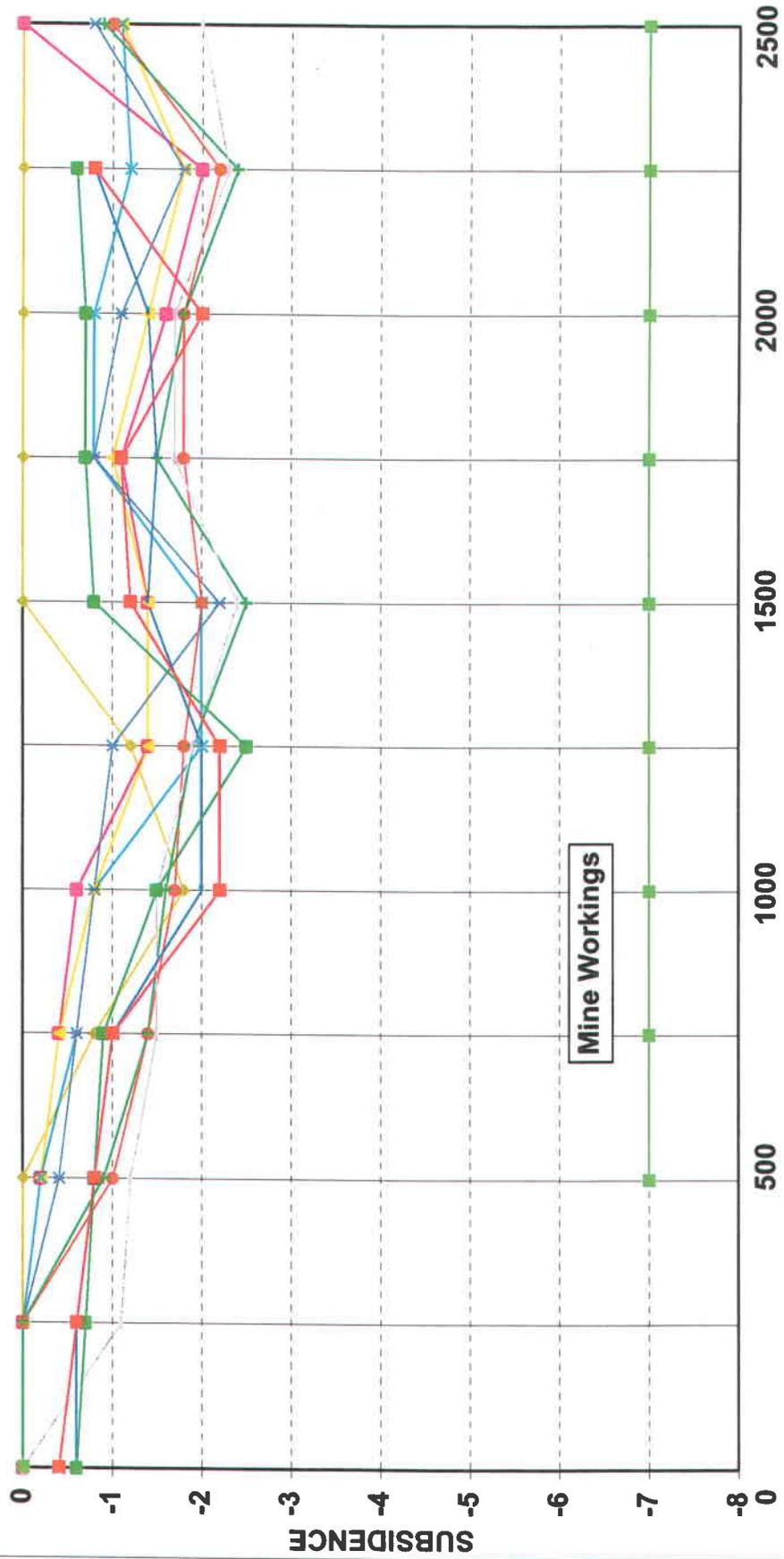


Figure 14

Area 4

Deer Creek 2nd through 17th Right Longwall Panels

Subsidence in Area 4 was detected for the first time in 1984 by photogrammetric methods. Longwall mining commenced in the 2nd Right longwall panels in 1980 and by the end of August 1991 the 2nd through 17th Right panels had been completed (Figure 15). In the Cottonwood mine, Longwall mining began in September of 1992 in the 9th Left Panel off 2nd north and the 8th Left Panel was terminated early because of unacceptable coal quality in February 1993. Mining resumed in this area in the 5th Left Longwall Panel in August of 1994 and continued through August of 1995 when mining was active in the 2nd Left Longwall Panel (Figure 15A).

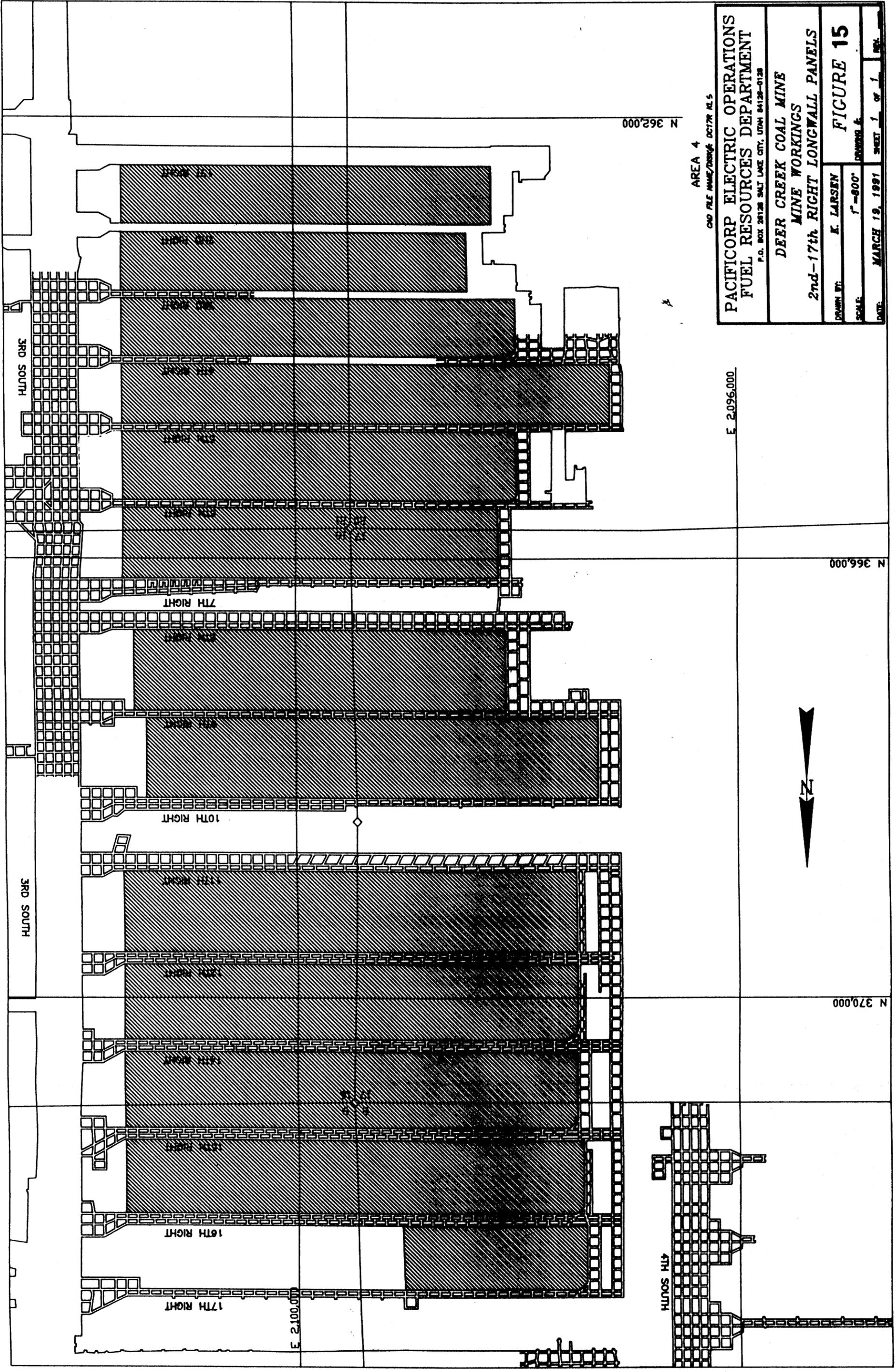
Maximum subsidence increased dramatically between 1994 and 1995 (8) feet to over thirteen (13) feet (Figure 16) due to the mining which occurred in the Hiawatha seam. The subsidence was virtually unchanged between 1995 and 2000 as shown in the profiles, Figures 17 and 18.

Surface fractures were identified in the field in late May of 1995. These fractures were located on Fee surface land and PacifiCorp filled in the fractures with a motor grader and reseeded the area. The location of the fractures are shown on figure 16. The revegetation in these areas is now established and no further fracturing has been identified.

The calculated angle-of-draw of the subsidence ranges from less than zero to 22 degrees. Several springs are located on East Mountain above these longwall panels and the 2nd through 5th Left panels located directly to the east (see Area 5). Fluctuations

in spring flow occur from year to year but seem to be related to variations in precipitation rather than mining. Flows are generally low in dry years and higher in wetter years (see Hydrologic Monitoring Report, 2000 and the Appendices to this report).

The left fork of the Grimes Wash drainage crosses the middle of the subsidence area. Stream monitoring has revealed no changes attributable to mining. This stream has been called Perennial by the US Forest Service, but our data indicates that it is ephemeral.



AREA 4

CAD FILE NAME/USER/ DCTWR RL.S

PACIFICORP ELECTRIC OPERATIONS
 FUEL RESOURCES DEPARTMENT

P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128

DEER CREEK COAL MINE

MINE WORKINGS

2nd-17th RIGHT LONGWALL PANELS

FIGURE 15

DRAWN BY: E. LARSEN

SCALE: 1" = 800'

DATE: MARCH 19, 1991

SHEET 1 OF 1

E 2,100,000

E 2,096,000

N 370,000

N 366,000

000' 299' N

AREA 4
CAD FILE DISK NAME: \SUBSIDE\1994\AREA4B.M.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

COTTONWOOD COAL MINE
MINE WORKINGS
2ND-5TH LEFT & 8TH-9TH LEFT PANELS

DRAWN BY: RODGER C. FRY

FIGURE 15A

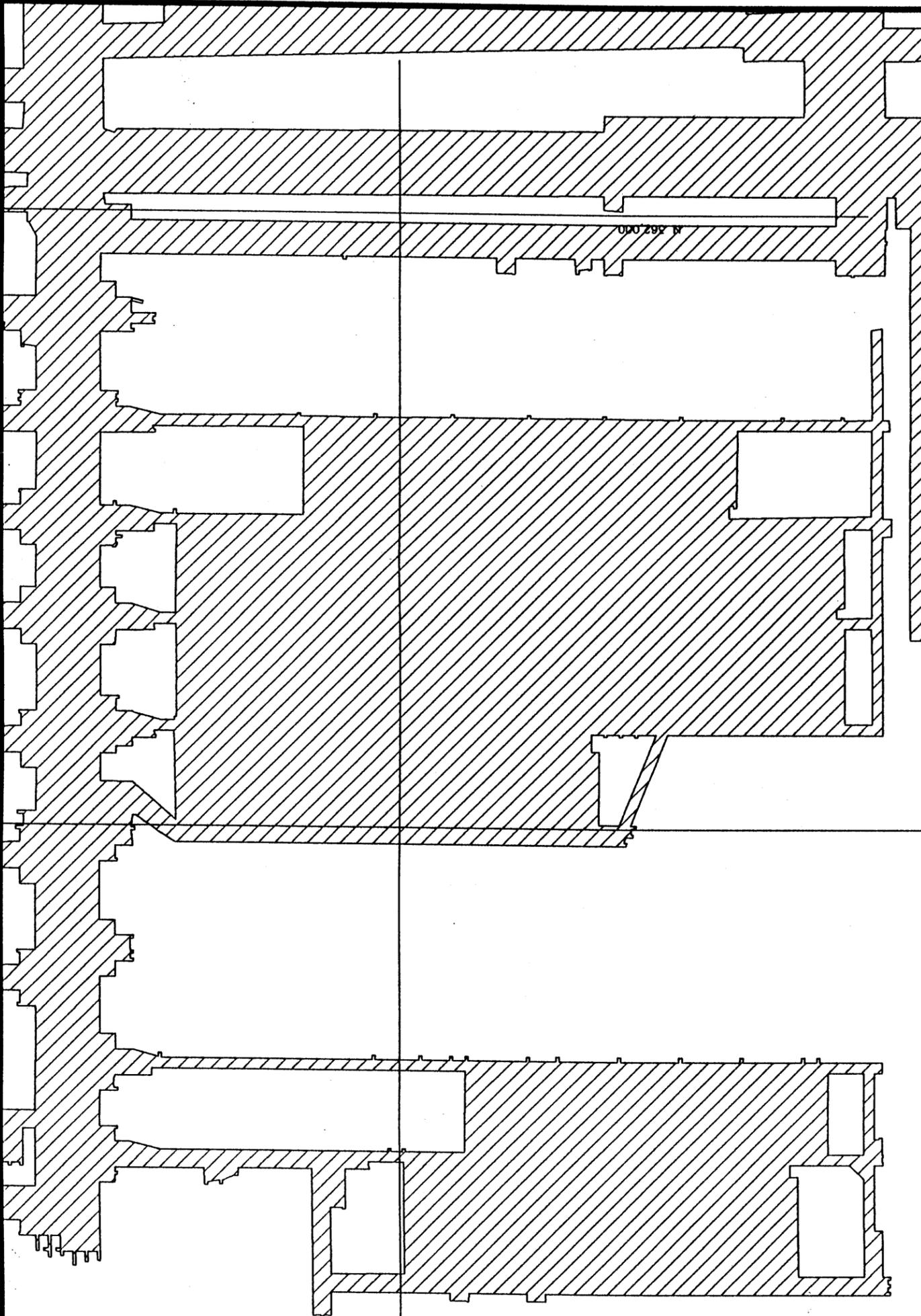
SCALE: 1" = 800'

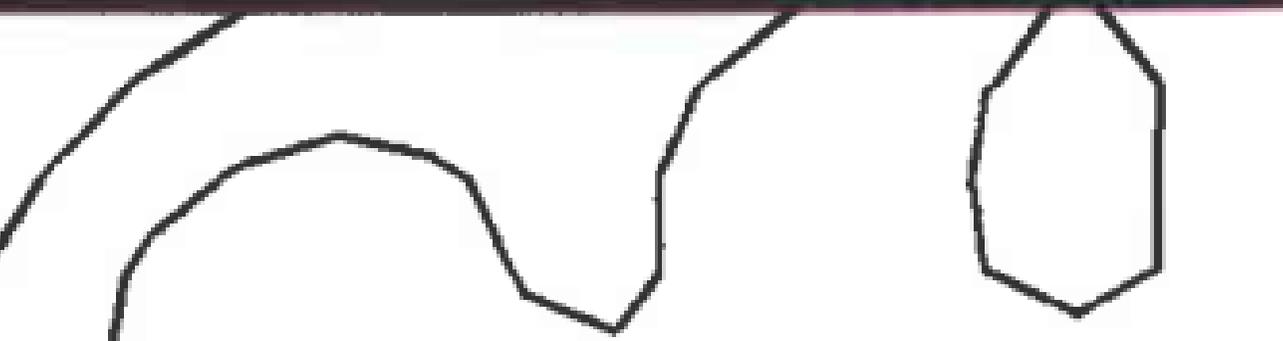
DRAWING #:

DATE: MARCH 31, 1995

SHEET 1 OF 1

REV:





0

V.:

Area 4 Subsidence Profile

North - South

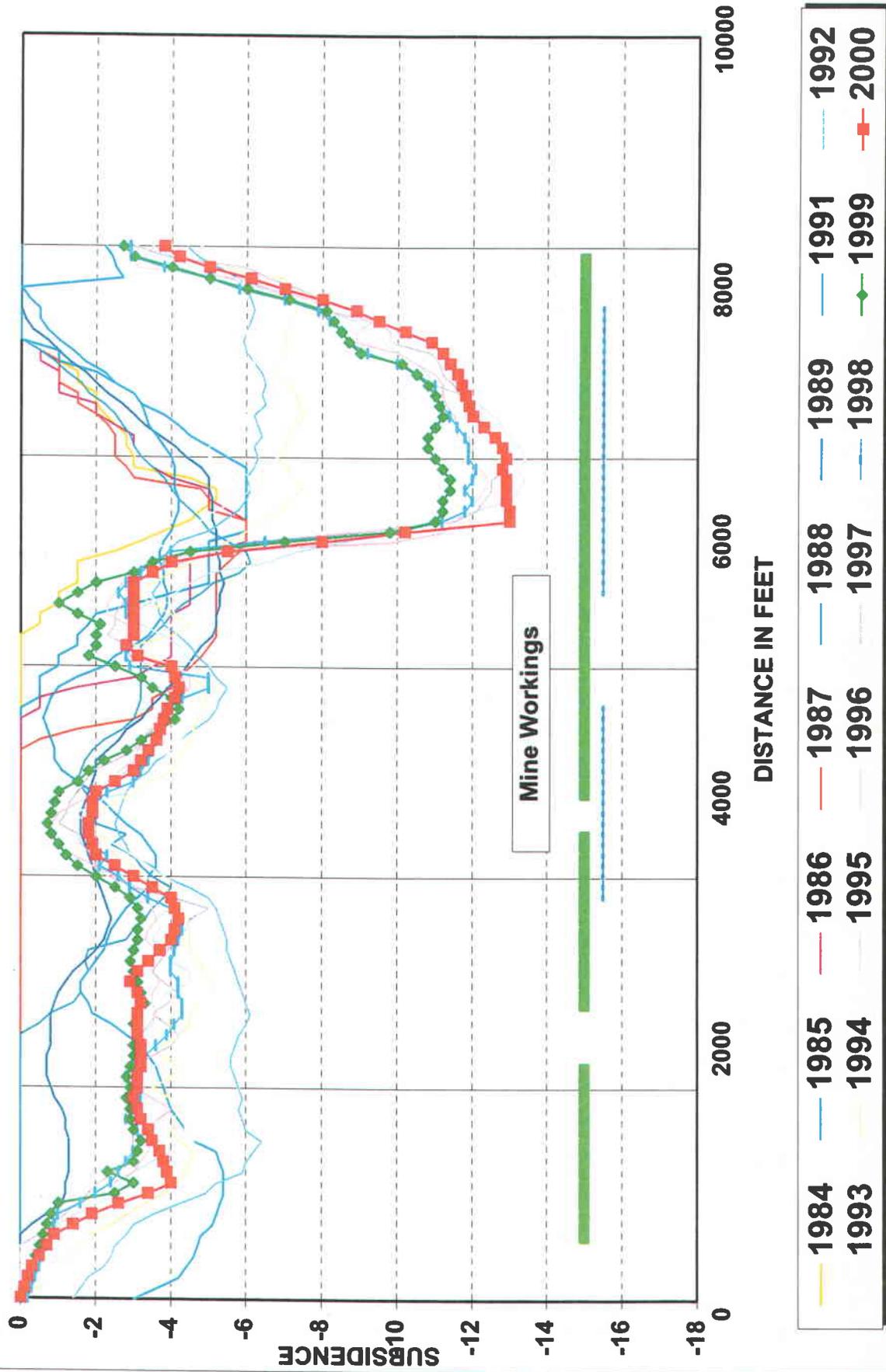


Figure 17

Area 4 Subsidence Profile

West - East

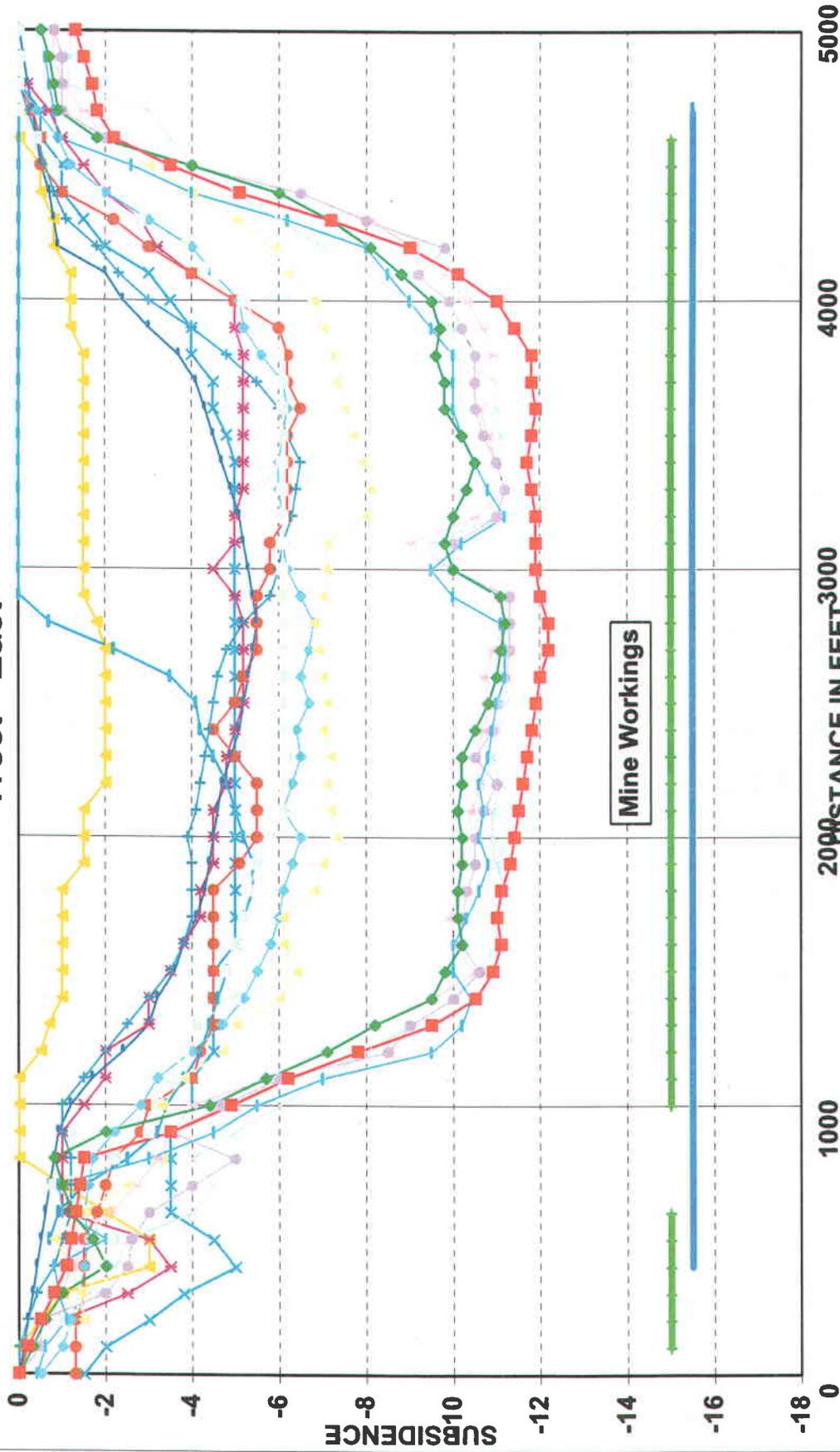


Figure 18

Area 5

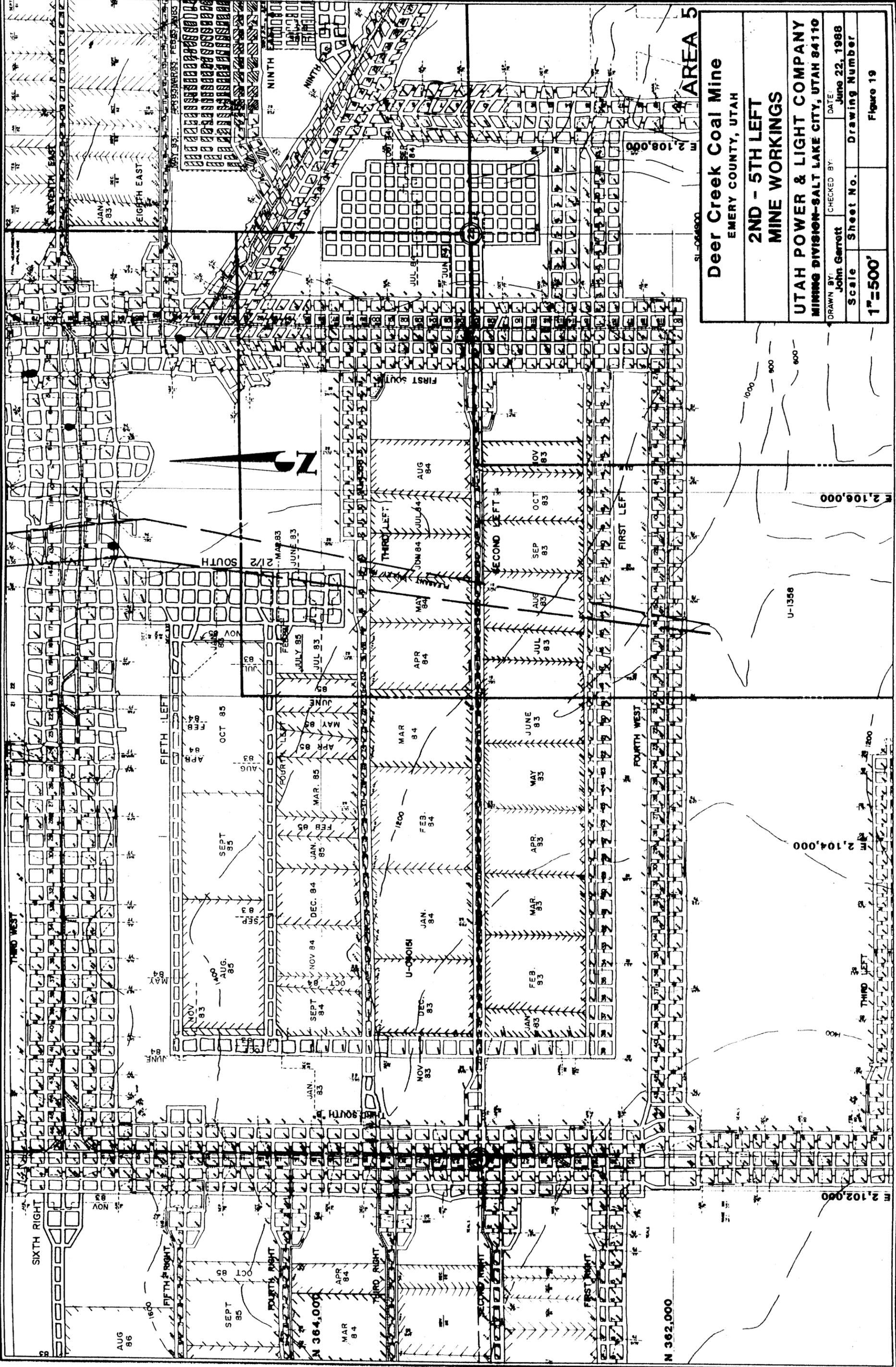
Deer Creek 2nd through 5th Left Longwall Panels

Photogrammetry revealed subsidence in Area 5 for the first time in 1984. Mining of the 2nd Left longwall panel in the Deer Creek Mine began in January 1983, and by October 1985 all four panels had been completed (Figure 19). In the Cottonwood Mine, longwall mining began in the 6th Right Longwall Panel in February 1993 and the last mining was completed in the 1st Right Longwall Panel in August 1994 completing all mining in this area (Figure 19A).

Maximum subsidence over the panels is slightly greater than thirteen (13) feet where both seams have been mined (Figure 20). The maximum subsidence showed a substantial increase between 1993 and 1994 but showed slight change between 1994 and 1998. The 2000 monitoring showed virtually no change as compared with the 1999 data. No surface disturbance has been identified over the panels.

As mentioned in the previous section, none of the springs located above the workings show any adverse effects due to mining.

Measured angle-of-draw is between zero and 13 degrees.

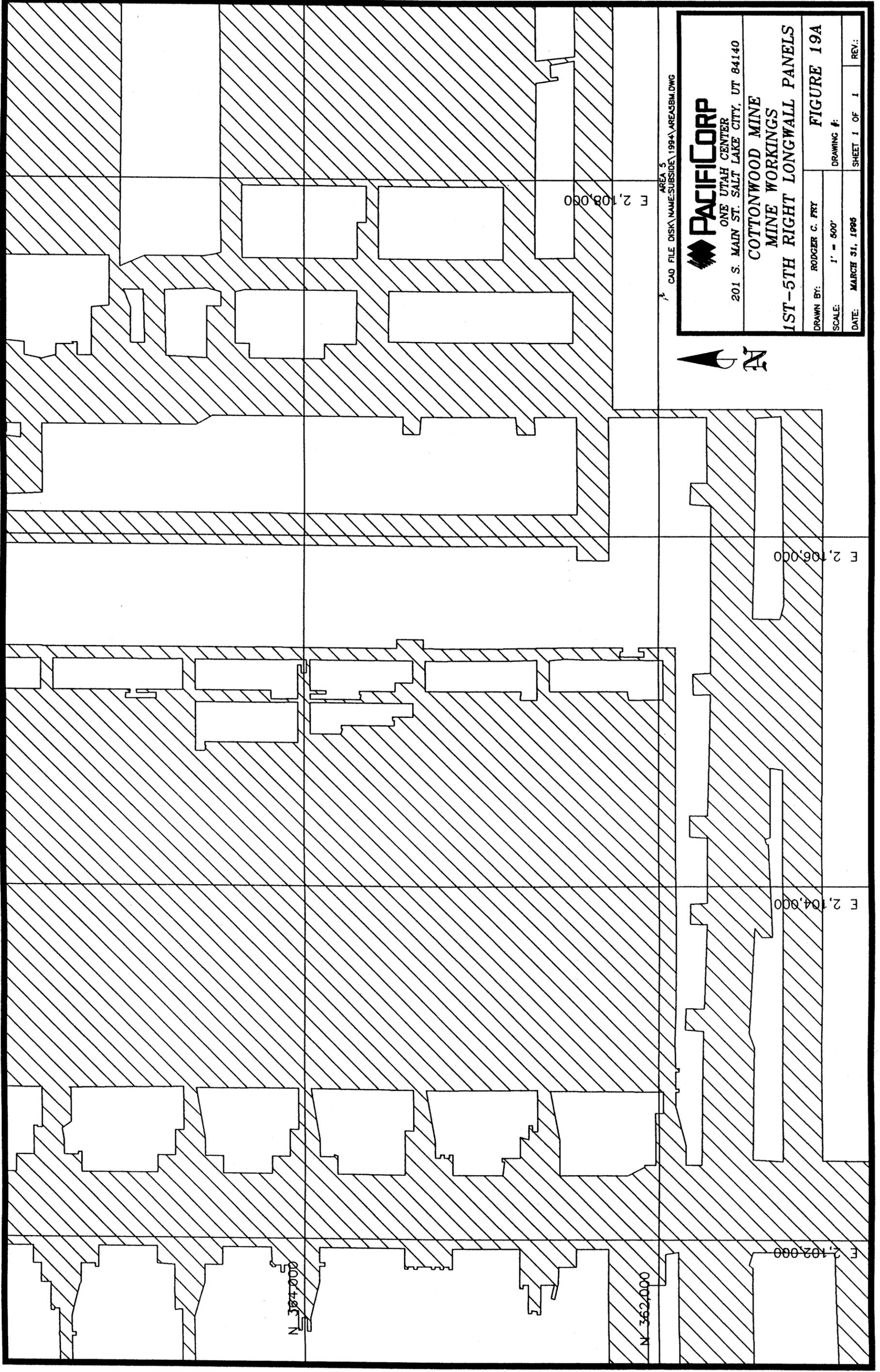


Deer Creek Coal Mine
 EMERY COUNTY, UTAH

2ND - 5TH LEFT
MINE WORKINGS

UTAH POWER & LIGHT COMPANY
 MINING DIVISION-SALT LAKE CITY, UTAH 84110

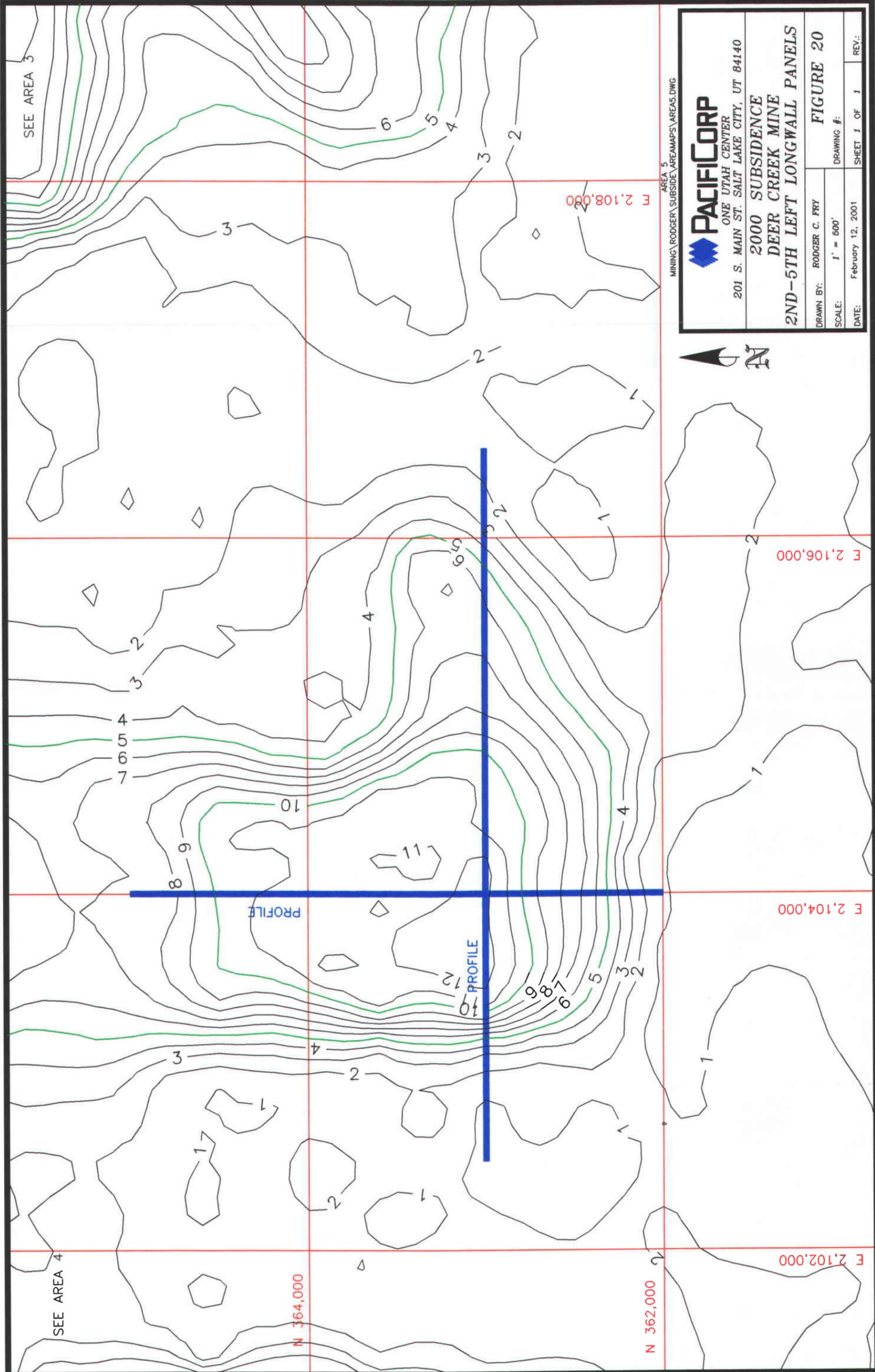
DRAWN BY: John Garrett CHECKED BY: DATE: June 22, 1988
 Scale Sheet No. Drawing Number
 1"=500' Figure 19



AREA 5
 CAD FILE DISK\NAME\SUBSIDE\1994\AREA5BM.DWG



ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140	
COTTONWOOD MINE MINE WORKINGS	
1ST-5TH RIGHT LONGWALL PANELS	
DRAWN BY: RODGER C. FRY	FIGURE 19A
SCALE: 1" = 500'	DRAWING #
DATE: MARCH 31, 1996	SHEET 1 OF 1
REV.:	



MINING\RODGER\SUBSIDE\AREAMAPS\AREA5.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

**2000 SUBSIDENCE
DEER CREEK MINE
2ND-5TH LEFT LONGWALL PANELS**

DRAWN BY: RODGER C. FRY		FIGURE 20	
SCALE: 1" = 500'		DRAWING #:	
DATE: February 12, 2001	SHEET 1 OF 1	REV.:	

Area 5 Subsidence Profile

North - South

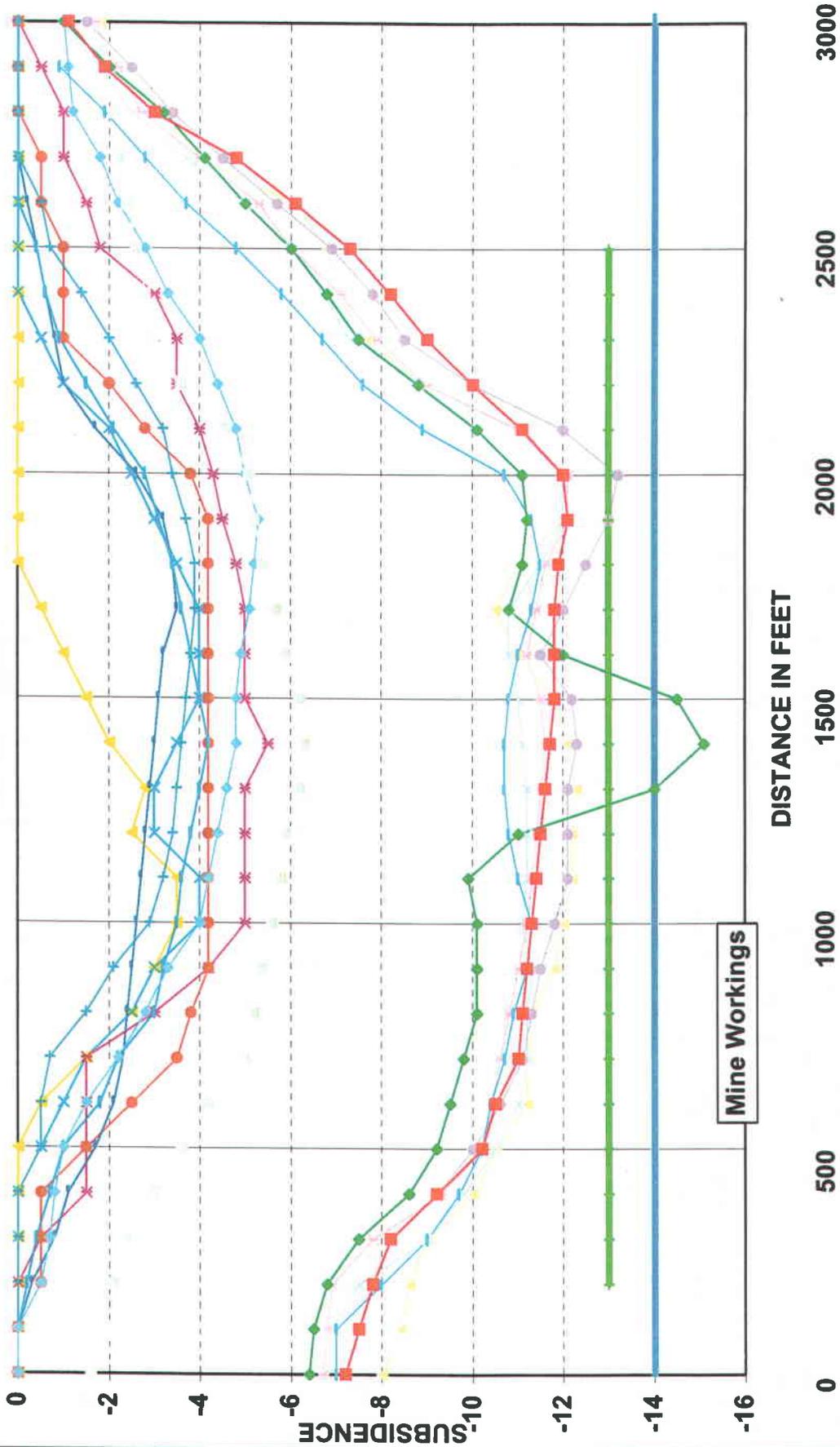


Figure 21

Area 5 Subsidence Profile

West - East

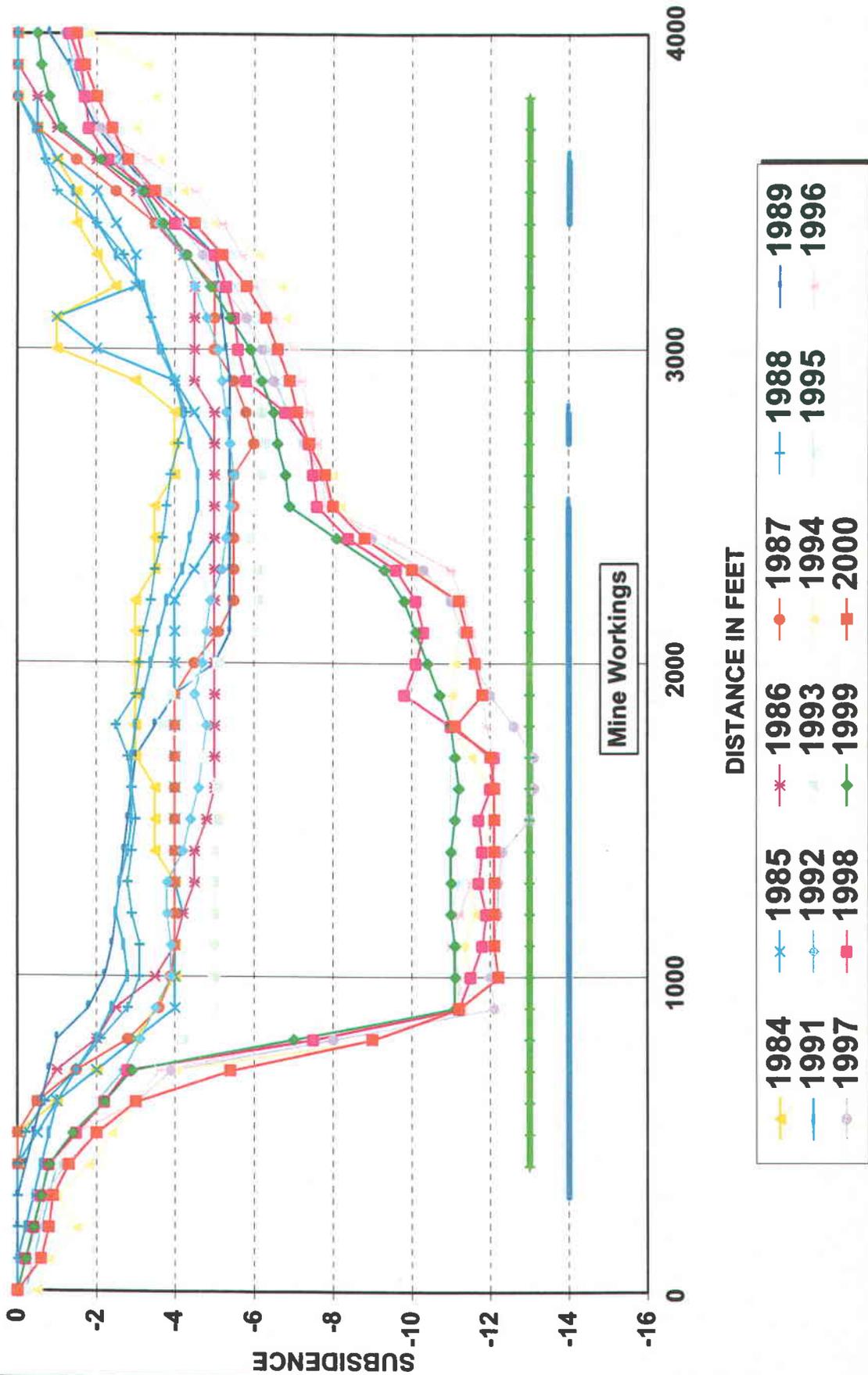


Figure 22

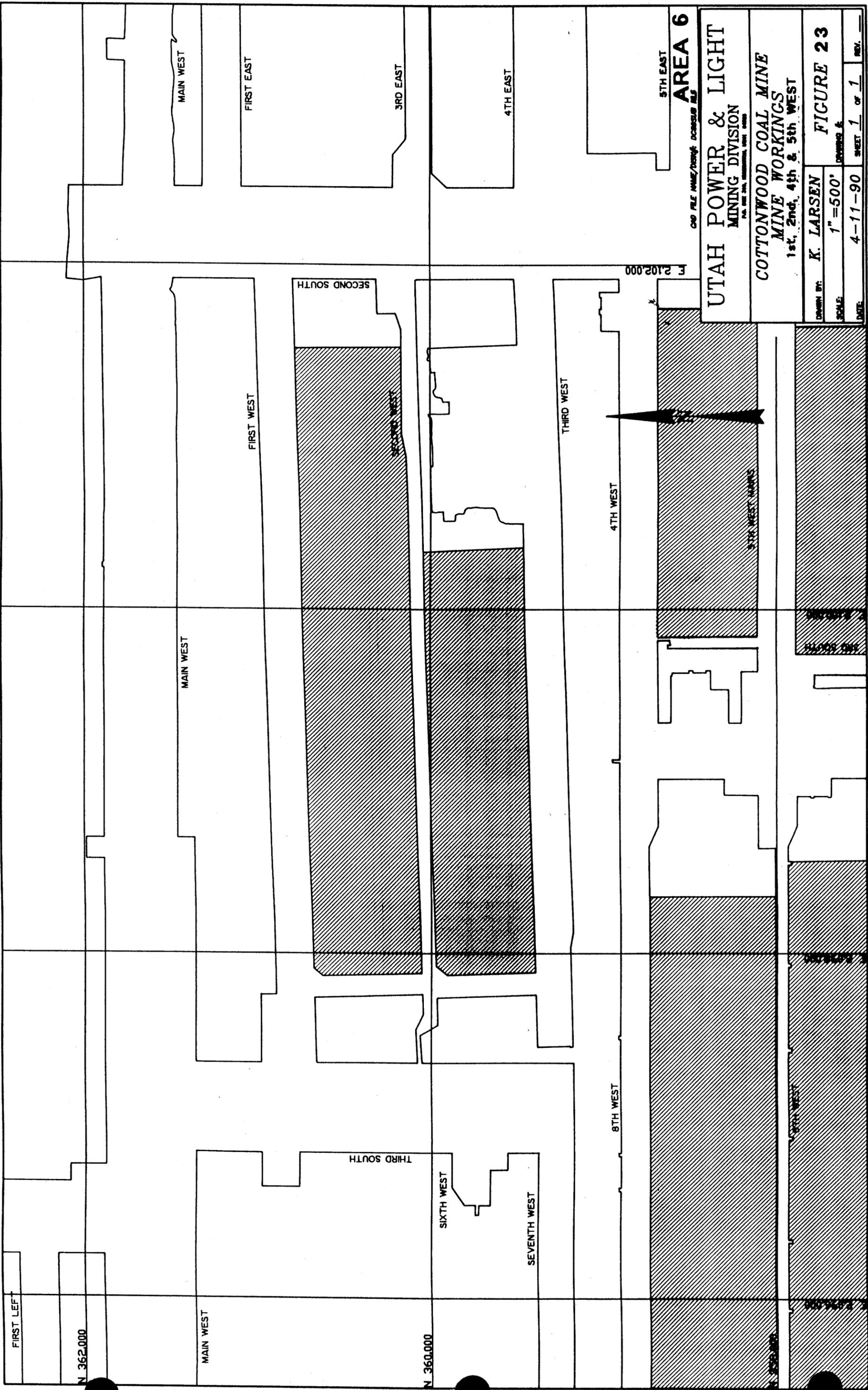
Area 6

Wilberg 1st and 2nd West Longwall Panels

Mining in the Wilberg 1st and 2nd West longwall panels was completed in June 1983 (Figure 23). This area of subsidence has now reached a maximum of between four and five feet over the Second West Longwall Panel (Figure 24). The subsidence in this area has been stable for the past four years. The subsidence profiles (Figures 25 and 26) show the change in subsidence since 1983.

Calculated angle-of-draw ranges from zero to 15 degrees where not influenced by other workings.

Four springs located just north of the area show no effect from the subsidence (see Hydrologic Monitoring Report, 2000).



