

Date: 12 December, 1990

To: Larry Bruss - AM/3

From: Mike Majewski - AM/3
John Hillery - SED

Subject: Preliminary Results of Analysis of WDNR Aircraft Data
for Some of the Flights From the 1990 Summer Field Study

This is a brief synopsis of some of the highlights we found after analyzing the data from the WDNR aircraft from the summer field study. For the majority of the flights the WDNR aircraft flew along the LMOS domain's western and southern boundaries. On occasion the aircraft made flights back and forth across the land/lake boundary of both shores and across the lake itself. Note, all times listed are CDT, in hours and minutes.

1. 2 July 1990 - A Flight - Stairsteps

- NOx peak:

1) at 5:47 - relative peak in NOx (.020 ppm) measured just east of the southwest corner of the domain (northeast of Peoria) - sharp drop in O3 concentration - source of NOx likely to be Chicago area as winds were measured from E-NE

2. 2 July 1990 - D Flight Spirals

- O3 peaks:

1) at 18:37 - .084 ppm at 3,847 ft above ground level (agl) in the upper half of the Streator, IL spiral
2) at 20:34 - .090 ppm at 1,100 - 1,200 ft agl southwest of Oshkosh, WI - wind direction about 148 degrees

3. 3 July 1990 - A Flight - Stairstep

- NOx peaks:

1) at 5:49 - .032 ppm just north of Pontiac, IL approximately 1,000 ft agl
2) at 6:00 - .036 ppm just southwest of Kankakee, IL approximately 2,200 ft agl

- wind direction measured from 221 degrees at 8 knots
- NOx is being transported into LMOS domain
- possible source is electrical generating plants in central Illinois (Powerton, Edwards, Duck Creek, and Havana)
- corresponding sharp drop in O3 as plane crossed this NOx plume

4. 3 July 1990 - B Flight Stairstep

- O3 peaks:

- 1) at 8:51 - .117 ppm just northwest of Rensselaer, IN approximately 3,600 ft agl - wind direction 230 degrees at 18 knots - O3 being transported into LMOS domain
- 2) at 10:15 - .113 ppm just northwest of Madison, WI approximately 2,800 ft agl - wind direction 230 degrees at 39 knots - O3 being transported into LMOS domain - possible ozone and/or precursor source region is Dubuque, IA

- NOx peaks:

- 1) at 8:14 - .026 ppm just south of Rochester, IN approximately 1,500 ft agl - wind direction 198 degrees at 28 knots - NOx being transported into LMOS domain

5. 3 July 1990 - C Flight NOAA Backup

-O3 peak:

- 1) at 13:26 - .121 ppm as airplane begins its approach to Waukegan, IL airport - low level O3 - highest NOx measured close to surface during approach (.016 ppm)

6. 3 July 1990 - D Flight NOAA Alpha, Bravo, Charlie

- O3 peaks:

- 1) at 15:15 - .110 ppm just east of shore on WI-IL state line, approximately 1,600 ft agl - aircraft is going back and forth across shore boundary and descending as it does
- 2) at 15:22 - .121 ppm measuring same plume but at lower elevation
- 3) at 15:46 - .128 ppm over the middle of Lake Michigan - airplane has been climbing to 2,750 ft agl
- 4) at 16:55 - 17:00 - ozone jumps from .055 ppm to .089 ppm as plane heads west, just crossing the eastern shore of Lake Michigan at 3,545 ft agl
- 5) at 17:27 - 17:36 - ozone jumps from .063 ppm to .097 ppm as plane heads east, just crossing the eastern shore of Lake Michigan at 5,725 ft agl
- 6) at 17:45 - 17:50 - ozone jumps from .106 ppm to .083 ppm to .112 ppm as plane is over the middle of Lake Michigan, at about 1450 ft agl - airplane crossed an NOx plume (NOx is .020 ppm when O3 is .083 ppm) - wind direction is 200 degrees at 20-30 knots - possibly sampling an NOx plume from the Gary, IN area

7. 3 July 1990 - E Flight NOAA Alpha / Return to Oshkosh

-O3 peaks:

- 1) at 19:52 - .114 ppm at WI-IL state line near the lake shore
- 2) at 20:24 - 20:26 ozone jumps from .063 ppm to .098 ppm as plane is descending to about 2,000 ft agl near West Bend, WI - ozone continues at about the .100 ppm level until Oshkosh

8. 4 July 1990 - A Flight Spirals

- O3 peaks:

- 1) at 4:35 - .089 ppm at 3,225 ft agl in the Lake Wisconsin spiral
- 2) at 5:17 - .090 ppm at 3,225 ft agl in the Rock Grove spiral
- 3) at 6:52 - .092 ppm at 5,725 ft agl just west of Rensselear, IN
- high level ozone coming into IMOS domain

9. 4 July 1990 - B Flight Spirals

- O3 peak:

- 1) at 9:15 - .086 ppm at 2,600 agl near Rensselear, IN - same plume as sampled during A flight (No. 8)

10. 16 July 1990 - B Flight - Secondary 2DDP

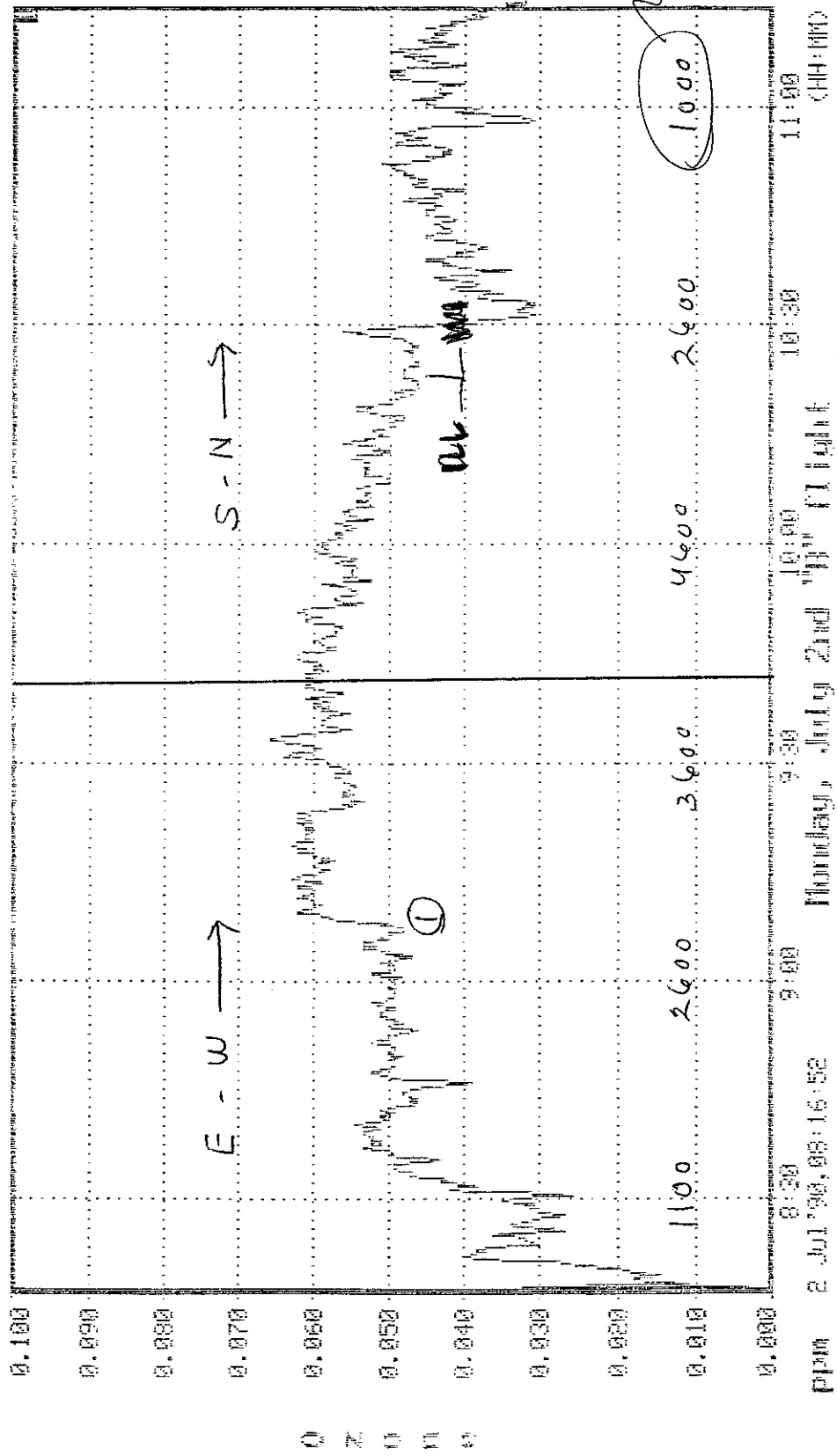
-O3 peak:

- 1) at 10:24 - .080 ppm at 1125 ft agl northeast of Milwaukee, WI out over Lake Michigan - wind direction 251 degrees at 28 knots - possibly sampling Milwaukee plume

Following is a list of questions and suggestions:

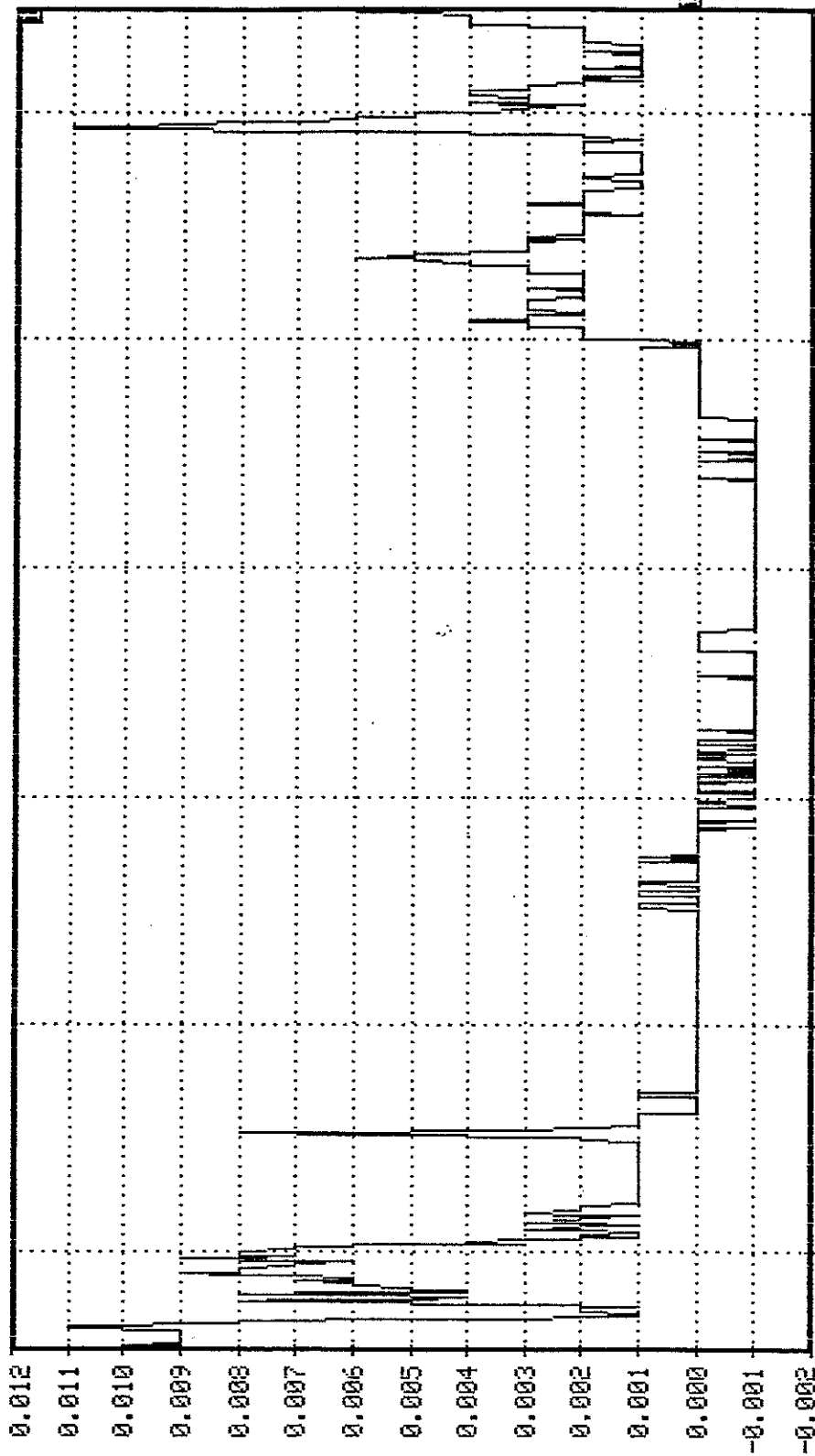
- 1) Do carbonyls have to be collected aloft? If so, logistical problems (e.g. sampling volume flow rates) are present in the method.
- 2) Performing two circuits of a flight box may present a problem of endurance time aloft for some aircraft.
- 3) Consider tilting the rectangular flight boxes to 500 ft over the water and 1000 ft over land.
- 4) Consider rotating a rectangular flight box across Lake Michigan like the one during the 1990 field program.
- 5) Consider afternoon traverses across the land/water masses to intersect the lake breeze convergence zone.
- 6) Consider locating monitoring equipment in lakeshore topographic areas where anomalies of higher ozone concentrations occur (e.g. Wind Point in Racine).
- 7) Consider flight patterns over sites that have recorded past exceedances (e.g. western shoreline sites all the way up to Newport Beach, WI and beyond).
- 8) Consider performing spirals at the NOx "hot spots" and the NOx "non hot spots" along the southern boundary.