AREA 6

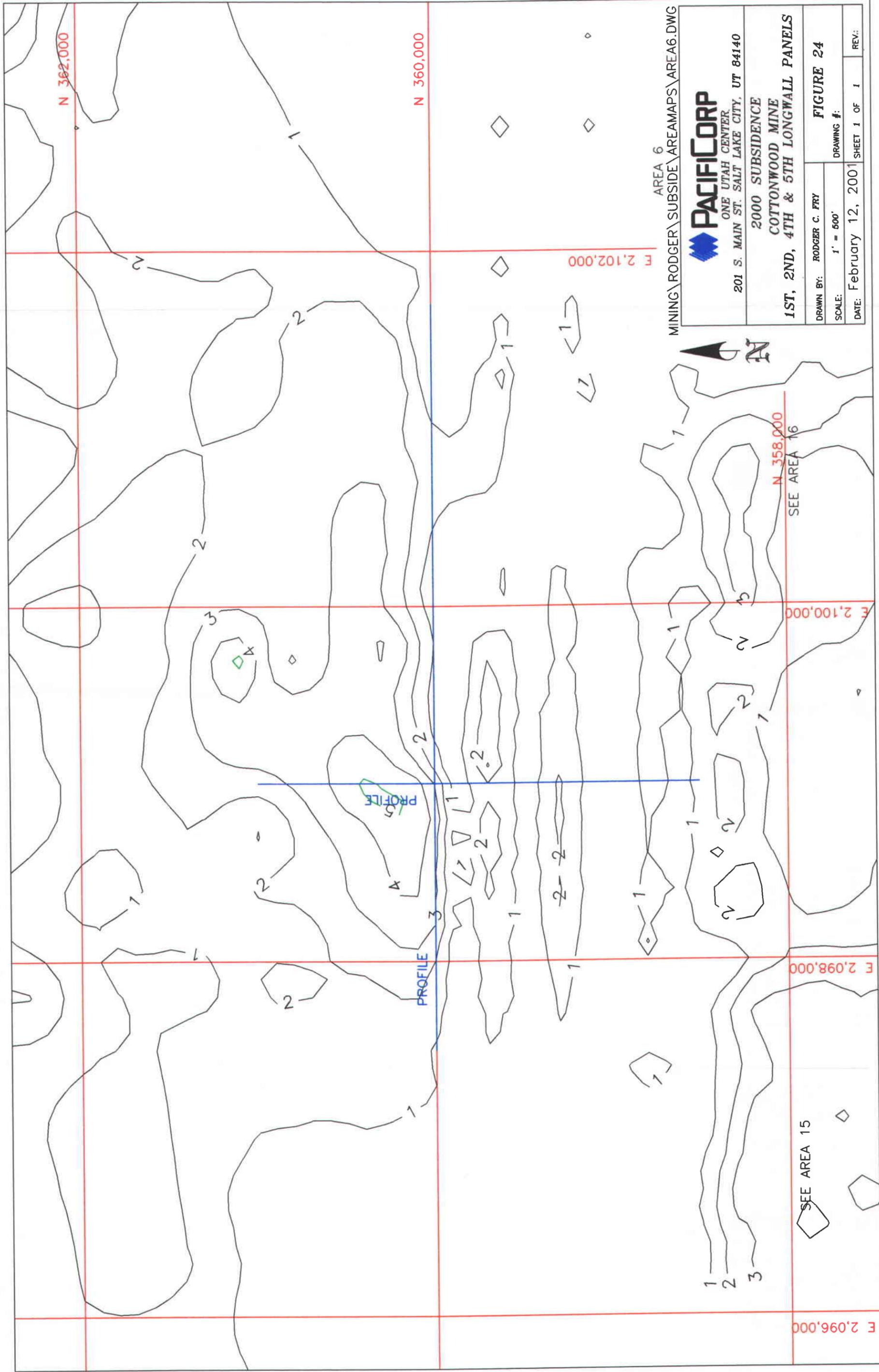
UTAH POWER & LIGHT
MINING DIVISION
COTTONWOOD COAL MINE
MINE WORKINGS
1st, 2nd, 4th & 5th WEST

DESIGNED BY:	K. LARSEN	FIGURE	23
SCALE:	1" = 500'	DRAWING &	
DATE:	4-11-90	SHEET	1 of 1 REV.

F 2102.000

N 362.000

N 360.000



MINING \ RODGER \ SUBSIDE \ AREAMAPS \ AREA6.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
COTTONWOOD MINE
1ST, 2ND, 4TH & 5TH LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 24
SCALE: 1" = 500'	DRAWING #:
DATE: February 12, 2001	SHEET 1 OF 1
	REV: 1

AREA 6

SEE AREA 16
N 358,000

E 2,098,000

E 2,100,000

E 2,102,000

N 360,000

N 362,000

SEE AREA 15

E 2,096,000

PROFILE

PROFILE

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5

5

5

5

Area 6 Subsidence Profile

North - South

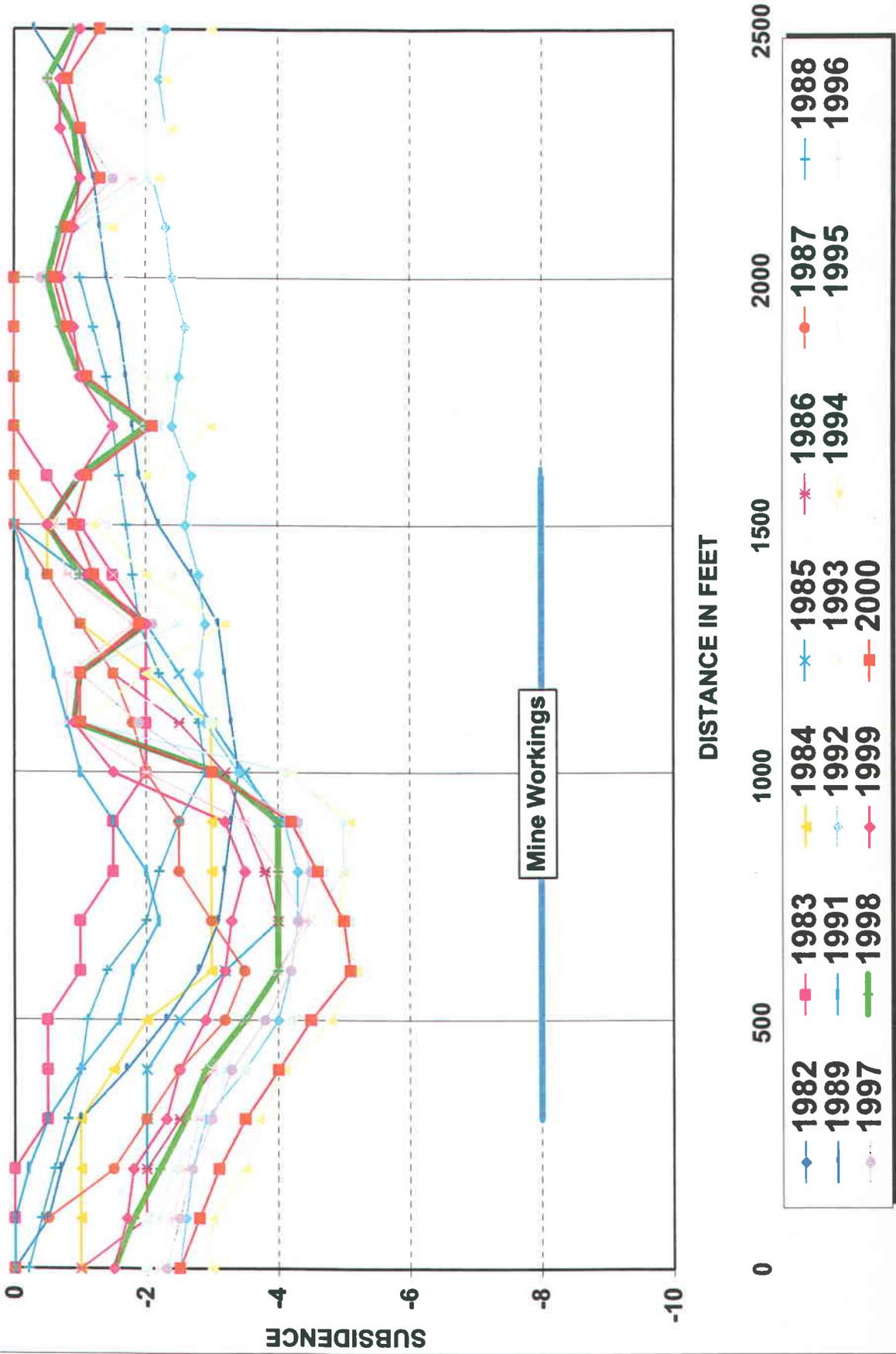


Figure 25

Area 6 Subsidence Profile West - East

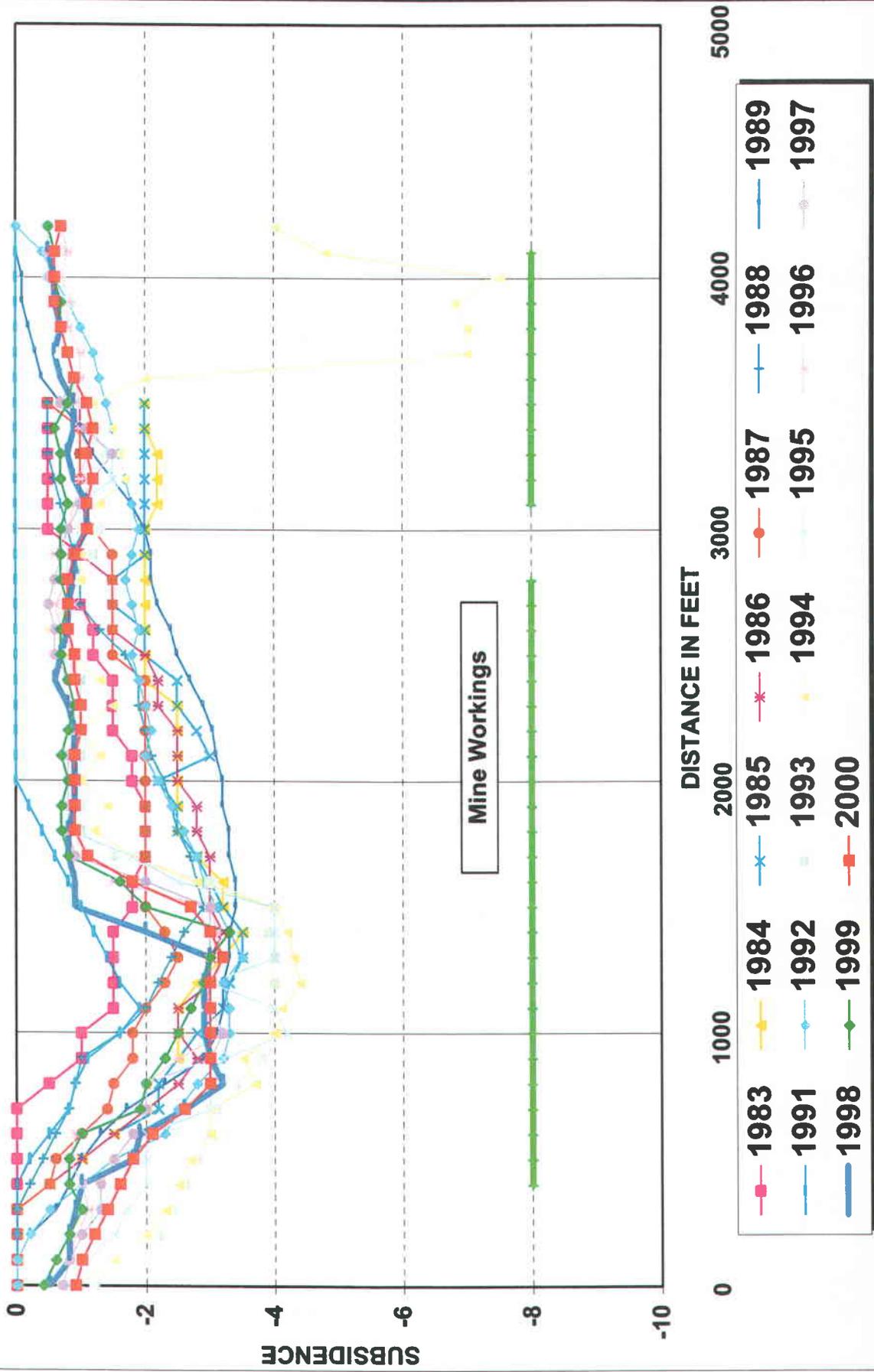


Figure 26

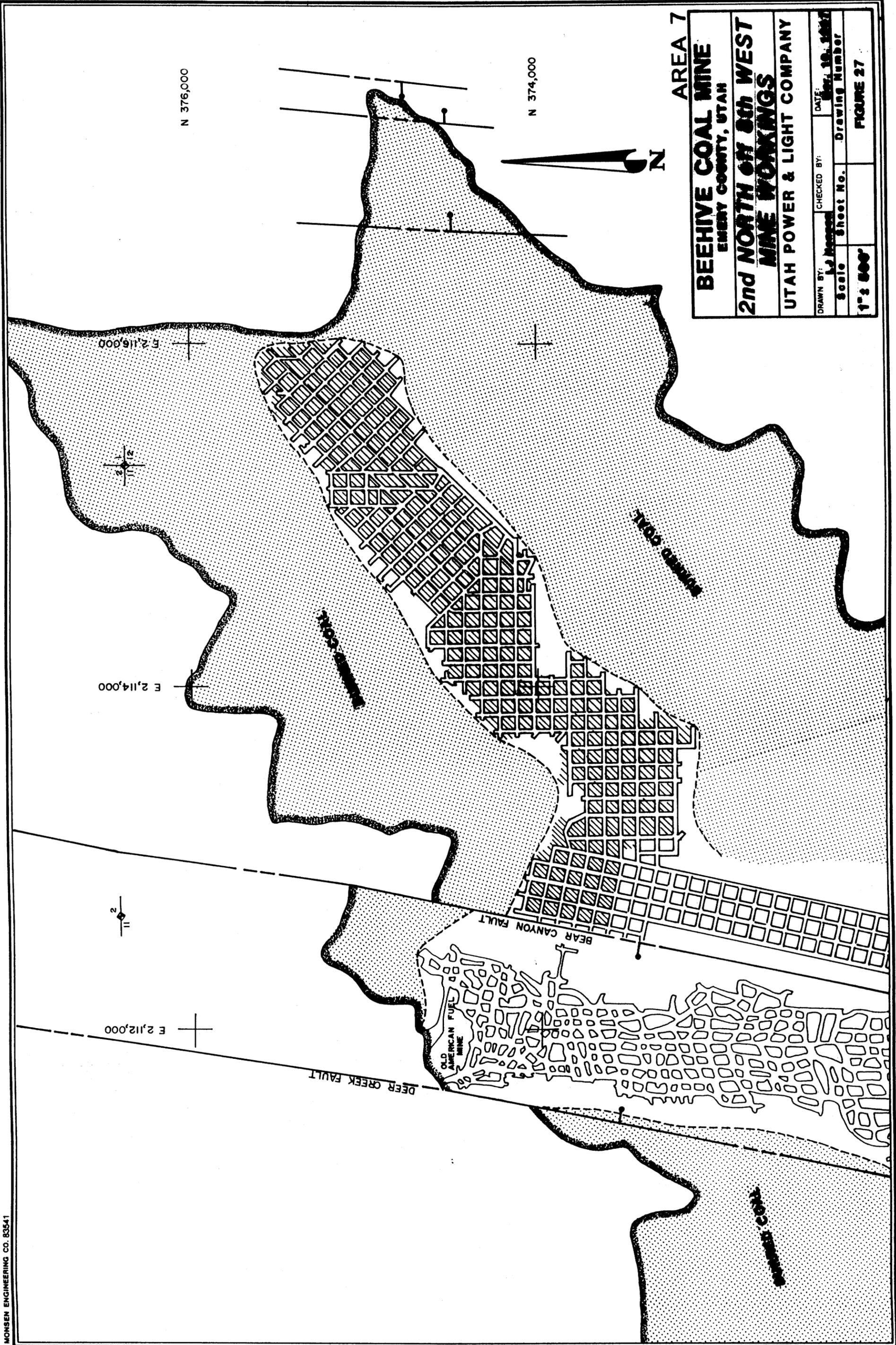
Area 7

Beehive Mine 2nd North off 8th West

Pillar extraction mining in 2nd North was completed in 1983 and, as shown in Figures 27, 28, and 29, little additional subsidence has occurred over the workings since 1984. The workings are surrounded by burned coal. Maximum subsidence is as much as seven (7) feet. In examining the area by helicopter and aerial photography, it is apparent that much of the elevation change measured was due to cliff failure and mass wasting on the steep slopes above the workings, where the rocks were highly fractured prior to mining. The profile, Figure 29, shows no measurable subsidence since 1991, this area is however, steep and rugged limiting the accuracy of the photogrammetric monitoring. Hence, the fluctuations in the reading are experienced from year to year.

It was not possible to get an accurate angle-of-draw because crushing of the surrounding clinker beds allowed subsidence to occur several thousand feet from the mine workings in some cases.

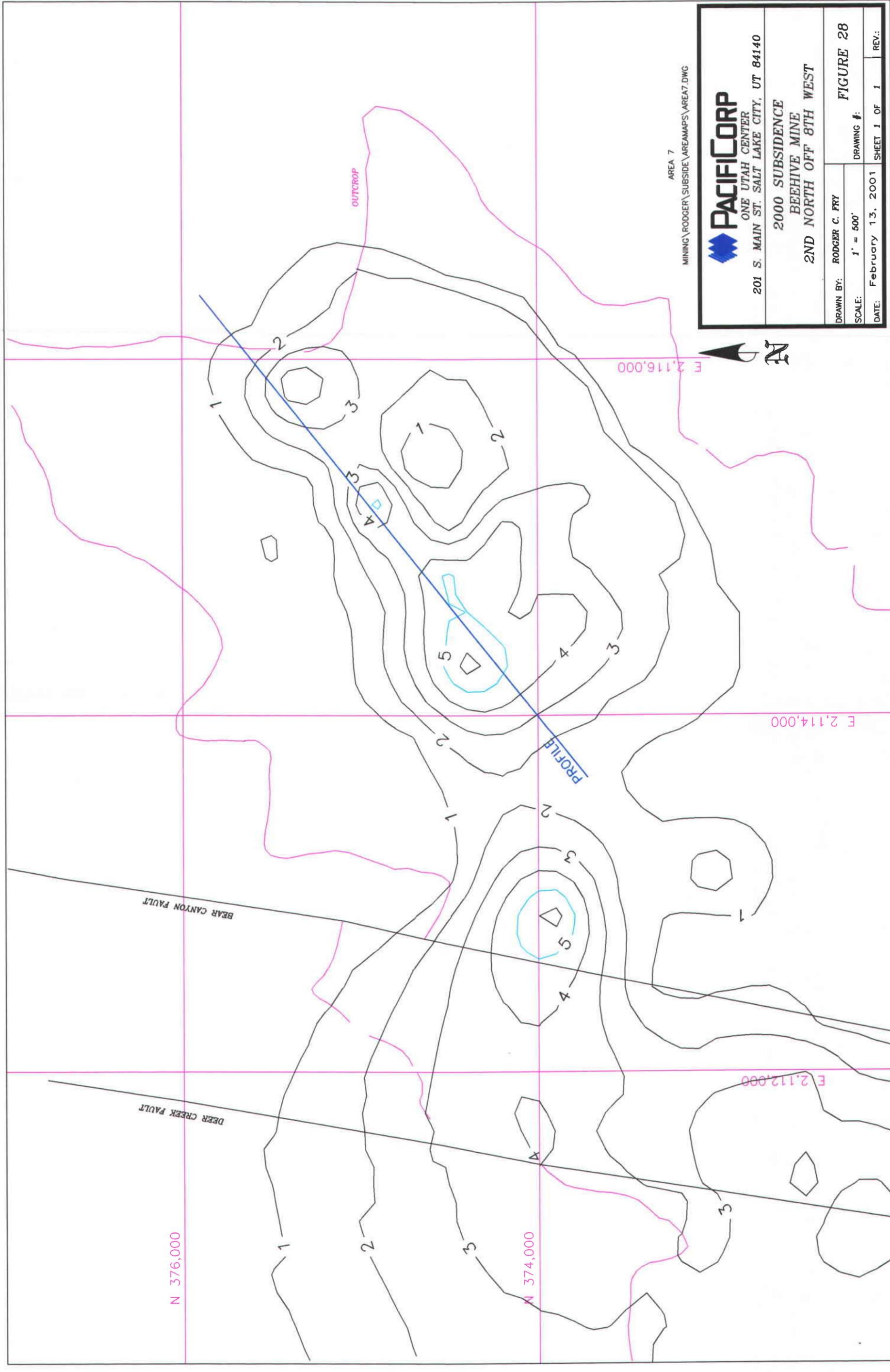
The subsidence has had no known influence on the hydrology in the area since they lack adequate recharge and are generally dry.



AREA 7

BEEHIVE COAL MINE
 EMERY COUNTY, UTAH
2nd NORTH OF 8th WEST
MINE WORKINGS
 UTAH POWER & LIGHT COMPANY

DRAWN BY:	CHECKED BY:	DATE:
J. J. Jensen		April 10, 1957
Scale	Sheet No.	Drawing Number
1" = 500'		FIGURE 27



AREA 7

MINING\RODGER\SUBSIDE\AREAMAPS\AREA7.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
BEEHIVE MINE
2ND NORTH OFF 8TH WEST

DRAWN BY: RODGER C. FRY

SCALE: 1" = 500'

DATE: February 13, 2001

FIGURE 28

DRAWING #:

SHEET 1 OF 1

REV.:



E 2,116,000

E 2,114,000

E 2,112,000

N 376,000

N 374,000

BEAR CANYON FAULT

DEER CREEK FAULT

PROFILE

OUTCROP

Area 7 Subsidence Profile Southwest - Northeast

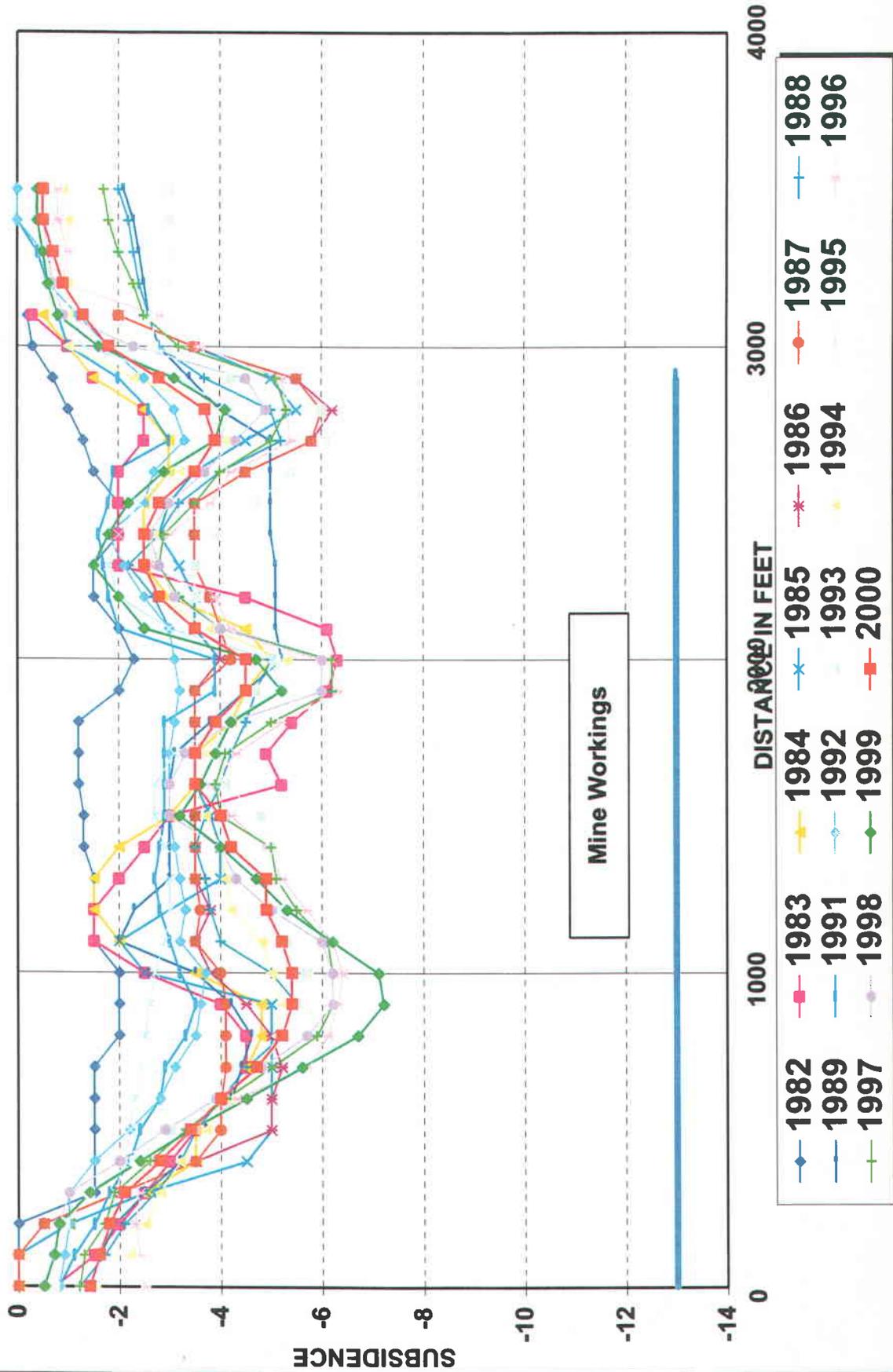


Figure 29

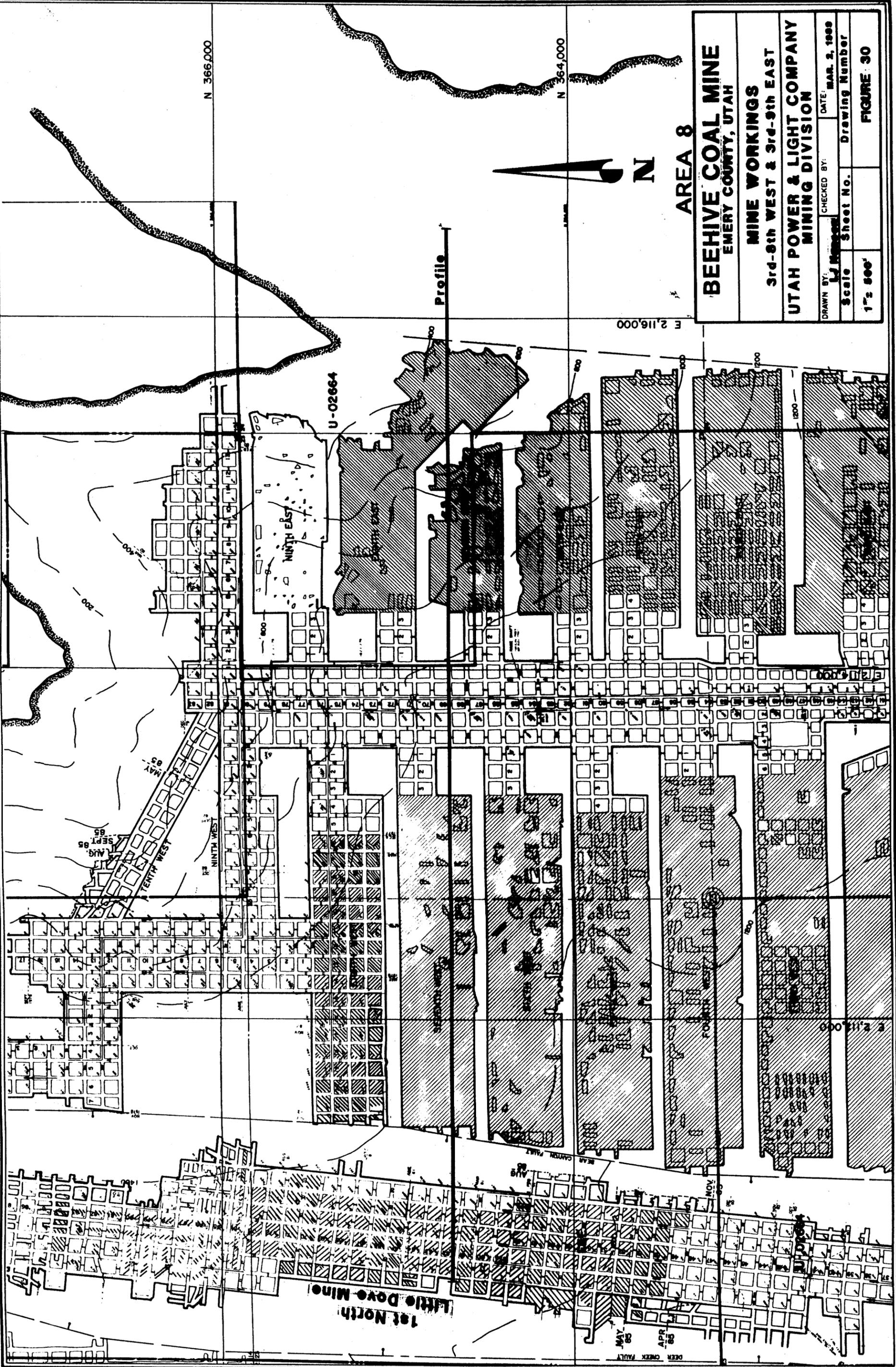
Area 8

Beehive 3rd Through 8th West and 3rd Through 9th East

Deseret 3rd Through 9th West and 1st Through 5th East

Some of the subsidence in Area 8 may have gone undetected because pillar extraction, and presumably subsidence, in part of the area was completed before the establishment of baseline survey data (Figures 30, 31, and 32). The west to east subsidence profile of the area depicted in Figure 33 indicates that subsidence as much as slightly less than seven (7) feet has occurred. The profile shows a fair amount of variability. This is due to the rugged terrain in the area. The profile indicates that no detectable change in subsidence has occurred in the past five years. Where not influenced by other workings, the angle-of-draw reached a maximum of 31 degrees on the eastern edge of the area.

The strata in this area is dry and the subsidence that has occurred has had no impact on the hydrology of the area.



AREA 8

BEEHIVE COAL MINE
 EMERY COUNTY, UTAH

MINE WORKINGS
 3rd-8th WEST & 3rd-9th EAST

UTAH POWER & LIGHT COMPANY
 MINING DIVISION

DRAWN BY: <i>[Signature]</i>	CHECKED BY: <i>[Signature]</i>	DATE: MAR. 2, 1959
Scale	Sheet No.	Drawing Number
1" = 500'		FIGURE 30

Profile

U-02664

NINTH EAST

NINTH WEST

TENTH WEST

FOURTH WEST

1st North Mine

DEER CREEK FAULT
MAY '56
APR '56
NOV '56

BEAR CANYON FAULT

N 366,000

N 364,000

E 2,116,000

E 2,114,000

1200

800

400

0

400

800

1200

1600

2000

2400

2800

3200

3600

4000

4400

4800

5200

5600

6000

6400

6800

7200

7600

8000

8400

8800

9200

9600

10000

10400

10800

11200

11600

12000

12400

12800

13200

13600

14000

14400

14800

15200

15600

16000

16400

16800

17200

17600

18000

18400

18800

19200

19600

20000

20400

20800

21200

21600

22000

22400

22800

23200

23600

24000

24400

24800

25200

25600

26000

26400

26800

27200

27600

28000

28400

28800

29200

29600

30000

30400

30800

31200

31600

32000

32400

32800

33200

33600

34000

34400

34800

35200

35600

36000

36400

36800

37200

37600

38000

38400

38800

39200

39600

40000

40400

40800

41200

41600

42000

42400

42800

43200

43600

44000

44400

44800

45200

45600

46000

46400

46800

47200

47600

48000

48400

48800

49200

49600

50000

50400

50800

51200

51600

52000

52400

52800

53200

53600

54000

54400

54800

55200

55600

56000

56400

56800

57200

57600

58000

58400

58800

59200

59600

60000

60400

60800

61200

61600

62000

62400

62800

63200

63600

64000

64400

64800

65200

65600

66000

66400

66800

67200

67600

68000

68400

68800

69200

69600

70000

70400

70800

71200

71600

72000

72400

72800

73200

73600

74000

74400

74800

75200

75600

76000

76400

76800

77200

77600

78000

78400

78800

79200

79600

80000

80400

80800

81200

81600

82000

82400

82800

83200

83600

84000

84400

84800

85200

85600

86000

86400

86800

87200

87600

88000

88400

88800

89200

89600

90000

90400

90800

91200

91600

92000

92400

92800

93200

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94000

94400

94800

95200

95600

96000

96400

96800

97200

97600

98000

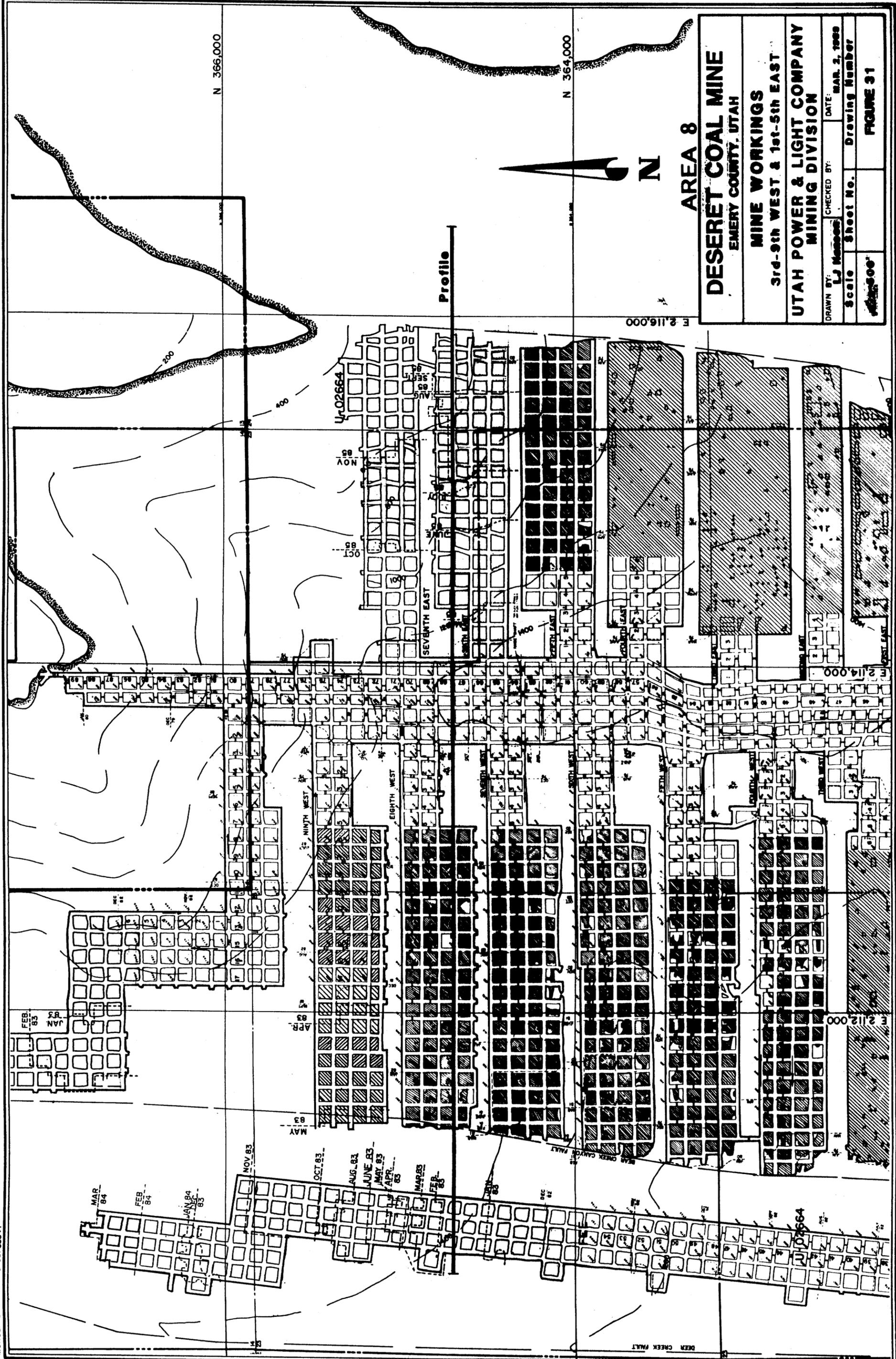
98400

98800

99200

99600

100000



N 366,000

N 364,000

E 2,116,000

E 2,114,000

E 2,112,000



AREA 8

DESERET COAL MINE EMERY COUNTY, UTAH	
MINE WORKINGS 3rd-9th WEST & 1st-5th EAST	
UTAH POWER & LIGHT COMPANY MINING DIVISION	
DRAWN BY: L.J. Madsen	CHECKED BY:
Scale As Shown	DATE: MAR. 2, 1983
Sheet No.	Drawing Number
	FIGURE 31

Profile

U-02664

NOV 83

800

1500

SEVENTH EAST

EIGHTH WEST

NINTH WEST

APR 83

MAY 83

NOV 83

OCT 83

AUG 83

JUNE 83

MAY 83

APR 83

MAR 83

FEB 83

MAR 84

FEB 84

JAN 84

DEC 83

NOV 83

OCT 83

SEP 83

AUG 83

JUL 83

JUN 83

MAY 83

APR 83

MAR 83

FEB 83

JAN 83

DEC 82

NOV 82

OCT 82

SEP 82

AUG 82

JUL 82

JUN 82

MAY 82

APR 82

MAR 82

FEB 82

JAN 82

DEC 81

NOV 81

OCT 81

SEP 81

AUG 81

JUL 81

JUN 81

MAY 81

APR 81

MAR 81

FEB 81

JAN 81

DEC 80

NOV 80

OCT 80

SEP 80

AUG 80

JUL 80

JUN 80

MAY 80

APR 80

MAR 80

FEB 80

JAN 80

DEC 79

NOV 79

OCT 79

SEP 79

AUG 79

JUL 79

JUN 79

MAY 79

APR 79

MAR 79

FEB 79

JAN 79

DEC 78

NOV 78

OCT 78

SEP 78

AUG 78

JUL 78

JUN 78

MAY 78

APR 78

MAR 78

FEB 78

JAN 78

DEC 77

NOV 77

OCT 77

SEP 77

AUG 77

JUL 77

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MAY 77

APR 77

MAR 77

FEB 77

JAN 77

DEC 76

NOV 76

OCT 76

SEP 76

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MAY 76

APR 76

MAR 76

FEB 76

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OCT 75

SEP 75

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JUN 63

MAY 63

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JAN 63

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SEP 62

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JUN 62

MAY 62

APR 62

MAR 62

FEB 62

JAN 62

DEC 61

NOV 61

OCT 61

SEP 61

AUG 61

JUL 61

JUN 61

MINING\RODGER\SUBSIDE\AREAMAPS\AREA8.DWG AREA 8



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
DES-BEE-DOVE MINES
DESERET 3-9 WEST & 1-5 EAST
BEEHIVE 3-8 WEST & 3-9 EAST

DRAWN BY: RODGER C. FRY

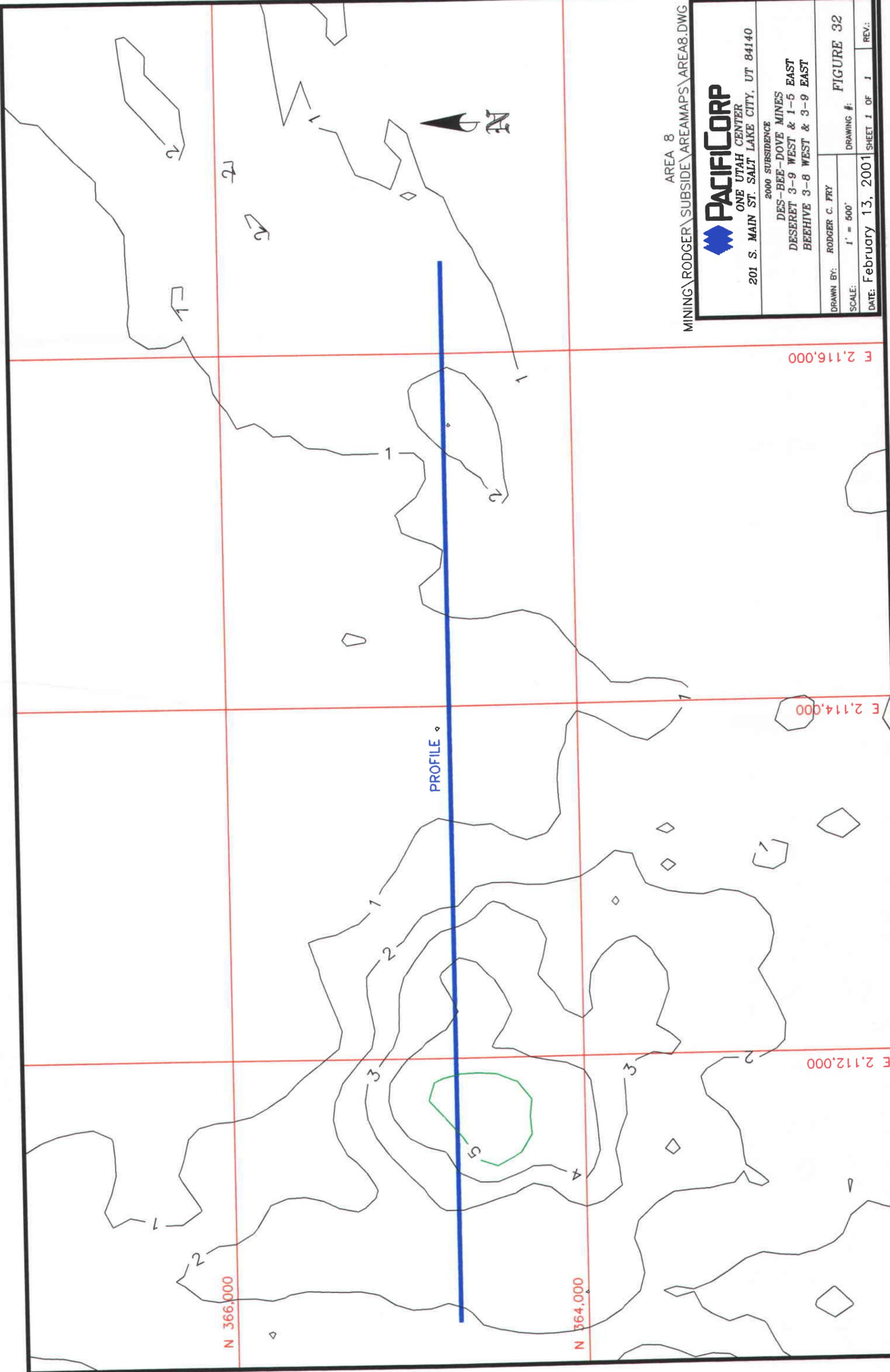
SCALE: 1" = 500'

DATE: February 13, 2001

FIGURE 32

DRAWING #:
SHEET 1 OF 1

REV.:



Area 8 Subsidence Profile

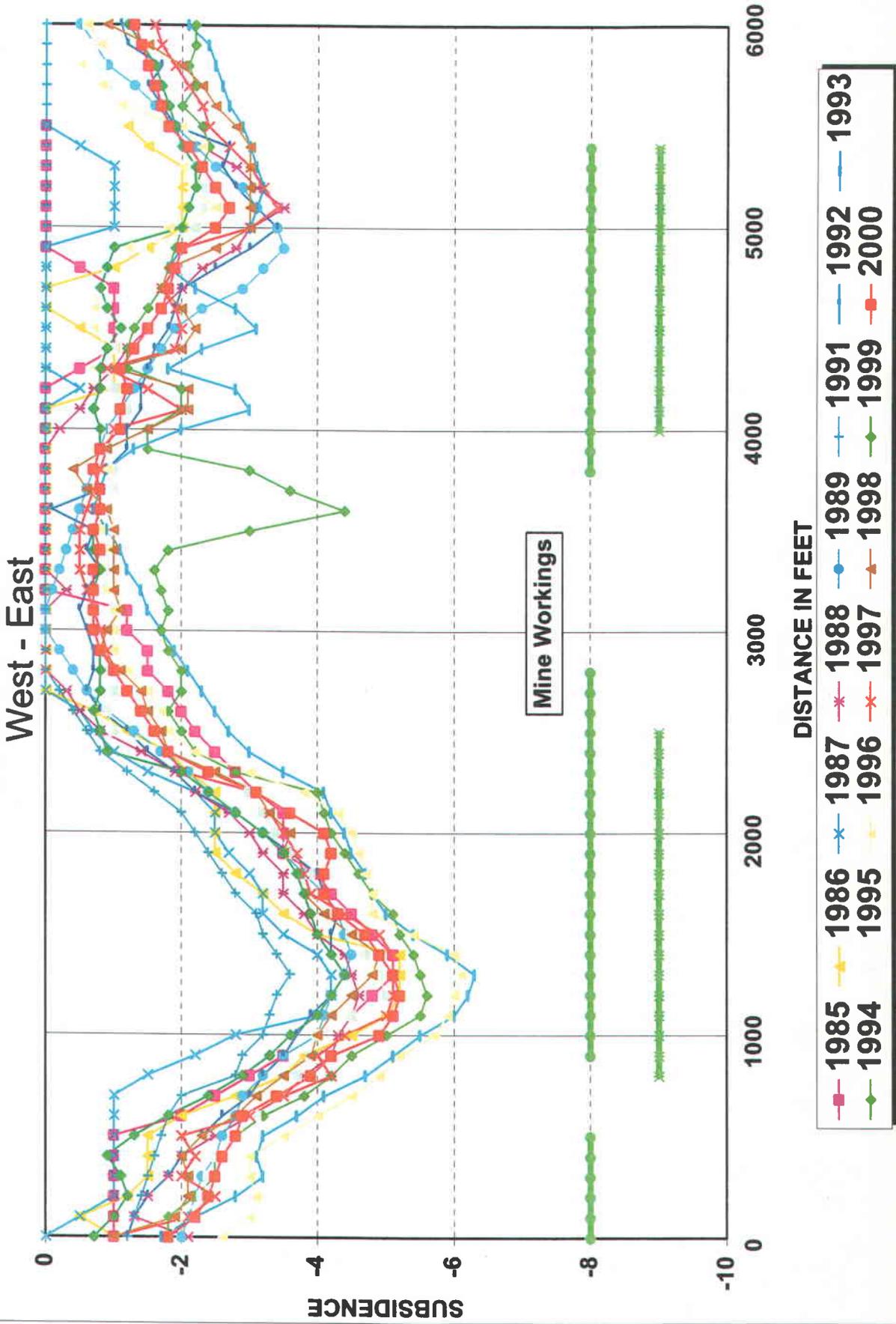


Figure 33

Areas 9 and 10

Little Dove 1st North and the old American Fuel Mine

The 1st North section of the Little Dove Mine and the American Fuel Mine workings are located in a graben formed by the Deer Creek and Bear Creek Canyon faults (see figures for Areas 7 and 8). In August 1982 the Little Dove workings, mining in a northerly direction, intersected the old workings of the American Fuel Mine about 1000 feet south of where available maps indicated they extend. Mining conditions in that area of Little Dove revealed that strata were highly stressed. In some cases pillars were crushed before they could be extracted. At that time pillar extraction mining was begun in 1st North and continued to the south with minor interruptions from 1982 through much of 1987.

To date the maximum observed subsidence over 1st North is about three to four feet, occurring over some of the most recently extracted pillars (see Subsidence Map in Appendix). No other notable subsidence has been detected over the remainder of 1st North.

Subsidence of over six (6) feet has been measured above the American Fuel Mine workings.

Any angle-of-draw calculation would be affected by both the surrounding mine workings and the faults on either side; therefore, no angle-of-draw was calculated for either the 1st North area of the Little Dove Mine or the old American Fuel Mine.

No fractures are known over the 1st North workings, but some cliff failure and

fractures are probably present over the American Fuel Mine on the cliffs and steep slopes.

Mining has had no known effect on the hydrology of the areas.

Area 11

Deer Creek C and D North Longwall Panels

Cottonwood 11th Right Longwall Panel off 2 ½ North

Cottonwood 6th & 7th Right Longwall Panel off of 2nd North

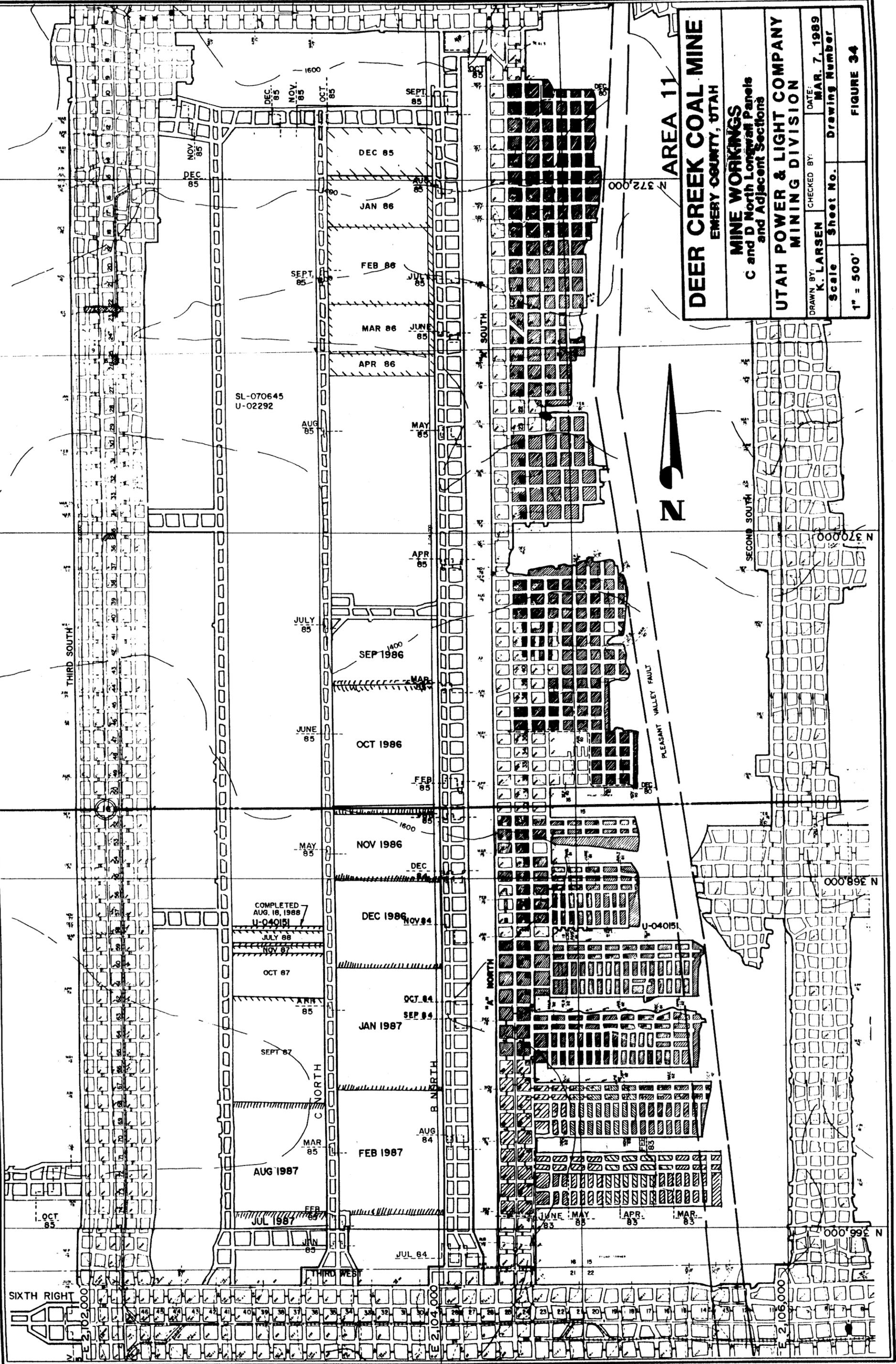
Longwall mining in the C North panel began in December 1984 and was terminated in April 1986 due to geologic complications. New setup entries were driven further south and mining resumed in September 1986; the panel was completed in March 1987. The D North longwall panel began production in July 1987, but after October 1987 production was limited due to poor coal quality. The panel was terminated in August 1988 at a length of 1750 feet. Pillar extraction mining in A North and A South was completed in June 1983 (Figure 34).

Mining in the 11th Right Panel in the Cottonwood Mine began In July of 1992 and was completed in September 1992 (Figure 35). The 10th Right Panel to the south was developed but couldn't be mined with longwall methods because of thin coal and poor coal quality. Mining began in the 7th Right Panel in February 1993 and by August 1993 mining in the 6th Right Panel had been completed.

Measurable subsidence to date has exceeded thirteen (13) feet in the area of multiple seam mining above the 6th and 7th Right Longwall Panels in the Cottonwood mine (Figures 36, 37, and 38). The maximum subsidence showed an increase between 1993 and 1994 but has been stable the past six years.

Fractures were discovered at the western end of coal extraction above the 7th Right

Longwall Panel. The fractures were first discovered on June 17, 1993. Mining of the longwall panel was completed on May 12, 1993. An aerial reconnaissance of the area on May 18, 1993 revealed no surface fractures at that time. This places the occurrence of the fractures between May 18, 1993 and June 17, 1993. Burnt Tree Springs is located approximately 800 feet to the southeast of the fractures. Measurements of the spring discharge throughout the summer of 1993 through 2000 indicated that the fracturing has had no effect on the spring. The angle-of-draw measured ranges from less than zero to 28 degrees.



AREA 11

DEER CREEK COAL MINE
EMERY COUNTY, UTAH

MINE WORKINGS
C and D North Longwall Panels
and Adjacent Sections

UTAH POWER & LIGHT COMPANY
MINING DIVISION

DRAWN BY: K. LARSEN
CHECKED BY: M. LARSEN
DATE: MAR. 7, 1989

Scale Sheet No. Drawing Number
1" = 500'
FIGURE 3-4



SIXTH RIGHT

THIRD WEST

SECOND SOUTH

A NORTH

B NORTH

C NORTH

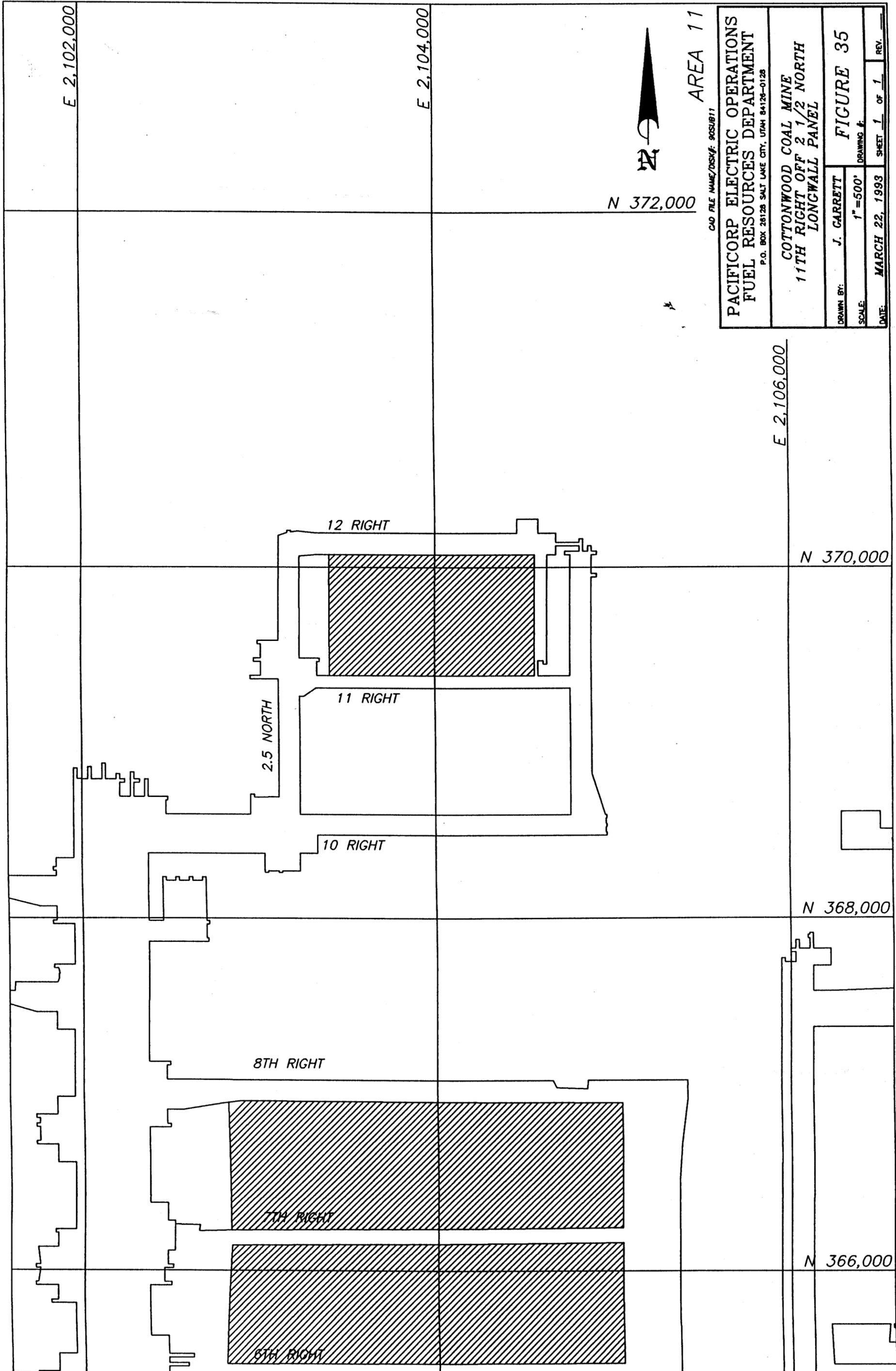
B SOUTH

C SOUTH

PLEASANT VALLEY FAULT

SL-070645
U-02292

COMPLETED
AUG. 18, 1988
U-040151



AREA 11

N 372,000

CAD FILE NAME/DISK# 90SUB11

PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128

COTTONWOOD COAL MINE
11TH RIGHT OFF 2 1/2 NORTH
LONGWALL PANEL

DRAWN BY: J. GARRETT
SCALE: 1" = 500'
DATE: MARCH 22, 1993

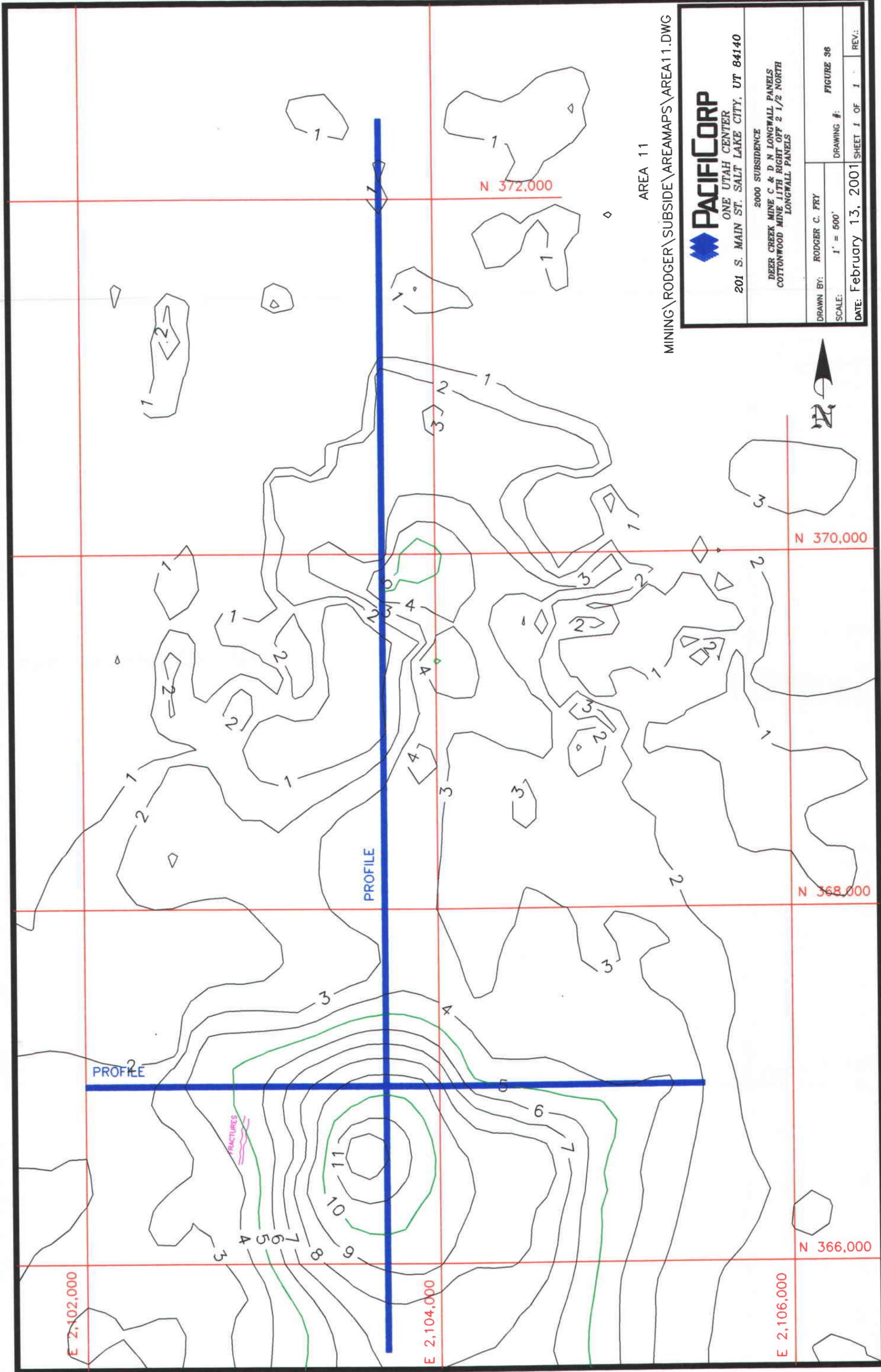
DRAWING #: **FIGURE 35**
SHEET 1 OF 1
REV. _____

E 2,106,000

N 370,000

N 368,000

N 366,000



MINING\RODGER\SUBSIDE\AREAMAPS\AREA11.DWG
 AREA 11



ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
 DEER CREEK MINE C & D N LONGWALL PANELS
 COTTONWOOD MINE LITH RIGHT OFF 2 1/2 NORTH
 LONGWALL PANELS

DRAWN BY: RODGER C. FRY

SCALE: 1" = 500'

DATE: February 13, 2001

FIGURE 36

DRAWING #:

SHEET 1 OF 1

REV.:

Area 11 Subsidence Profile

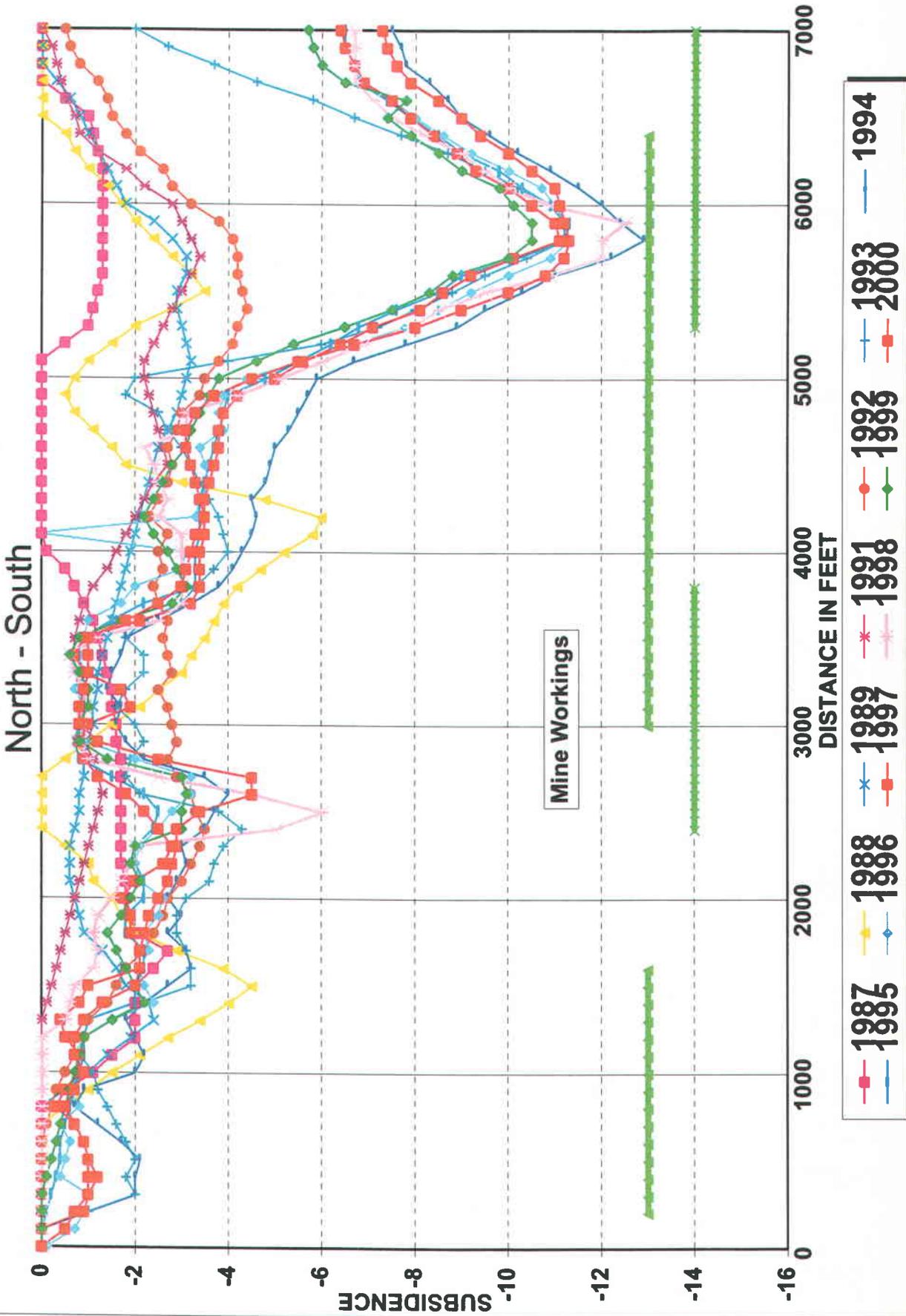


Figure 37

Area 11 Subsidence Profile

West - East

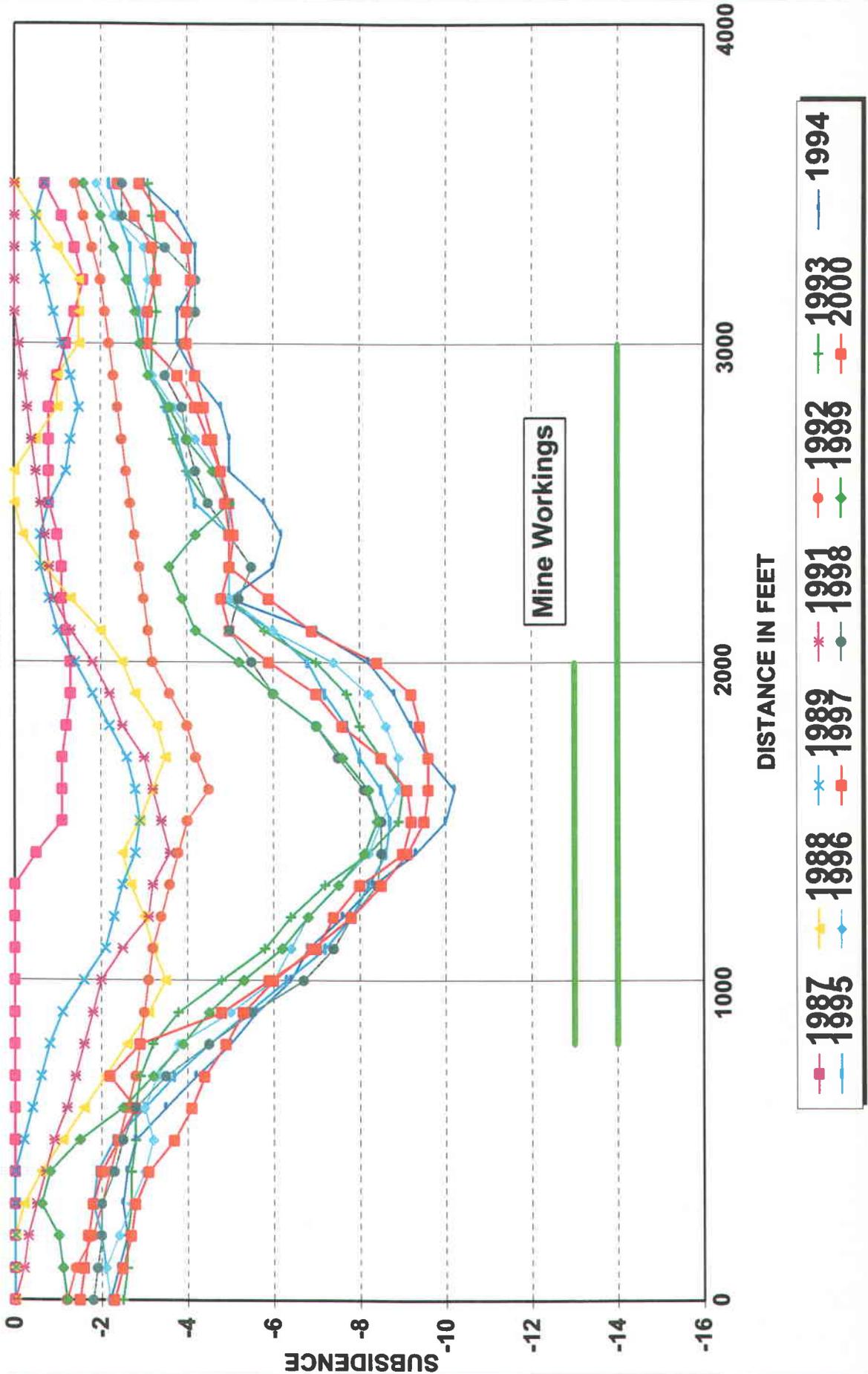


Figure 38

Area 12

Wilberg 2nd Left Longwall Panel

The 2nd Left longwall panel is located in the western portion of the Wilberg Mine (Figure 2). A block of coal measuring 2300 feet by 530 feet was extracted during 1981 and 1982. To date no measurable subsidence has occurred and no visible surface disturbance has been observed. Overburden ranges from 1500 to 1900 feet over the panel. It is somewhat surprising that no movement has been detected since subsidence has been observed in other instances where smaller blocks of coal were extracted and overburden was of similar thickness.

One spring is located approximately 800 feet northeast of the extracted workings on the surface. It has not been affected by mining.

Area 13

Des-Bee-Dove Southern Areas

Area 13, covering the southern portions of the Deseret, Beehive, and Little Dove Mines, was first monitored for subsidence in 1986. Some of the sections were mined before baseline survey data were established; therefore, subsidence measured over these sections will likely not represent what actually occurred. The 4th North section in the Little Dove Mine was completed in February 1987 (Figures 39 and 40).

Maximum subsidence over the area as of August 1998 was about three (3) feet over the second and third north sections of the Little Dove Mine (Figures 41, 42, and 43). No change in subsidence has occurred in the past five years.

The subsidence profiles, figures 42 and 43 show subsidence yearly since 1986. These profiles show that the readings in 1993 and 1994 are somewhat lower than in 1995, 1996, 1997 or in previous years. This is most likely a problem with the aerial triangulation because a comparison of the survey monuments in the area show no subsidence change in that time period.

No visible surface disturbance of any kind has been found.

There are no known springs over the workings, and mining is not expected to have any effect on the hydrology of the area.

U-1358

AREA 13

Beehive & Little Dove Coal Mines
EMERY COUNTY, UTAH

SOUTHERN AREAS
MINE WORKINGS

UTAH POWER & LIGHT COMPANY
MINING DIVISION

DRAWN BY: LJ
CHECKED BY: MAR. 6, 1989
Scale Sheet No. Drawing Number

1" = 500' FIGURE 39



U-1358

E 2,110,000

22 23
27 26

DEER CREEK FAULT

U-02664

Profile

Profile

E 2,115,000

23 24
26 25

FEE

E 2,114,000

N 362,000

U-02664

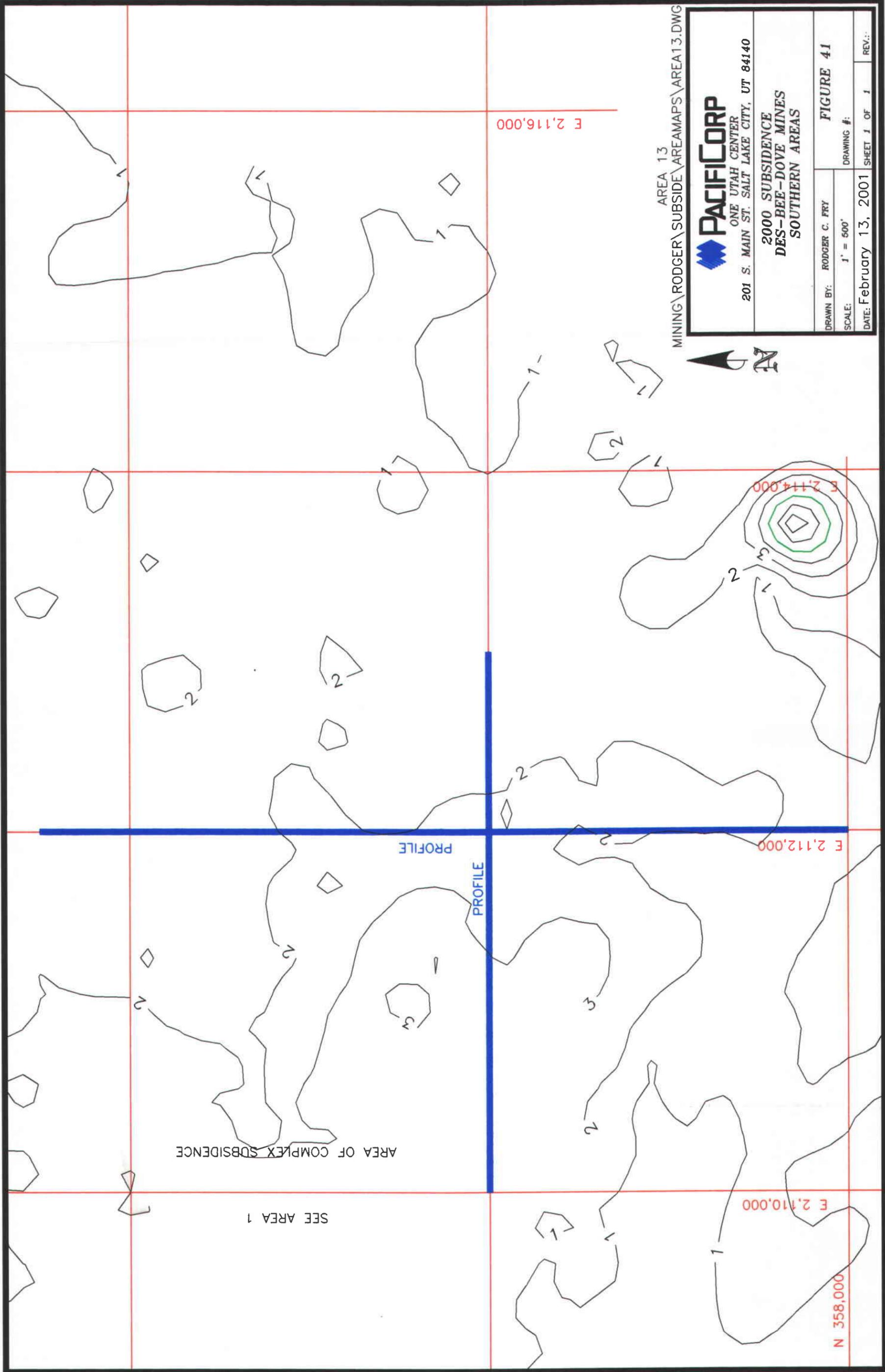
N 360,000



AREA 13

DESERET COAL MINE	
EMERY COUNTY, UTAH	
SOUTHERN AREAS	
MINE WORKINGS	
UTAH POWER & LIGHT COMPANY	
MINING DIVISION	
DRAWN BY: John Garrett	CHECKED BY:
Scale	Sheet No.
DATE: MAR. 2, 1989	Drawing Number
1" = 500'	
FIGURE 40	

N 358,000



MINING\RODGER\SUBSIDE\AREAMAPS\AREA13.DWG

AREA 13



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
DES-BEE-DOVE MINES
SOUTHERN AREAS

FIGURE 41

DRAWN BY: RODGER C. FRY

SCALE: 1" = 500'

DATE: February 13, 2001

SHEET 1 OF 1

REV.:

AREA OF COMPLEX SUBSIDENCE

SEE AREA 1

PROFILE

PROFILE

E 2,116,000

E 2,114,000

E 2,112,000

E 2,110,000

N 358,000

Area 13 Subsidence Profile

North - South

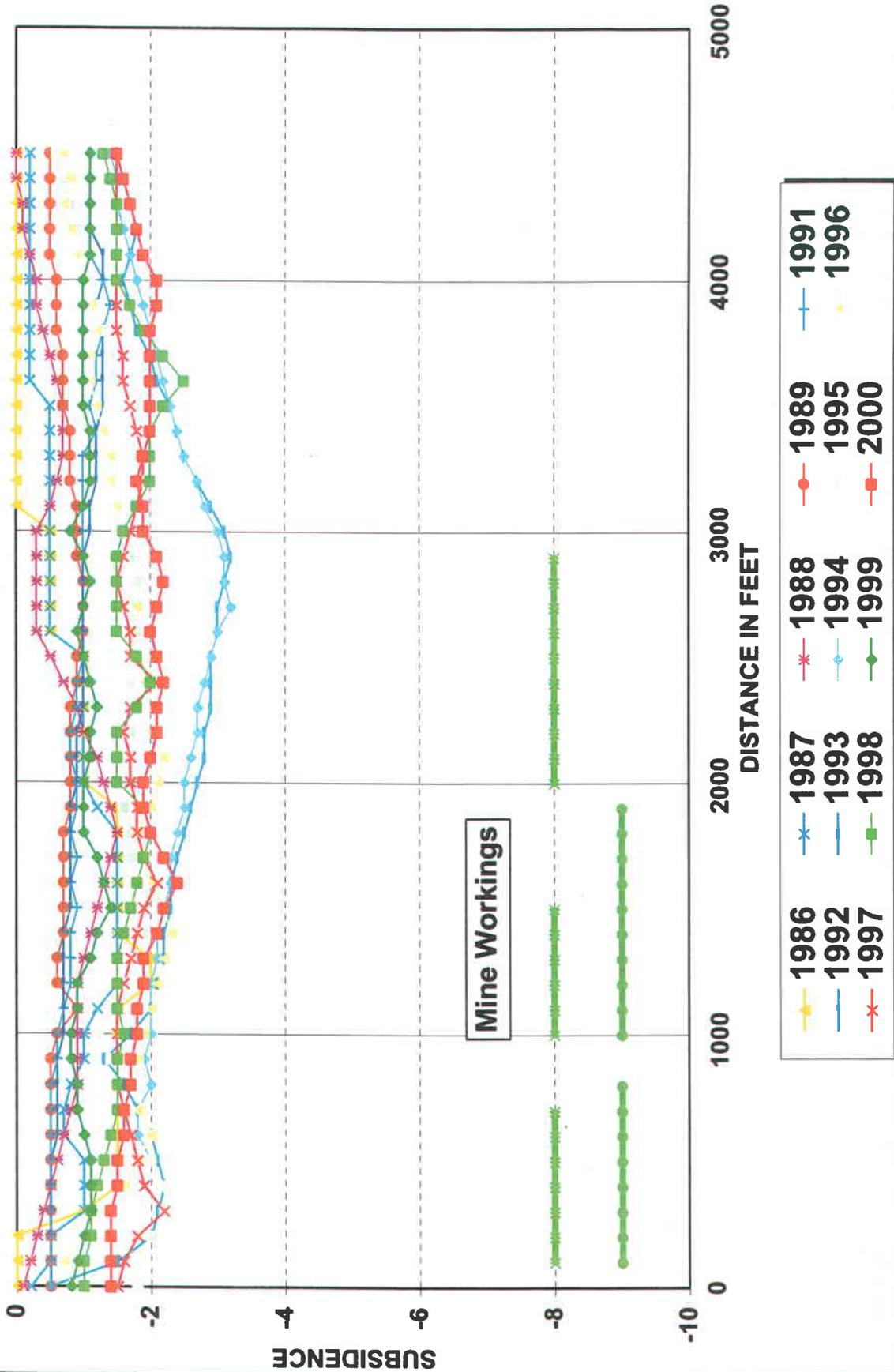


Figure 42

Area 13 Subsidence Profile

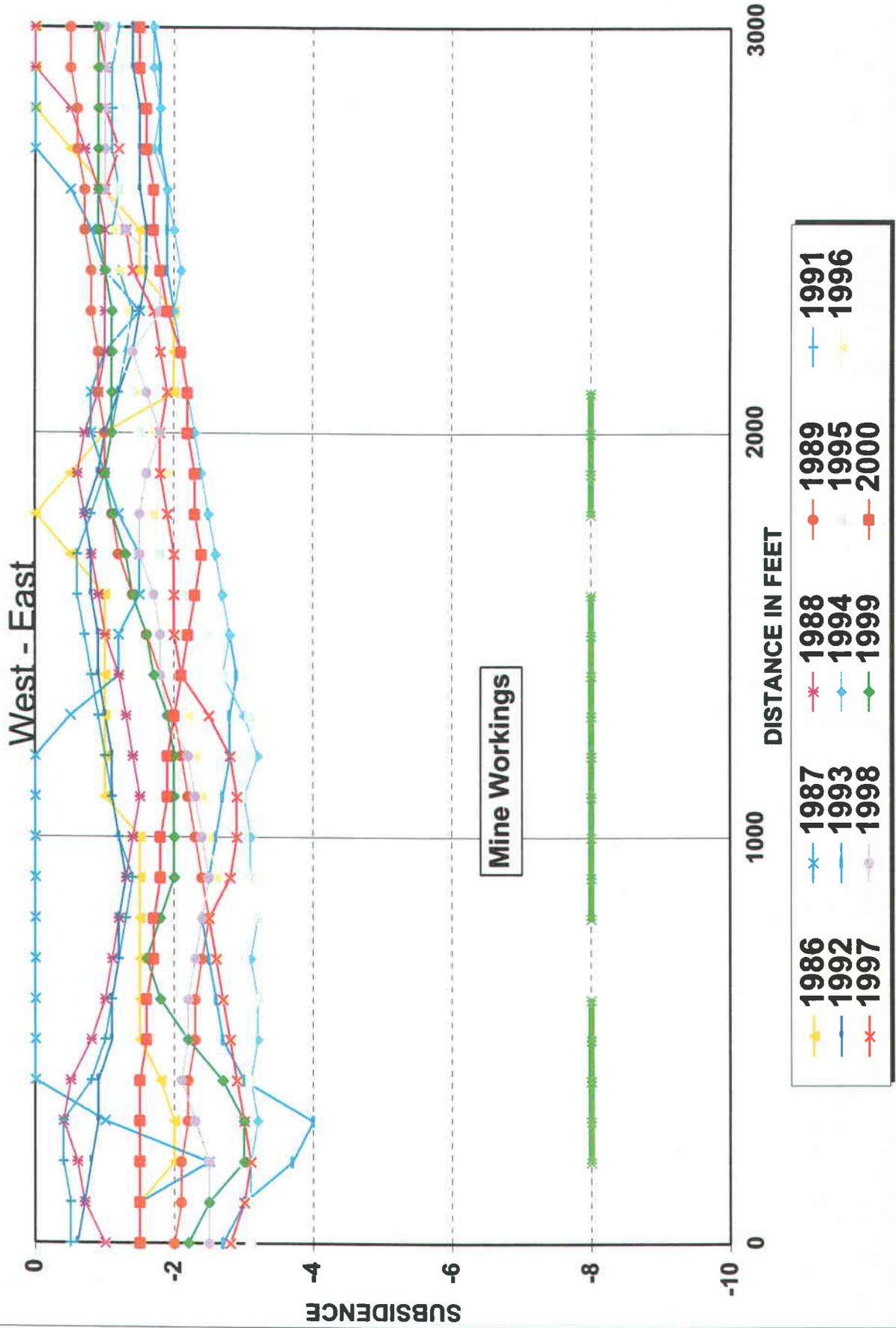


Figure 43

Area 14

Cottonwood 6th and 7th East Longwall Panels

Subsidence in Area 14 was first monitored and detected in 1987. Mining began in the 6th East panel in September 1986 and continued until the panel was completed in March 1987. Mining in the 7th East panel began in April 1987, and the panel was finished in September 1987 (Figure 44).

Topography consists of very steep south facing slopes and cliffs with slopes covered by a few scattered pinon, juniper, mountain brush, and grasses. Overburden ranges from 200 to near 1,400 feet.

The Castlegate Sandstone forms a 200-foot high escarpment along the north side of Newberry Canyon with numerous naturally occurring joints and fractures. Stress caused by removal of coal was transferred to the fractures resulting in brittle failure of the cliff face (spalling) in some places. Talus from the spalling has accumulated on the steep slopes below the cliffs on older natural talus slopes. The newer debris remains mostly above the coal outcrop level and reaches the canyon floor in only one location. Surface cracks have been observed and mapped along the ridge above the cliff. The cracks are discontinuous and extend for approximately 2,000 feet parallel to the northern edge of the 6th East longwall panel. A few cracks are also found directly on top of the Castlegate Sandstone escarpment. Maximum subsidence to date is over seven (7) feet above the western end of the 7th East Longwall Panel and five (5) feet over the eastern end of 6th East along the Pleasant Valley Fault (Figures 45, 46, and 47). Because this area has rugged and steep

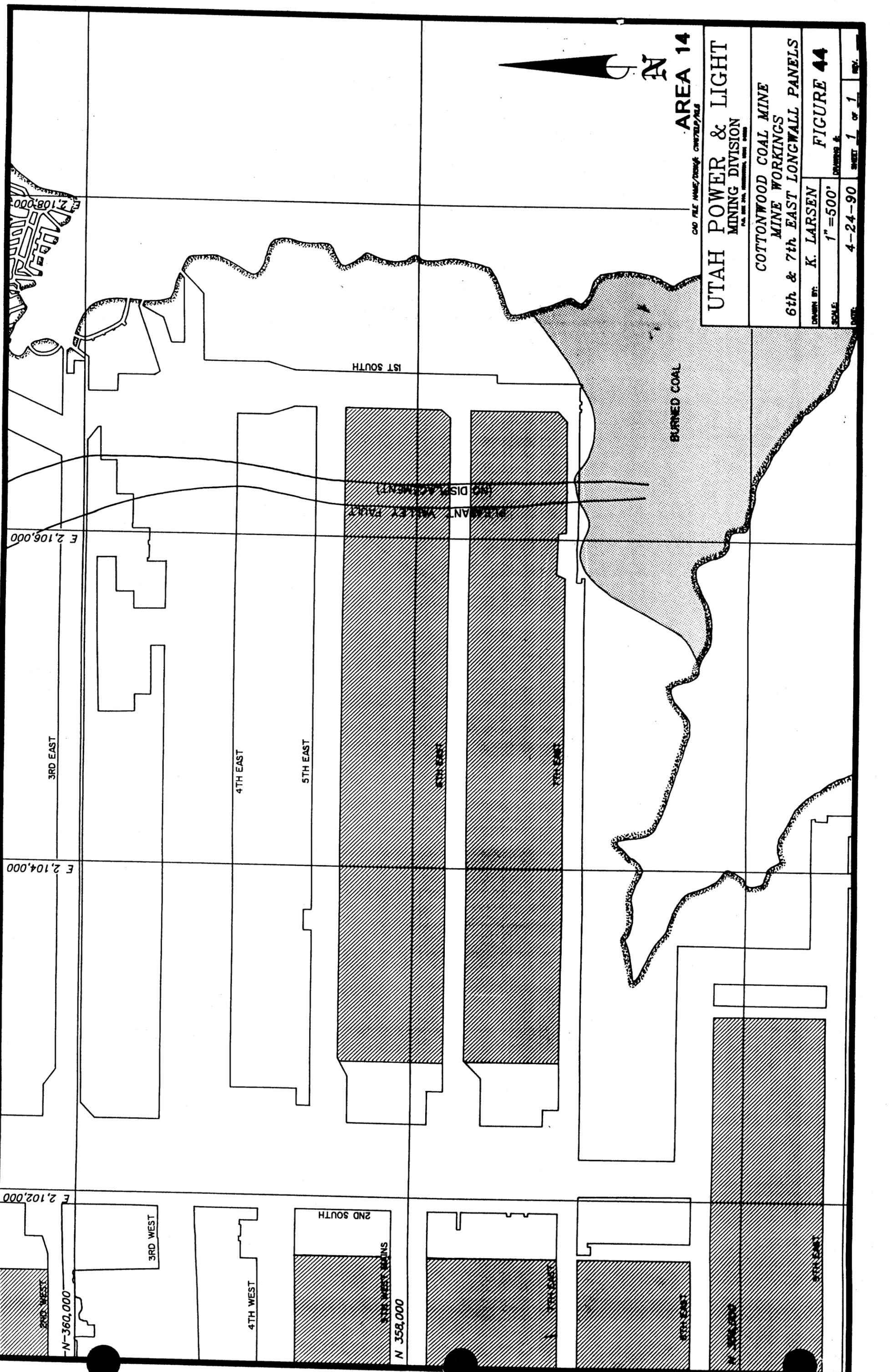
terrain, it is the most difficult to achieve consistent results using the photogrammetric monitoring. As can be seen on the subsidence map (Figure 45) and the profiles (Figures 46 and 47) the subsidence appears to vary substantially from one location to another and change up and down in time. This is because the photogrammetric monitoring is difficult in this type of terrain. The "bulls-eyes" of subsidence shown in 1996 are still present in the 2000 data. The aerial reconnaissance on July 11, 2000 showed no visible indication of change in these areas. It should be expected that inaccuracies in the reading will occur in this area because of the rugged terrain. Several survey targets were established in this area on the Castlegate cliff and have been surveyed since their emplacement from 1996 through 1997. This monitoring shows no changes in the last six years of the monitoring period. The angle-of-draw was not calculated to the west, south and east because of the steep slopes, burned coal, and other workings surrounding the 6th and 7th East panels. The angle of draw on the north side of the 6th East Panel is 25 degrees.

There are no springs in the vicinity of Area 14. The strata are generally dry; thus, mining is expected to have no adverse impact on the hydrology.

Wildlife in the area includes deer, elk, nesting golden eagles in spring and summer, wintering bald eagles, hares, rabbits, grouse, and other species. Grazing cattle can also be found along the ridge top in the summer months.

The major impacts associated with subsidence and resulting cliff failure, surface cracking, and talus deposition in Area 14 are 1) possible loss of golden eagle nests and/or nest sites, 2) disruption of grazing and hunting land use, and 3) loss of wildlife habitat.

Prior to longwall mining in the area an eagle monitoring plan was developed and implemented. It went into effect in February 1986 and is an ongoing program. The purpose of the plan is to collect data whereby the impacts of subsidence and cliff spalling upon eagle nesting can be assessed. The report entitled "Assessment of Mining Related Impacts in Newberry Canyon" submitted to the Utah Division of Oil, Gas and Mining discusses all mining related impacts in Area 14 and includes the eagle monitoring plan as an appendix.



AREA 14

CAD FILE NAME/DESIGN: CWT/2024/PLS

UTAH POWER & LIGHT
MINING DIVISION

COTTONWOOD COAL MINE
MINE WORKINGS
6th & 7th EAST LONGWALL PANELS

DRAWN BY: K. LARSEN
SCALE: 1" = 500'

FIGURE 44
DRAWING &
DATE: 4-24-90
SHEET 1 of 1 REV.