① South of KANKAKEE



ppm 2 Jul '90, 08:16:52 Monday, July 2nd '90 Flight 10:30 11:00

FWA OSA



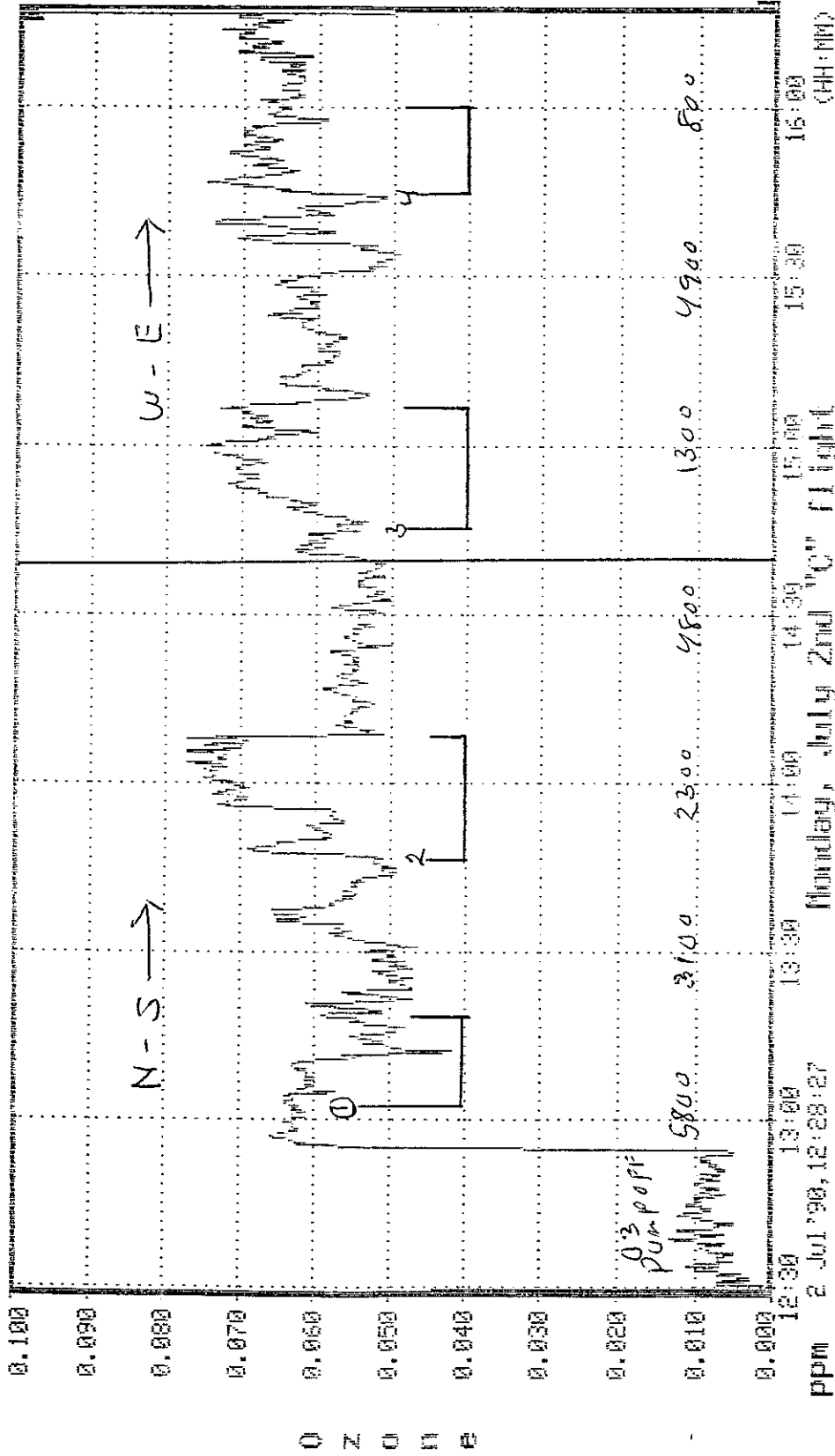
M
O
x

PPM 2 Jul '90, 08:16:52 8:30 9:00 9:30 10:00 10:30 11:00 <HH:MM>
Monday, July 2nd "B" flight

SPIRAL LOCATIONS

- 1) LAKE WISCONSIN
- 2) ROCK GROVE, ILL.
- 3) STREATOR, ILL.
- 4) JASPER CO., IND.