1ST SOUTH

BURNED COAL

STEWART MINE EX. FAULT
(NO DISPLACEMENT)

3RD EAST

4TH EAST

5TH EAST

6TH EAST

7TH EAST

E 2,106,000

E 2,104,000

E 2,102,000

3RD WEST

4TH WEST

2ND SOUTH

5TH WEST WORKINGS

N 358,000

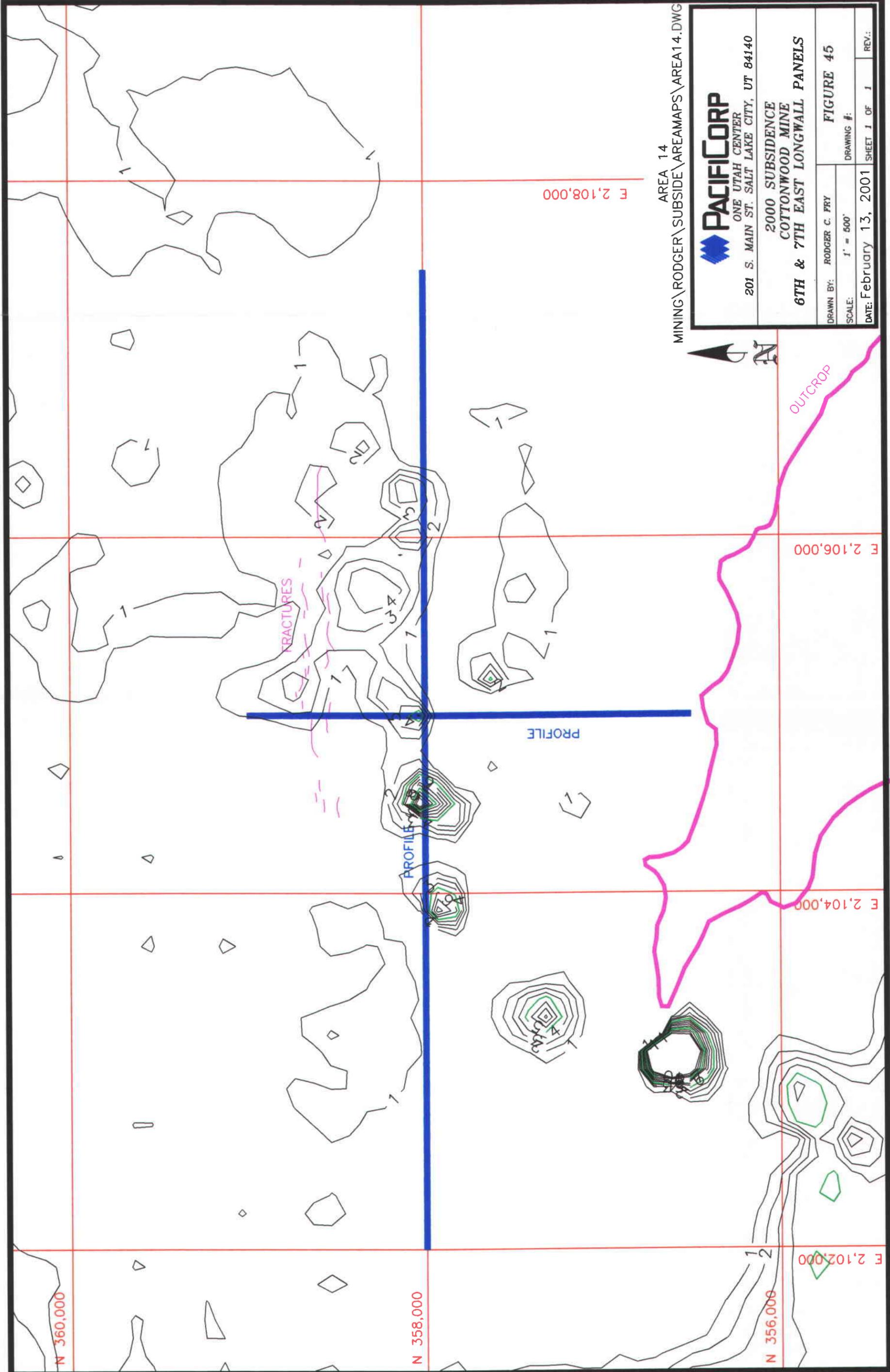
6TH WEST

7TH WEST

6TH EAST

7TH EAST

N-360,000



MINING\RODGER\SUBSIDE\AREAMAPS\AREA14.DWG AREA 14

 PACIFIC CORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140	
2000 SUBSIDENCE COTTONWOOD MINE 6TH & 7TH EAST LONGWALL PANELS	
DRAWN BY: RODGER C. FRY	FIGURE 45
SCALE: 1" = 500'	DRAWING #
DATE: February 13, 2001	SHEET 1 OF 1
REV.:	REV.:

OUTCROP

PROFILE

FRACTURES

PROFILE

N 360,000

N 358,000

N 356,000

E 2,102,000

E 2,104,000

E 2,106,000

E 2,108,000

Area 14 Subsidence Profile

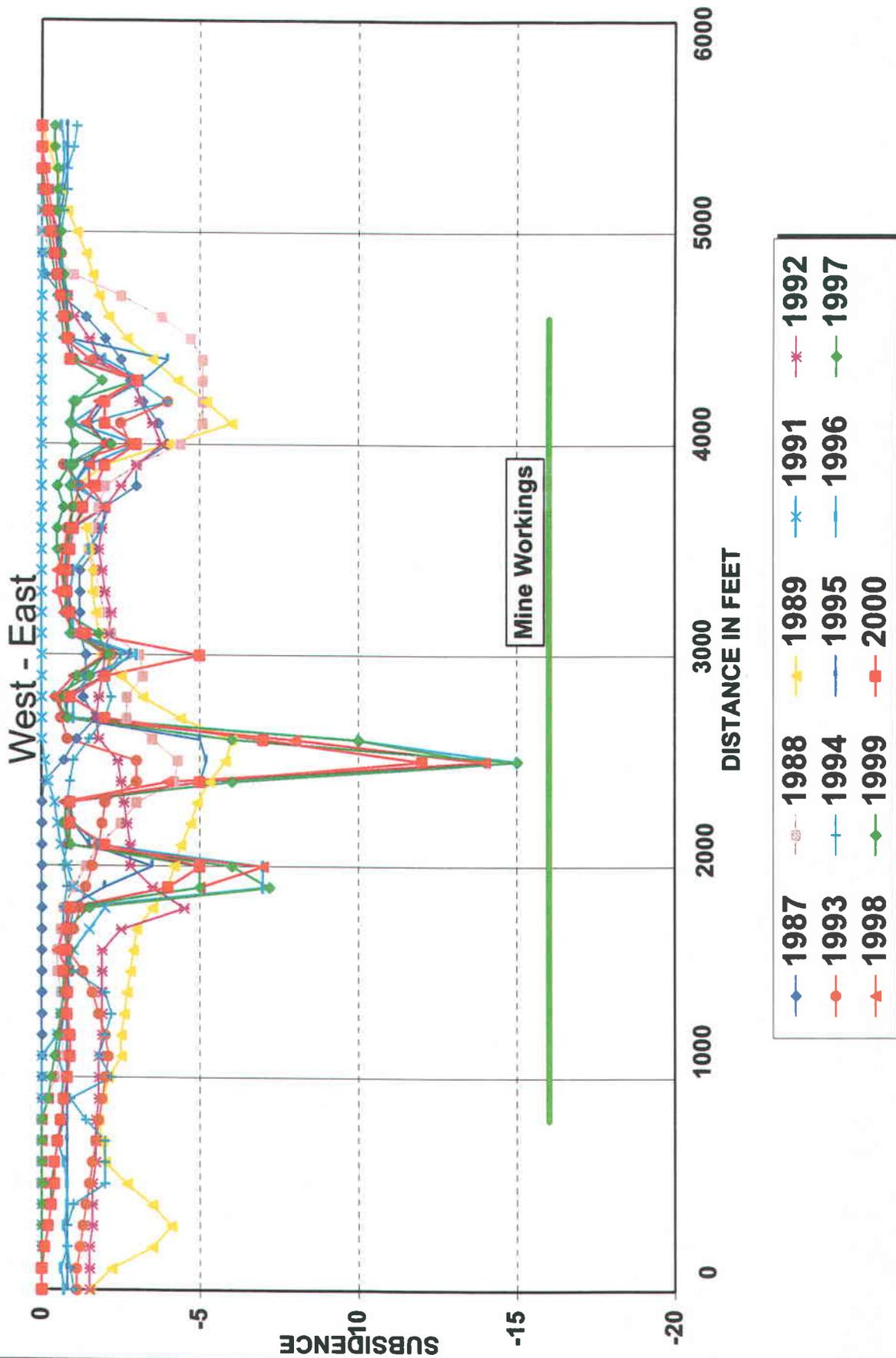


Figure 46

Area 14 Subsidence Profile

North - South

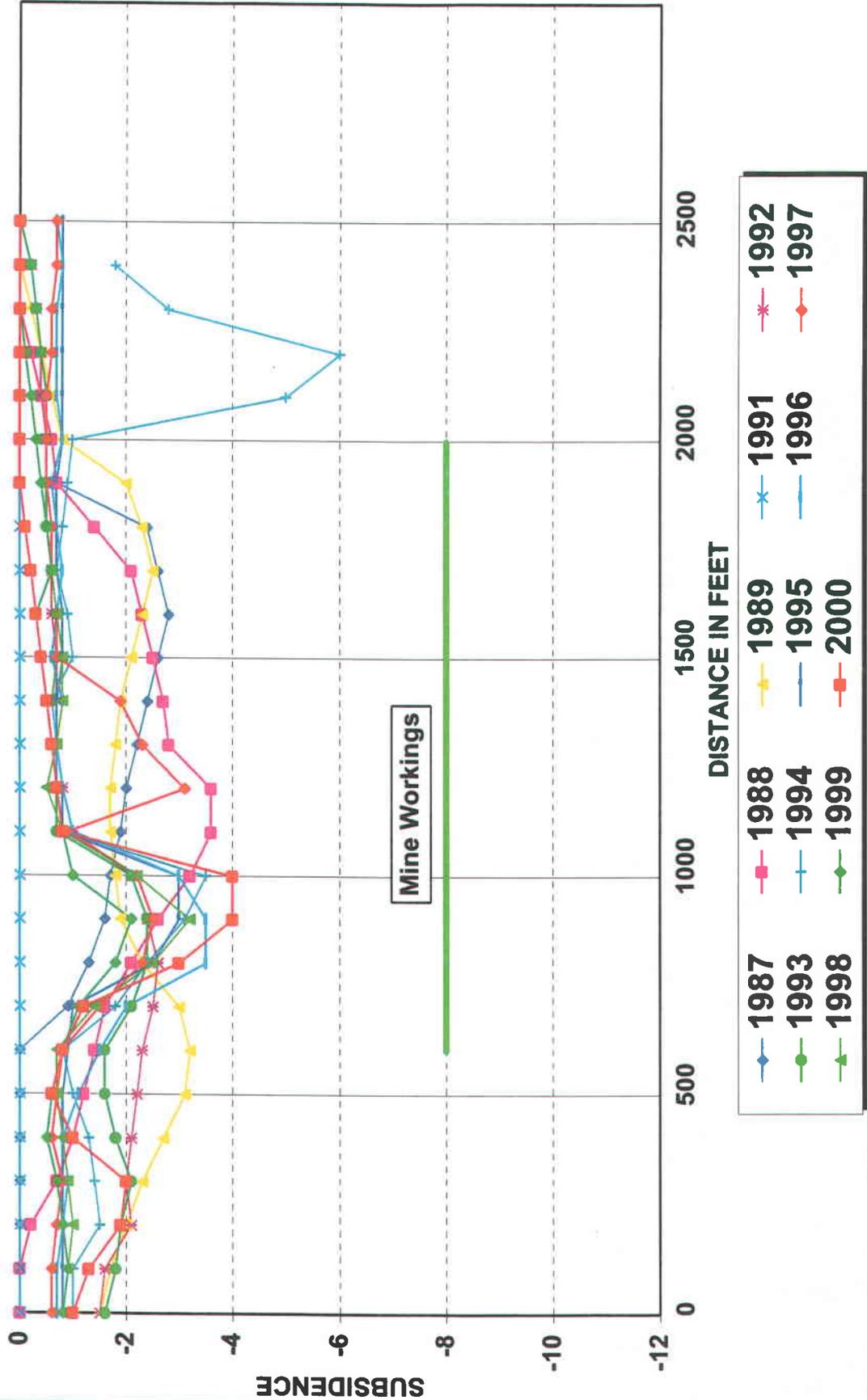


Figure 47

Area 15

Cottonwood 9th and 12th West Longwall Panels

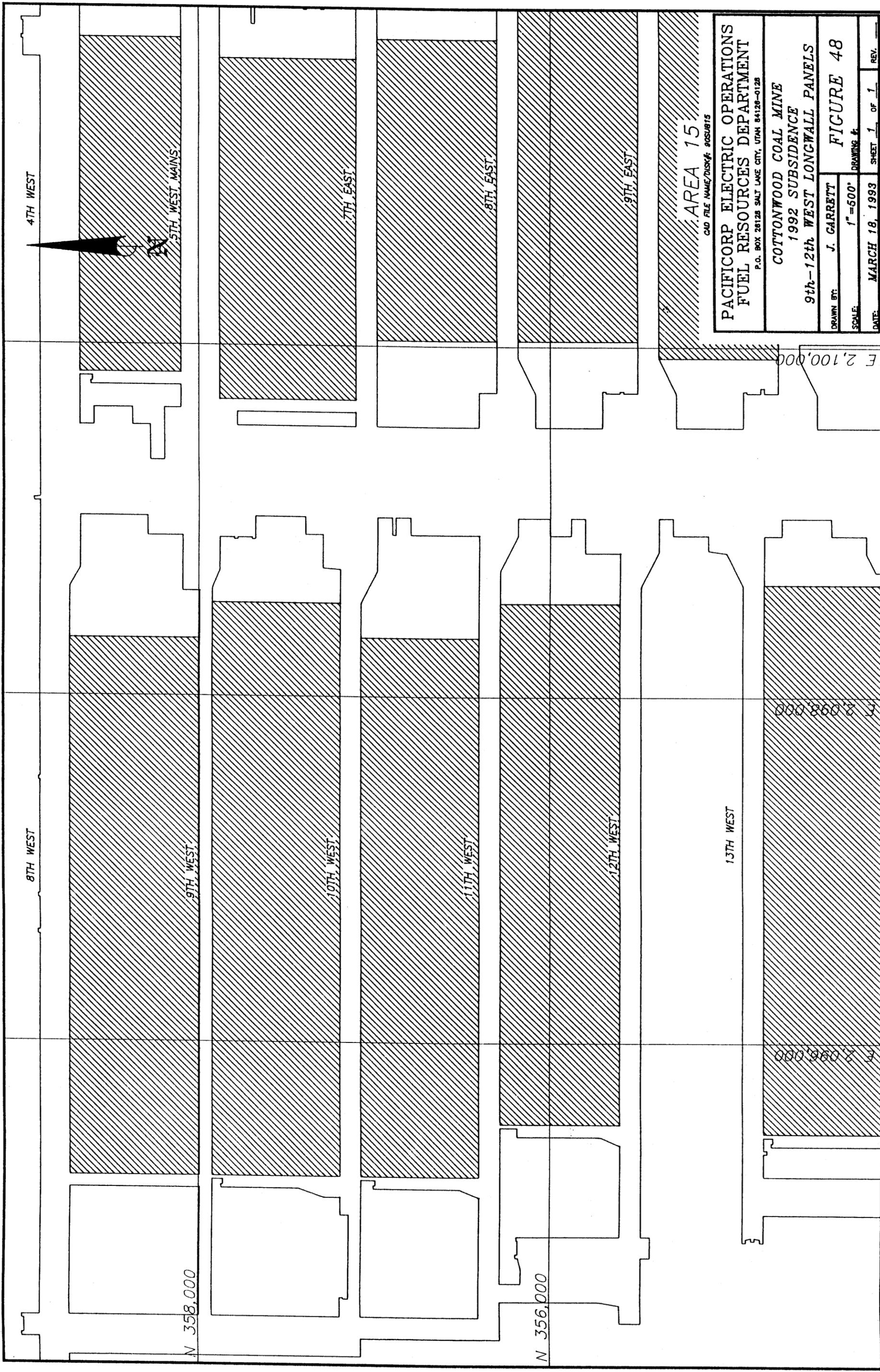
Subsidence in 9th and 10th West was first monitored and detected in 1988 when longwall extraction began there. The 9th through 12th West panels were all completed by the fall of 1989 (Figure 48).

The surface above these panels is comprised mainly of steep to moderate slopes with a small flat area forming the top of East Mountain on the area's eastern edge. Overburden ranges from 800 feet to over 2000 feet.

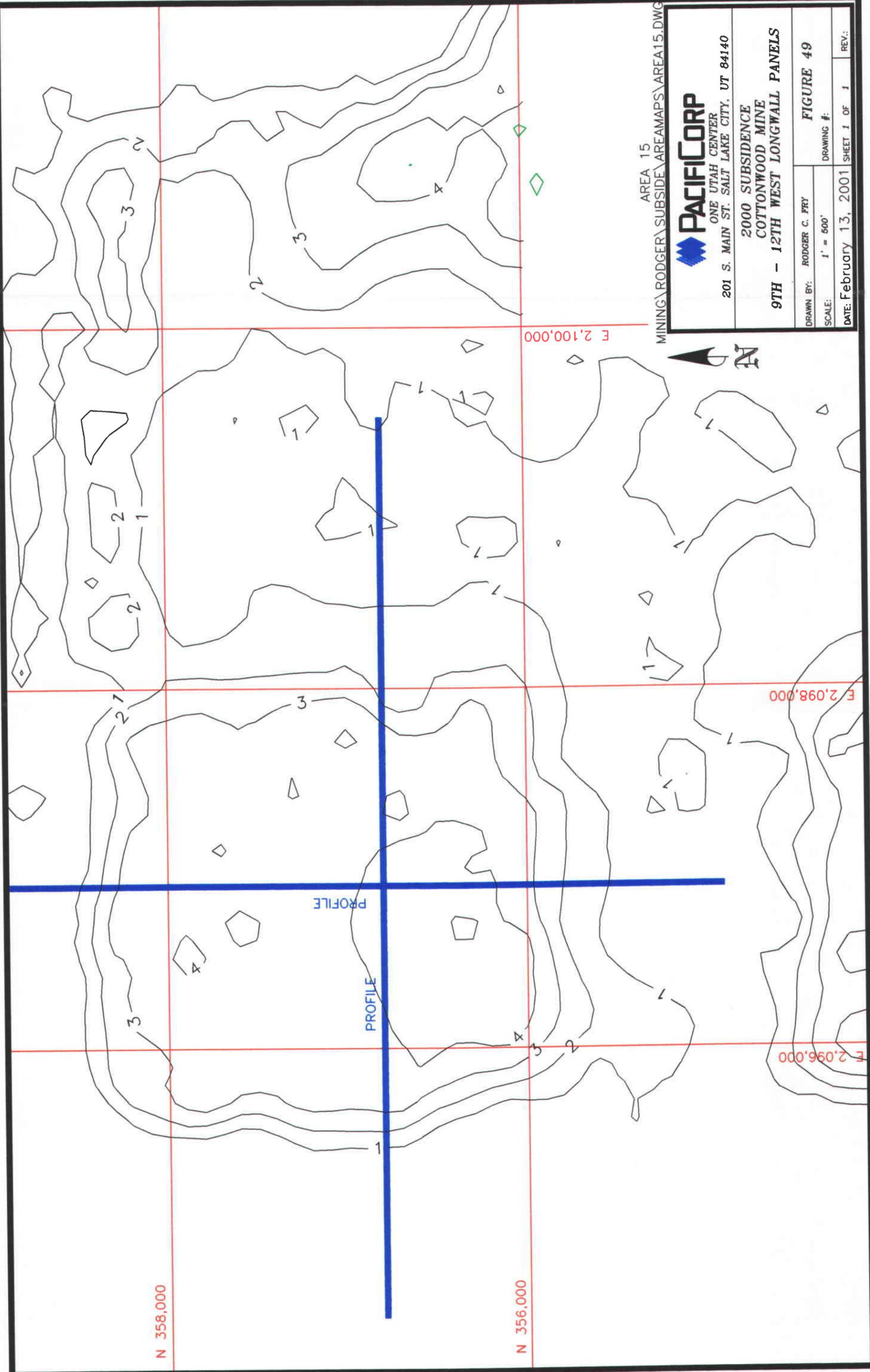
Maximum measured subsidence in 2000 is slightly over four feet which is similar to that which was measured since 1995 above 11th West (Figures 49, 50, and 51). This area has experienced no additional subsidence in the past nine years.

Calculated angle-of-draw is less than zero on the south and east and reaches 20 degrees on the west.

There are no known springs in the area.



CAD FILE NAME/DISK# 905UR15
PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
 P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128
COTTONWOOD COAL MINE
1992 SUBSIDENCE
9th-12th WEST LONGWALL PANELS
 DRAWN BY: J. GARRETT
 SCALE: 1" = 500'
 DATE: MARCH 18, 1993
 DRAWING #:
FIGURE 48
 SHEET 1 OF 1
 REV.



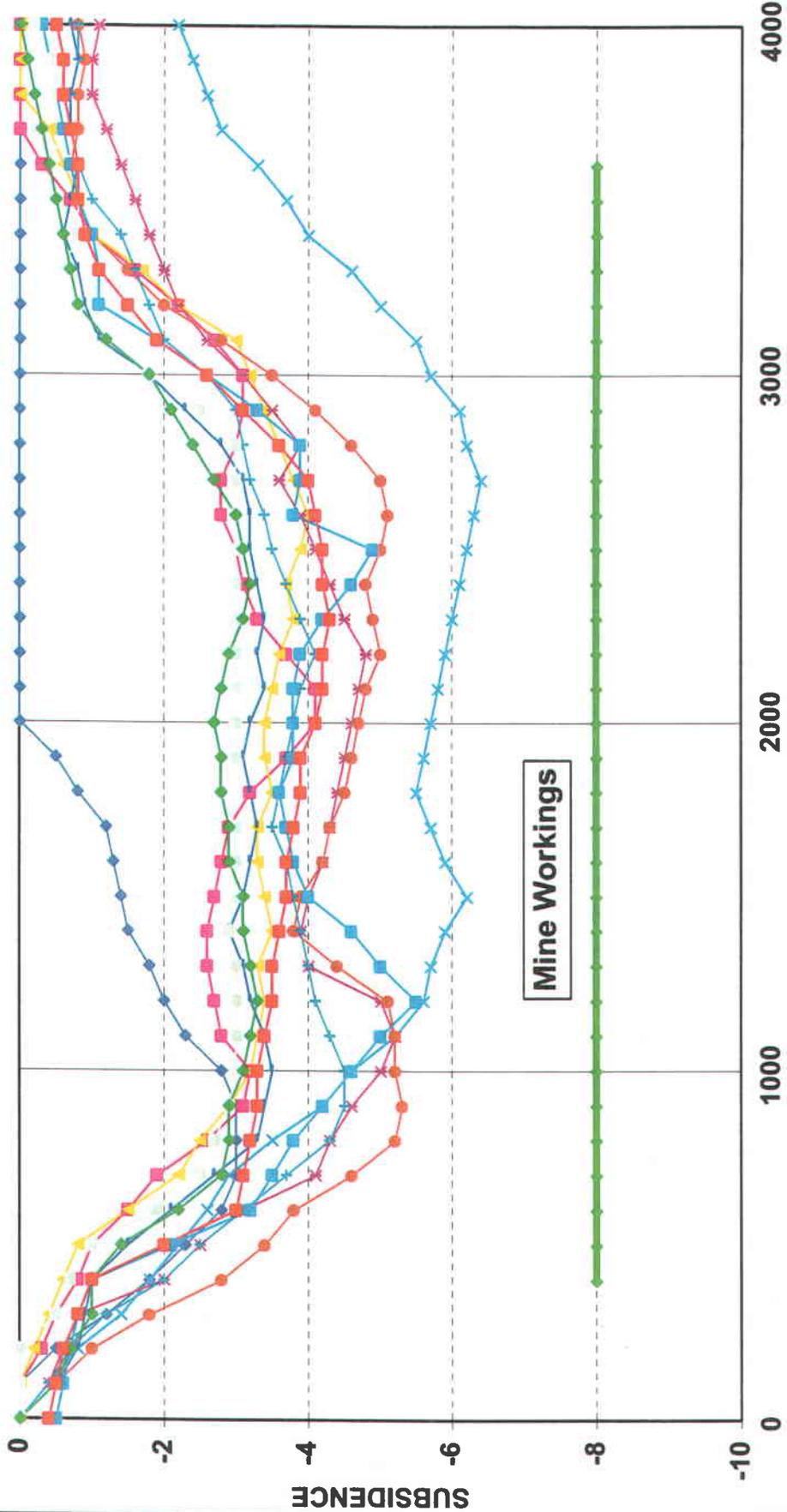
MINING\RODGER\SUBSIDE\AREAMAPS\AREA15.DWG

AREA 15
PACIFIC CORP
 ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140
 2000 SUBSIDENCE
 COTTONWOOD MINE
 9TH - 12TH WEST LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 49
SCALE: 1" = 500'	DRAWING #:
DATE: February 13, 2001	SHEET 1 OF 1
	REV.:

Area 15 Subsidence Profile

North - South



- 1988
- 1989
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000

Figure 50

Area 15 Subsidence Profile

West - East

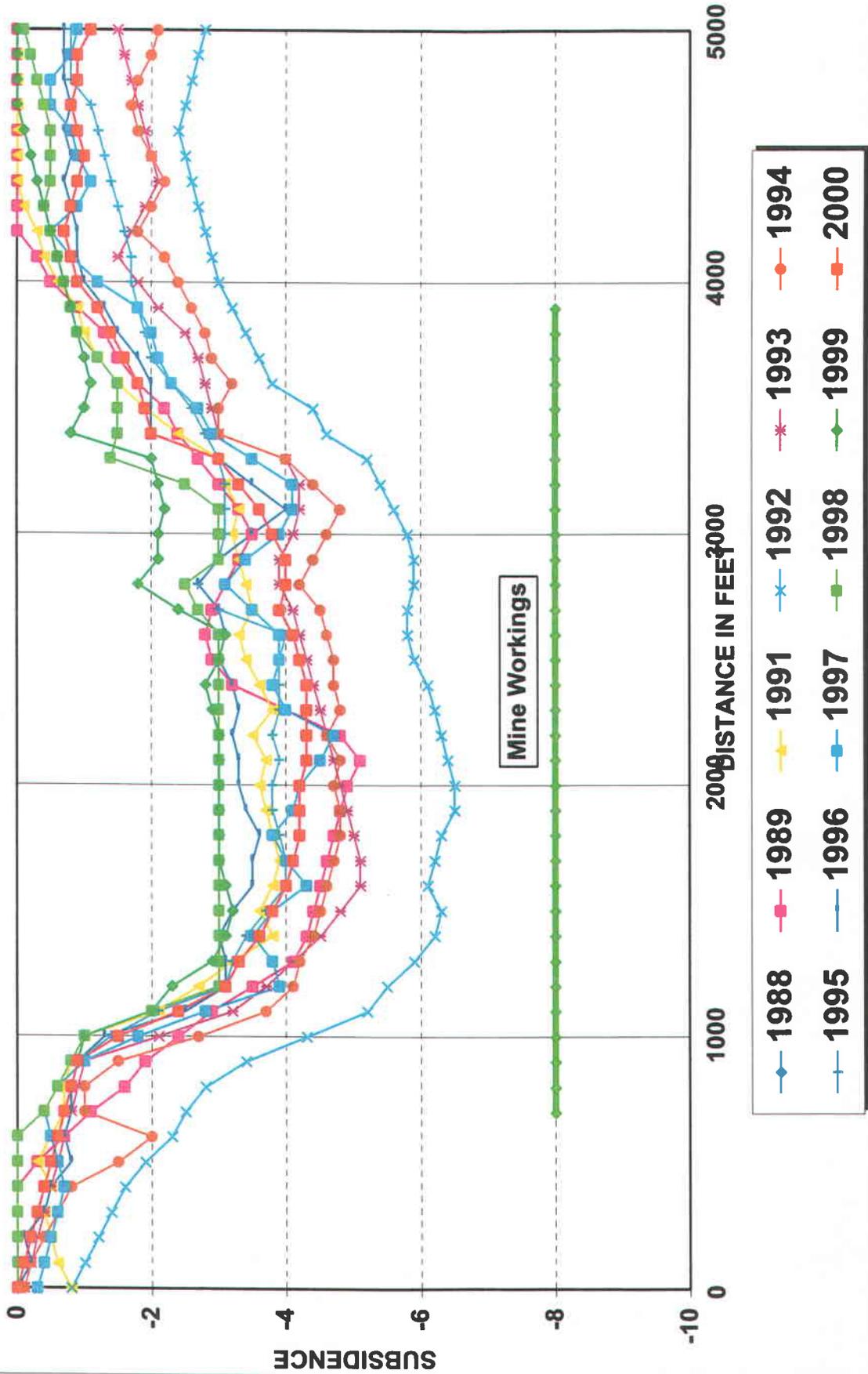


Figure 51

Area 16

Cottonwood 8th Through 11th East Longwall Panels

Mining in Area 16 began in the 8th East panel in June of 1989, and ended in the 8th East panel in May, 1992 (Figure 52).

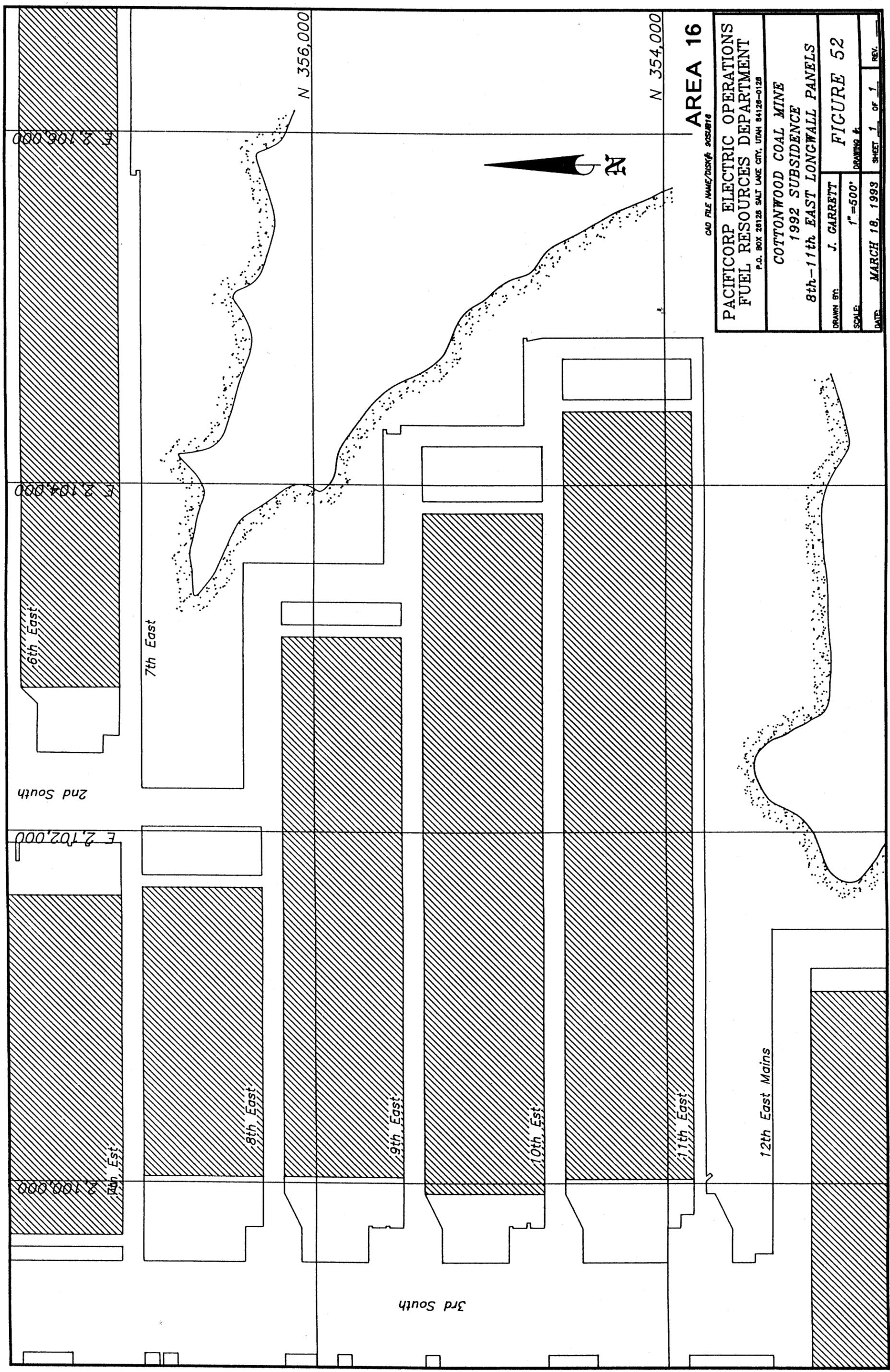
Topography in Area 16 is very similar to that of Area 14 with cliffs and very steep slopes covered by a few scattered pinon, juniper, mountain brush, and grasses. Overburden ranges from near 100 feet at the outcrop to about 1,800 feet.

As with Area 14 cliff spalling has occurred in places and the resulting talus has accumulated on the slopes below the cliffs. No surface cracks have been observed to date.

Maximum subsidence observed in 2000 is similar to the 1997 measurement that exceeded five (5) feet and occurs over the 11th East panel where the overburden is less than 600 feet (Figure 53, 54, and 55). Figure 53 shows several "bulls-eyes" in the area of the Castlegate cliff which are in very steep and rugged areas. The photogrammetric method is not reliable in these areas and it is not felt that the areas have subsided to the extent shown on figure 53. This is supported by the fact that subsidence survey targets placed along the cliff in 1986 have shown no movement in recent years.

The angle-of-draw was not calculated because the steep slopes and other adjacent workings make accurate measurement difficult.

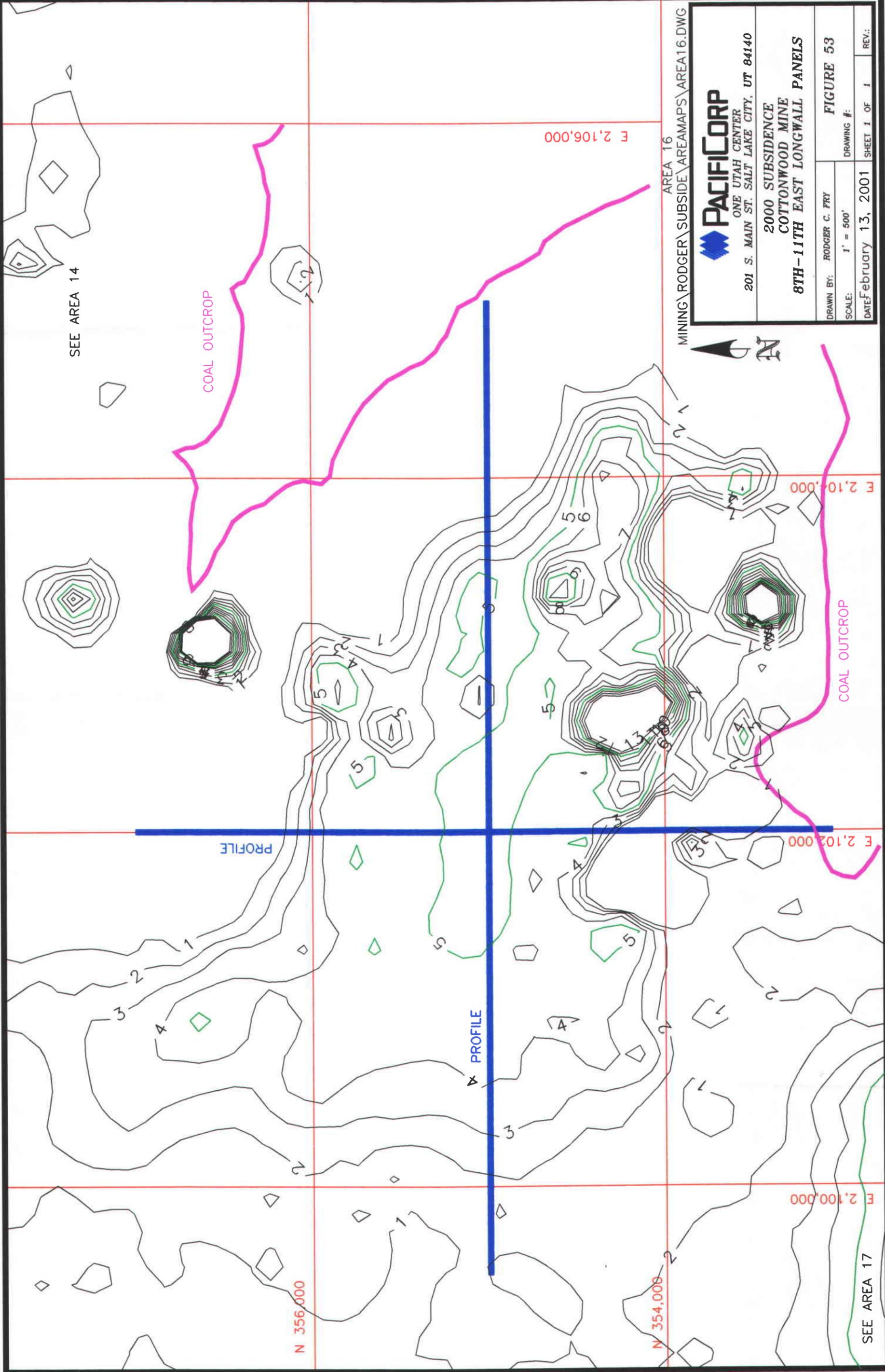
There are no known springs in the area. Strata on both the surface and in underground mine workings are typically very dry; therefore, mining is not expected to affect the hydrology.



AREA 16

CAD FILE NAME/DISK# 905UB16

PACIFICORP ELECTRIC OPERATIONS FUEL RESOURCES DEPARTMENT	
P.O. BOX 26128 SALT LAKE CITY, UTAH 84126-0128	
COTTONWOOD COAL MINE 1992 SUBSIDENCE	
8th-11th EAST LONGWALL PANELS	
DRAWN BY:	J. GARRETT
SCALE:	1" = 500'
DATE:	MARCH 18, 1993
DRAWING #:	FIGURE 52
SHEET	1 OF 1
REV.	



MINING\RODGER\SUBSIDE\AREAMAPS\AREA16.DWG
 AREA 16



ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
 COTTONWOOD MINE
 8TH-11TH EAST LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 53
SCALE: 1" = 500'	DRAWING #:
DATE: February 13, 2001	SHEET 1 OF 1
	REV.:

SEE AREA 17

Area 16 Subsidence Profile

North - South

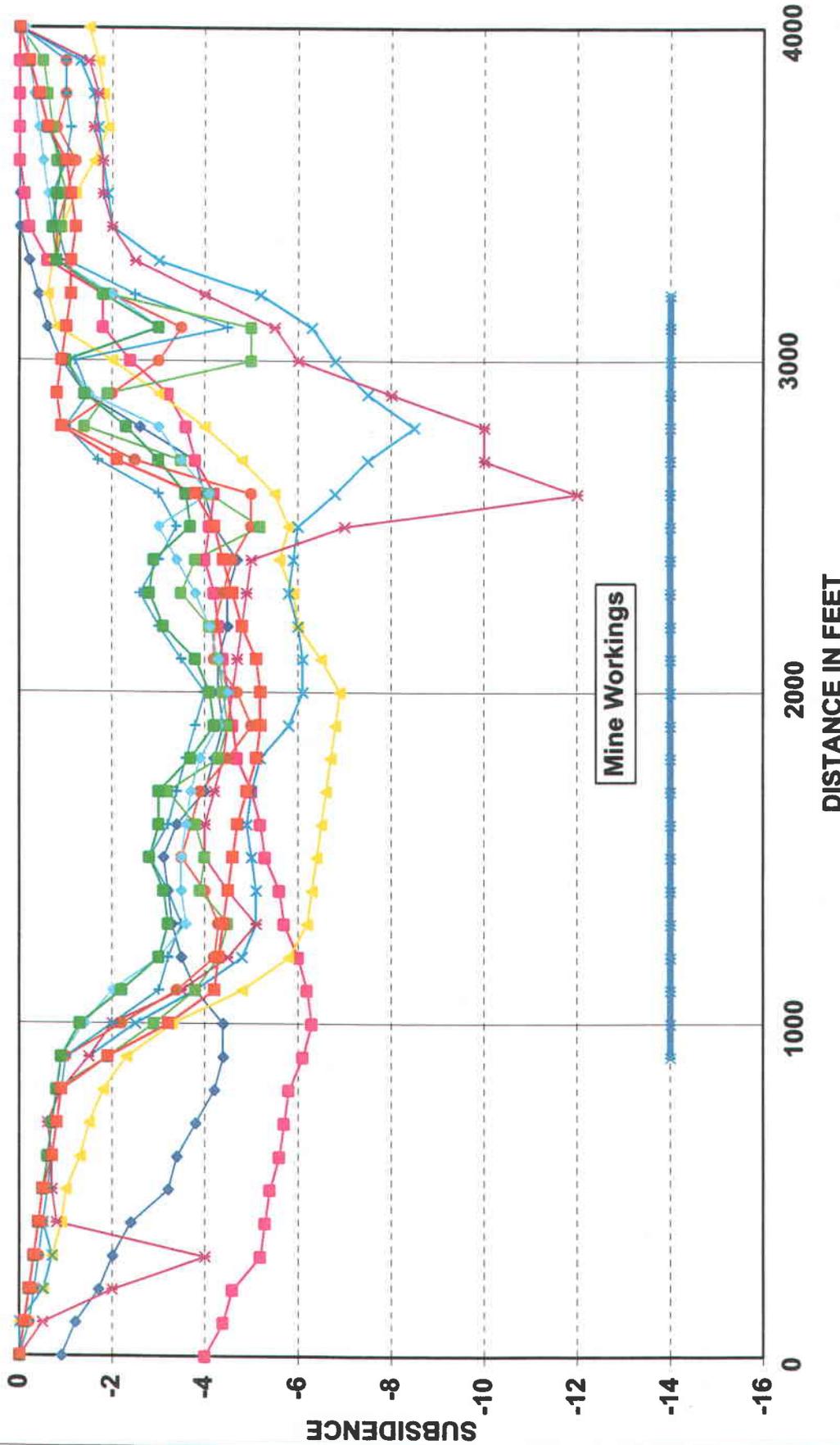


Figure 54

Area 16 Subsidence Profile

West - East

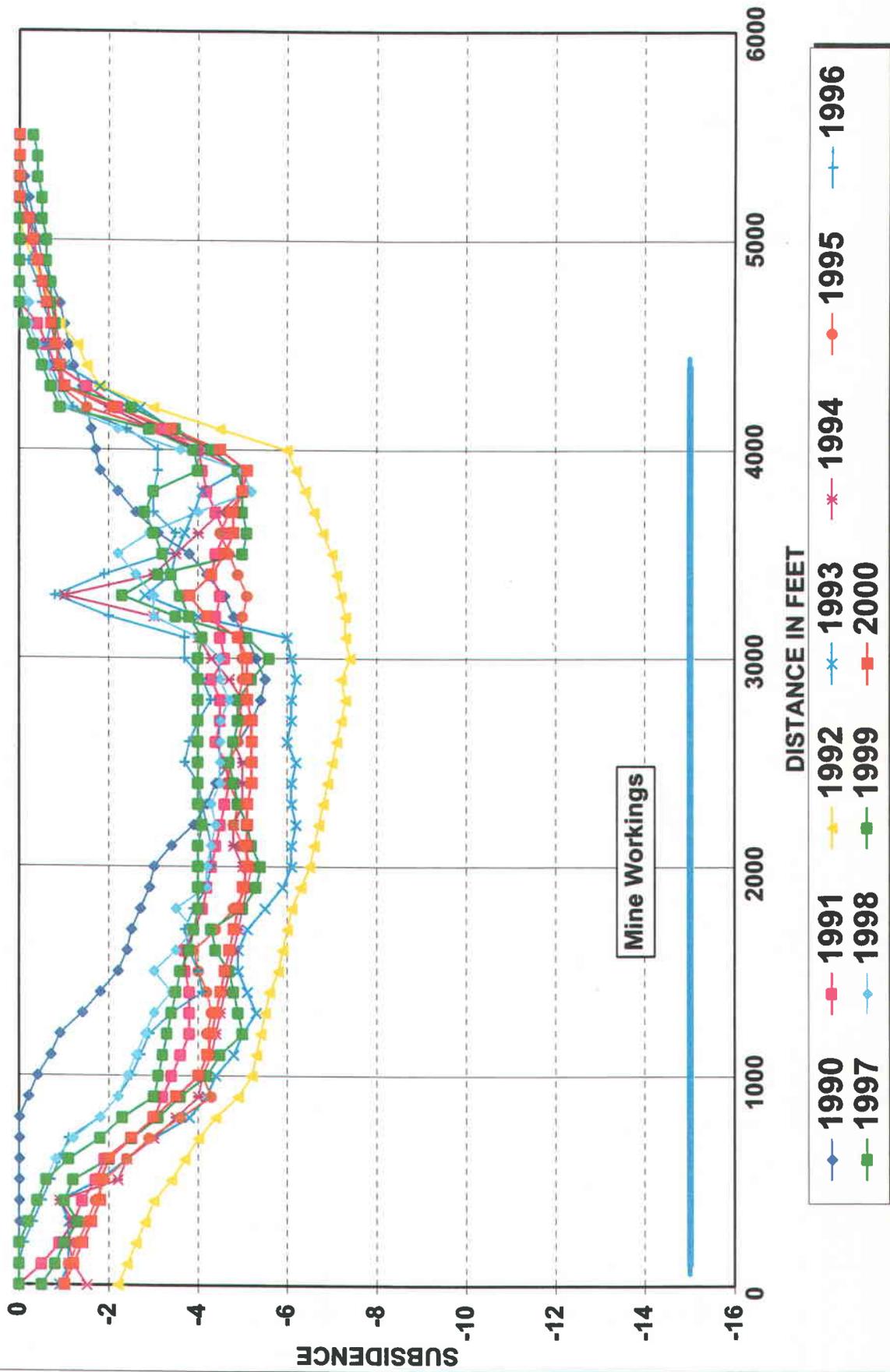


Figure 55

Area 17

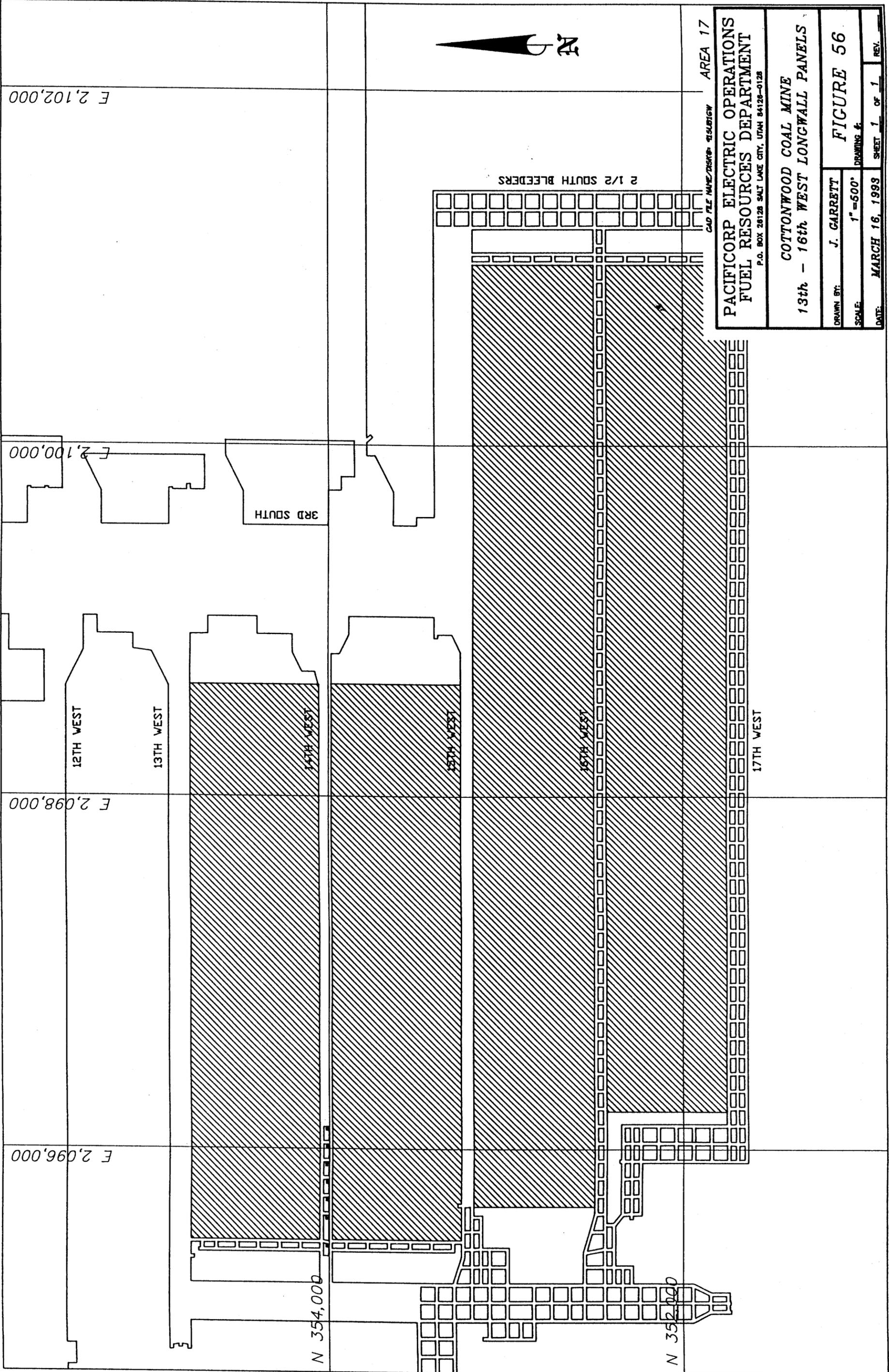
Cottonwood 13th Through 16th West Longwall Panels

Mining in the 16th West longwall panel began in October 1990 and the panel was completed in March 1991. Mining in the area was finished in March, 1992 with the completion of the 13th West longwall panel (figure 56). The topography over these longwall panels is characterized by steep slopes covered with conifer and aspen trees which extend up from the cliffs which surround the east, south and west sides of the panels. The panels are covered by overburden ranging from 800 feet at both the west and east end of the panels to over 1,800 feet in the center of the panels.

The measured subsidence exceeds seven (7) feet in an area above the 16th west panel, which is similar to the measurements, made in the past five years. The subsidence zone follows a narrow east-west trending trough centered above the two longer panels and then extends north above the 14th and 13th west longwall panels (figures 57, 58, and 59). No surface fractures have been observed in the area above these longwall panels. Subsidence in this area has been stable for over eight years.

On the south side of the subsidence zone, the angle of draw is less than 10 degrees.

No springs are located above this area and the strata is not saturated. Therefore, it is not likely that this subsidence will have any effect on the hydrology of the area.



AREA 17

CAD FILE NAME/DISK# 415L01G1W

PACIFICORP ELECTRIC OPERATIONS
 FUEL RESOURCES DEPARTMENT

COTTONWOOD COAL MINE
 13th - 16th WEST LONGWALL PANELS

DRAWN BY: J. GARRETT

SCALE: 1" = 500'

DATE: MARCH 16, 1993

FIGURE 56

DRAWING #

SHEET 1 OF 1

REV.

17TH WEST

16TH WEST

15TH WEST

14TH WEST

13TH WEST

12TH WEST

3RD SOUTH

2 1/2 SOUTH BLEEDERS

E 2,102,000

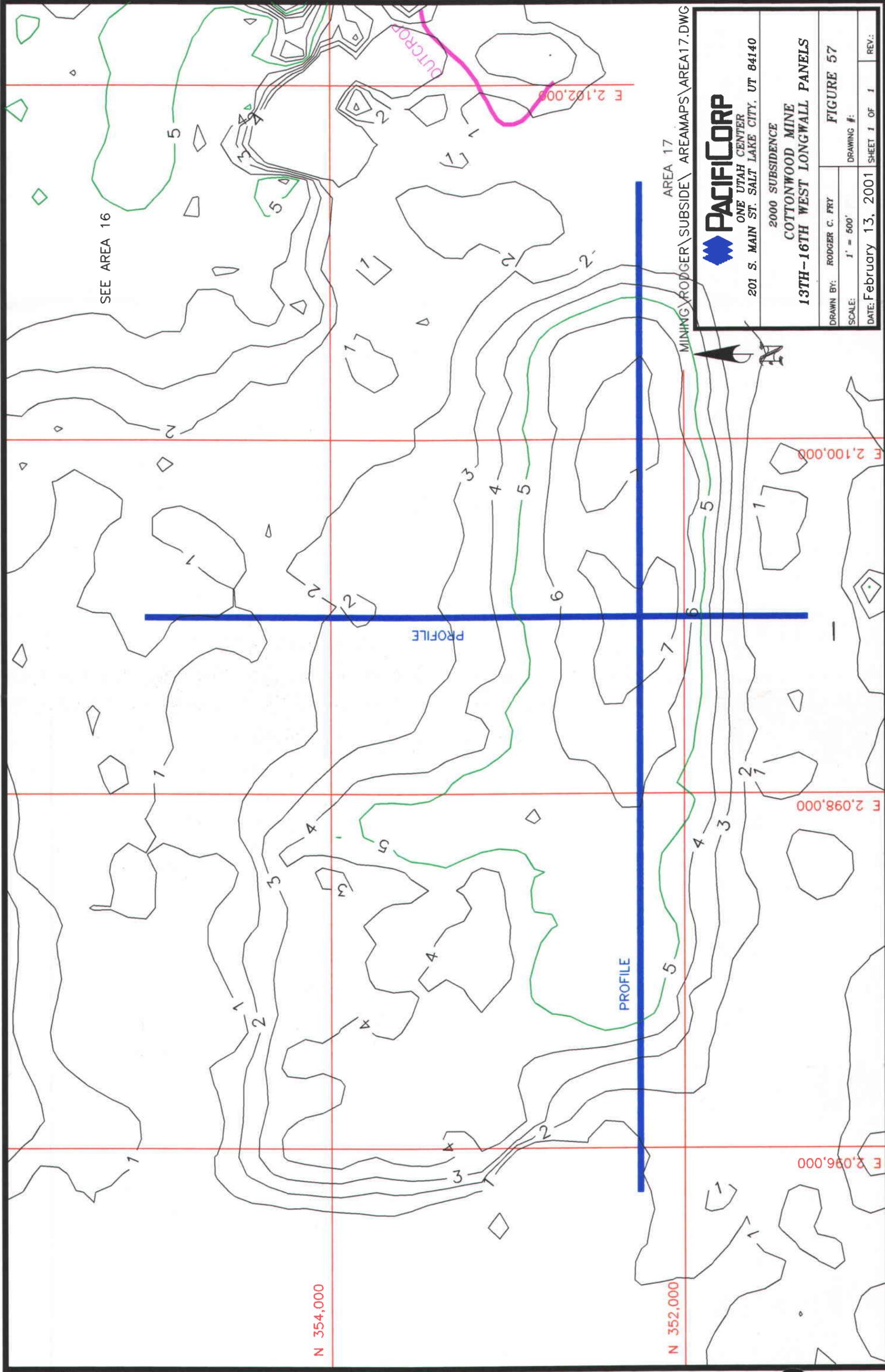
E 2,100,000

E 2,098,000

E 2,096,000

N 354,000

N 352,000



AREA 17
 MINING\RODGER\SUBSIDE\ AREAMAPS\AREA17.DWG

 PACIFIC CORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140	
2000 SUBSIDENCE COTTONWOOD MINE 13TH-16TH WEST LONGWALL PANELS	
DRAWN BY: RODGER C. FRY	FIGURE 57
SCALE: 1" = 500'	DRAWING #:
DATE: February 13, 2001	SHEET 1 OF 1
REV.:	

SEE AREA 16

PROFILE

PROFILE

N 354,000

N 352,000

E 2,096,000

E 2,098,000

E 2,100,000

E 2,102,000

OUTCROP

Area 17 Subsidence Profile

West - East

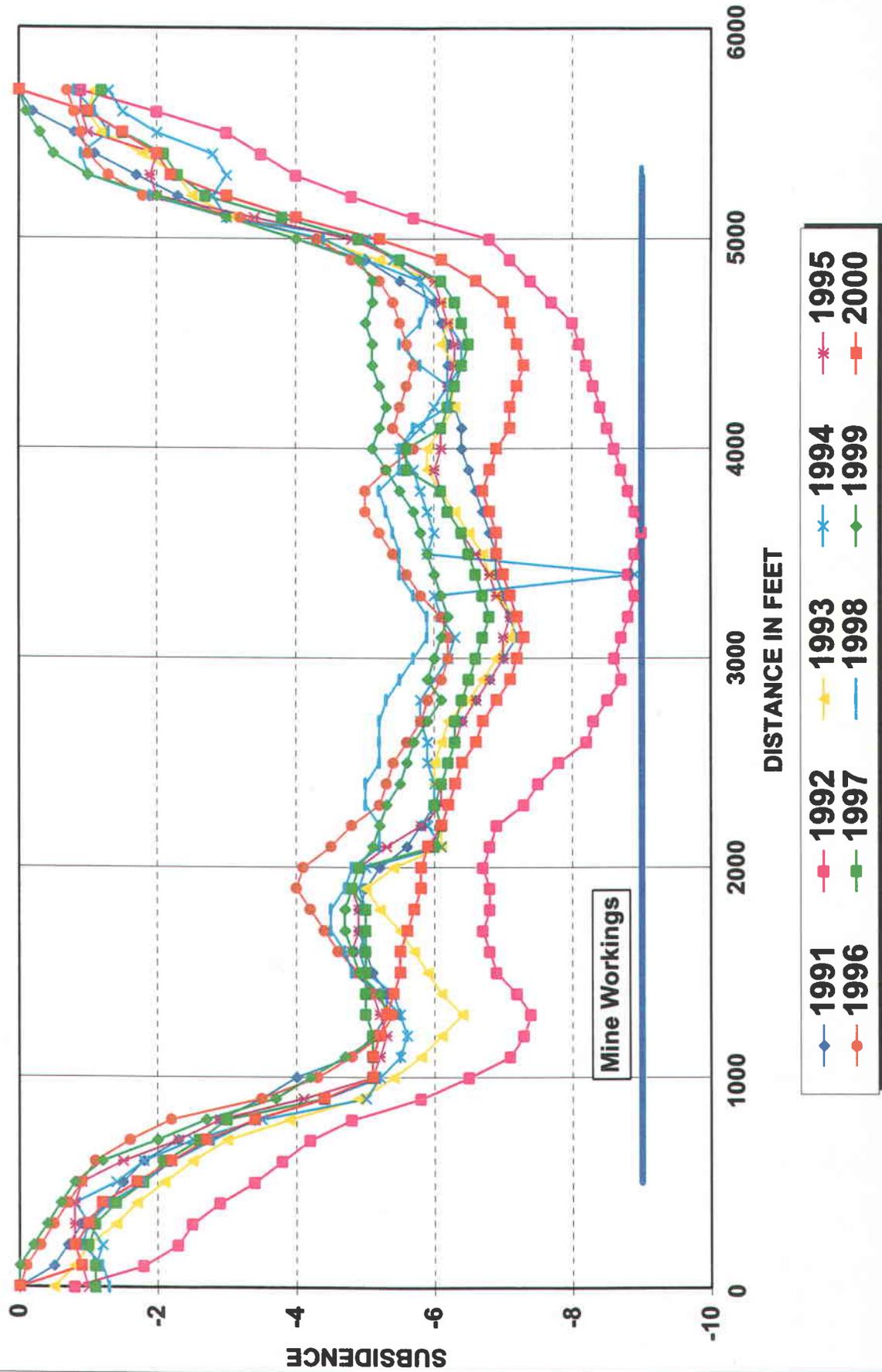


Figure 58

Area 17 Subsidence Profile North - South

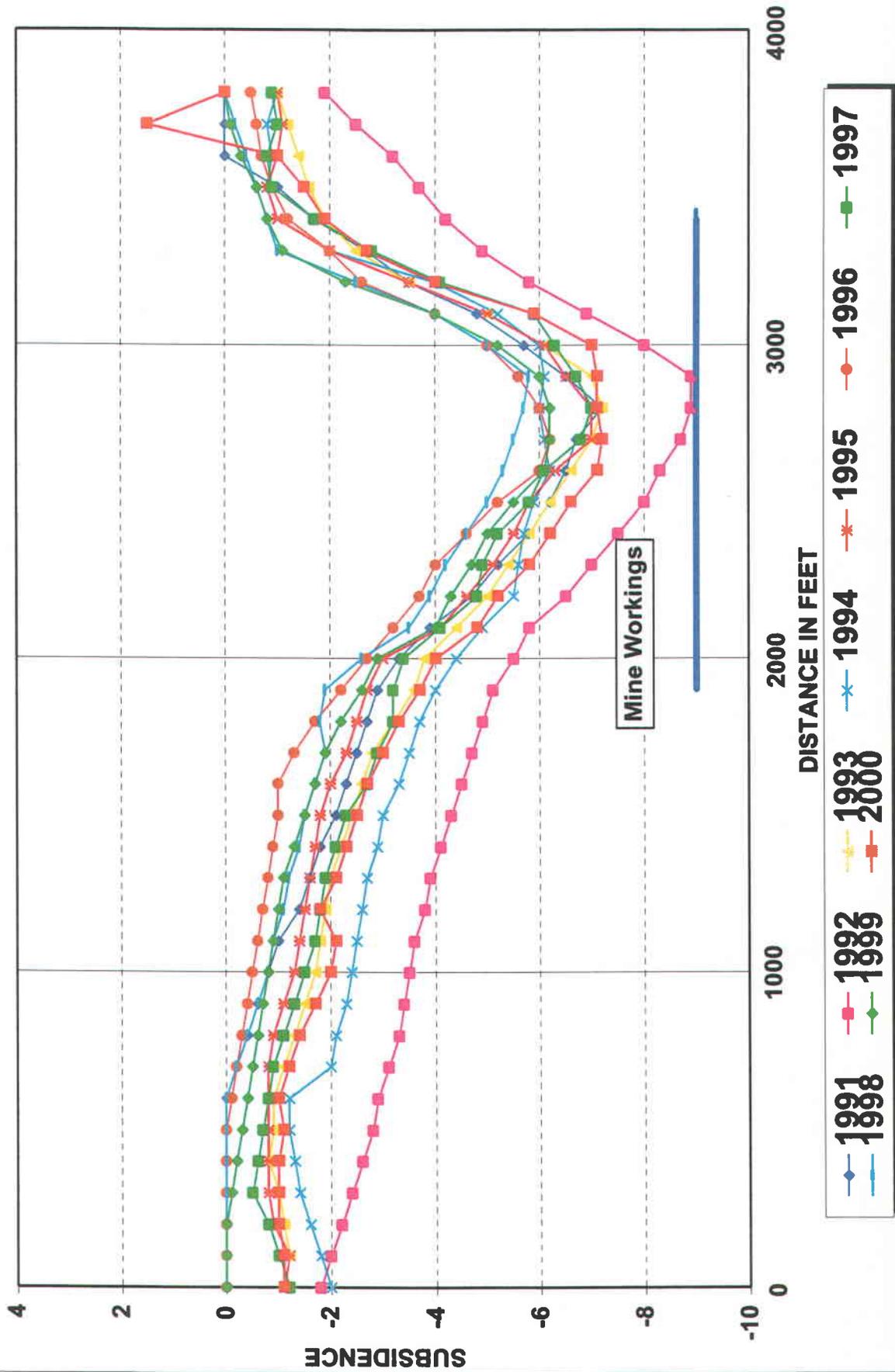


Figure 59

Area 18

Deer Creek Mine 2nd through 7th Right Longwall Panels

Longwall mining in this area was completed in May, 1992 with the extraction of six adjacent longwall panels (figure 60). The 3rd and 4th Right panels were terminated short of the entire panel due to geologic complications. The land surface in the area of these panels contains steep slopes covered by conifer and aspen trees, and sagebrush. The longwall panels have overburden ranging from 1,800 feet on the west end of the panels to 2,000 feet on the east side of the panels.

Subsidence in this area has reached a maximum of over six (6) feet, which is slightly less than measured in 1997 but similar to the 1998 and 1999 measurements (Figures 61, 62, and 63). The subsidence zone is a broad trough running in a north - south direction. This area is overlain by several springs. Monitoring of these springs has shown no change in the quality or quantity of water discharged from them (see appendix and the 2000 Hydrologic Monitoring report).

ROANS CANYON FAULT

FIRST RIGHT

SECOND RIGHT

THIRD RIGHT

PROFILE

FOURTH RIGHT

FIFTH RIGHT

SIXTH RIGHT

SEVENTH RIGHT

N 378,000

N 374,000

N 372,000

N 370,000

4TH SOUTH

E 2,096,000

E 2,092,000

E 2,094,000



CAD FILE NAME/DISK#: 91SUB7R AREA 18

PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128

DEER CREEK MINE
2nd-7th RIGHT LONGWALL PANELS

DRAWN BY: J. GARRETT

FIGURE 60

SCALE: 1"=500'

DRAWING #:

DATE: MARCH 16, 1993

SHEET 1 of 1

E 2,092,000

E 2,094,000

N 370,000

E 2,096,000

N 372,000

N 374,000

N 376,000

DATE: February 13, 2001	SCALE: 1" = 600'
SHEET 1 OF 1	DRAWING #: FIGURE 61
REV:	DRAWN BY: RODGER C. FRY

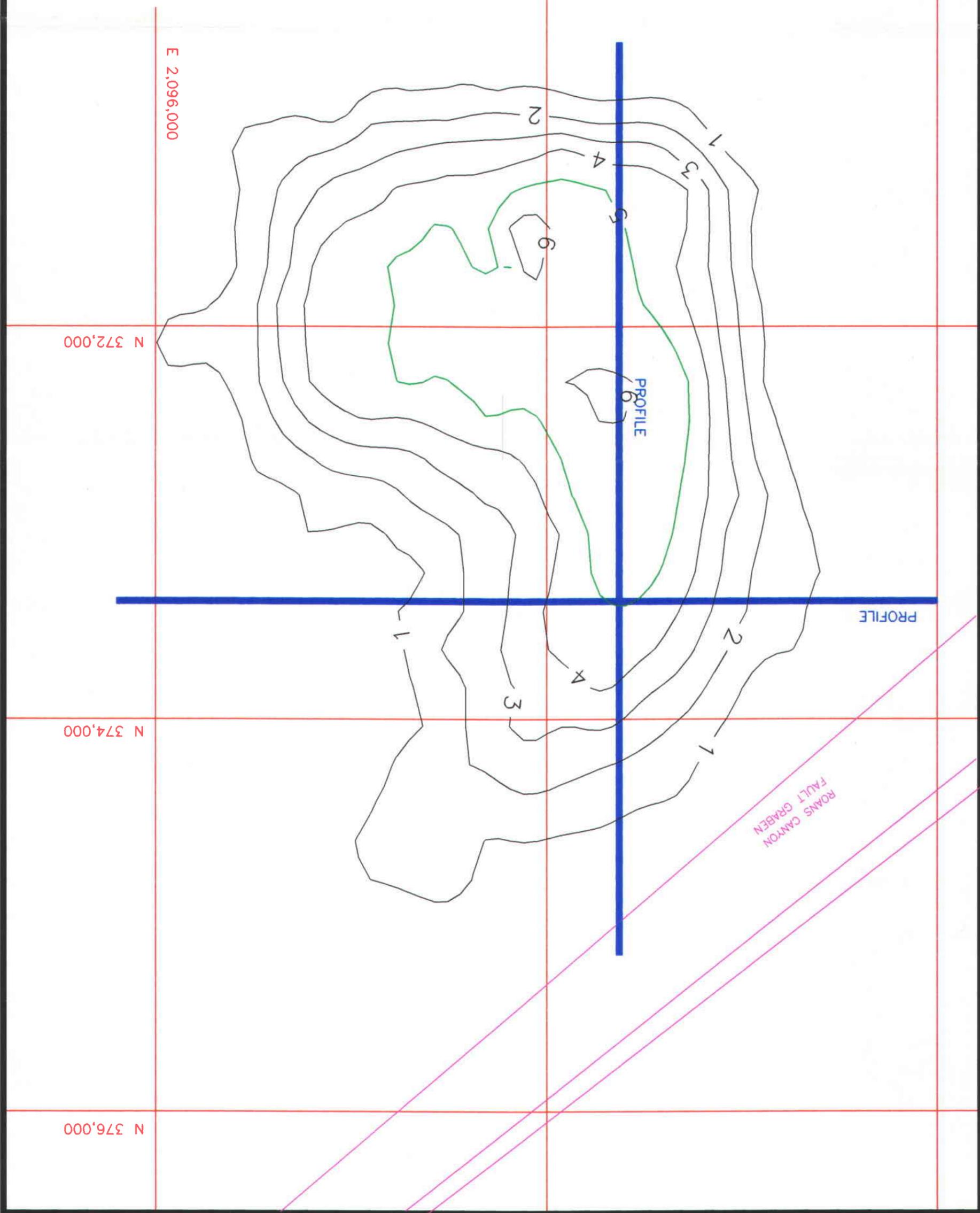
2000 SUBSIDENCE
DEER CREEK MINE
2ND-7TH RIGHT LONGWALL PANELS

ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

PACIFICORP



MINING\RODGER\SUBSIDE\AREAMAPS\AREA18.DWG
AREA 18



Area 18 Subsidence Profile

North - South

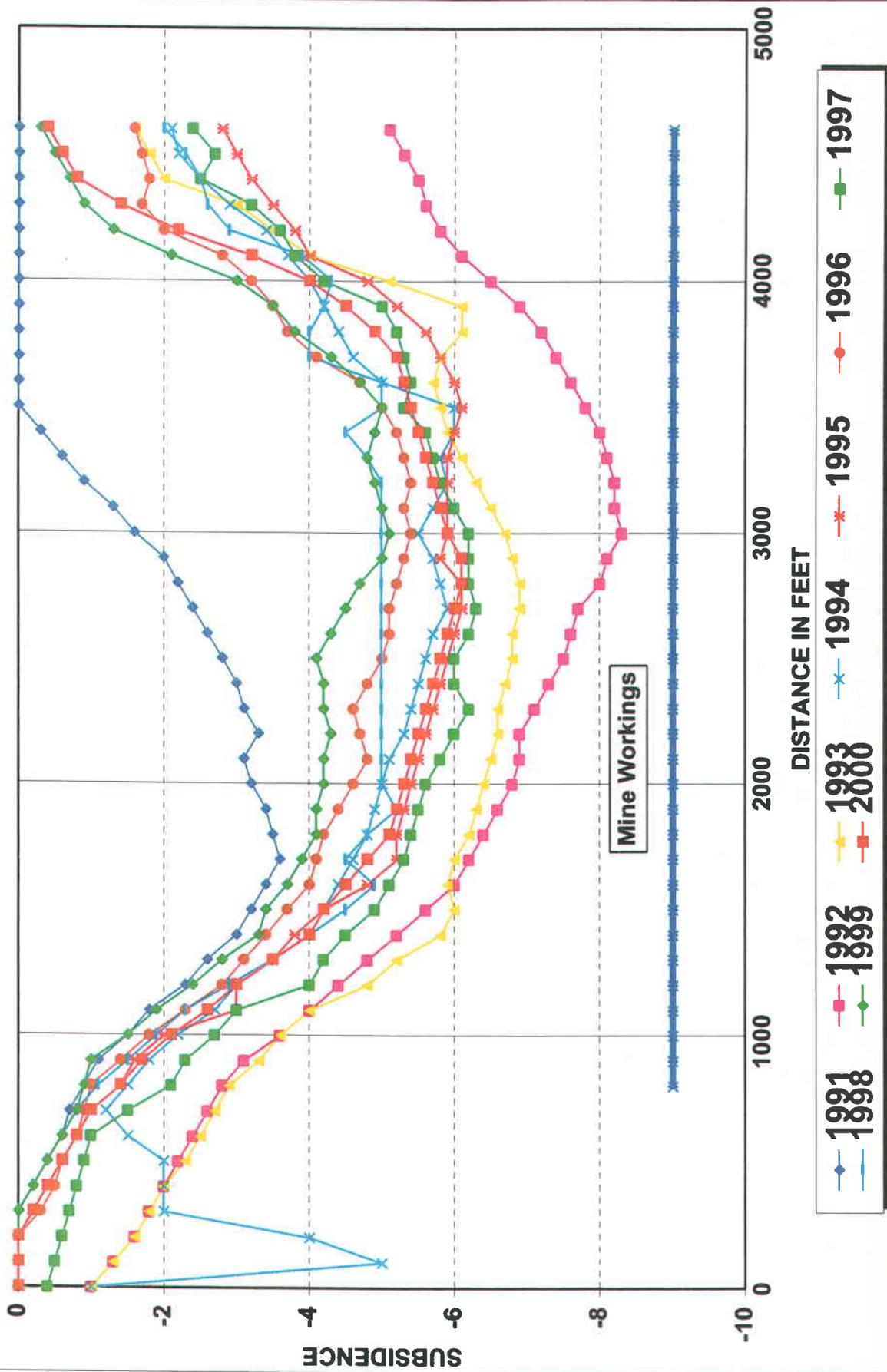


Figure 62

Area 18 Subsidence Profile

West - East

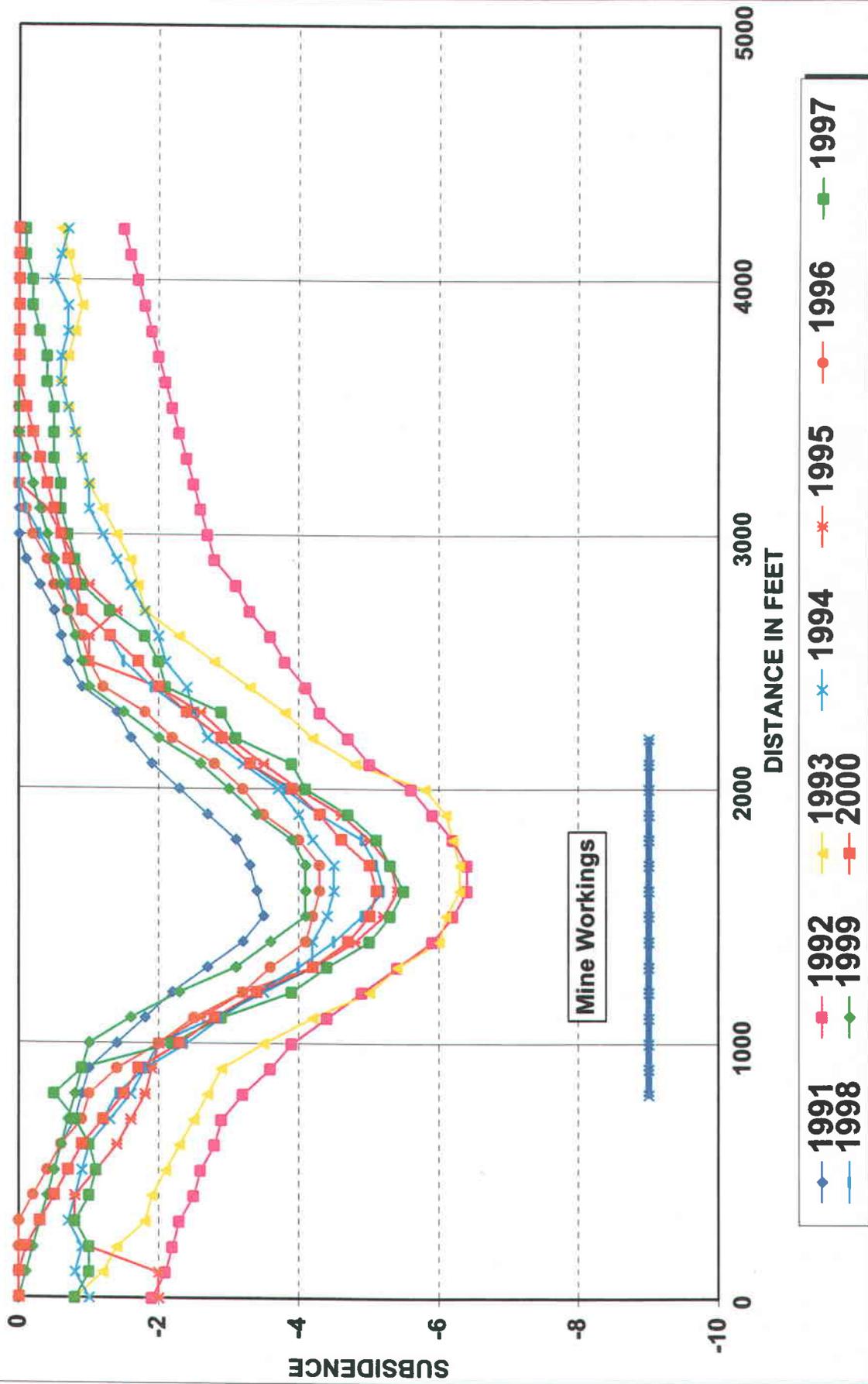


Figure 63

Area 19

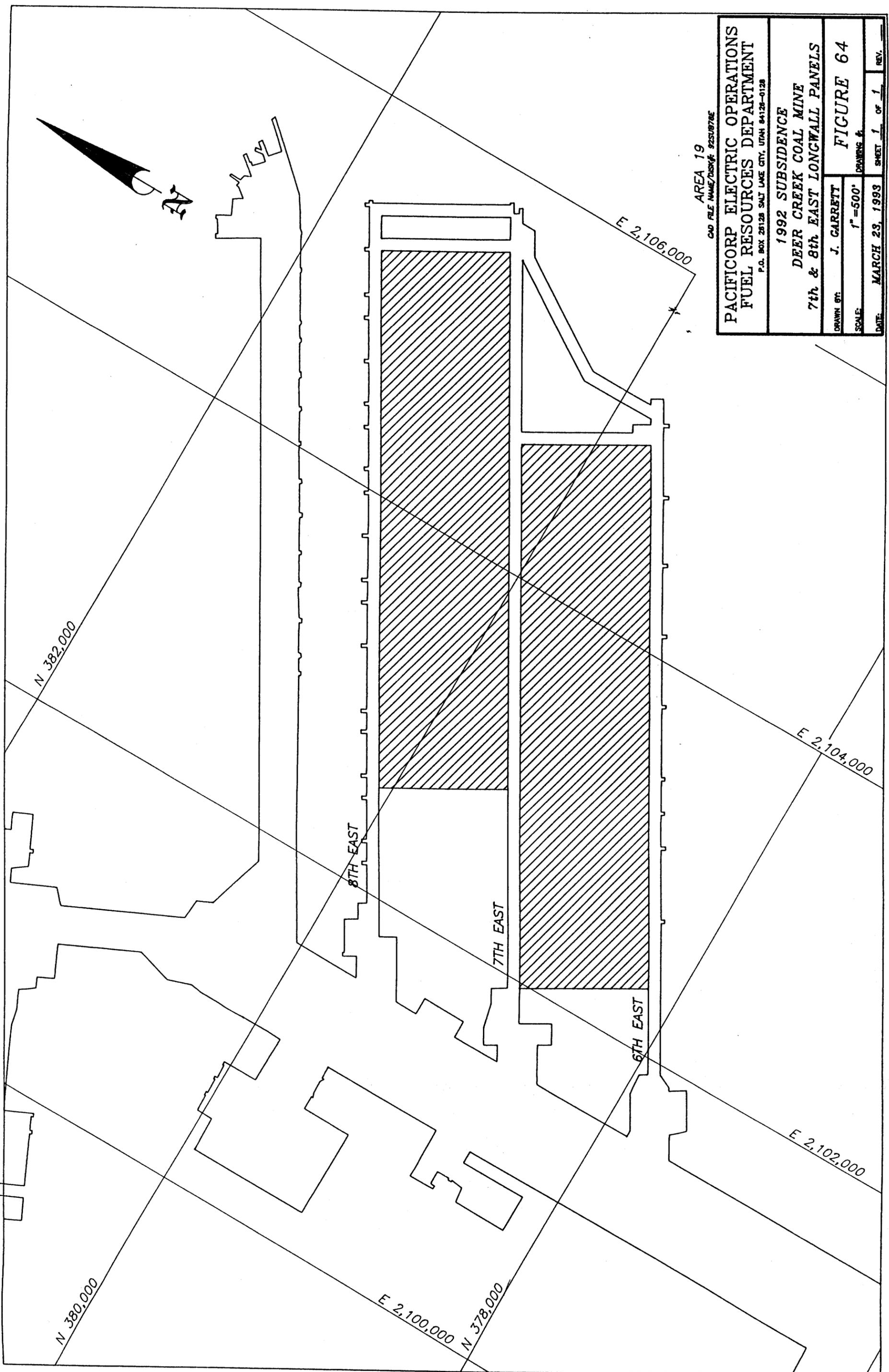
Deer Creek 7th and 8th East Longwall Panels off 3rd North

Mining in the 7th East Longwall Panel began in May, 1992 and by January 1993 mining was completed in the 8th East Longwall Panel (Figure 64).

The land surface above these two panels is very rugged. The longwall panels are located beneath a ridge located between the left and right forks of Meetinghouse Canyon. The area is covered by sagebrush on the south facing slopes and dense stands of spruce trees on the north facing slopes. The overburden in the area of these panels ranges from 400 feet on the north to over 1,800 feet on the south.

Subsidence in this area has increased from slightly over one foot in 1992 to over four feet in 1993 but has been stable between 1993 and 2000 (Figures 65 and 66).

This area is overlain by a few springs. Monitoring of these springs has shown no change in the quality or quantity of water discharged from them (see appendix and the 2000 Hydrologic Monitoring Report).

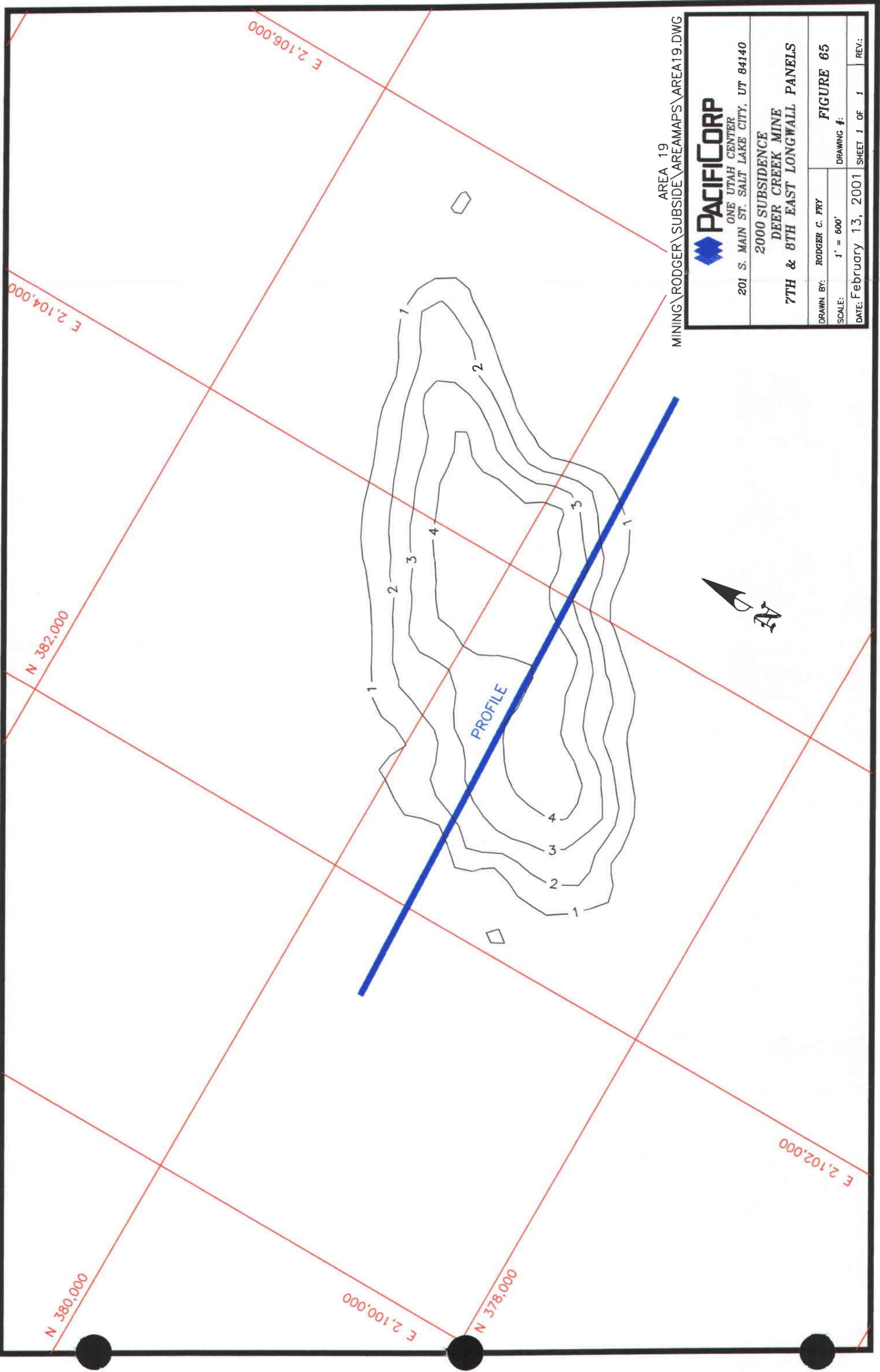


AREA 19
 CAD FILE NAME/DISK# 925UB78E

PACIFICORP ELECTRIC OPERATIONS
 FUEL RESOURCES DEPARTMENT
 P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128

1992 SUBSIDENCE
 DEER CREEK COAL MINE
 7th & 8th EAST LONGWALL PANELS

DRAWN BY:	J. GARRETT	FIGURE 64
SCALE:	1" = 500'	DRAWING #
DATE:	MARCH 23, 1993	SHEET 1 OF 1
		REV.



MINING\RODGER\SUBSIDE\AREAMAPS\AREA19.DWG AREA 19



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
DEER CREEK MINE
7TH & 8TH EAST LONGWALL PANELS

DRAWN BY: RODGER C. FRY

FIGURE 65

SCALE: 1" = 600'

DRAWING #:

DATE: February 13, 2001

SHEET 1 OF 1

REV.:

Area 19 Subsidence Profile

West - East

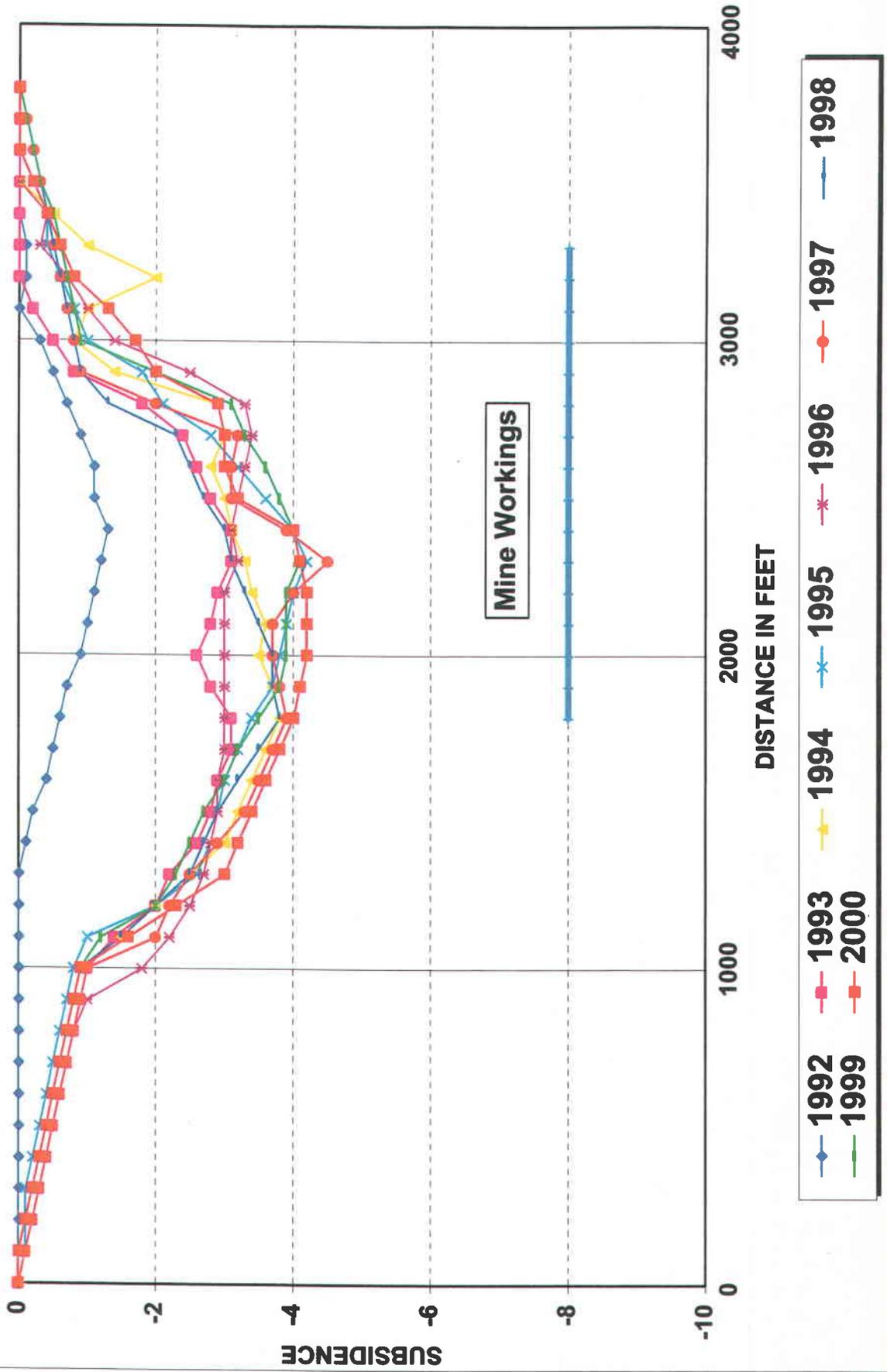


Figure 66

Area 20

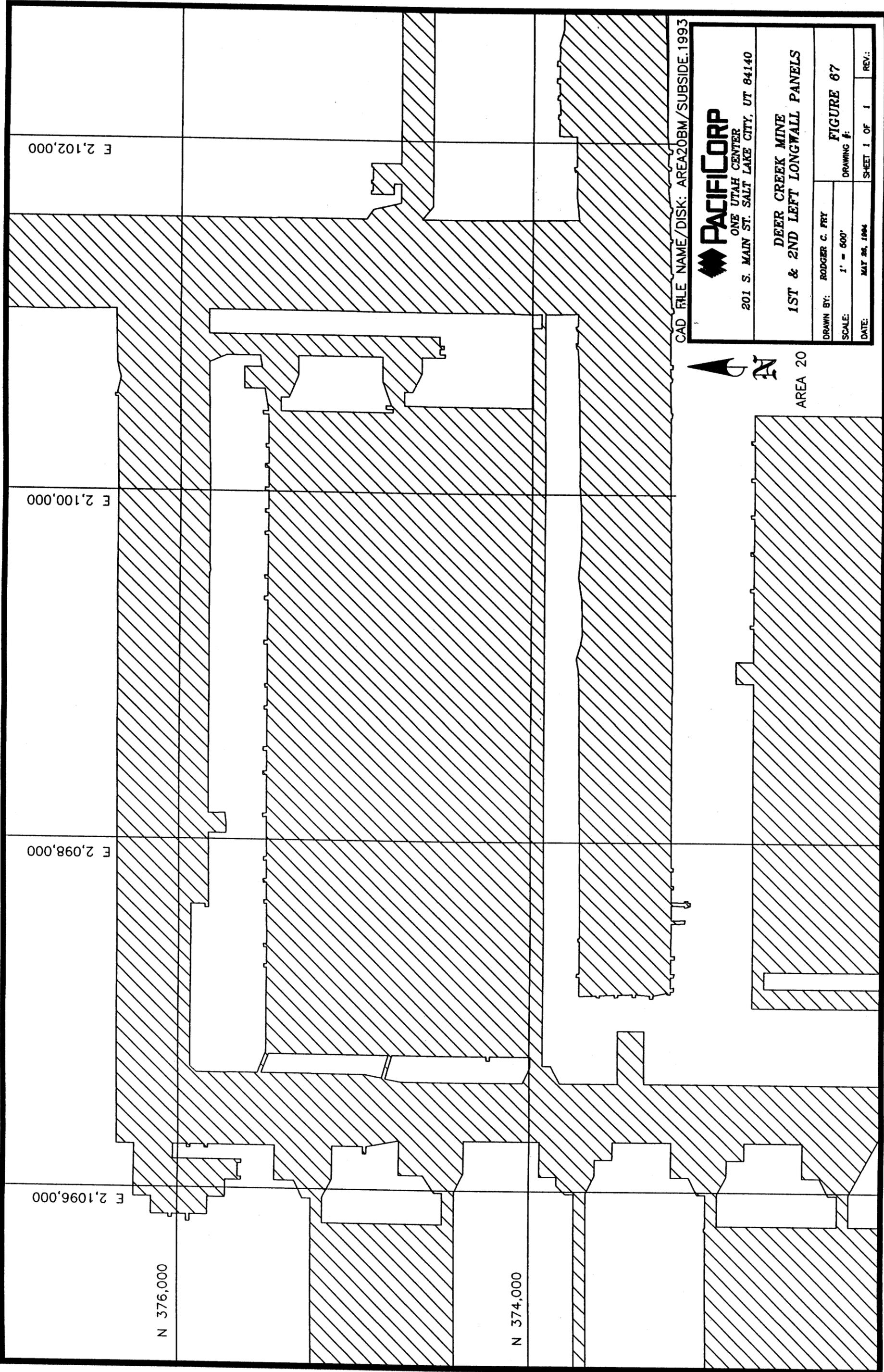
Deer Creek 1st & 2nd Left Longwall Panels off 3 ½ South

Mining in the 2nd Left Longwall Panel began in February 1993 and was completed in June 1993. Mining then started in the 1st Left Longwall Panel in July 1993 and was completed in November of 1993 (Figure 67).

These longwall panels are overlain by moderately steep slopes that are heavily covered with aspen and spruce trees. The overburden above these panels range from 1,400 feet at their east end to over 2,000 feet above their west end.

The monitoring detected a maximum of slightly over four (4) feet of subsidence in 2000 which is similar to that measured in 1997, 1998 and 1999 but less than the maximum of slightly over six (6) feet of subsidence above the 2nd Left Longwall Panel measured in 1996. The 1996 reading showed an increase from the maximum of slightly over four feet that was measured in 1995 and a foot greater than that measured in 1994 which showed a maximum of five feet of subsidence (Figures 68 and 69). It is believed that subsidence in this area is substantially complete. All of the subsidence detected falls within the bounds of the longwall area. Therefore; the angle of draw in this area is considered to be steeper than 10°.

These longwall panels are overlain by several springs. Monitoring of the springs revealed no impacts due to the subsidence.



CAD FILE NAME/DISK: AREA20BM/SUBSIDE.1993



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

DEER CREEK MINE
1ST & 2ND LEFT LONGWALL PANELS

DRAWN BY: RODGER C. FRY	DRAWING #:	FIGURE 67	REV.:
SCALE: 1" = 500'			
DATE: MAY 26, 1994			



AREA 20

N 376,000

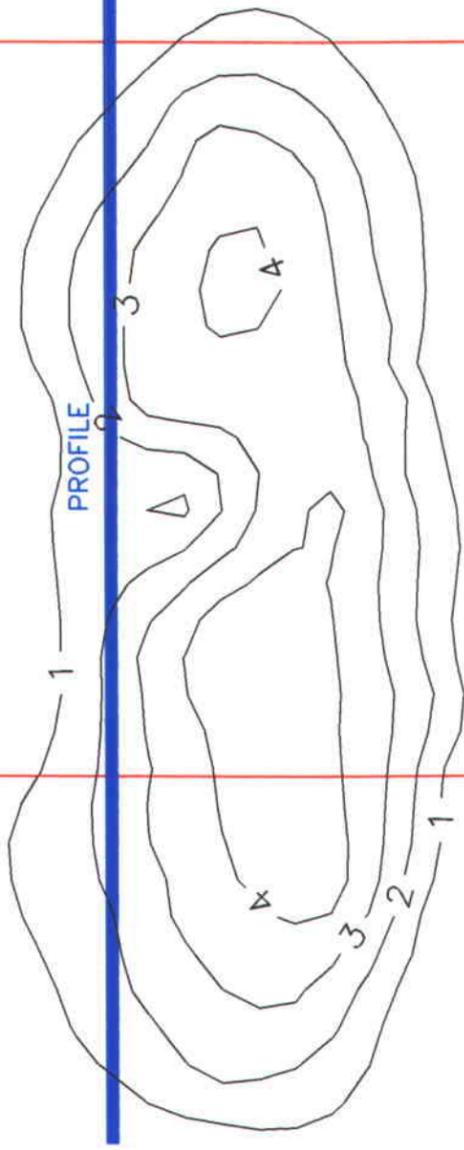
N 374,000

E 2,096,000

E 2,098,000

E 2,100,000

E 2,102,000



MINING\RODGER\SUBSIDE\AREAMAPS\AREA20.DWG
 AREA 20



ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
 DEER CREEK MINE
 1ST & 2ND LEFT LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 68
SCALE: 1" = 500'	DRAWING #:
DATE: February 13, 2001	SHEET 1 OF 1
	REV.:

Area 20 Subsidence Profile

West - East

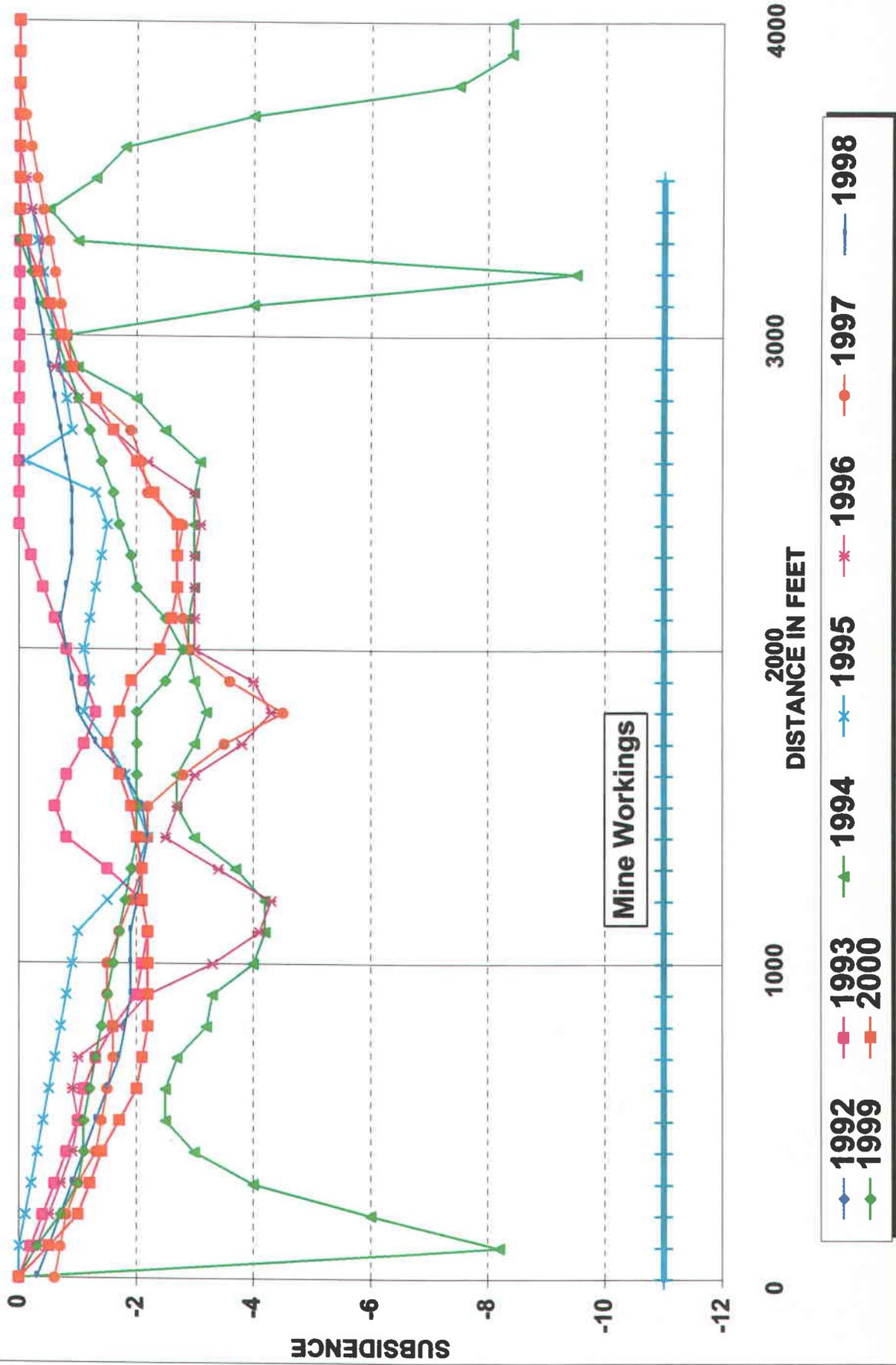


Figure 69

Area 21

Deer Creek Mine 2nd East Through 7th East Longwall Panels

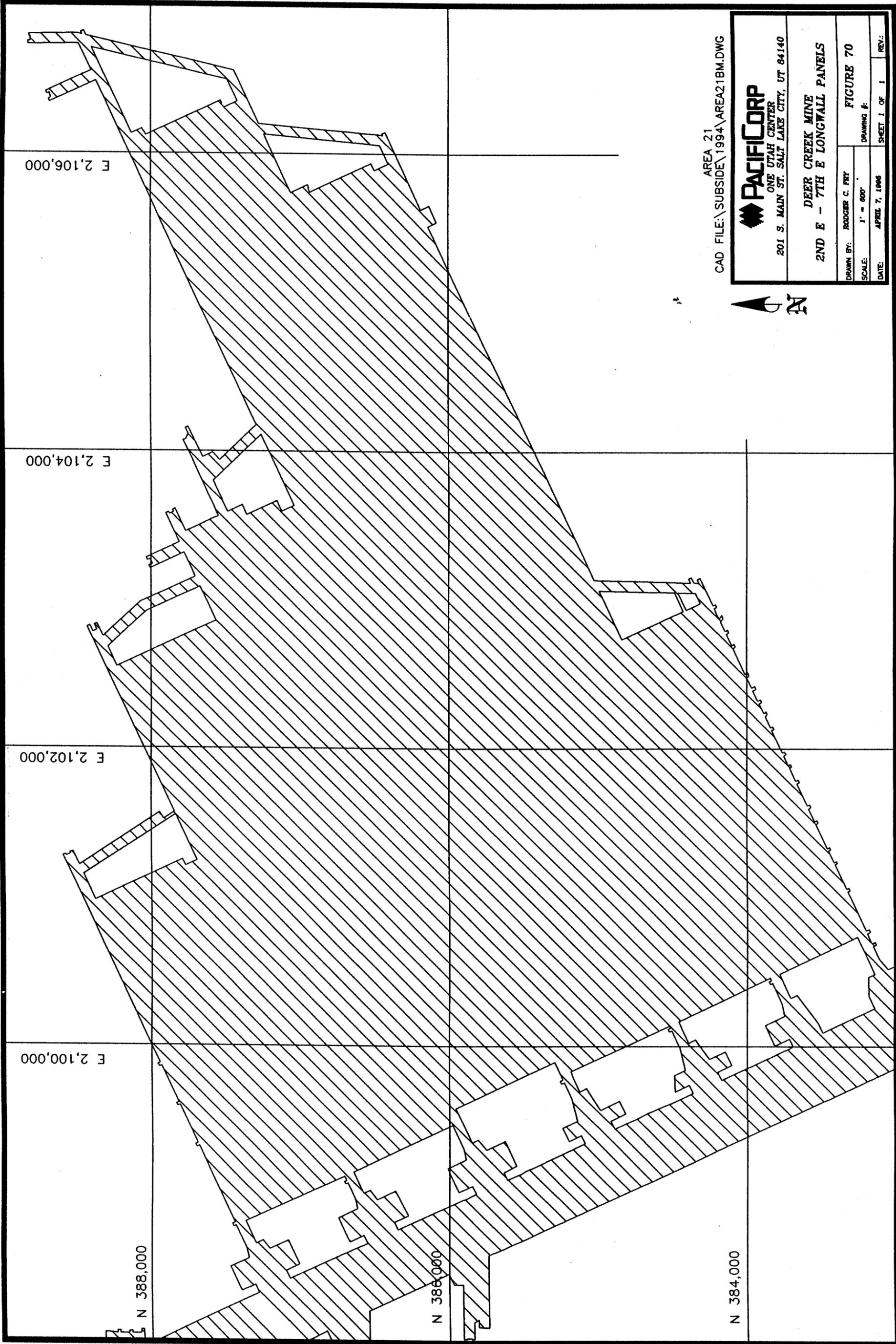
Mining in the 2nd East Longwall panel began in November of 1993 and by the End of August 1995 longwall mining had removed all of the 2nd through 5th East Longwall Panels and the eastern 1,100 feet of the 6th East Longwall Panel (Figure 70). Mining in this area, including the remainder of the 6th East and all of the 7th East Longwall Panels, was completed in January 1996.