6006
↓
400-506
↓
Doseints



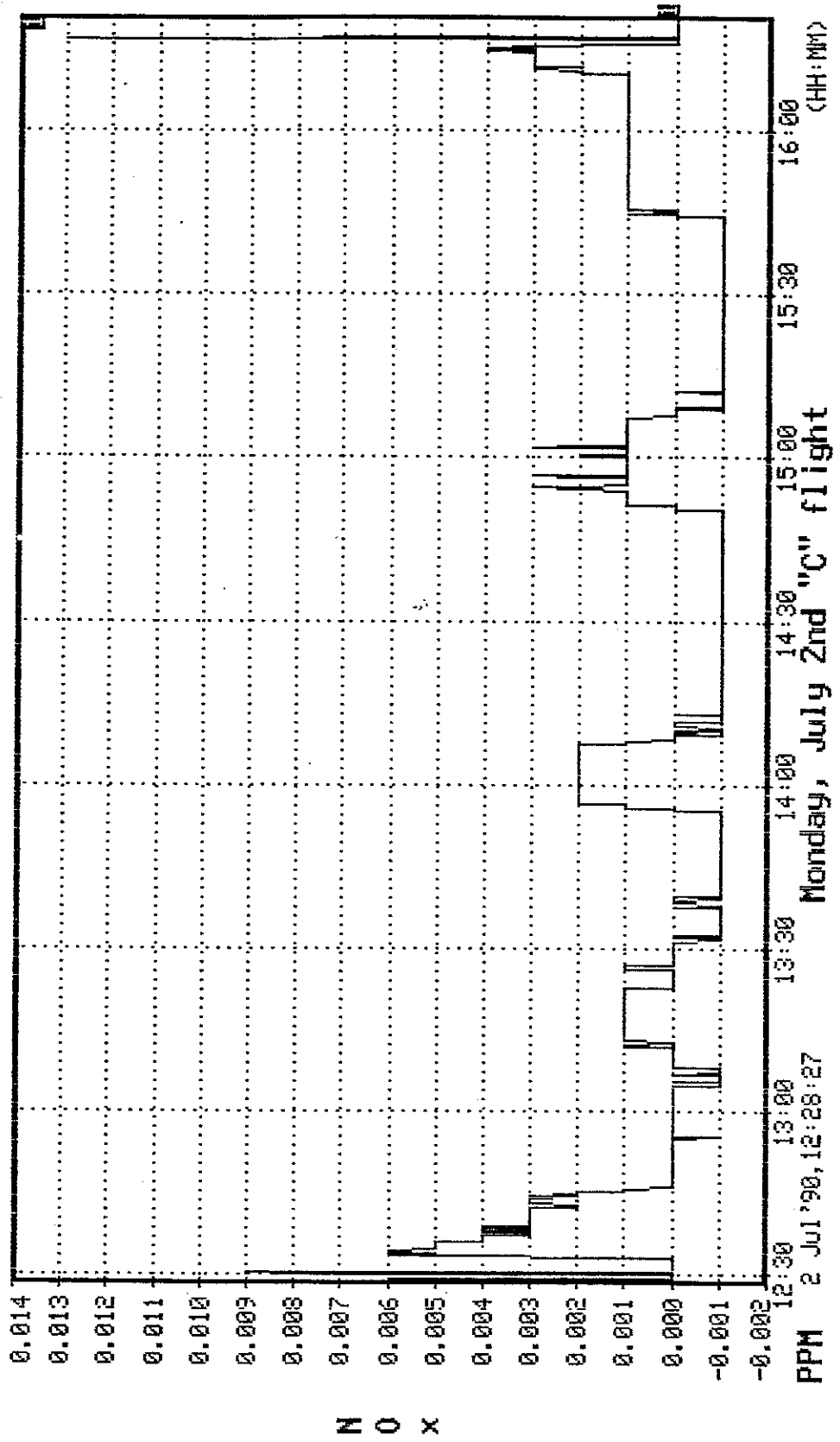
ppm 2 Jul 90, 12:28:27

Monday, July 2nd '90 flight

(HH:MM)