The topography in this area is fairly rugged. A ridge along the south side of Rilda Canyon is located through the center of the area. The slopes leading down from this ridge to Rilda Canyon on the north are heavily vegetated with conifer trees. Overburden in this area ranges from less than 200 feet in the north to greater than 1,800 feet beneath the ridge top.

Subsidence detected in 1994 had reached a maximum of over four (4) feet above the 2nd East Longwall Panel (Figures 71, 72 and 73). Subsidence over the 3rd East longwall panel was not detected because this panel is longer than the 2nd East panel and subsidence doesn't usually occur until two panel widths have been mined. In 1995, subsidence had progressed to where most of the areas underlain by the 2nd through 6th East Longwall Panels had subsided between 5 and 6 feet. In 1996, the maximum subsidence that was measured had not increased from that measured in 1995 but an increase in subsidence was noted on the north end of figure 72 and on the western end of figure 73. This is in the area of the 6th and 7th East Longwall Panels that were the last to be extracted. The 1997

through 1999 monitoring indicated that subsidence has been stable during those years. The 2000 monitoring showed a slight increase in subsidence in the center of the area (see figures 72 and 73). This may be some additional settling that has occurred or may be a slight error in the aerial triangulation. During the helicopter reconnaissance in 1995, several fractures were identified and several areas were noted where boulders had rolled from the Castlgate cliff. These are shown on figure 71. The area of subsidence is completely contained within the mining area; Therefore, the angle of draw is near vertical.

Several springs are located above these longwall panel. However, hydrologic monitoring has not detected any change to the spring flow that is attributable to mining (see 2000 Hydrologic Monitoring Report).



AREA 21
 CAD FILE: \SUBSIDE\1994\AREA21BM.DWG



ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

DEER CREEK MINE
 2ND E - 7TH E LONGWALL PANELS

DRAWN BY: RODGER C. FRY	DRAWING #:	FIGURE 70
SCALE: 1" = 800'	DATE: APRIL 7, 1996	SHEET 1 OF 1
		REV.:

MINING\RODGER\SUBSIDE\AREAMAPS\AREA21.DWG AREA 21



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
DEER CREEK MINE

2ND E - 7TH E LONGWALL PANELS

DRAWN BY: RODGER C. FRY

SCALE: 1" = 600'

DATE: February 13, 2001

SHEET 1 OF 1

FIGURE 71

DRAWING #:

REV.:



E 2,106,000

E 2,104,000

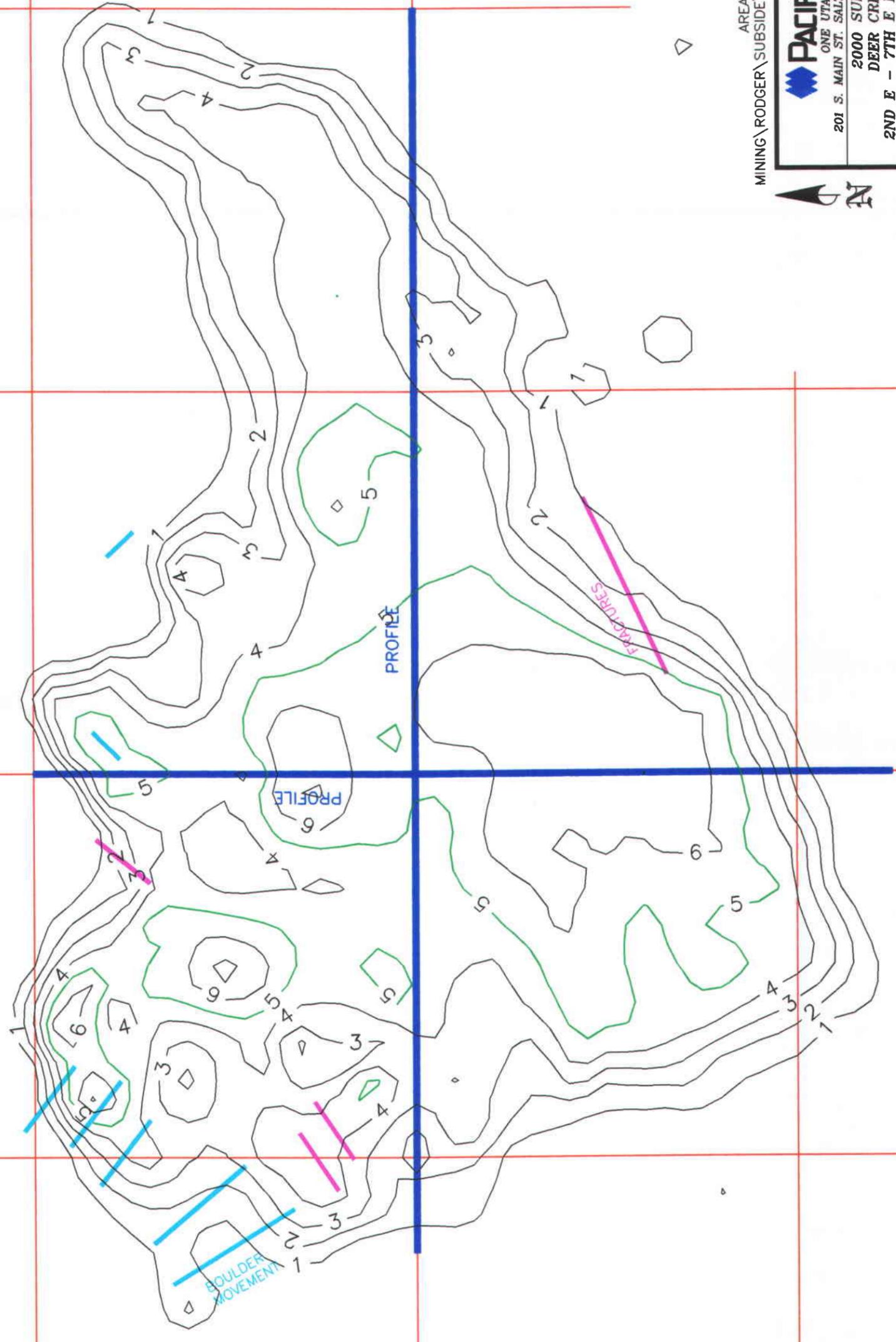
E 2,102,000

E 2,100,000

N 388,000

N 386,000

N 384,000



Area 21 Subsidence Profile

North - South

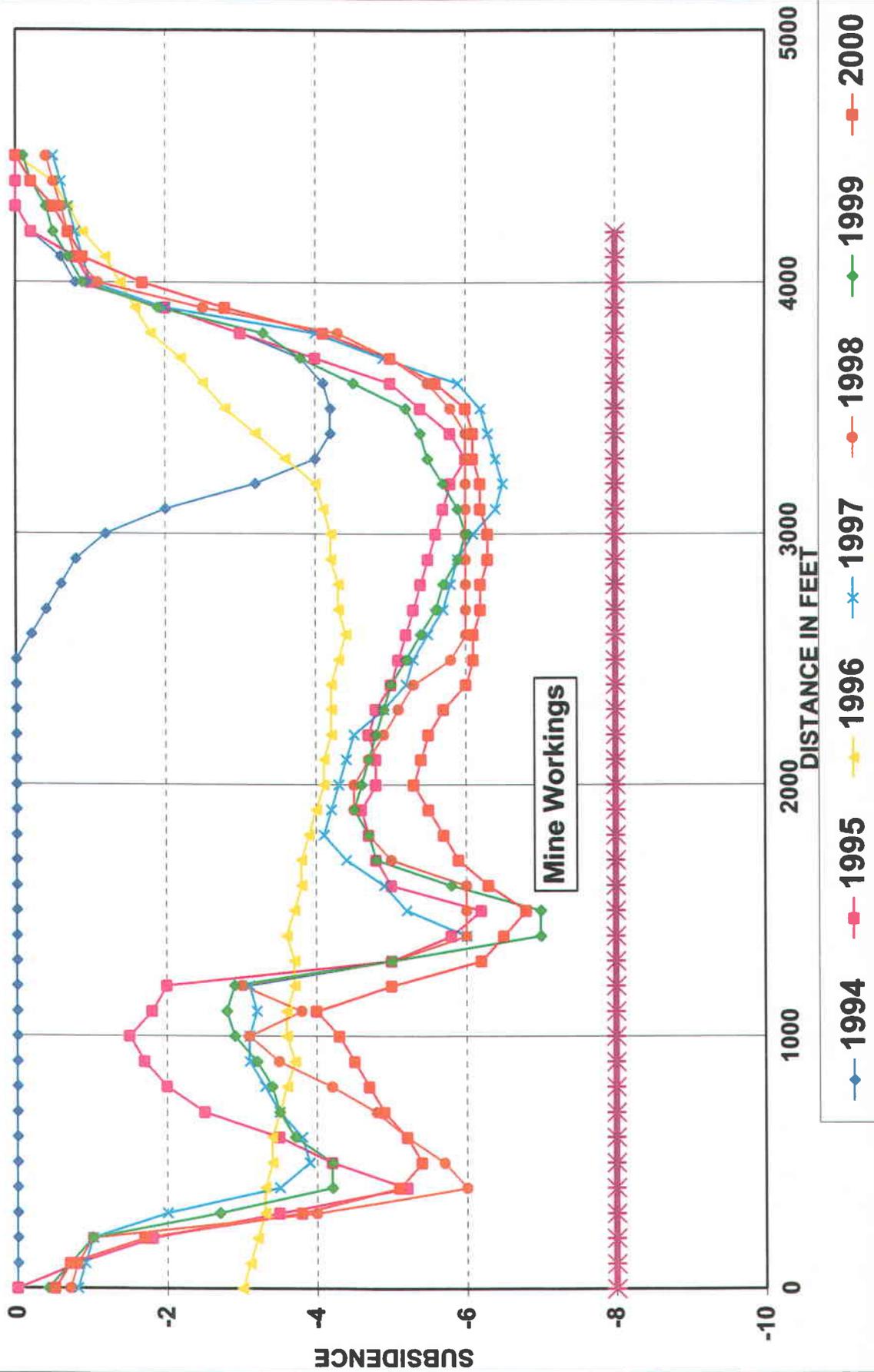


Figure 72

Area 21 Subsidence Profile

West - East

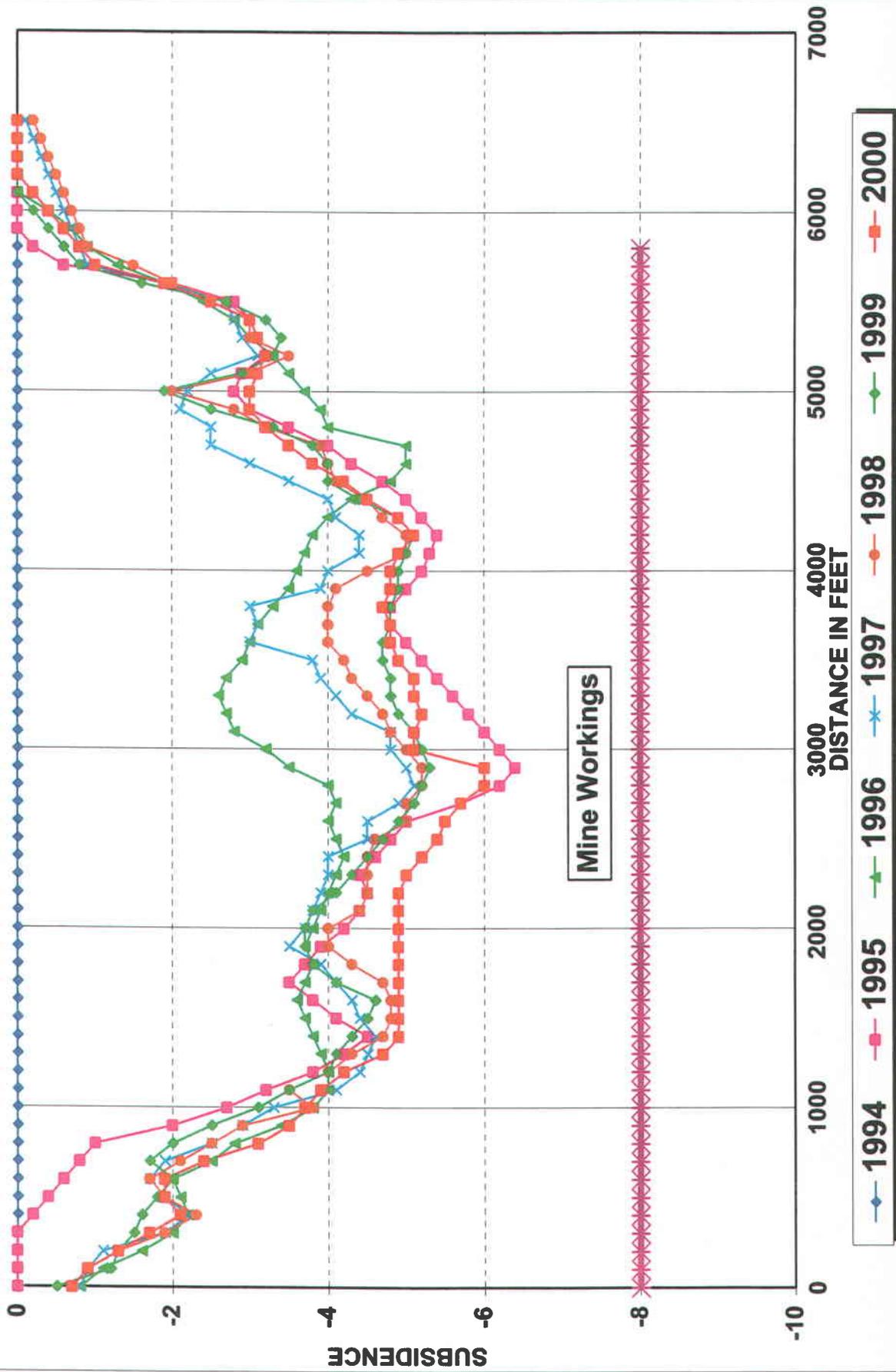


Figure 73

Area 22

Deer Creek Mine 2nd through 8th West Longwall Panels off 3rd North

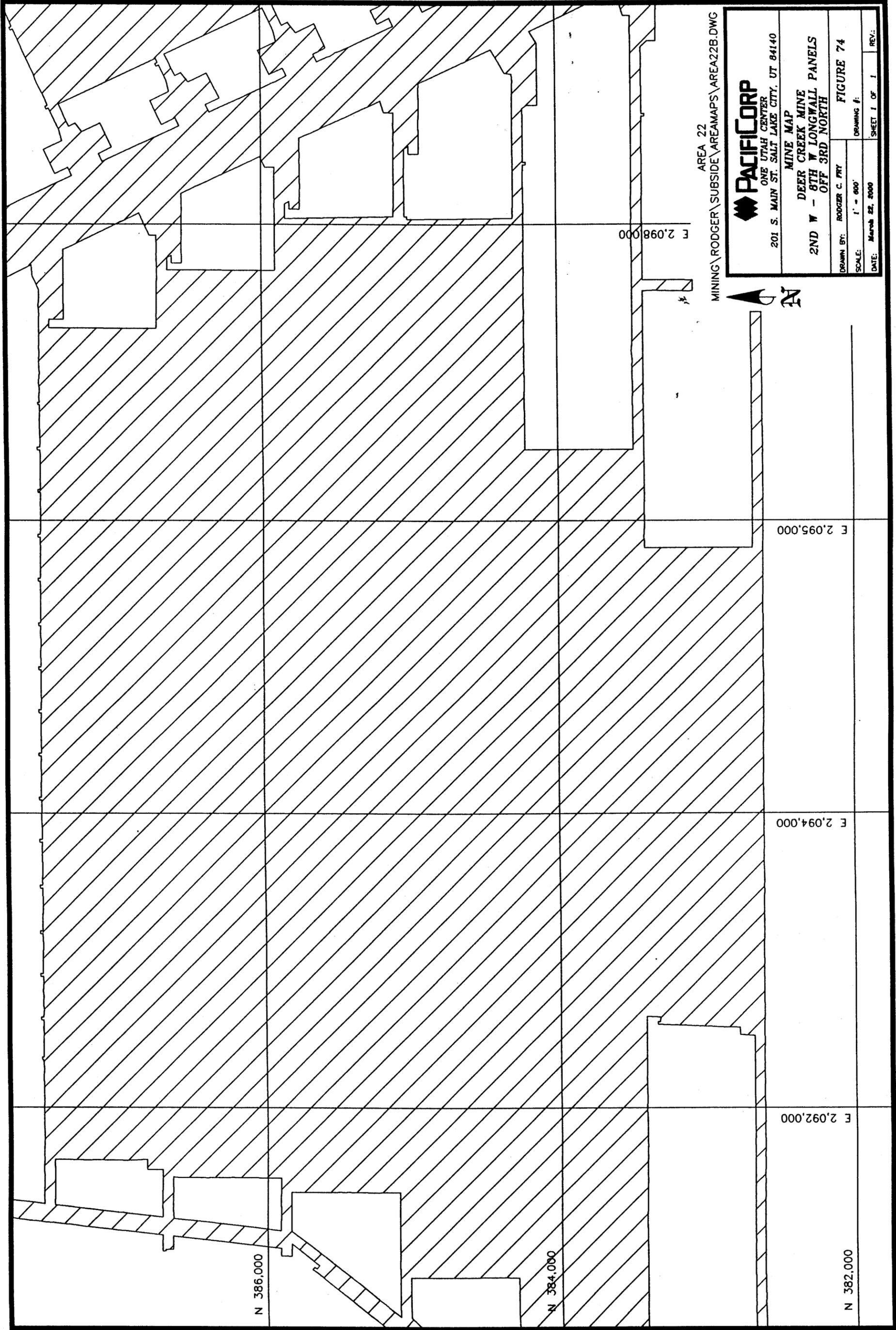
Longwall Mining began in the 8th West Longwall Panel in February 1996 and the entire panel was mined by July 1996. Mining then moved to the 7th West Longwall Panel in July 1996 and was completed in January 1997. Mining then started in the 6th west panel in January 1997 and this panel was completed in July 1997. Mining in the 5th west panel began in July 1997 and was completed in February 1998. Mining in the 4th west panel began in March 1998 and was completed in November 1998. The 3rd west panel was not mined in its entirety. The western 2,000 feet of the panel was not longwall mined because of inferior quality coal. The central 3,200 feet was mined between November 1998 and January 1999. A faulted area was then not mined and the longwall equipment mined the eastern 1,500 feet of the panel between January 1999 and April 1999 when mining in this area was completed (see figure 74).

This area is located on the southern side of Rilda Canyon in an area where the terrain is very rugged. Several north-south side tributaries to Rilda Canyon are located in the area and form a series of canyons and steep ridges along the flanks of Rilda Canyon. Elevations range from 8,000 feet at the coal outcrop to 9,900 feet along the ridge tops. The area is heavily vegetated with spruce trees, aspen trees at the higher elevations and pinion-junipers at the lower elevations.

The subsidence monitoring showed a slight increase in subsidence in 2000 over previous years as would be expected. The increase in subsidence is above the southern

panels that were mined last as would be expected. The maximum subsidence above the northern panels remained unchanged which shows stability has been reached in those areas. The topography in this area is fairly rugged which limits the resolution of the photogrammetric monitoring (see figures 75, 76 and 77).

Several springs are located in the area and have been catalogued and are being monitored (see 2000 Annual Hydrologic Monitoring Report).



AREA 22
 MINING\RODGER\SUBSIDE\AREAMAPS\AREA22B.DWG

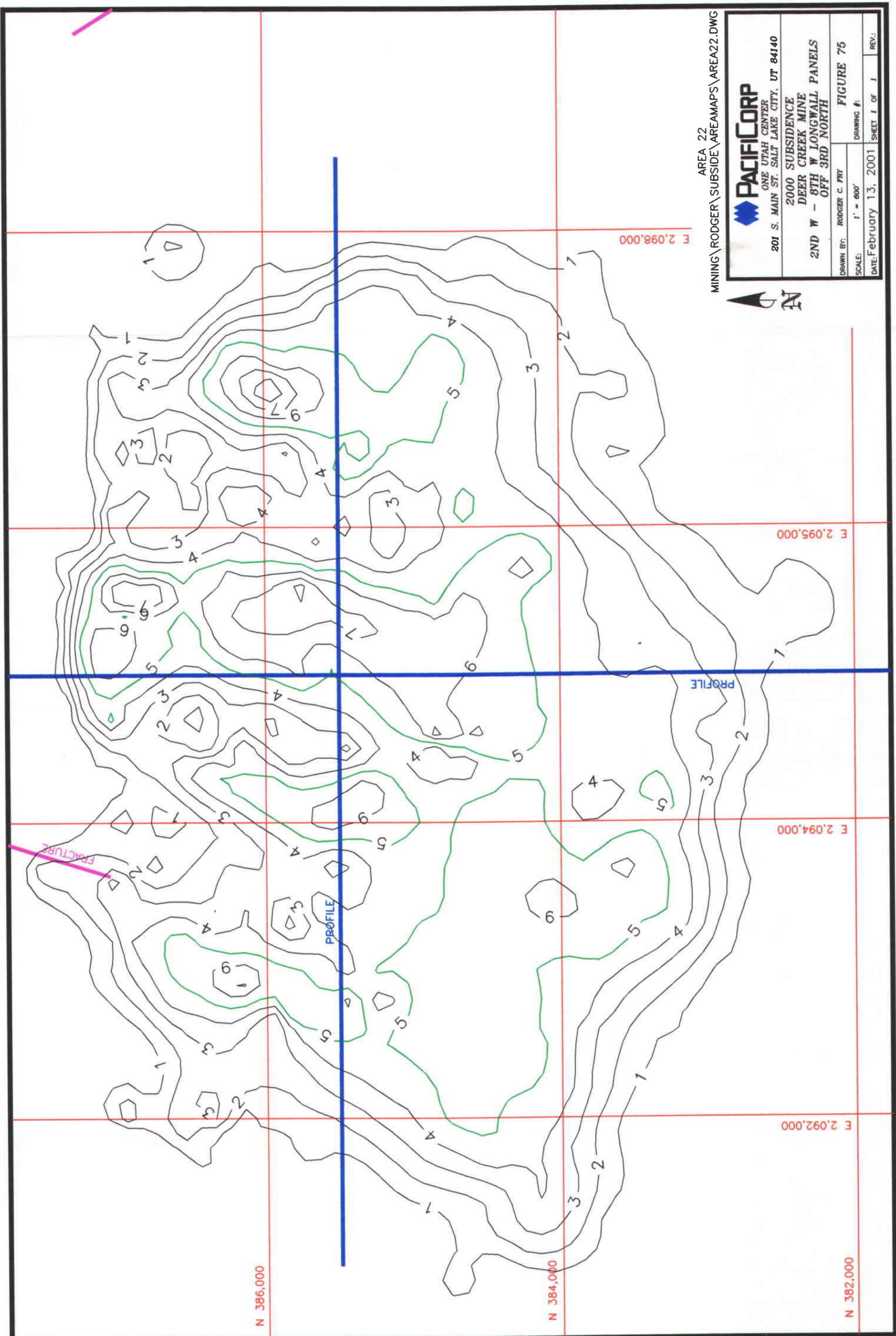


ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

MINE MAP
 DEER CREEK MINE
 2ND W - 8TH W LONGWALL PANELS
 OFF 3RD NORTH

DRAWN BY: RODGER C. FRY
 SCALE: 1" = 600'
 DATE: March 22, 2000

FIGURE 74
 DRAWING #:
 SHEET 1 OF 1
 REV.:



AREA 22
 MINING\RODGER\SUBSIDE\AREAMAPS\AREA22.DWG



ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
 DEER CREEK MINE
 2ND W - 8TH W LONGWALL PANELS
 OFF 3RD NORTH

DRAWN BY: RODGER C. FRY
 SCALE: 1" = 600'
 DATE: February 13, 2001

FIGURE 75
 DRAWING #:
 SHEET 1 OF 1
 REV.:

Area 22 Subsidence Profile

North - South

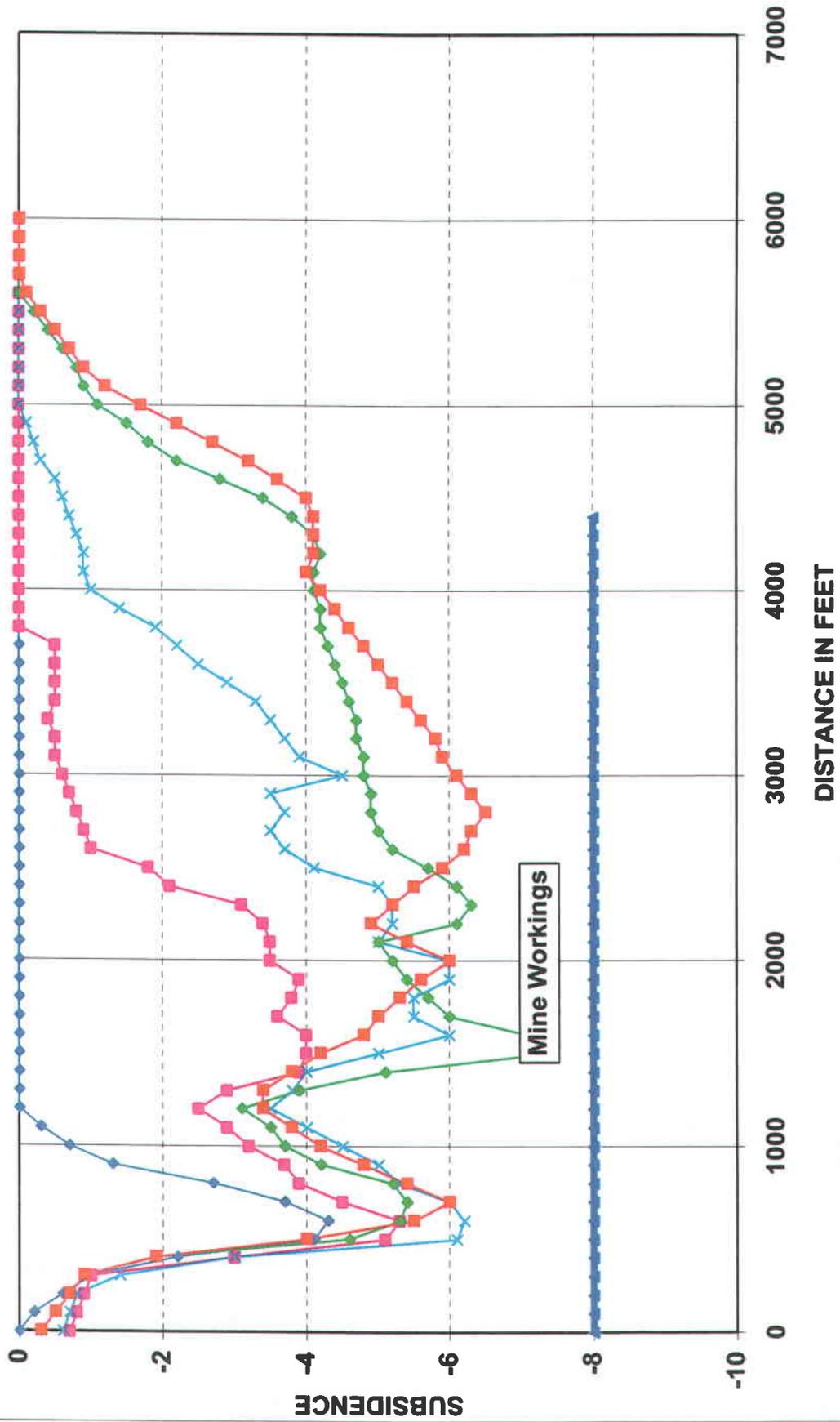


Figure 76

Area 22 Subsidence Profile

West - East

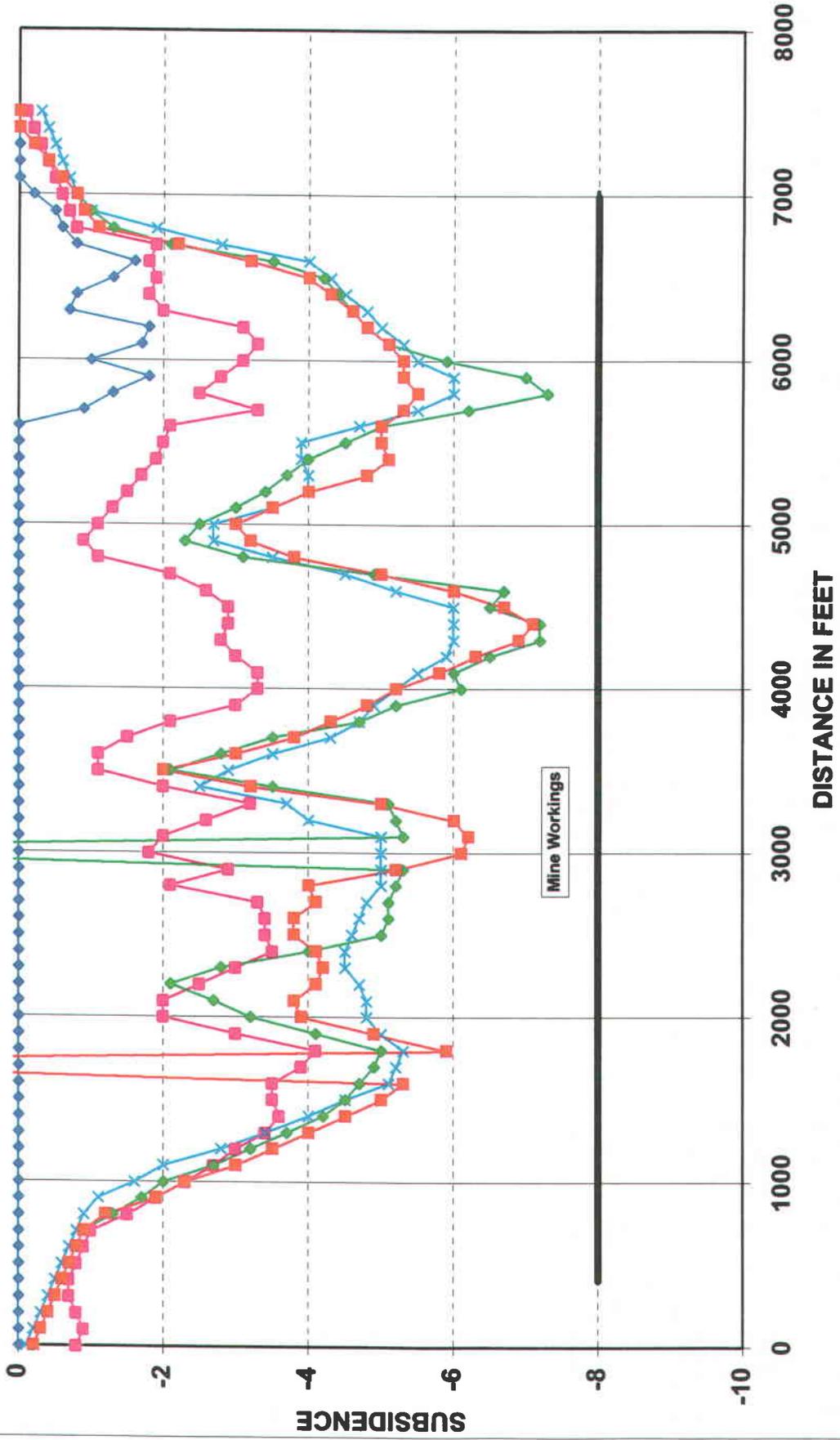


Figure 77

Area 23

Trail Mountain Mine 2nd through 5th East Longwall Panels off 5th Left

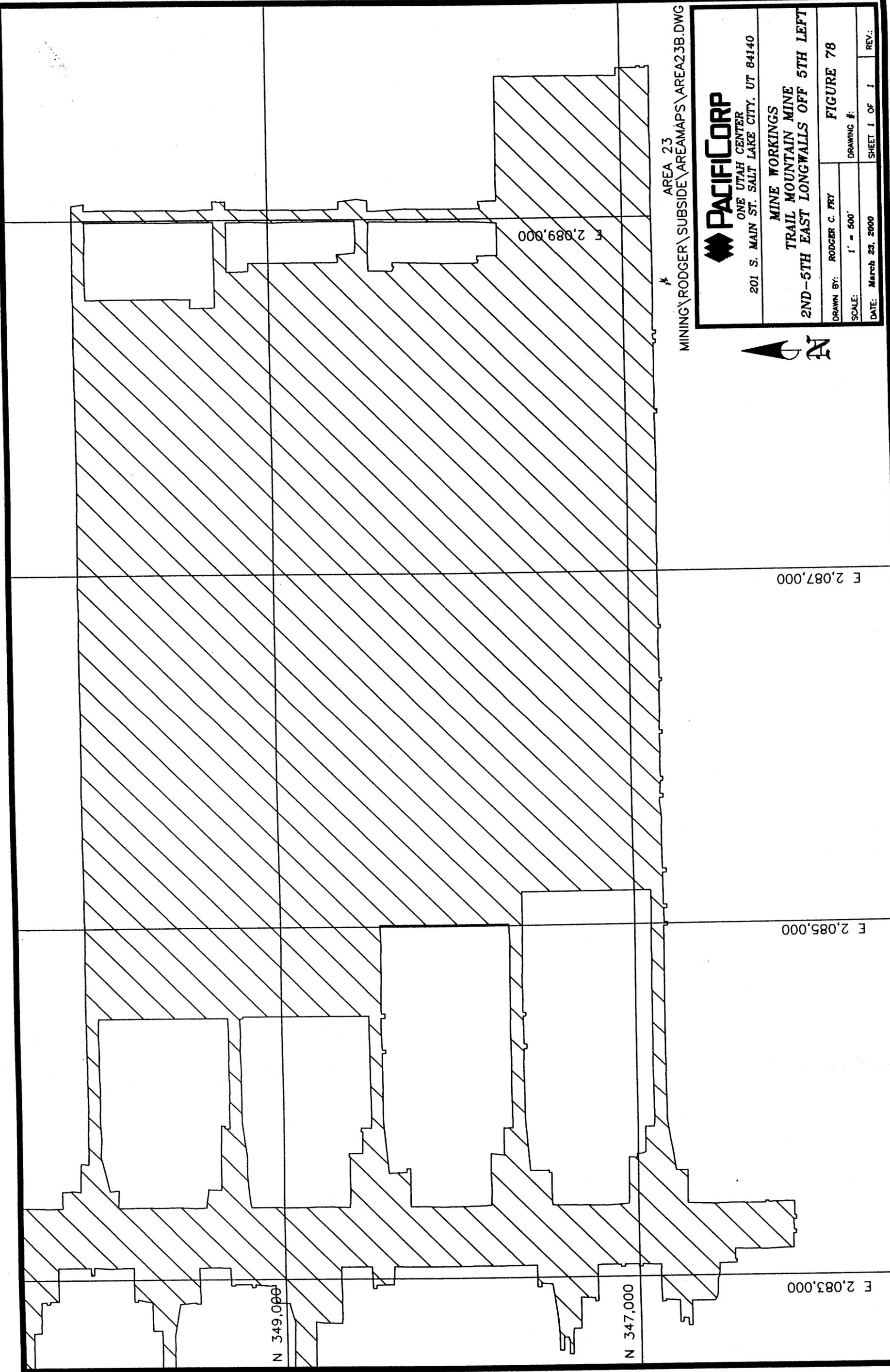
Mining in the 2nd East Longwall Panel began in October 1995 and mining continued until February 1996. In this panel only the eastern 2,600 feet was mined because the western 2,000 feet was not minable due to high ash content in the coal. Mining Began in the 3rd East Panel in February and was completed in June 1996. Mining began in the 4th East panel starting in June 1996 and was completed in October 1996. Mining then began in the 5th East panel which was completed in March 1997 (see figure 78). All of the longwall mining conducted to date has extracted an average thickness of 8 feet of coal. Mining in this area is now complete.

This area generally contains gentle south-facing slopes that project down to a steep escarpment along the south and east end of the area. Elevations in the area range from 8,750 feet to less than 6,700 feet along the coal outcrop in Straight Canyon. The land is sparsely vegetated with grasses and brush with some dense patches of ponderosa pine at the higher elevations and pinion-juniper trees in the steeper slopes above and below the escarpment.

The subsidence monitoring has detected up to eight (8) feet of subsidence that has occurred. This maximum subsidence is located over the east end of the 4th East longwall panels (see figures 79, 80 & 81). Most of the undermined area has subsided between five (5) and seven (7) feet. One point at the extreme east side of the 5th East panel shows

subsidence up to over 22 feet. This is in an area of steep terrain and may be reading inaccuracies or a large boulder may have moved causing the change in readings between 1996 and 1997 but no additional change was noted in the past three years. The subsidence area is entirely contained within the undermined area, therefore; the angle of draw is steeper than 10 degrees from the vertical.

No surface fractures or visual evidence of subsidence has been observed. One spring is located in the area but has not been effected (see 2000 Annual Hydrologic Monitoring Report).



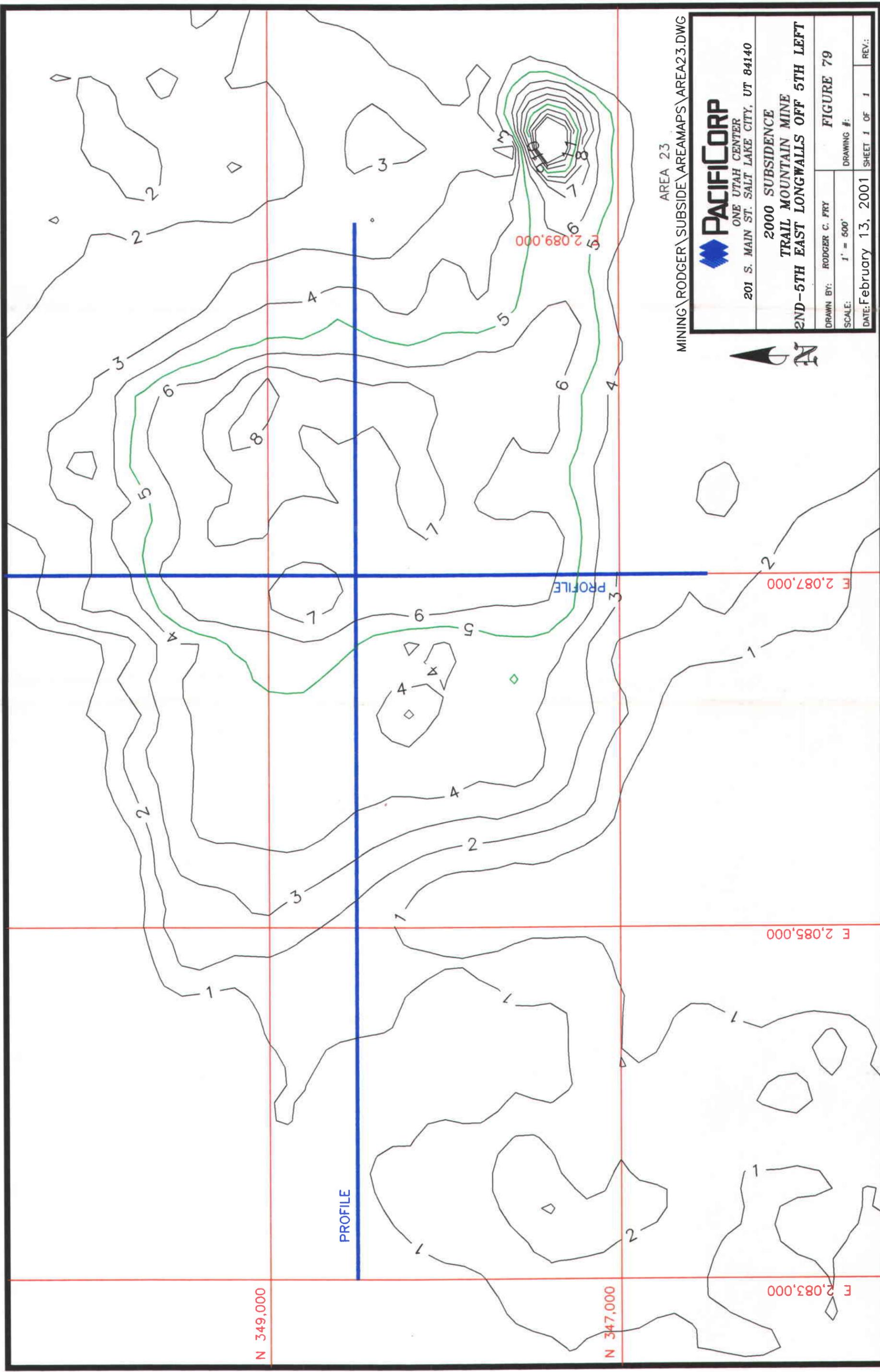
MINING\RODGER\SUBSIDE\AREAMAPS\AREA23B.DWG AREA 23



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

MINE WORKINGS
TRAIL MOUNTAIN MINE
2ND-5TH EAST LONGWALLS OFF 5TH LEFT

DRAWN BY: RODGER C. FRY	FIGURE 78
SCALE: 1" = 600'	DRAWING #:
DATE: March 23, 2000	SHEET 1 OF 1
	REV.:



MINING\RODGER\SUBSIDE\AREAMAPS\AREA23.DWG
 AREA 23



ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
 TRAIL MOUNTAIN MINE
 2ND-5TH EAST LONGWALLS OFF 5TH LEFT

DRAWN BY: RODGER C. FRY	FIGURE 79
SCALE: 1" = 500'	DRAWING #:
DATE: February 13, 2001	SHEET 1 OF 1
	REV.:

Area 23 Subsidence Profile

North - South

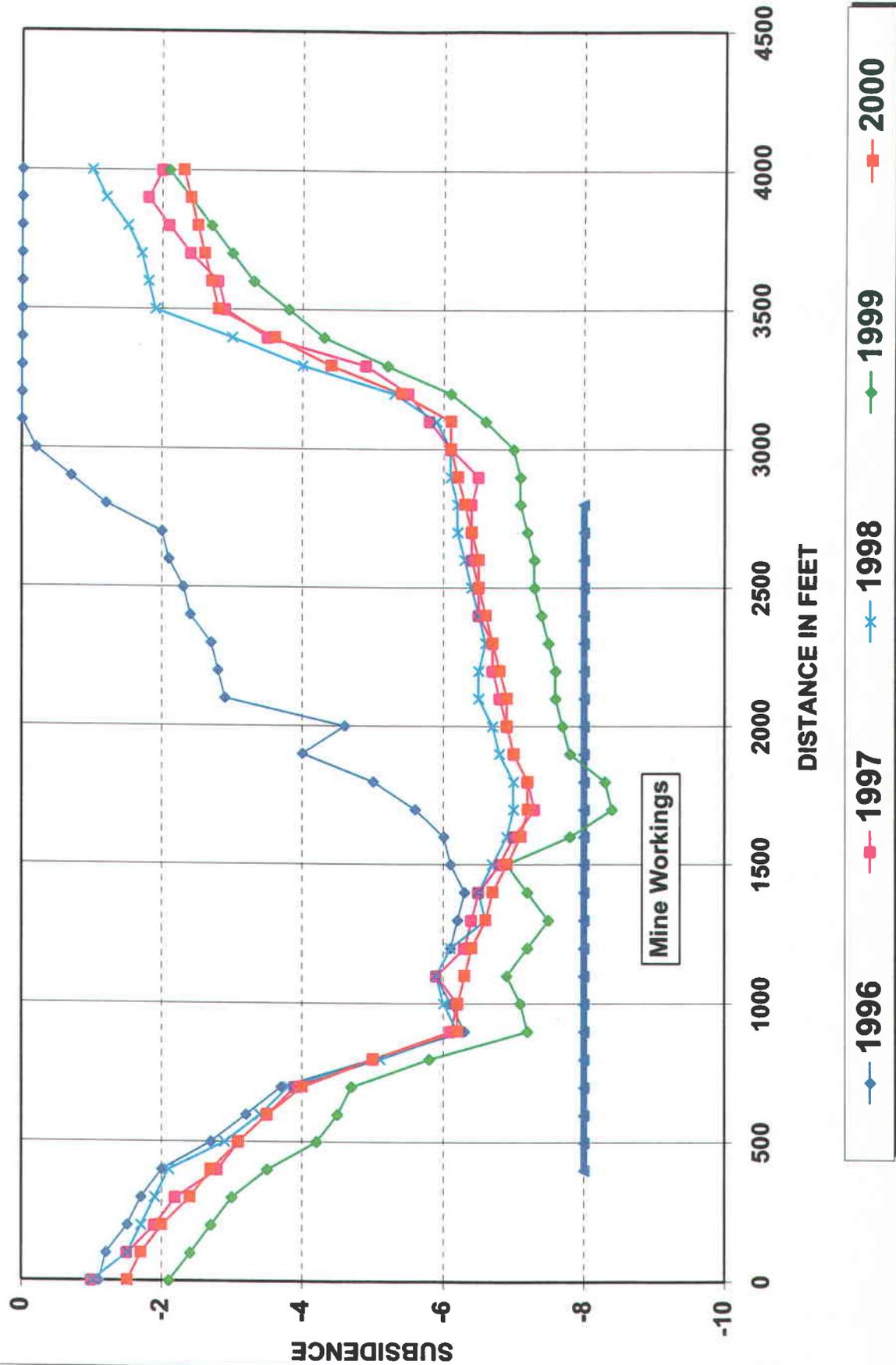


Figure 80

Area 23 Subsidence Profile

West - East

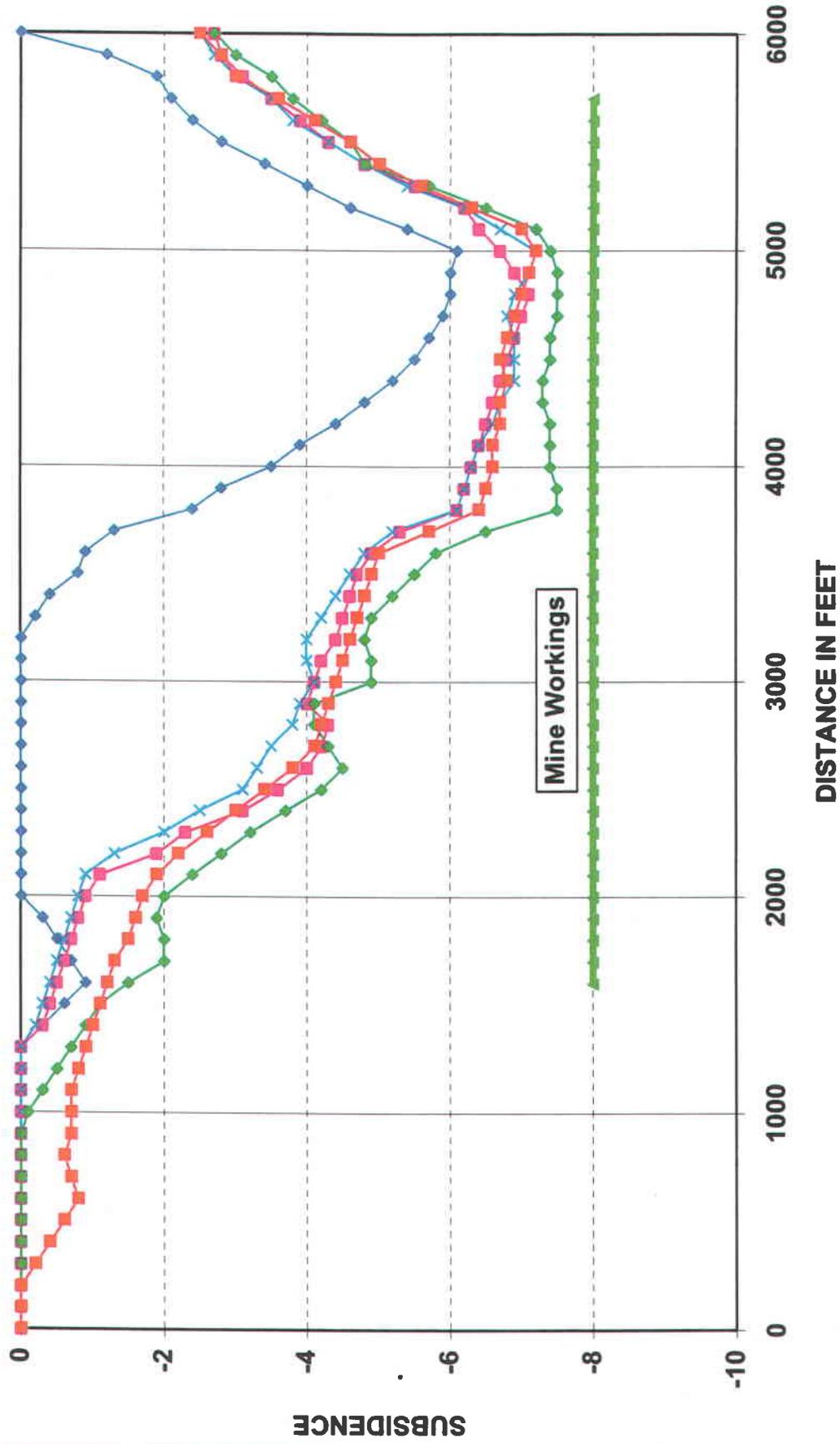


Figure 81

AREA 24

TRAIL MOUNTAIN MINE 1ST-10TH RIGHT OFF 5TH LEFT

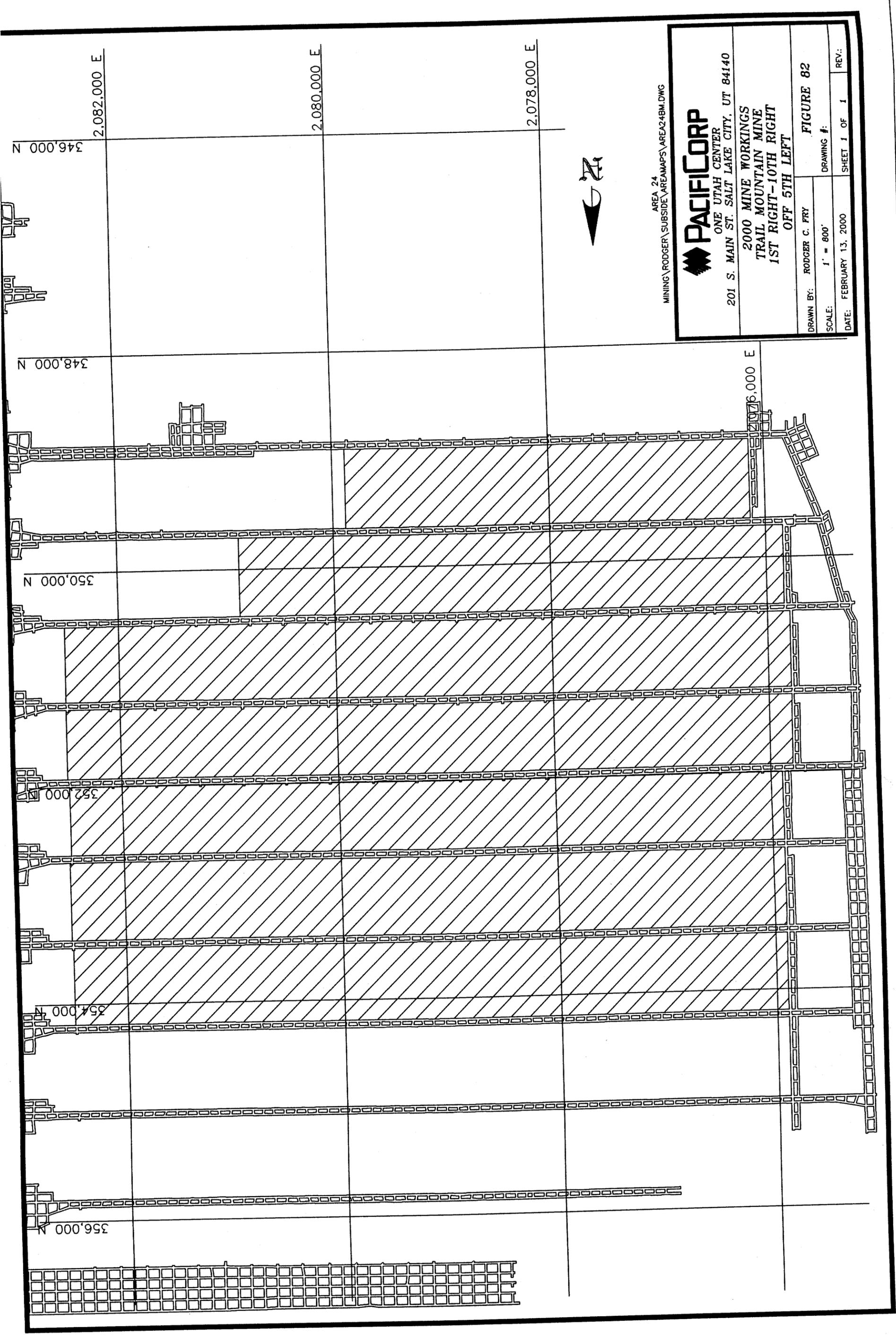
Mining in the 9th Right panel began in March 1997 and was completed at the end of August 1997. In 1998, the western 4,800 feet of the 8th Right panel had been extracted leaving the remaining 1,600 feet unmined due to inferior coal quality. Mining then moved into the 7th Right panel and by the end of August, 1998, all of this panel had been extracted. By August 1999, the entire 6th right panel had been extracted and all but the eastern 750 feet of the 5th right panel had been mined. By the end of August of 2000, longwall mining had been completed in both the 4th and 3rd Right Panels. The mining was completed to an average mining height of nine (9) feet.

The topography within this mining area is quite variable. Elevations range from less than 7,000 feet in Straight Canyon on the southwest side of the area, where the topography is very rugged, to over 8,800 feet in the northeast portion of the area where the land is gently sloping to the south. The lower elevation areas are heavily vegetated with pinion and juniper trees interspersed with grasses. The higher elevations have stands of spruce and aspen trees separated by areas of sage brush and grasses.

The overburden above the coal seam in this area ranges from less than 1,400 feet in the southwest corner of the area to over 2,200 feet in the northeast corner of the area.

The subsidence monitoring showed an increase in subsidence in 2000 from that measured the previous years. This increase was mainly in the north where mining continues but the maximum subsidence above the 8th Right Panel increased to over six feet.

It is expected that the subsidence will continue to increase slightly and progress to the north as mining advances in that direction (see figures 83, 84 and 85). Because subsidence in this area is not mature, no angle of draw has been calculated. The subsidence that has occurred has not had any effect on the current land use or on the hydrology of the area (see 2000 Annual Hydrologic Monitoring Report).



AREA 24
 MINING\RODGER\SUBSIDE\AREAMAPS\AREA24BM.DWG



ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 MINE WORKINGS
 TRAIL MOUNTAIN MINE
 1ST RIGHT-10TH RIGHT
 OFF 5TH LEFT

DRAWN BY: RODGER C. FRY

SCALE: 1" = 800'

DATE: FEBRUARY 13, 2000

FIGURE 82

DRAWING #:

SHEET 1 OF 1

REV.:

30

30

30

30

30

30

Area 24 Subsidence Profile

North - South

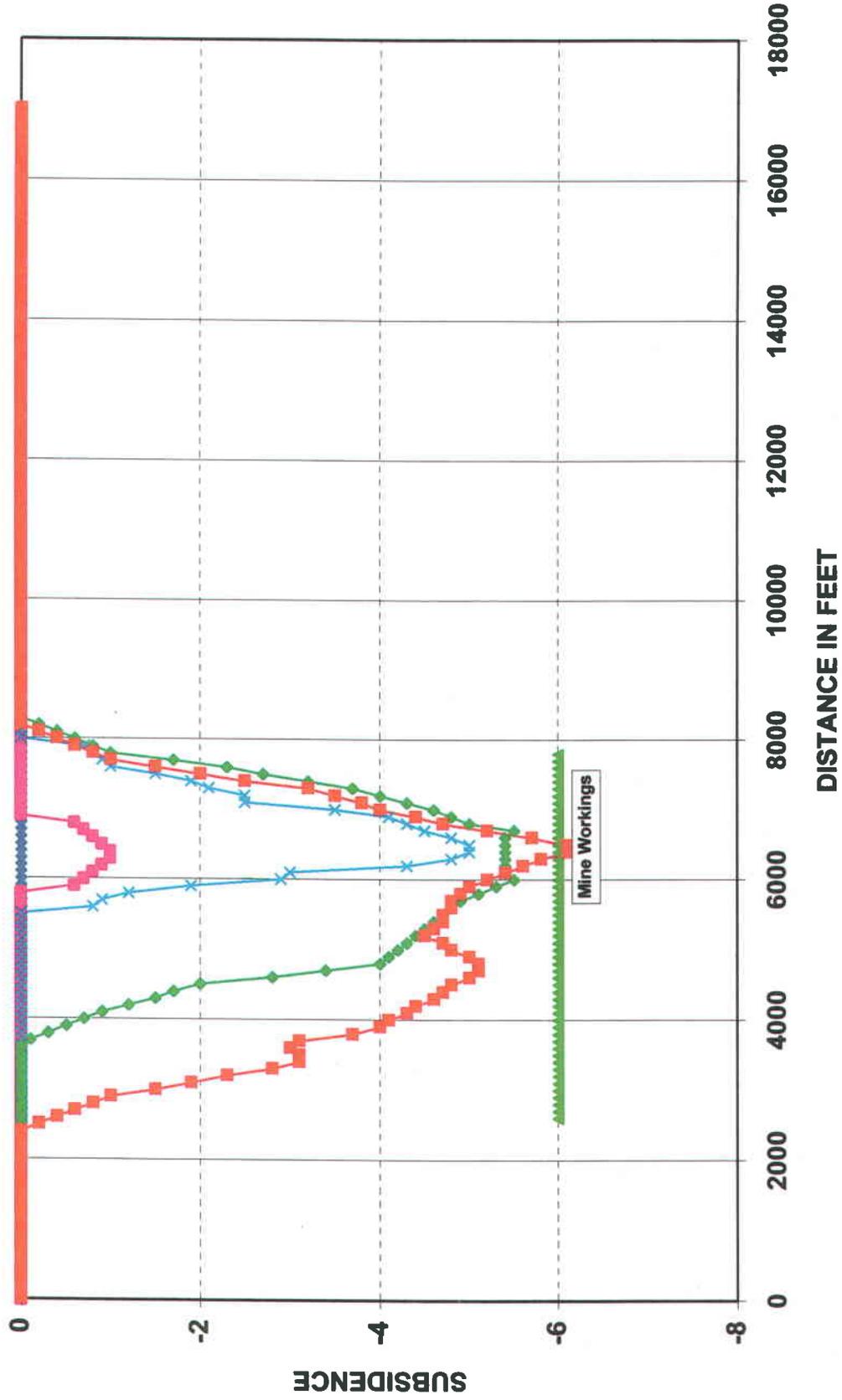


Figure 84

Area 24 Subsidence Profile

West - East

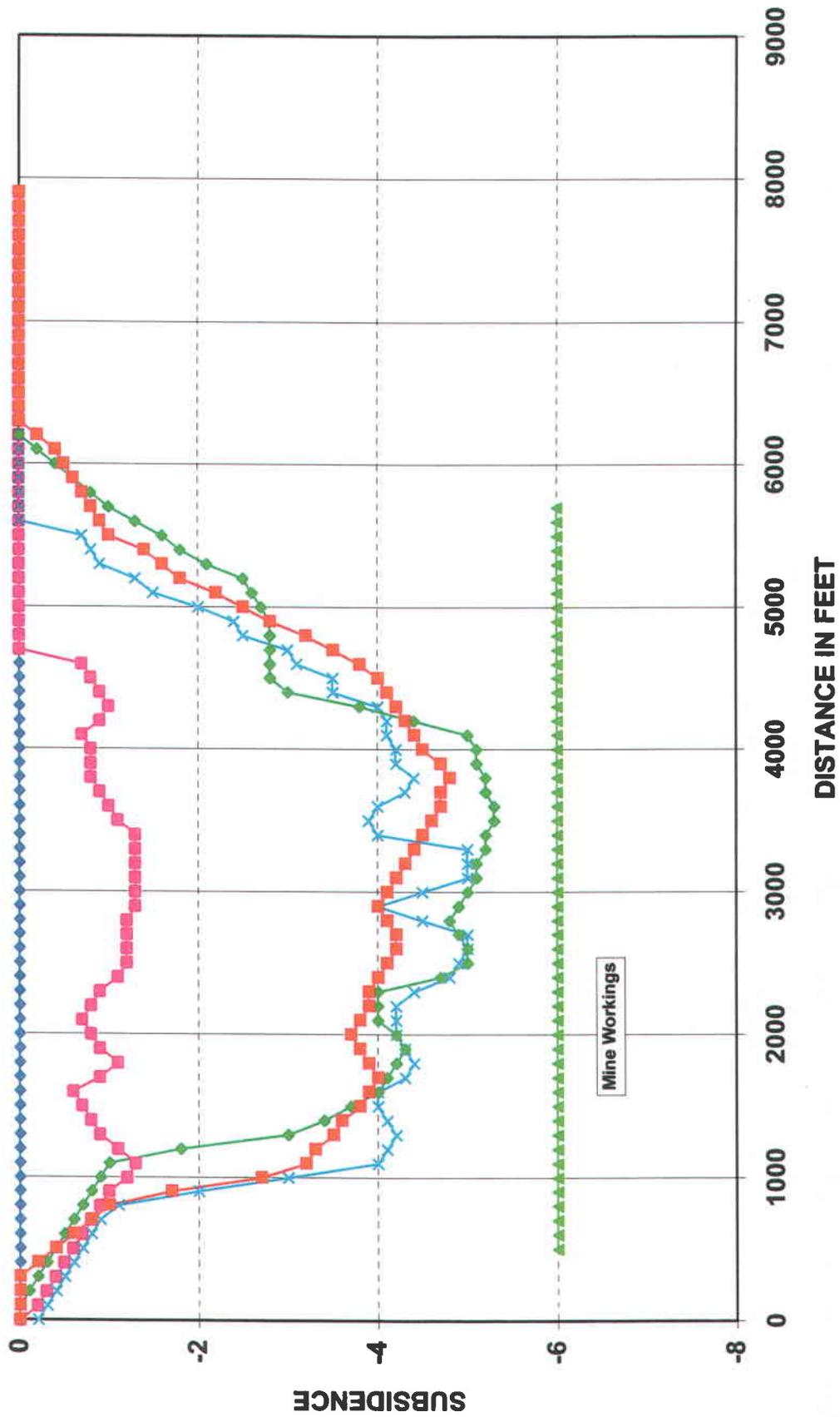


Figure 85

AREA 25

Deer Creek Mine 5th Through 14th East off 5th North Longwall Panels

Mining in this area will eventually be completed in both the Blind Canyon and Hiawatha seams where as present mining has only been completed in the Blind Canyon Seam. Longwall Mining began in this area in the eleventh west panel in April of 1999. By August 31, 1999, the eastern 4,400 feet of this panel had been mined. By the end of August 2000, the Twelfth East Panel had been completed and the eastern 1900 feet of the Fourteenth East Panel had been mine (there is no Thirteenth East Panel). Future mining in this area will remove the remaining panels in the Blind Canyon Seam and then will progress to the Hiawatha Seam. Overburden in this area ranges from less than 400 in both the north and south of the area to over 1,700 feet beneath North Rilda Ridge.

The topography in this region is very rugged. North Rilda Ridge is situated in an east-west trend in the center of the area and the topography drops off steeply to the north into Mill Fork and the South into Rilda Canyon. The Castlegate Sandstone forms an escarpment, which is present near the top and encircles North Rilda Ridge on the North, East and South. The south facing slopes below the cliff are covered with grass brush and juniper trees while the north facing slopes in Mill Canyon are densely covered with conifers.

The subsidence monitoring in this area shows that subsidence has occurred over most of the Eleventh East Panel and begun in the eastern portion of the Twelfth East Panel. A maximum of 6 feet of subsidence has been observed in a small area. In the coming

years, as mining progresses the subsidence trough will widen and will become more pronounced. It should be expected that maximum subsidence with one seam mined will be between 5 and 7 feet and after mining of the second seam it should reach 12 or 13 feet.

In June of 1999 several prisms were placed on the top of the Castlegate sandstone cliff to enable the monitoring of the cliff stability as they are undermined. Some of the prisms have been undermined but no major movement has been detected to date. The prism data can be found in the appendix.

A few minor springs are located on top of North Rilda Ridge. Monitoring has shown mining to have no effects on the hydrology of the area (see Hydrologic Monitoring Report for 2000).

MINING\RODGER\SUBSIDE\AREAMAPS\AREA25BASE.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

2000 SUBSIDENCE
DEER CREEK MINE
10TH THROUGH 14TH EAST OFF 5TH NORTH

DRAWN BY: RODGER C. FRY

FIGURE 86

SCALE: 1" = 800'

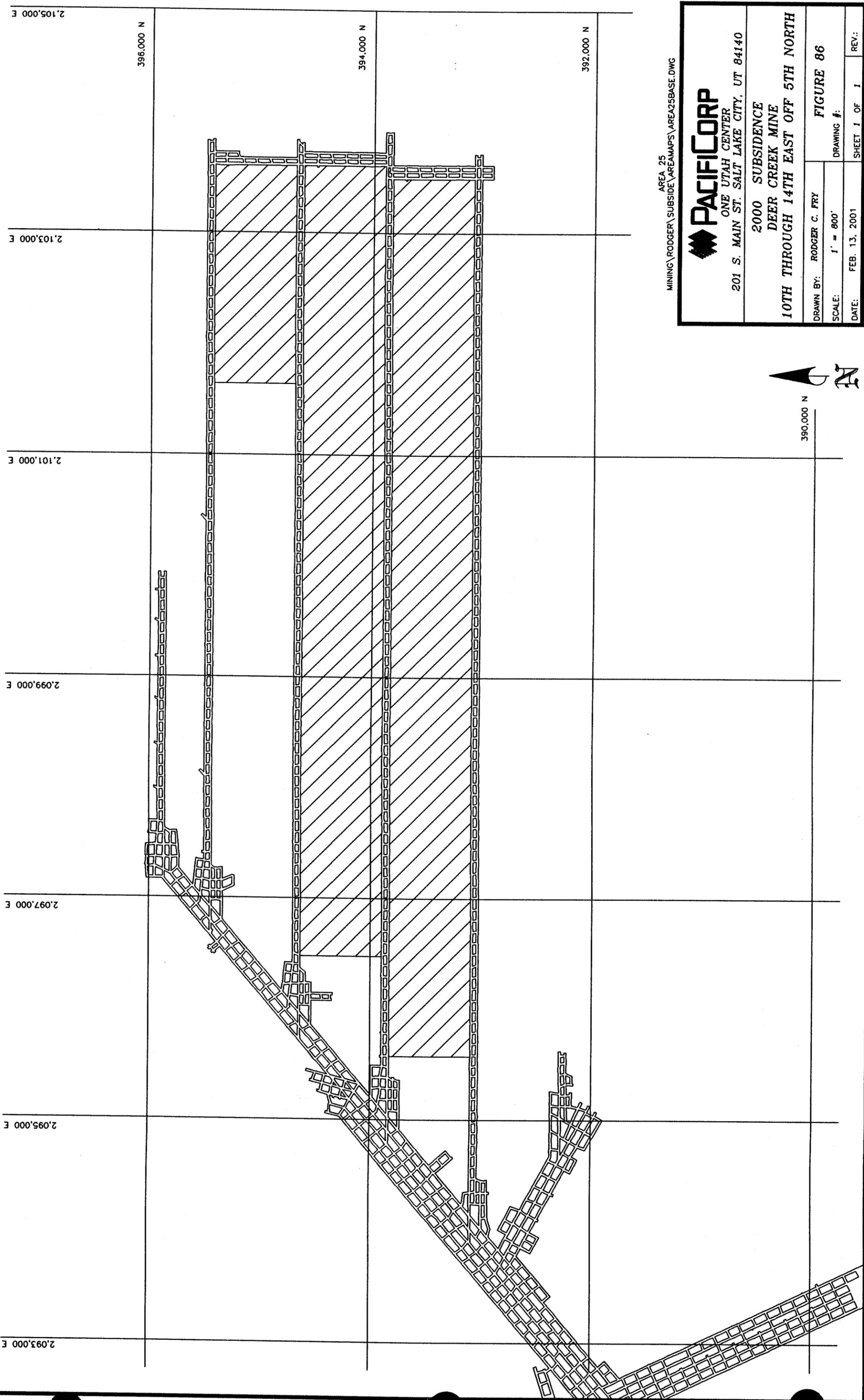
DATE: FEB. 13, 2001

SHEET 1 OF 1

REV.:

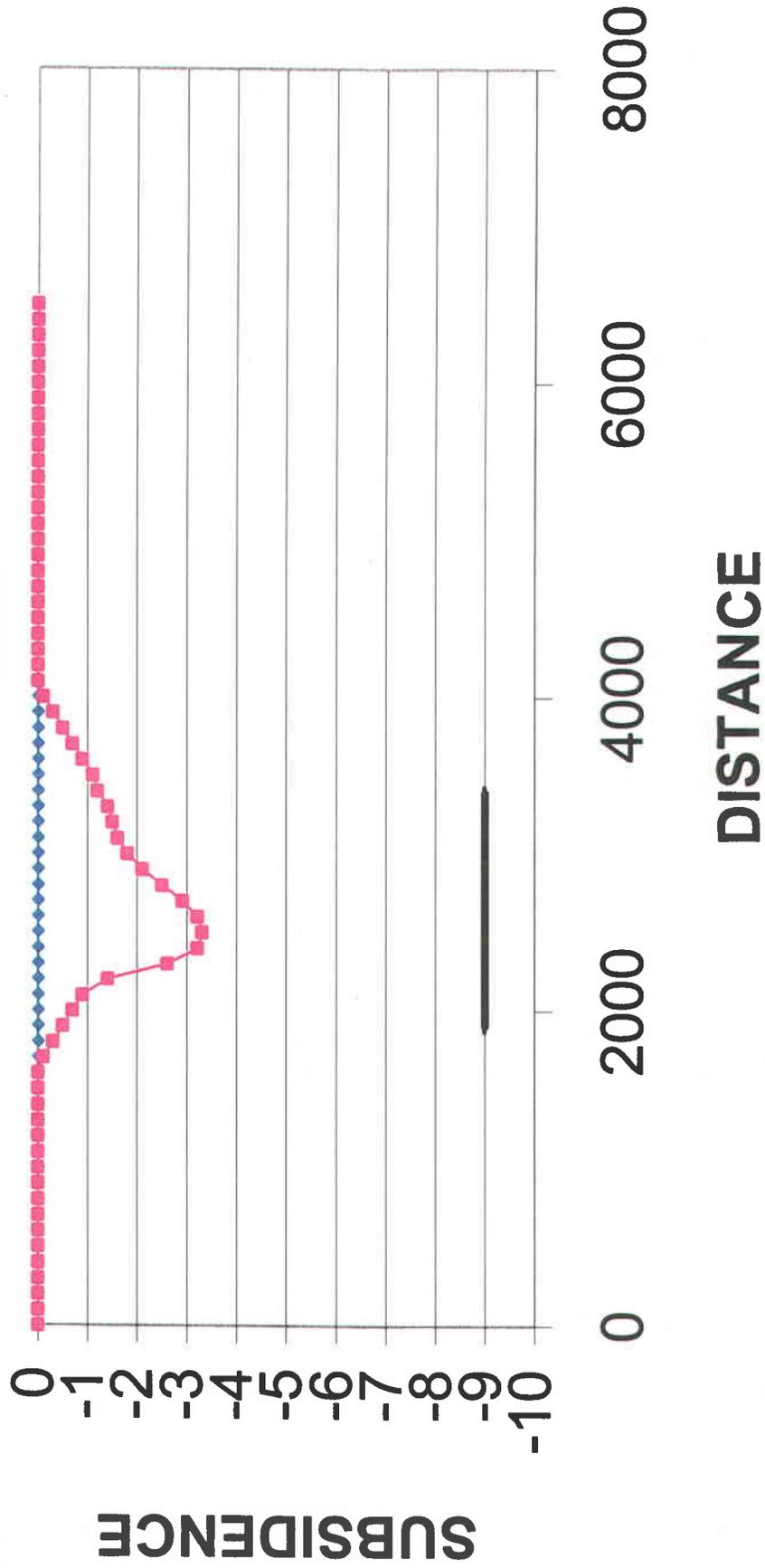


390,000 N





AREA 25 NORTH-SOUTH PROFILE



◆ 1999 ■ 2000 ■ 2001 — WORKINGS

FIGURE 88

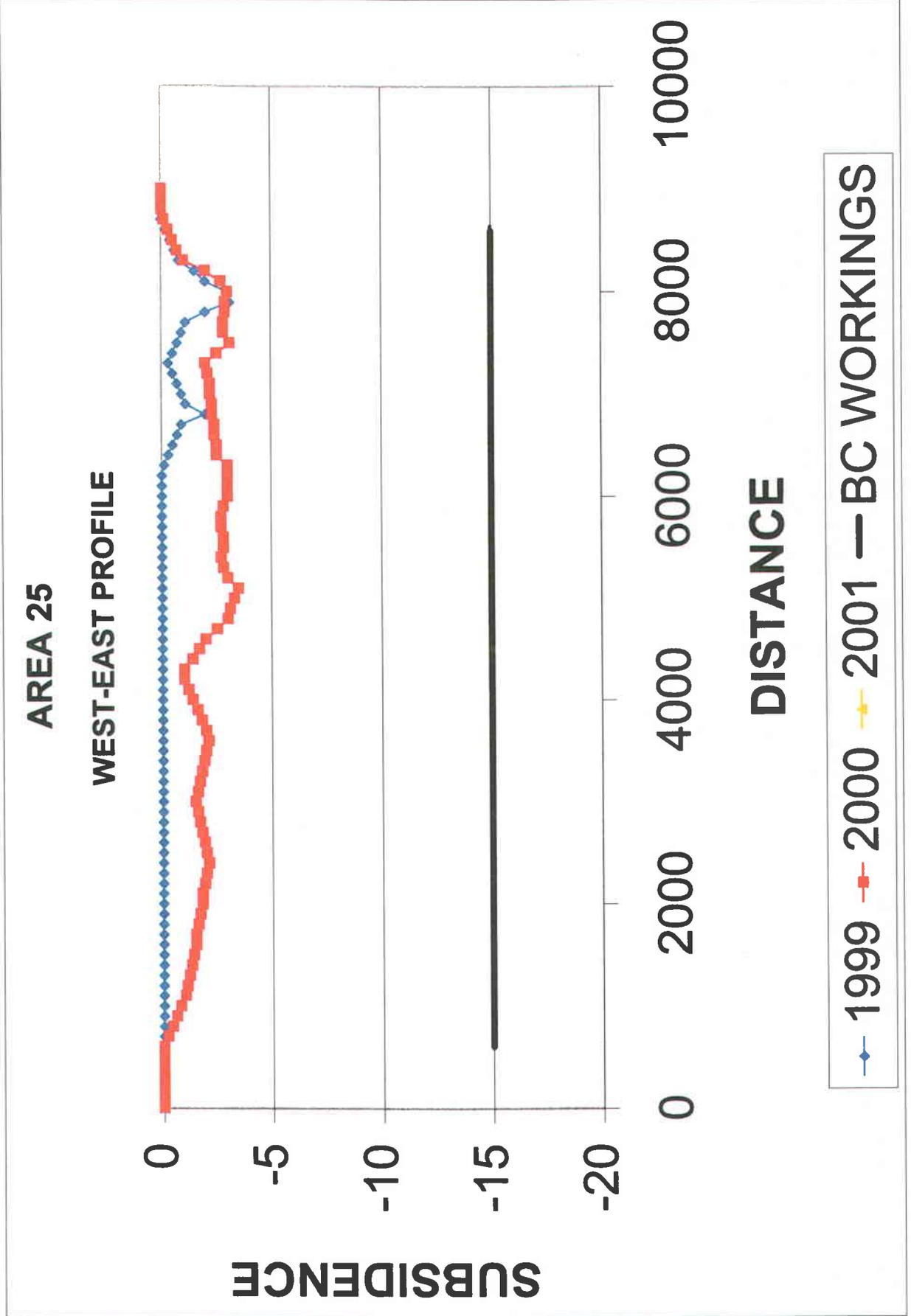


FIGURE 89

Predicted Maximum Subsidence

A comparison between observed and predicted maximum subsidence for the various areas on PacifiCorp's property has been made using a method developed by the British National Coal Board (NCB). The NCB method utilizes graphs compiled from numerous field observations and takes into consideration the length and width of the mined-out area, thickness of coal extracted, and depth of cover. The method is claimed to be correct to $\pm 10\%$ in the majority of cases, assuming certain limiting conditions are met. The table below compares predicted maximum subsidence with observed subsidence for areas on East Mountain.

Area	Subsidence (feet)		
	Predicted Maximum	Observed	% of Predicted
1* DC 9E/W 1R	15.2	28.0	184
2 DC 5-8E/W, 3-13R	13.8	13.1	95
3 DC 1N Area 7.7	7.7	5.5	71
4 DC 2-17R	13.6	13.5	99
5 DC 2-5L	13.5	15.5	114
6 W 1-2W	5.0	4.5	90
7 Bee 2N off 8W	6.6	7.4	112
8 Bee/Des E&W Sections	6.8	4.8	104

Area	Subsidence (feet)		
	Predicted Maximum	Observed	% of Predicted
9 Little Dove 1N	4.3	3.5	81
10 Old American Fuel Mine	7.0	6.1	87
11 DC C&D N	13.7	13.2	96
12 W 2L	1.5	0.0	0
13 Des-Bee-Dove Southern Areas	2.0	1.8	90
14 Cottonwood 6-7E	7.6	4.7	62
15 Cottonwood 9-12W	7.2	5.0	69
16 Cottonwood 8-11E	7.4	4.5	61
17 Cottonwood 16-15 W	8.1	7.2	89
18 Deer Creek 2nd-7th R	7.7	7.2	94
19 Deer Creek 7th & 8th E	7.9	4.5	57
20 Deer Creek 1st & 2nd L	7.8	6.1	79
21 Deer Creek 2nd- 7th E	7.5	7.5	100
22 Deer Creek 2nd-8th W	7.5	8.1	108
23 Trail Mountain 2 nd -5 th E	7.8	8.1	104
24 Trail Mountain 1 st - 10 th Right	7.5	6.4	85
25 Deer Creek 10-14 th West	6	6	100

* This area does not fit the NCB prediction model.

In most areas subsidence is less than the maximum predicted by the NCB model. The observed subsidence shown here represents the actual maximum subsidence for the

particular geologic conditions -- probably the case in some areas since subsidence appears to have ceased in several areas where the NCB predicted maxima were not reached. In areas showing greater than expected subsidence, chain pillars or barriers between sections are probably crushing so that strata above the working caves as it would if a wider zone had been mined.

Mitigation of Surface Effects

Prior to mining in an area, we notify the land owner that mining will be in progress beneath his property. The land owners within our permit boundary are as follows:

Karl A. Seely, Inc.

LDS Church

US Forest Service

US Bureau of Land Management

Elk Springs Property Users Assn.

Kent Barton

We will continue to notify those owners prior to undermining their properties.

Over most areas where subsidence has been observed on East Mountain, present land use has not been affected in any way. Areas 2, 5, 6, 8, 9, 10, 12, 13, 15, 16, 17, 18, 19, 20, 23, 24 and 25 are good examples of subsidence without visible surface disturbance or adverse hydrologic effects. In such areas no mitigation is necessary.

In a few areas, such as Areas 1, 3, 4, 7, 10, 11, 14, 21 and 22, surface fractures have been detected. In order to protect livestock PacifiCorp has erected a fence around Area 1 where fractures are of sufficient magnitude to pose a threat to wandering cattle. In the regions where the fractures could be reclaimed they have been filled in with heavy equipment and the escarpments have been evenly contoured and reseeded. In Area 4, the small tension

fractures that formed were reclaimed by filling in the fractures using a motor-grader and reseeding the area. In Area 14, where cracks have also been observed, these were filled in by hand in 1998 and reseeded. The U.S. Forest Service accepted this mitigation as being sufficient and complete.

In Areas 3, 7, 10, 11, 21 and 22 where only minor fracturing has occurred on remote ridges and/or where land use has not been affected, more damage would be done by gaining access to and repairing or fencing fractures than can be justified; therefore, mitigation is counterproductive in those areas and is not planned.

Summary

As of August 2000 PacifiCorp has identified twenty-five (25) areas of mining-induced subsidence on the East Mountain/Trail Mountain property. Terrain in the subsidence areas ranges from relatively flat mountain tops with thick overburden of up to 2,200 feet to steep slopes and cliffs with overburden of less than 200 feet. The most noticeable subsidence effects occur in the steep cliff areas and where mining next to burned coal appears to have caused crushing of the clinker beds. Most of the fractures observed over mined areas have occurred under these conditions, especially where the Castlegate Sandstone (or similar lithologic unit) crops out or is near the surface. The sandstones yield to stress by brittle deformation (fracturing).

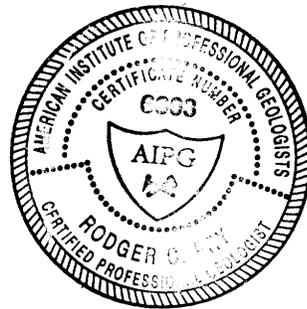
In areas where overburden is thicker and other, more clay-rich formations crop out, longwall and room-and-pillar mining methods have allowed the multiple seam mining of large quantities of coal without apparent impact on the environment because the overburden yields through plastic deformation. Areas such as the Beehive-Deseret east and west room-and-pillar sections (Areas 8 and 13) and the Deer Creek 4th through 8th East-Wilberg 3rd through 13th Right longwall panels (Area 2) have demonstrated that subsidence can occur over a broad area with no visible or hydrologic effects. In excess of eighty percent (80%) of the East Mountain property has conditions similar to those areas; therefore, the mining methods being utilized are well suited to the geologic conditions, allowing subsidence to occur without impacting the hydrology or present land use of the area.

An effort was made again this year to predict maximum possible subsidence for the various areas where subsidence has been detected. The prediction was then compared with observed subsidence for each area. It appears that the actual subsidence occurring on East Mountain/Trail mountain is slightly less than that predicted by the NCB model.

Professional Certification of Subsidence Data

I, Rodger C. Fry being a Certified Professional Geologist, with significant experience in subsidence monitoring, certify that the subsidence data contained in this document was collected under my direction, and the attached subsidence materials were prepared by me using industry-accepted methods. I further certify that the interpretations contained herein are an accurate representation of the subsidence that has occurred.

Dated this 30th day of March, 2001.



Rodger C. Fry

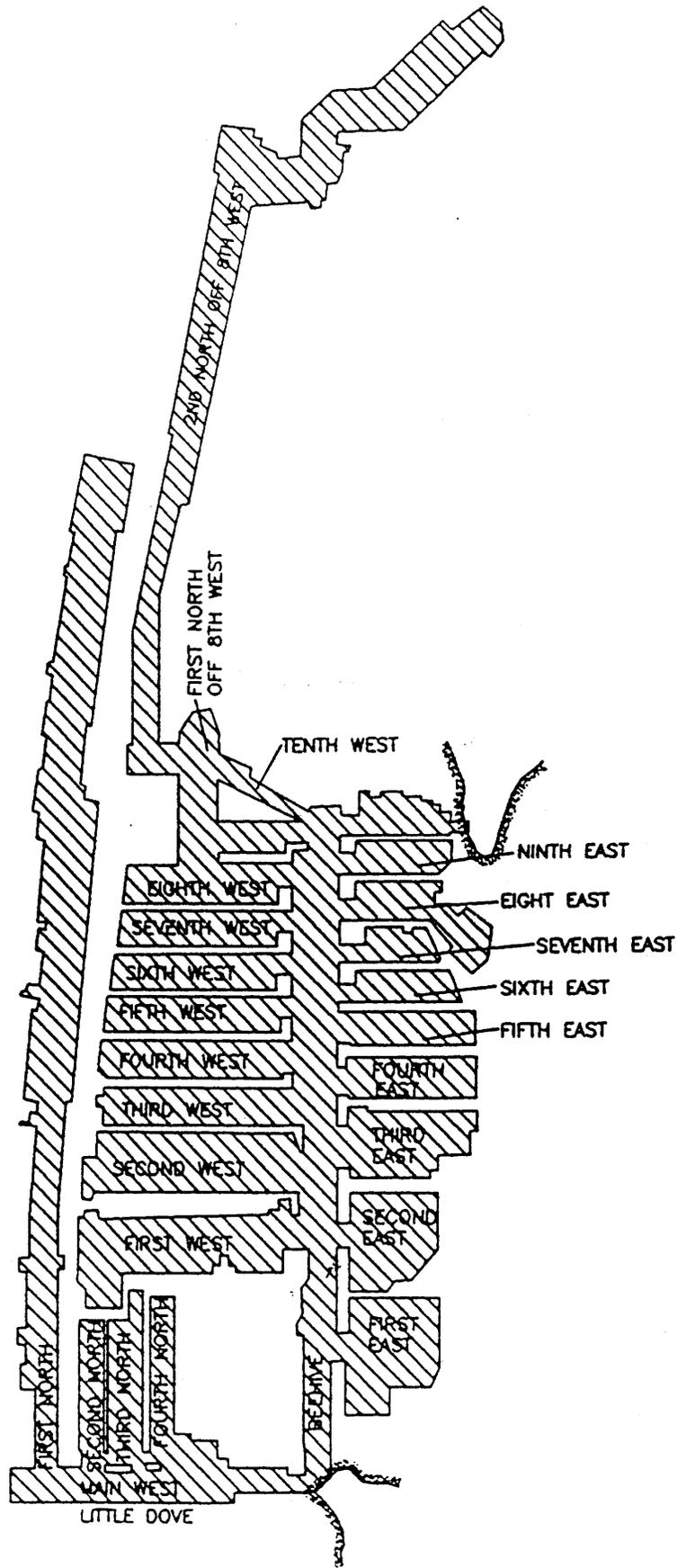
No. 6603

APPENDICES

SUBSIDENCE MAP

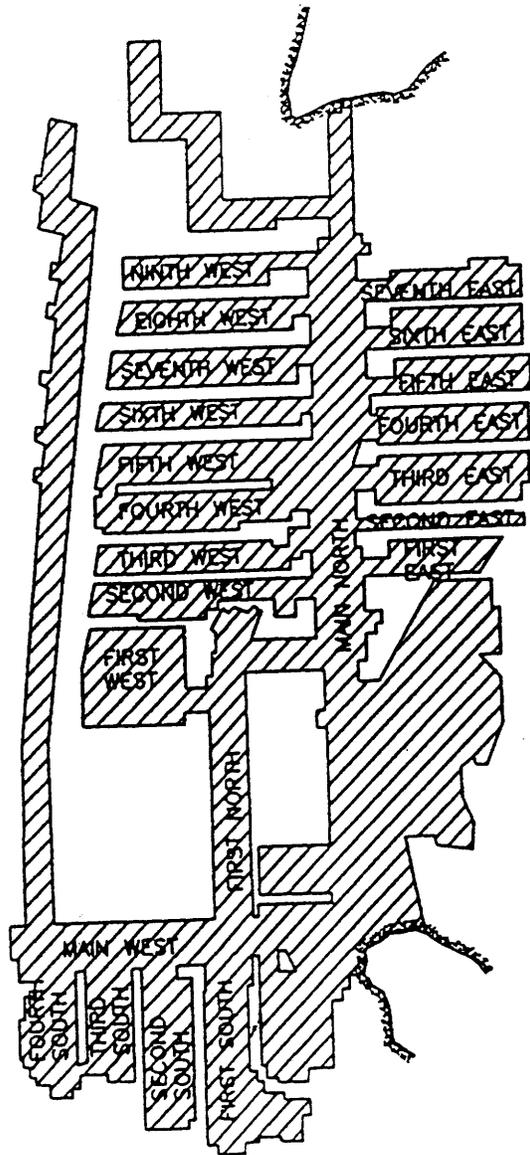
RAW DATA

Des-Bee-Dove Mines



BEEHIVE & LITTLE DOVE COAL MINES

SCALE: 1" = 2,000'



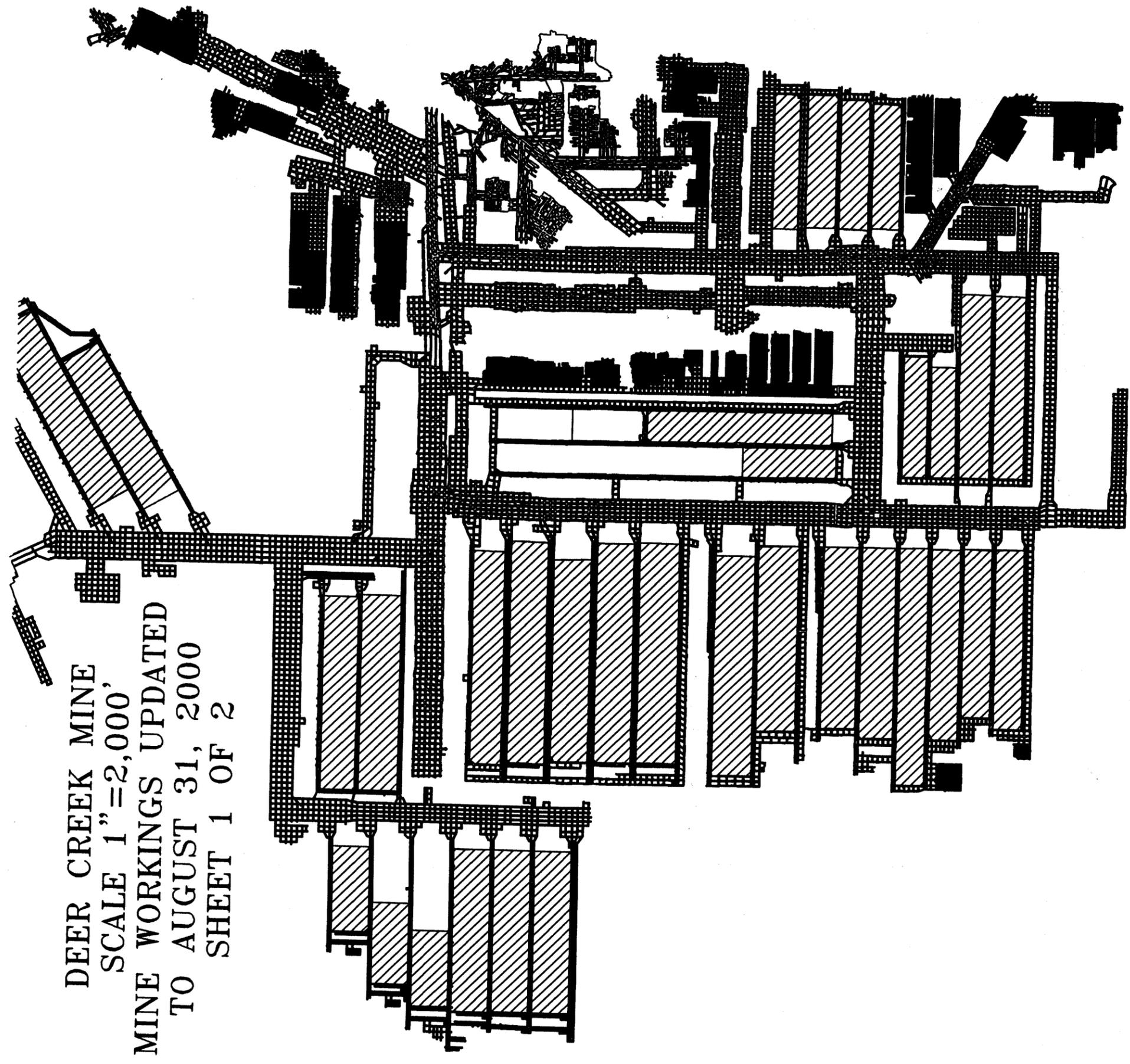
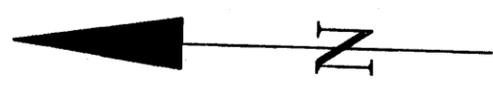
DESERET COAL MINE

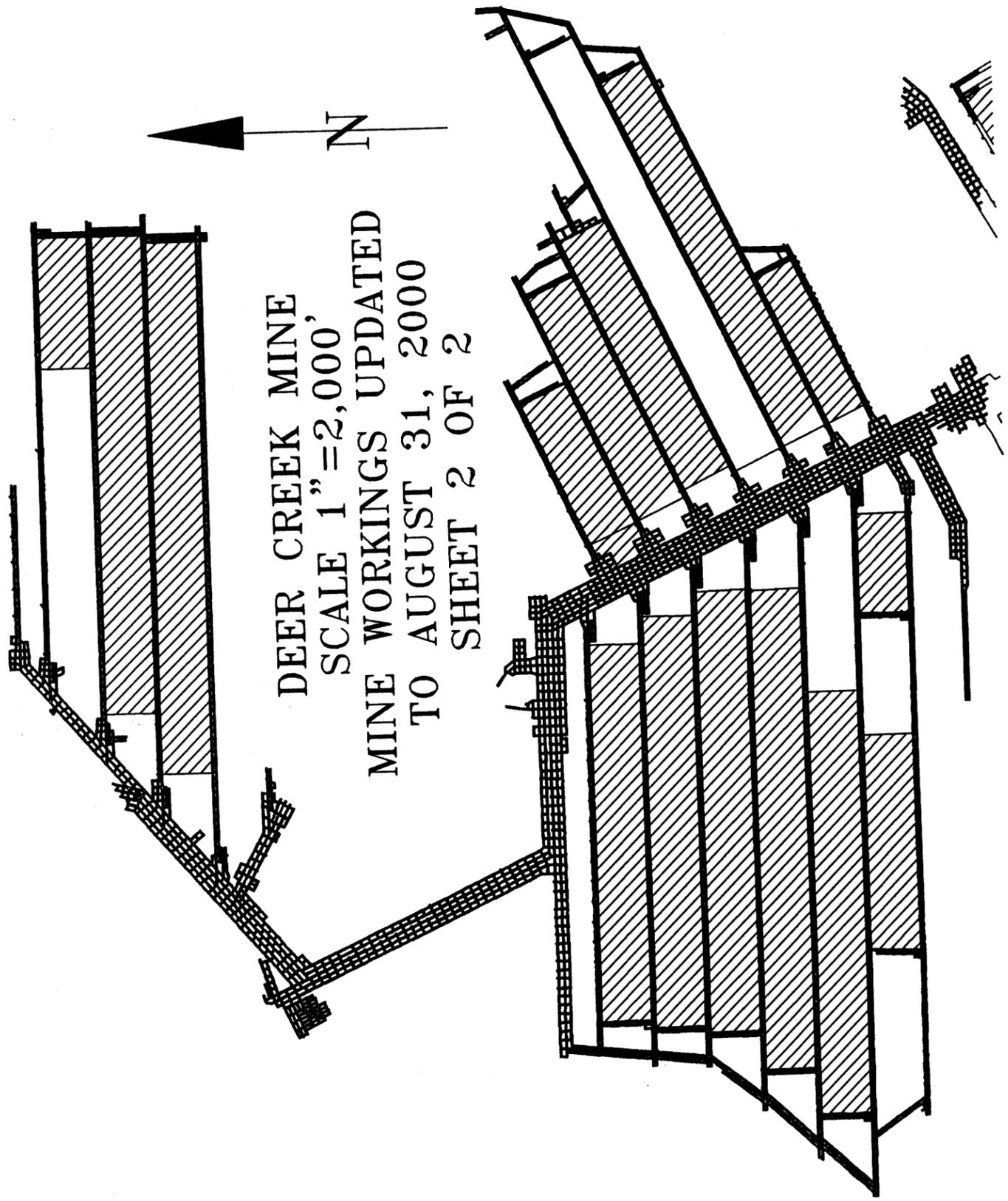
SCALE: 1" = 2,000'