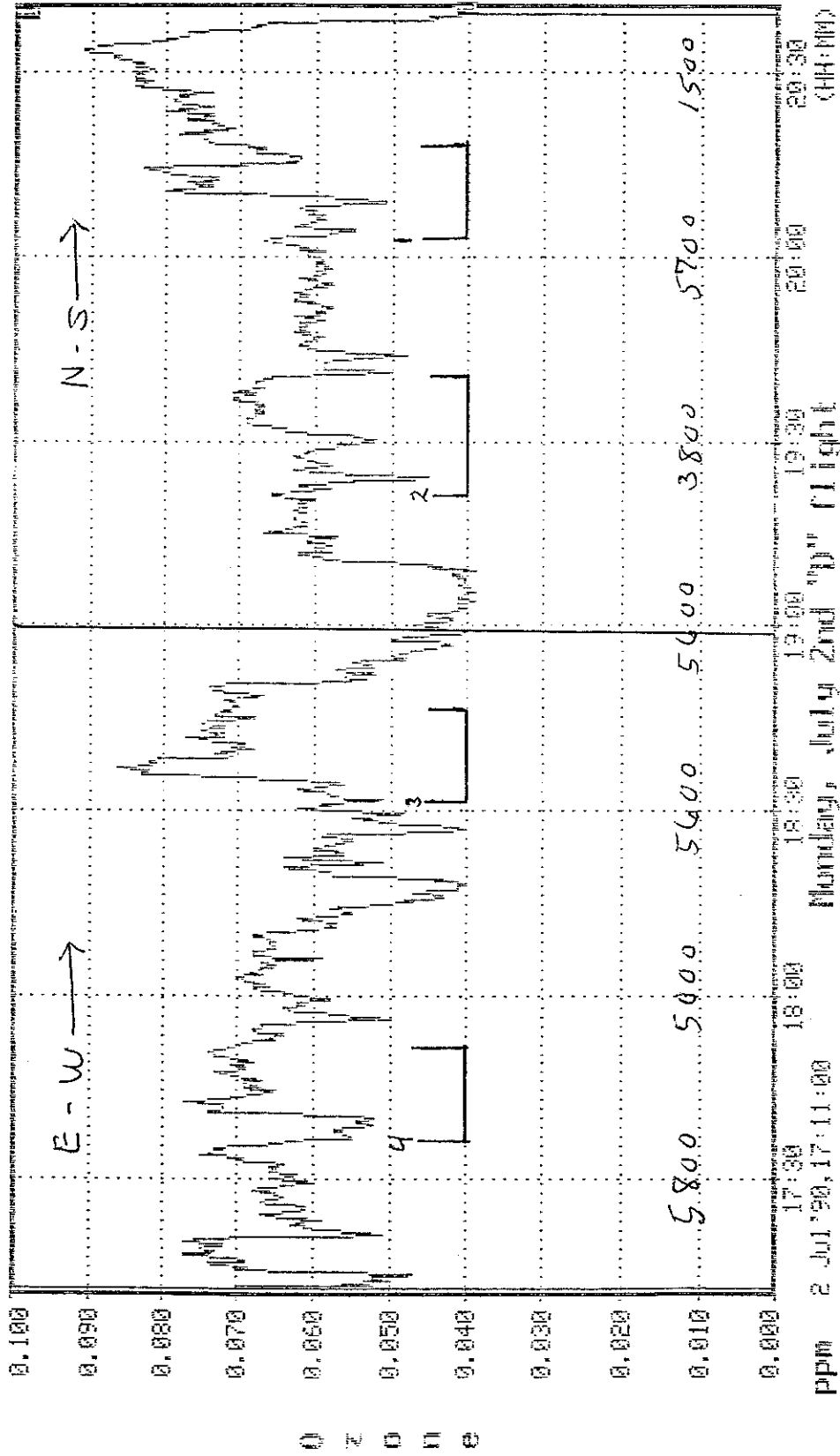
OSH

LAF



SPIRAL LOCATIONS

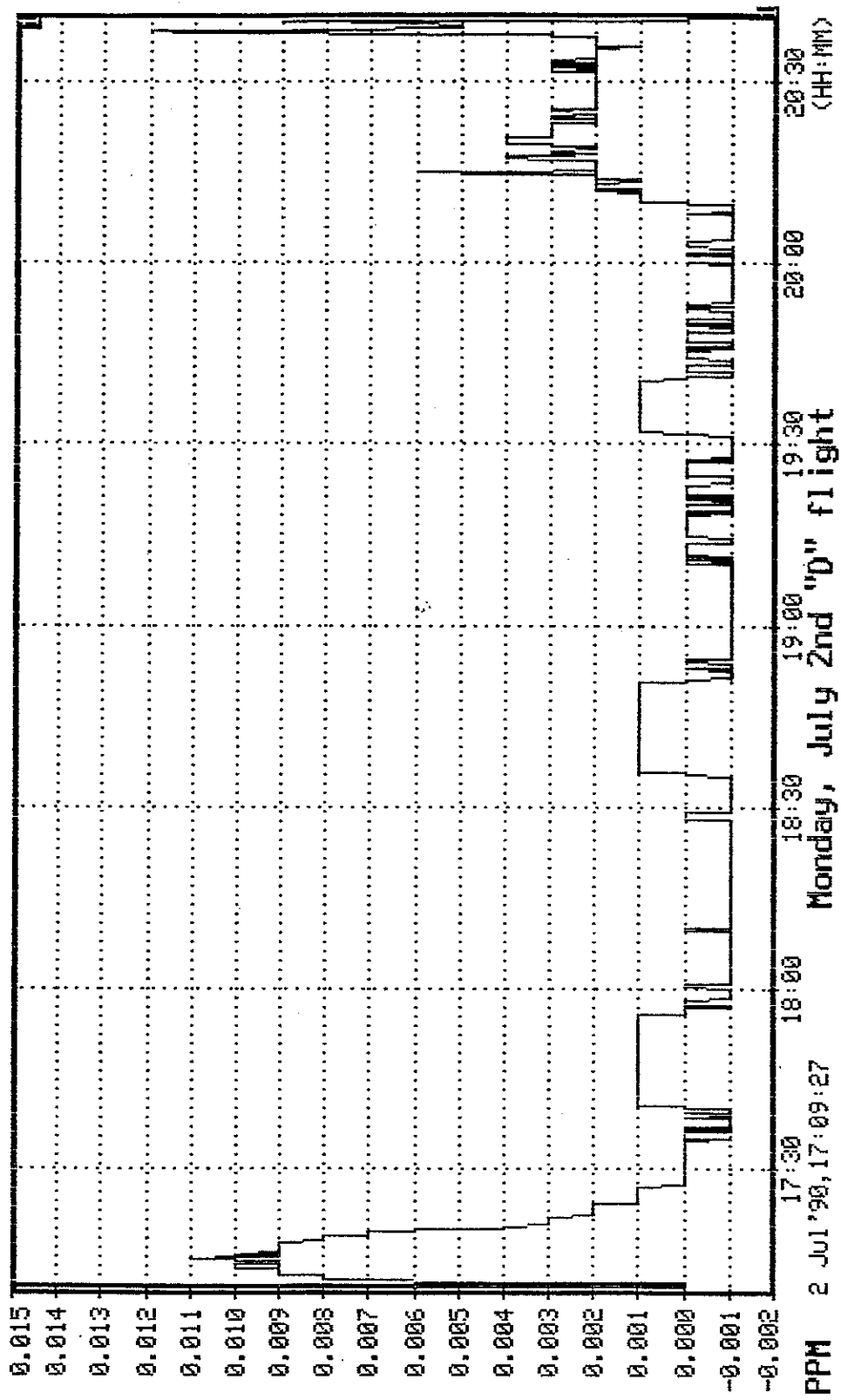
- 1) LAKE WISCONSIN
- 2) ROCK GROVE, ILL.
- 3) STREATOR, ILL.
- 4) JASPER CO., IND.



Monday, July 2nd '90 Flight (HH:MM)

OSH

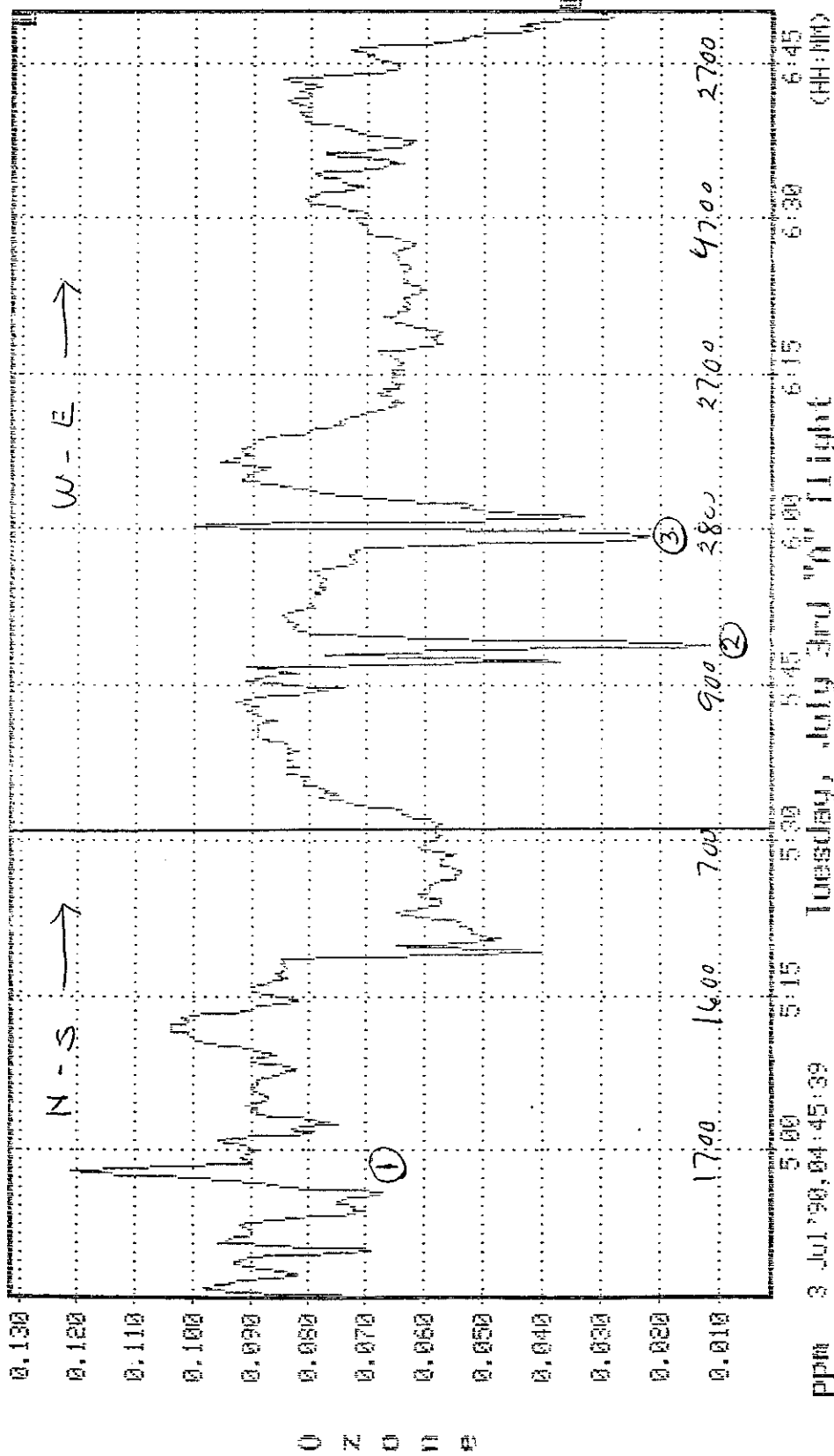
EAF



NOx

PPM 2 Jul '98, 17:09:27 17:30 18:00 18:30 19:00 19:30 20:00 20:30 (HH:MM)
 Monday, July 2nd "D" flight