Deer Creek Mine

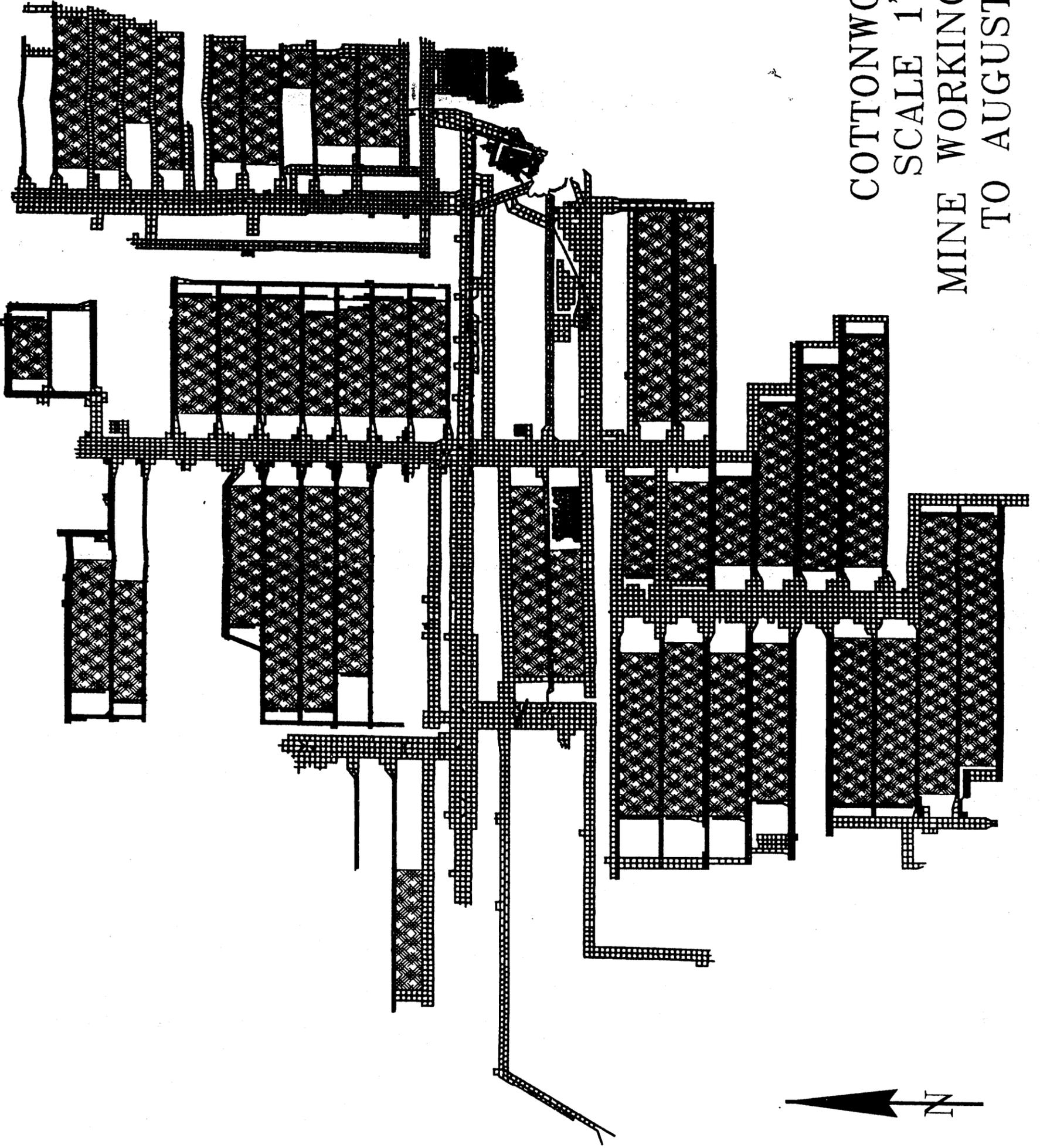
DEER CREEK MINE
SCALE 1"=2,000'
MINE WORKINGS UPDATED
TO AUGUST 31, 2000
SHEET 1 OF 2





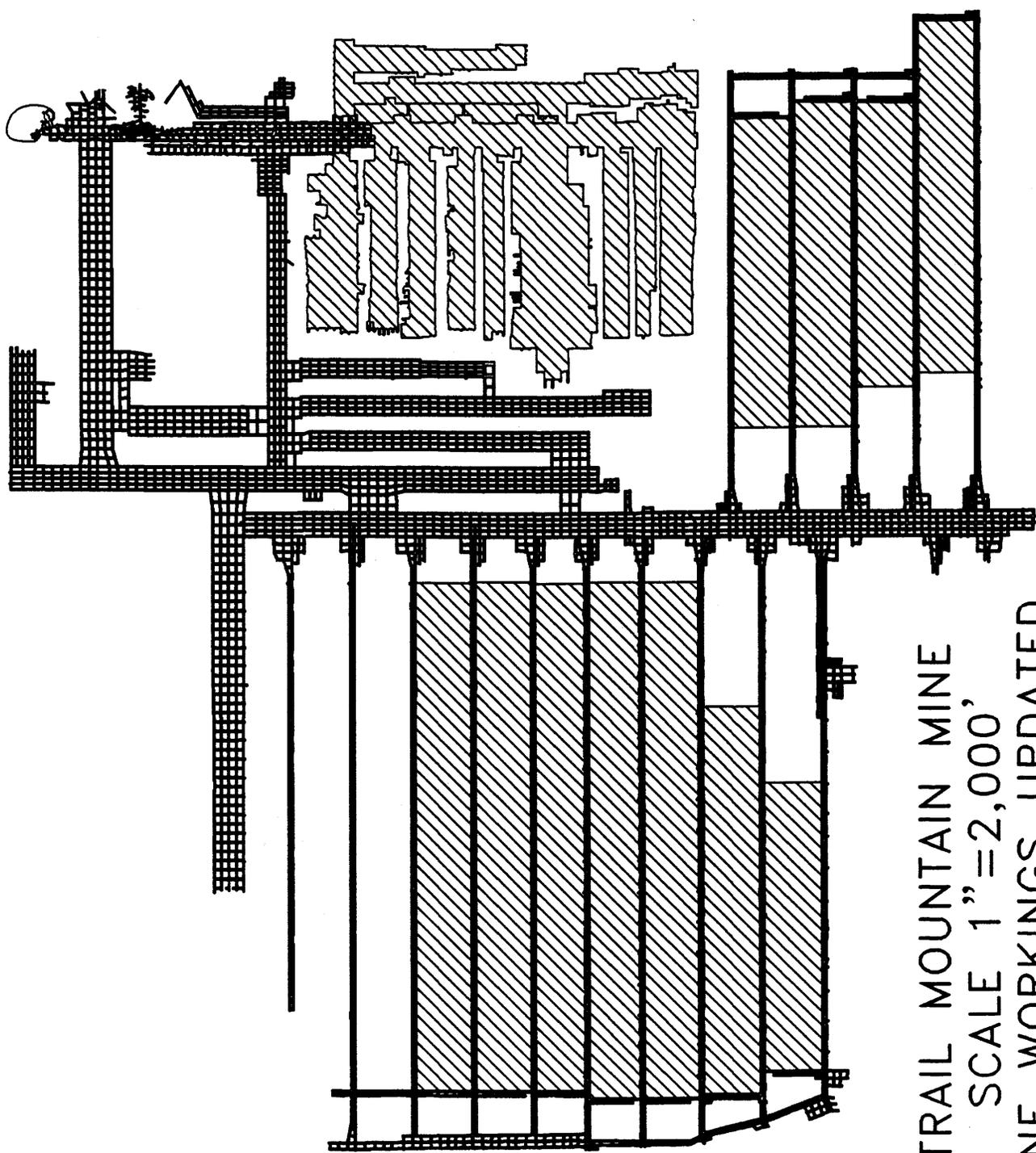
DEER CREEK MINE
SCALE 1"=2,000'
MINE WORKINGS UPDATED
TO AUGUST 31, 2000
SHEET 2 OF 2

Wilberg/Cottonwood Mine



COTTONWOOD MINE
SCALE 1" = 2,000'
MINE WORKINGS UPDATED
TO AUGUST 31, 1996

Trail Mountain Mine



TRAIL MOUNTAIN MINE
SCALE 1" = 2,000'
MINE WORKINGS UPDATED
TO AUGUST 31, 2000

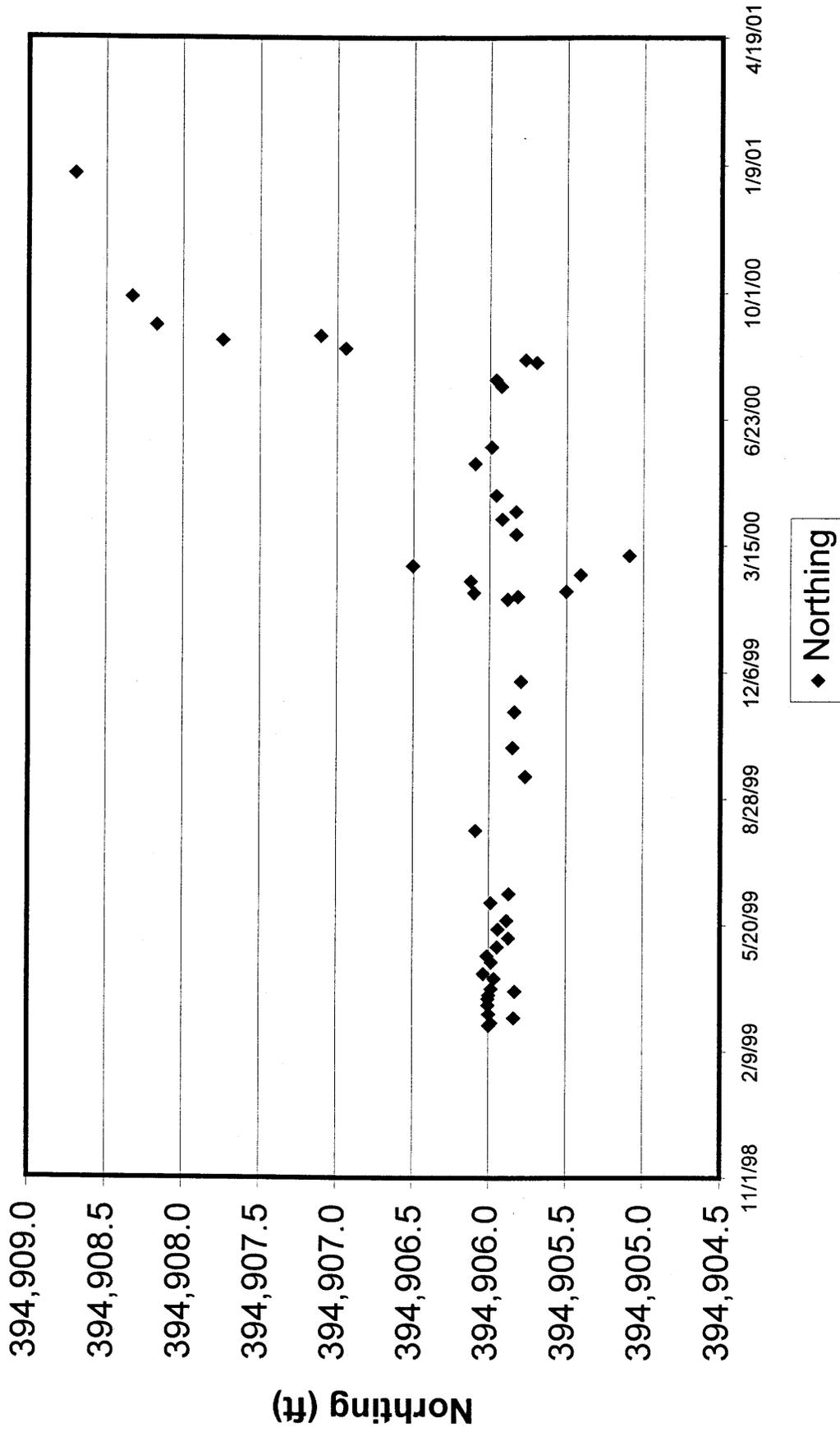


Spring Map with 5-Year Mine Plan

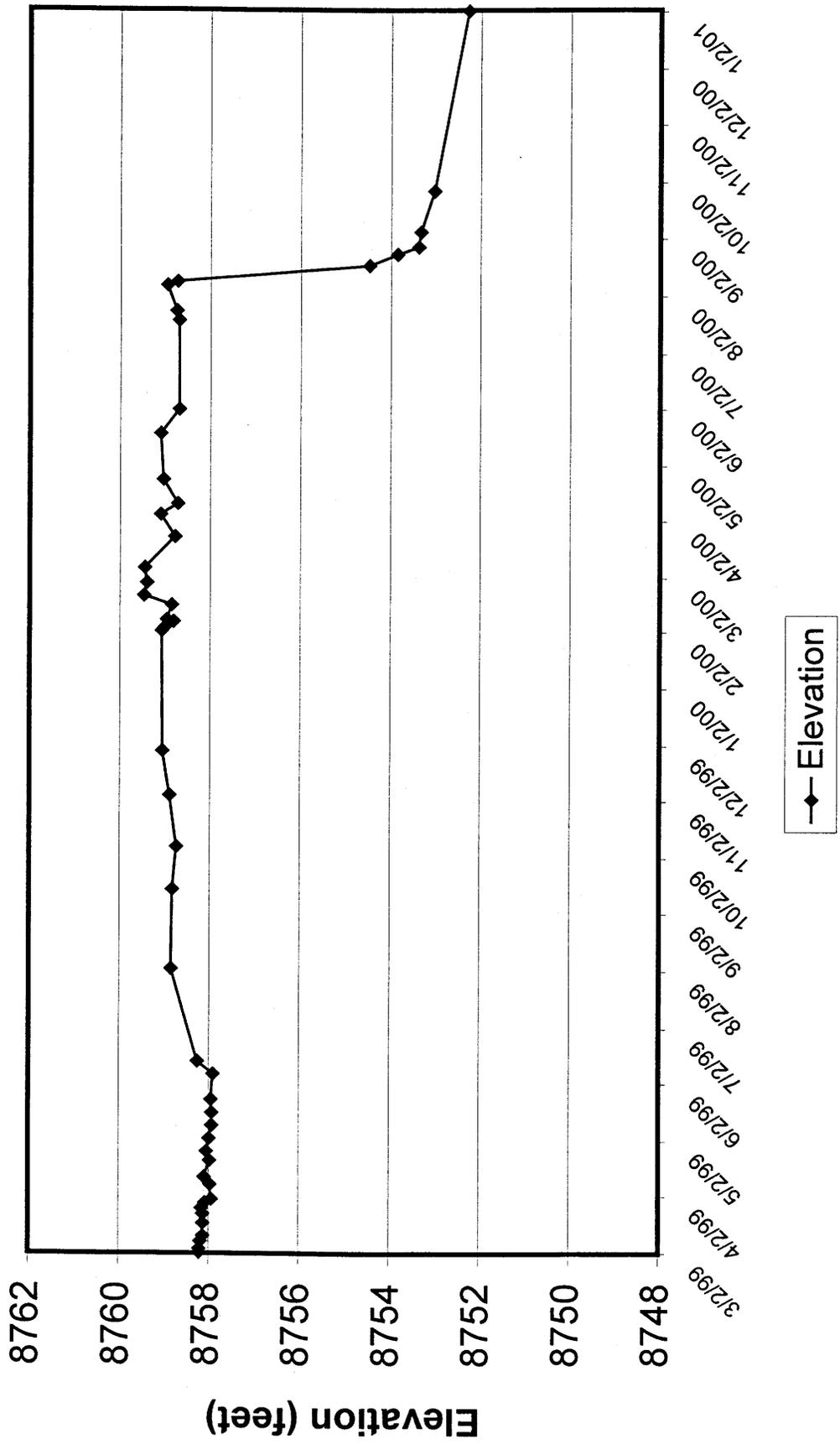
Showing Subsidence

Cliff Stability Survey Targets

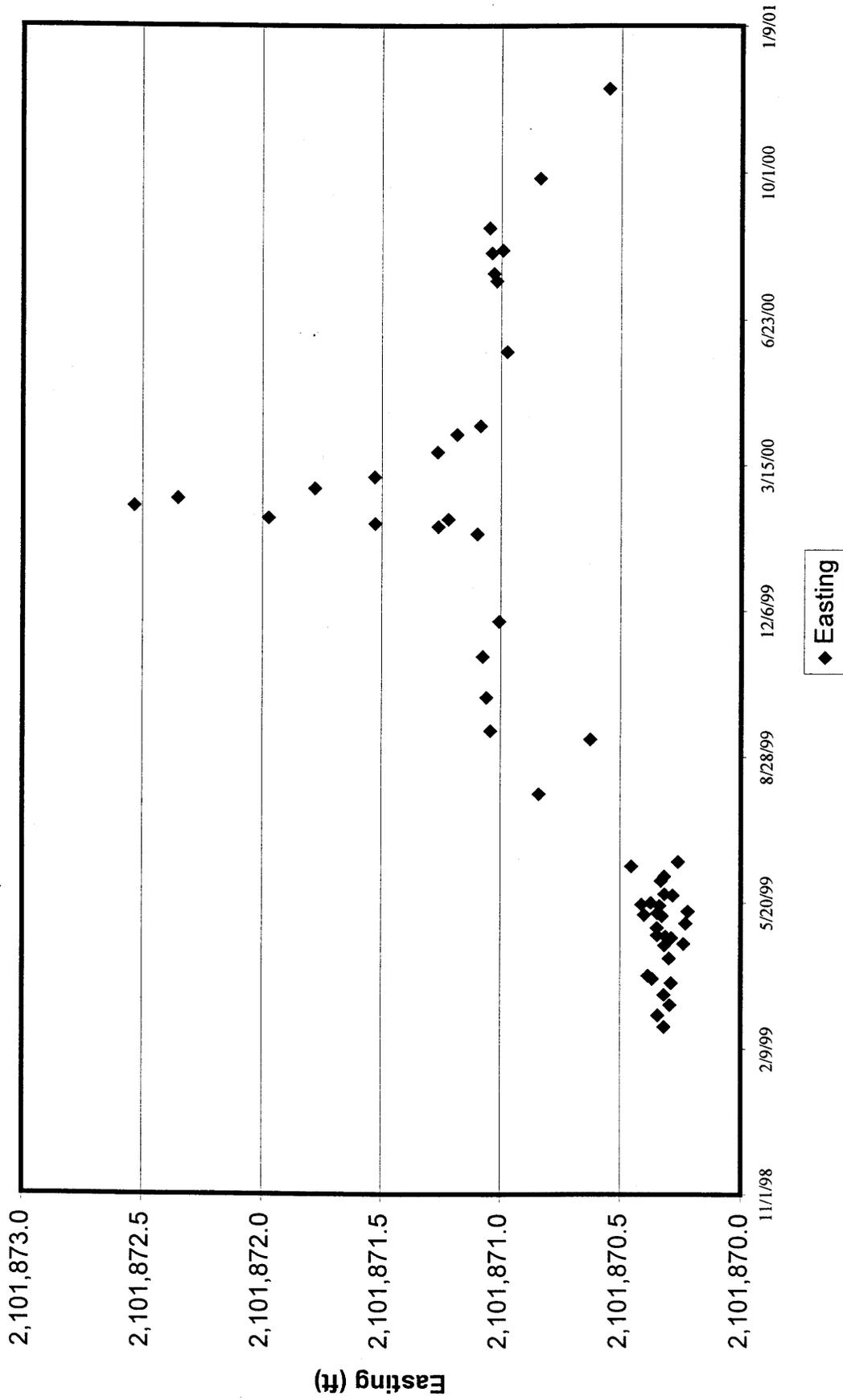
Rilda Canyon Prism #1



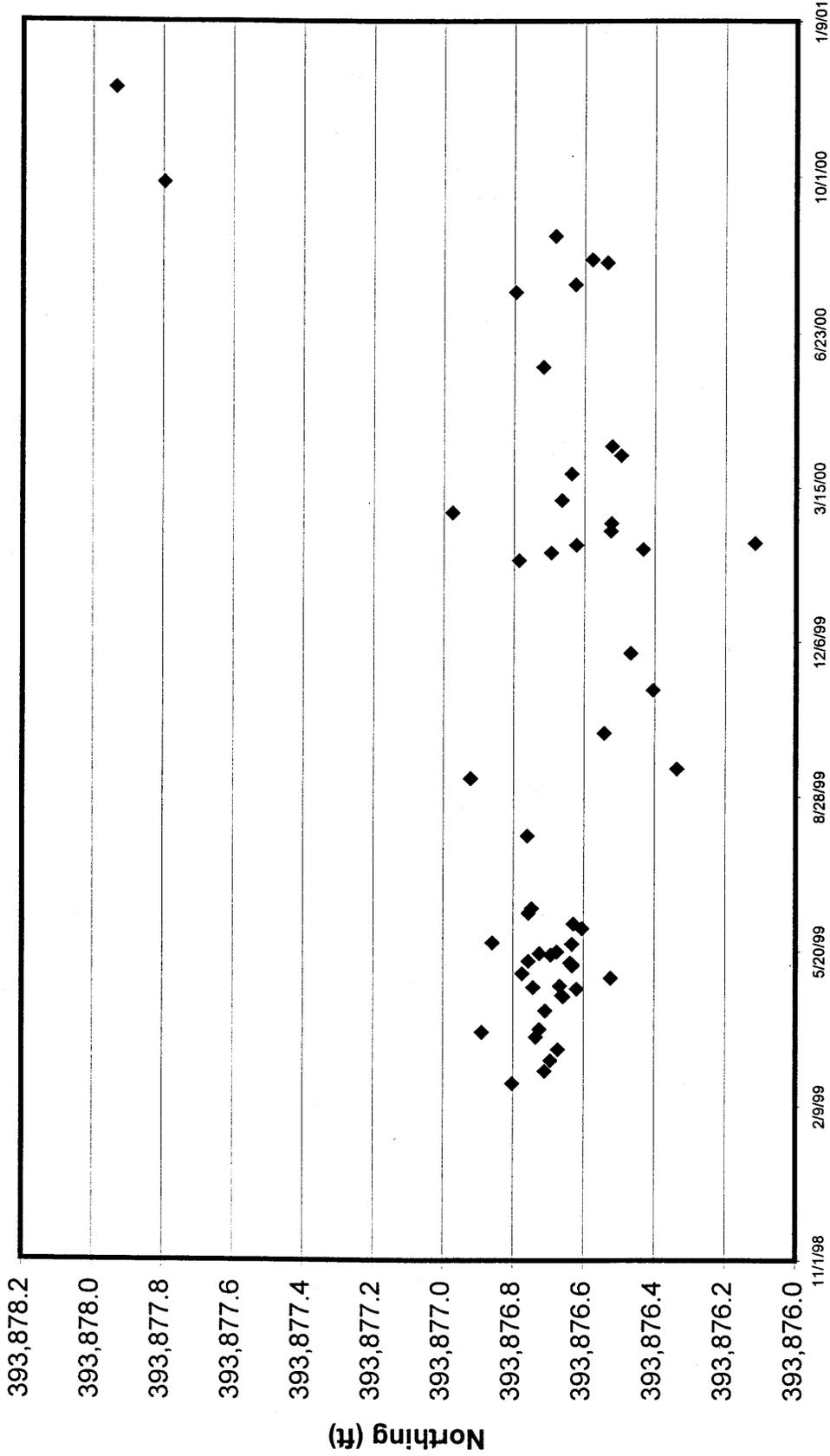
Rilda Canyon Prism #1



Rilda Canyon Prism #2

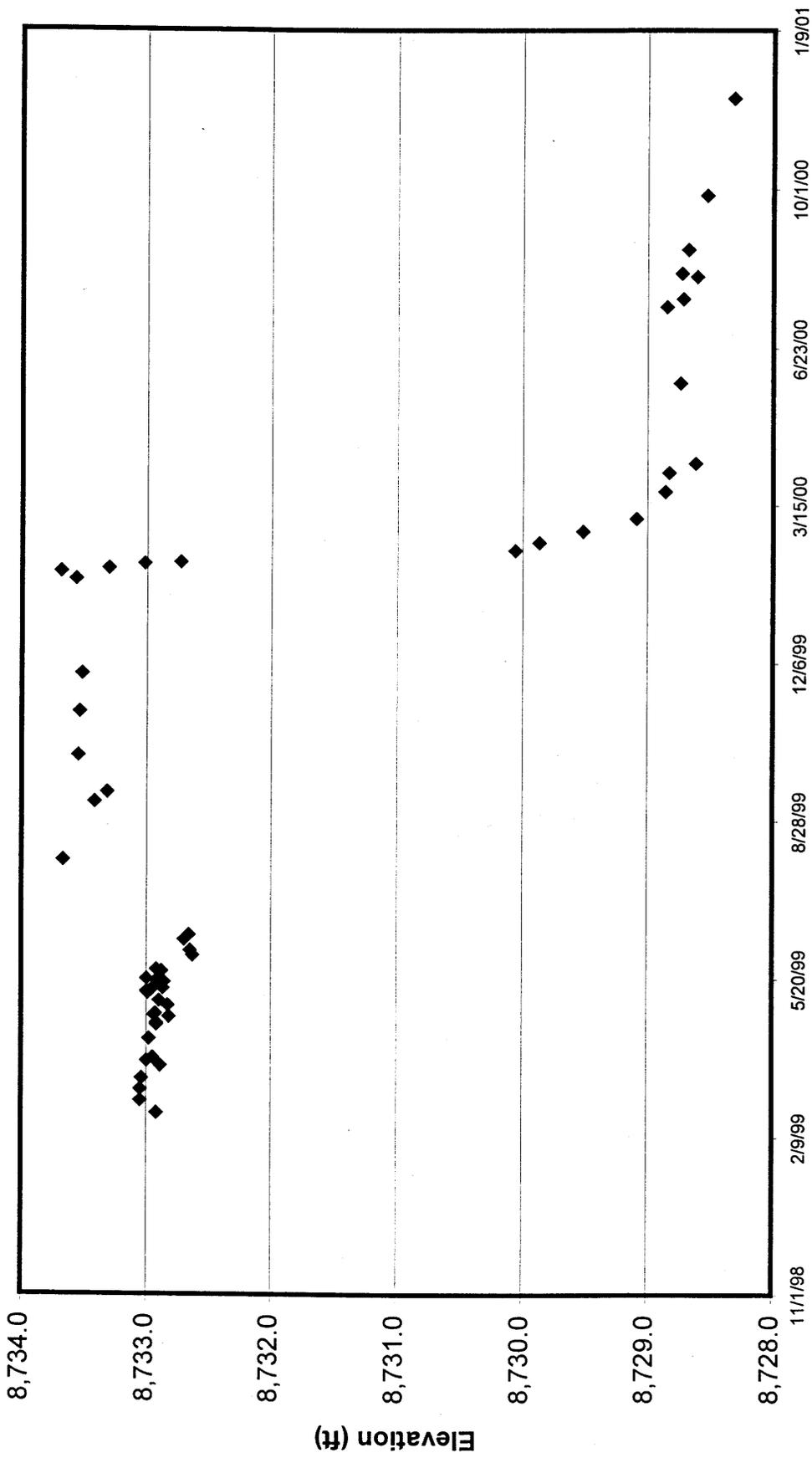


Rilda Canyon Prism #2



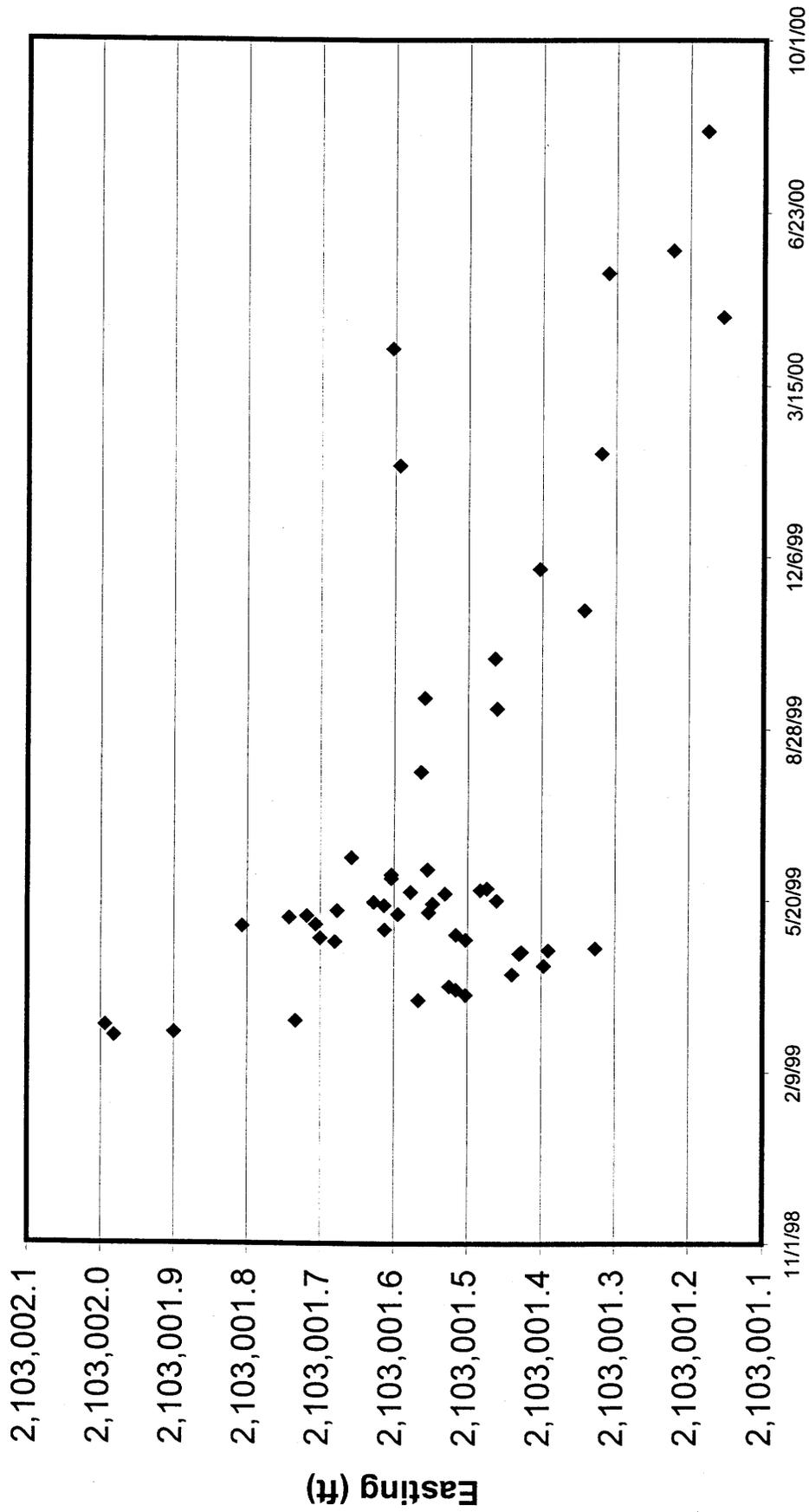
◆ Northing

Rilda Canyon Prism #2



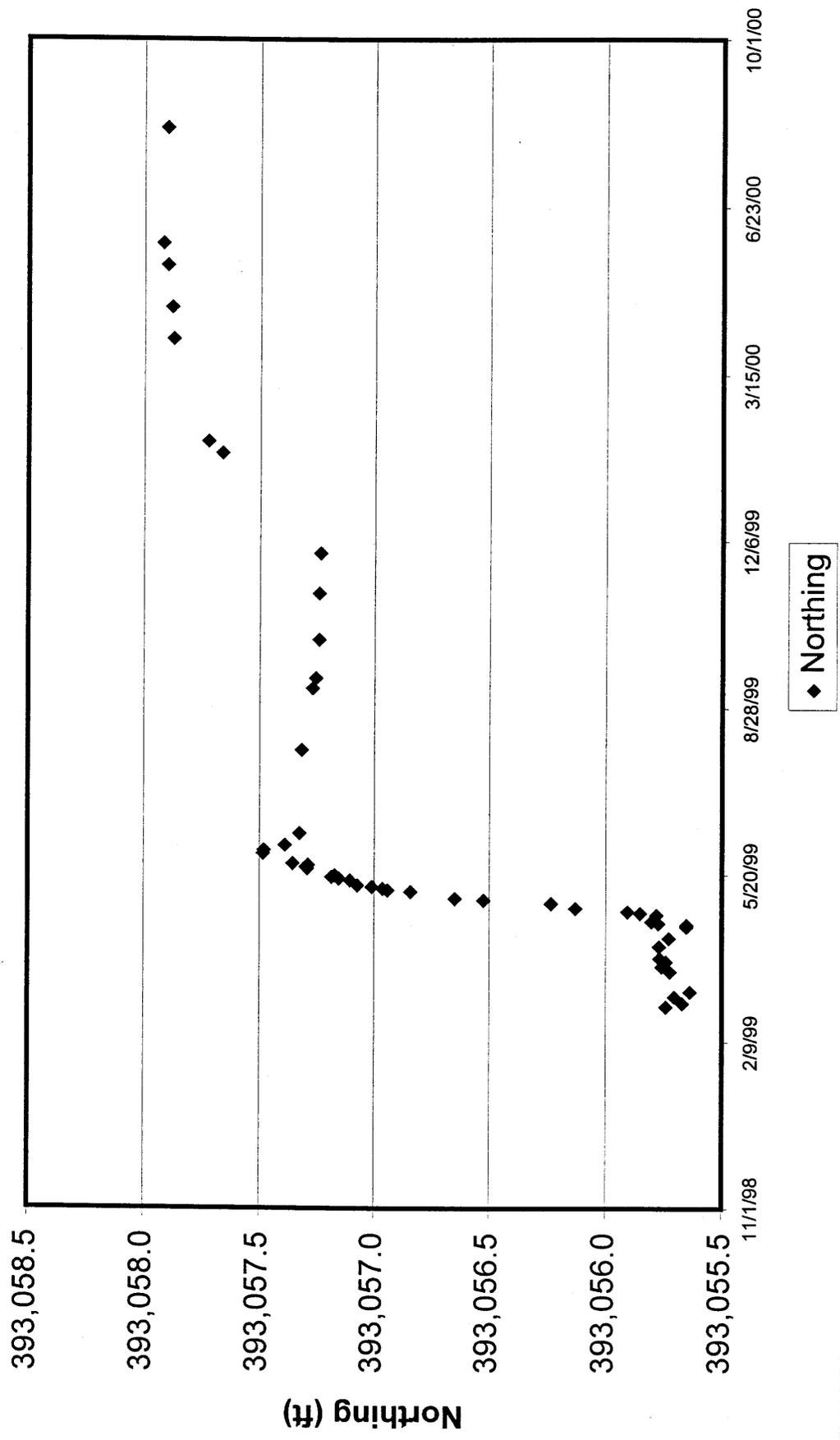
◆ Elevation

Rilda Canyon Prism #3

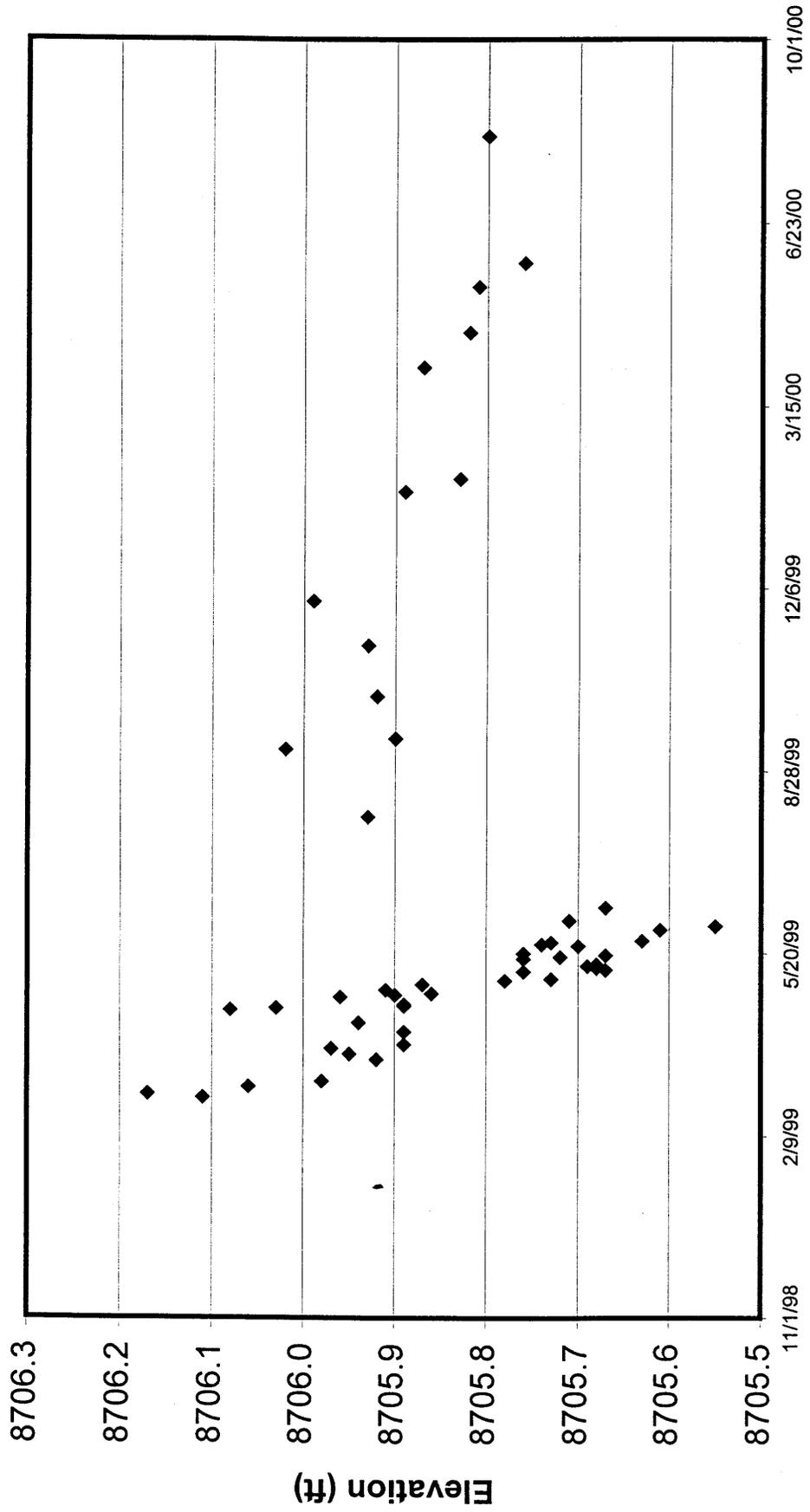


◆ Easting

Rilda Canyon Prism #3



Rilda Canyon Prism #3



◆ Elevation

RILDA CANYON PRISMS

Prisms 4-6 Installed on JUNE 21, 1999

Baseline Data

PRISM 4

Date	Northing		Easting		Elev
	Reading	Variance	Reading	Variance	Reading
6/29/99	392,315.99		2,100,862.09		8794.10
8/3/99	392,316.03		2,100,862.00		8794.14
9/15/99	392,316.01		2,100,861.69		8794.12
10/8/99	392,315.84		2,100,861.96		8794.24
11/5/99	392,315.89		2,100,861.99		8794.14
11/29/99	392,315.94		2,100,861.81		8794.20
4/24/00	392,316.27		2,100,861.75		8794.09
5/19/00	392,316.24		2,100,861.73		8794.35
6/5/00	392,316.24		2,100,861.64		8794.10
9/5/00	392,316.28		2,100,861.24		8794.04
9/27/00	392,316.25		2,100,862.06		8794.13

AVERAGE

392,316.09

2,100,861.81

8794.15

tion

Variance

RILDA CANYON PRISMS

Prisms 4-6 Installed on JUNE 21, 1999

Baseline Data

PRISM 5

Date	Northing		Easting		Elevation	
	Reading	Variance	Reading	Variance	Reading	Variance
6/29/99	391,820.30		2,099,639.96		8814.77	
8/3/99	391,820.29		2,099,639.88		8814.82	
9/15/99	391,820.20		2,099,639.59		8814.79	
10/8/99	391,820.18		2,099,639.89		8814.82	
11/5/99	391,820.24		2,099,639.83		8814.77	
11/29/99	391,820.20		2,099,639.65		8814.83	
4/24/00	391,820.36		2,099,639.79		8814.76	
5/19/00	391,820.35		2,099,639.76		8814.87	
6/5/00	391,820.44		2,099,639.83		8814.74	
9/5/00	391,820.41		2,099,639.78		8814.81	
9/27/00	391,820.42		2,099,640.10		8814.82	

AVERAGE

391,820.31

2,099,639.82

8814.80

RILDA CANYON PRISMS

Prisms 4-6 Installed on JUNE 21, 1999

Baseline Data

PRISM 6

Date	Northing		Easting		Elev
	Reading	Variance	Reading	Variance	Reading
6/29/99	391,695.08		2,097,768.41		8862.11
8/3/99	391,695.11		2,097,768.49		8862.19
9/15/99	391,694.89		2,097,768.38		8862.15
10/8/99	391,695.05		2,097,768.60		8862.23
11/5/99	391,695.03		2,097,768.53		8862.26
11/29/99	391,694.93		2,097,768.37		8862.32
4/24/00	391,694.85		2,097,768.35		8862.23
5/19/00	391,694.90		2,097,768.35		8862.24
6/5/00	391,695.15		2,097,768.53		8862.19
9/5/00	391,695.02		2,097,768.47		8862.31
9/27/00	391,695.22		2,097,768.68		8862.37

AVERAGE

391,695.02

2,097,768.47

8862.24

RILDA CANYON PRISMS

Prisms 4-6 Installed on JUNE 21, 1999

Baseline Data

PRISM 5

Date	Northing		Easting		Elevation	
	Reading	Variance	Reading	Variance	Reading	Variance
6/29/99	391,820.30		2,099,639.96		8814.77	
8/3/99	391,820.29		2,099,639.88		8814.82	
9/15/99	391,820.20		2,099,639.59		8814.79	
10/8/99	391,820.18		2,099,639.89		8814.82	
11/5/99	391,820.24		2,099,639.83		8814.77	
11/29/99	391,820.20		2,099,639.65		8814.83	
4/24/00	391,820.36		2,099,639.79		8814.76	
5/19/00	391,820.35		2,099,639.76		8814.87	
6/5/00	391,820.44		2,099,639.83		8814.74	
9/5/00	391,820.41		2,099,639.78		8814.81	
9/27/00	391,820.42		2,099,640.10		8814.82	

AVERAGE

391,820.31

2,099,639.82

8814.80

RILDA CANYON PRISMS

Prisms 4-6 Installed on JUNE 21, 1999

Baseline Data

PRISM 6

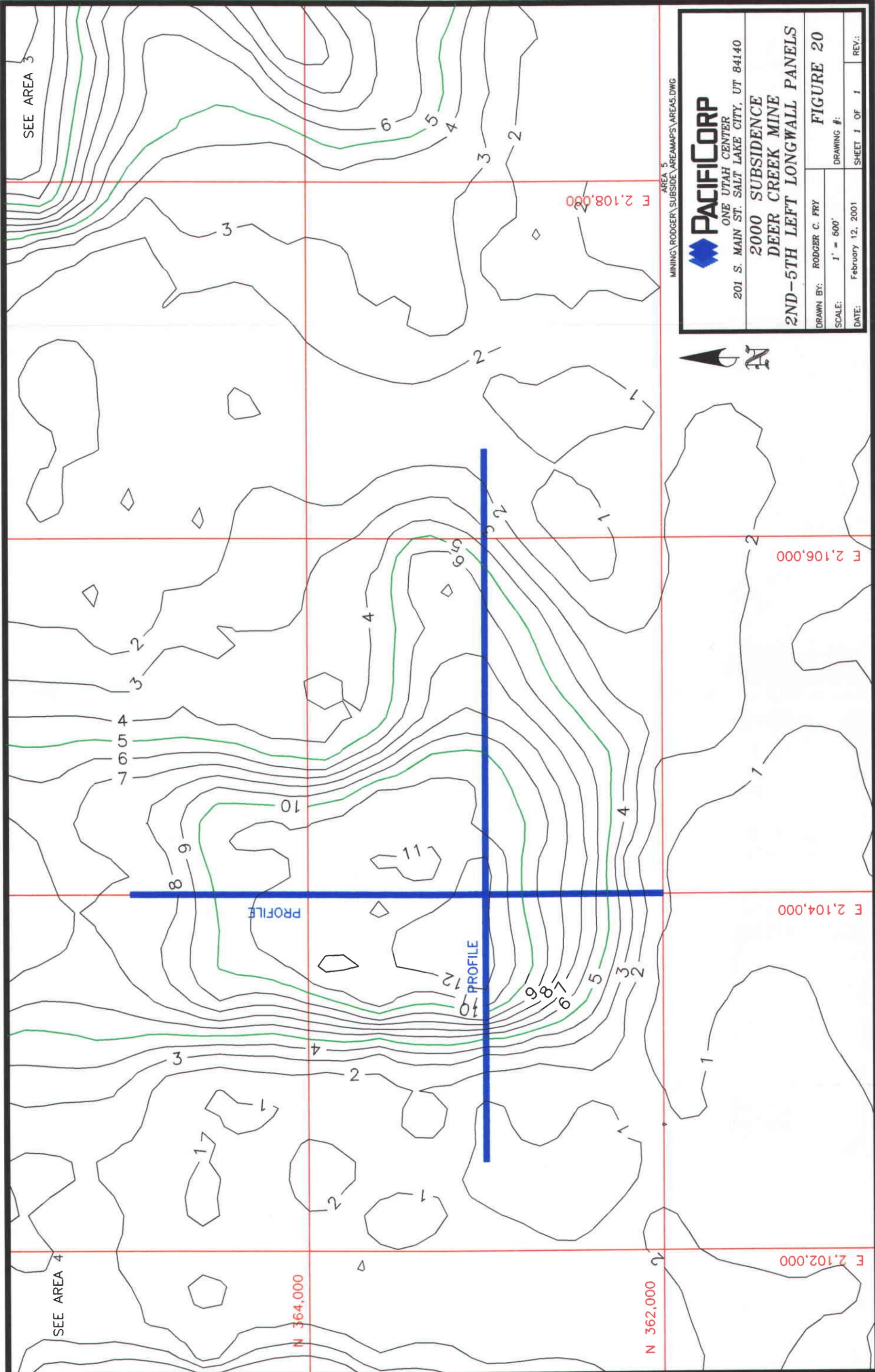
Date	Northing		Easting		Elev
	Reading	Variance	Reading	Variance	Reading
6/29/99	391,695.08		2,097,768.41		8862.11
8/3/99	391,695.11		2,097,768.49		8862.19
9/15/99	391,694.89		2,097,768.38		8862.15
10/8/99	391,695.05		2,097,768.60		8862.23
11/5/99	391,695.03		2,097,768.53		8862.26
11/29/99	391,694.93		2,097,768.37		8862.32
4/24/00	391,694.85		2,097,768.35		8862.23
5/19/00	391,694.90		2,097,768.35		8862.24
6/5/00	391,695.15		2,097,768.53		8862.19
9/5/00	391,695.02		2,097,768.47		8862.31
9/27/00	391,695.22		2,097,768.68		8862.37

AVERAGE

391,695.02

2,097,768.47

8862.24



MINING\RODGER\SUBSIDE\AREAMAPS\AREA5.DWG



ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140

**2000 SUBSIDIARY
DEER CREEK MINE
2ND-5TH LEFT LONGWALL PANELS**

DRAWN BY: RODGER C. FRY		FIGURE 20	
SCALE: 1" = 500'		DRAWING #:	
DATE: February 12, 2001	SHEET 1 OF 1	REV.:	