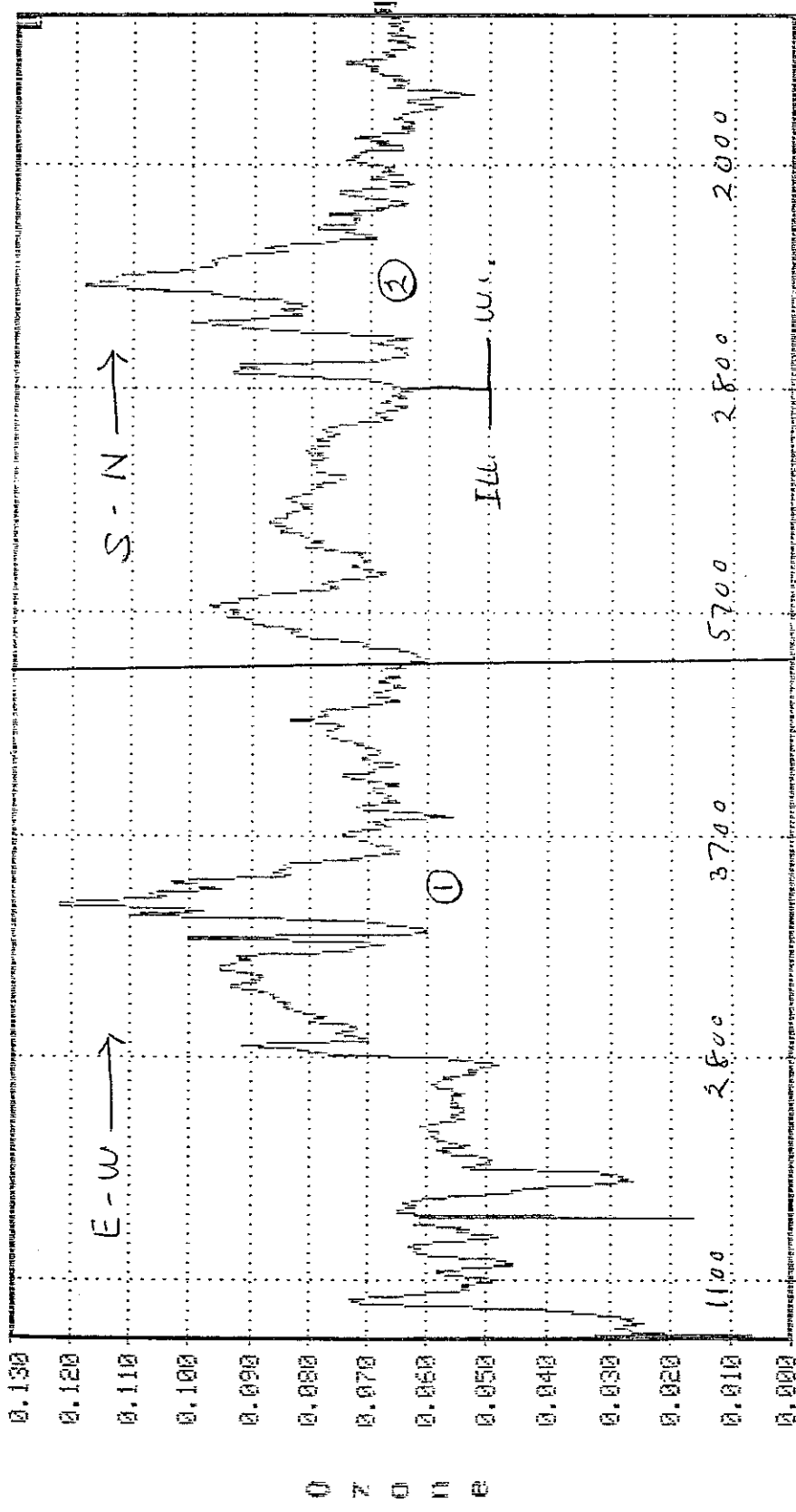
- 1) 10 NE DIXON, ILL.
- 2) 20 SE STREATOR, ILL.
- 3) 13 SW KANKAKEE, ILL.



OSH

FWA

- 1) 10 SE KANKAKEE, ILL.
- 2) OVER WAUNAKEE, WIS.

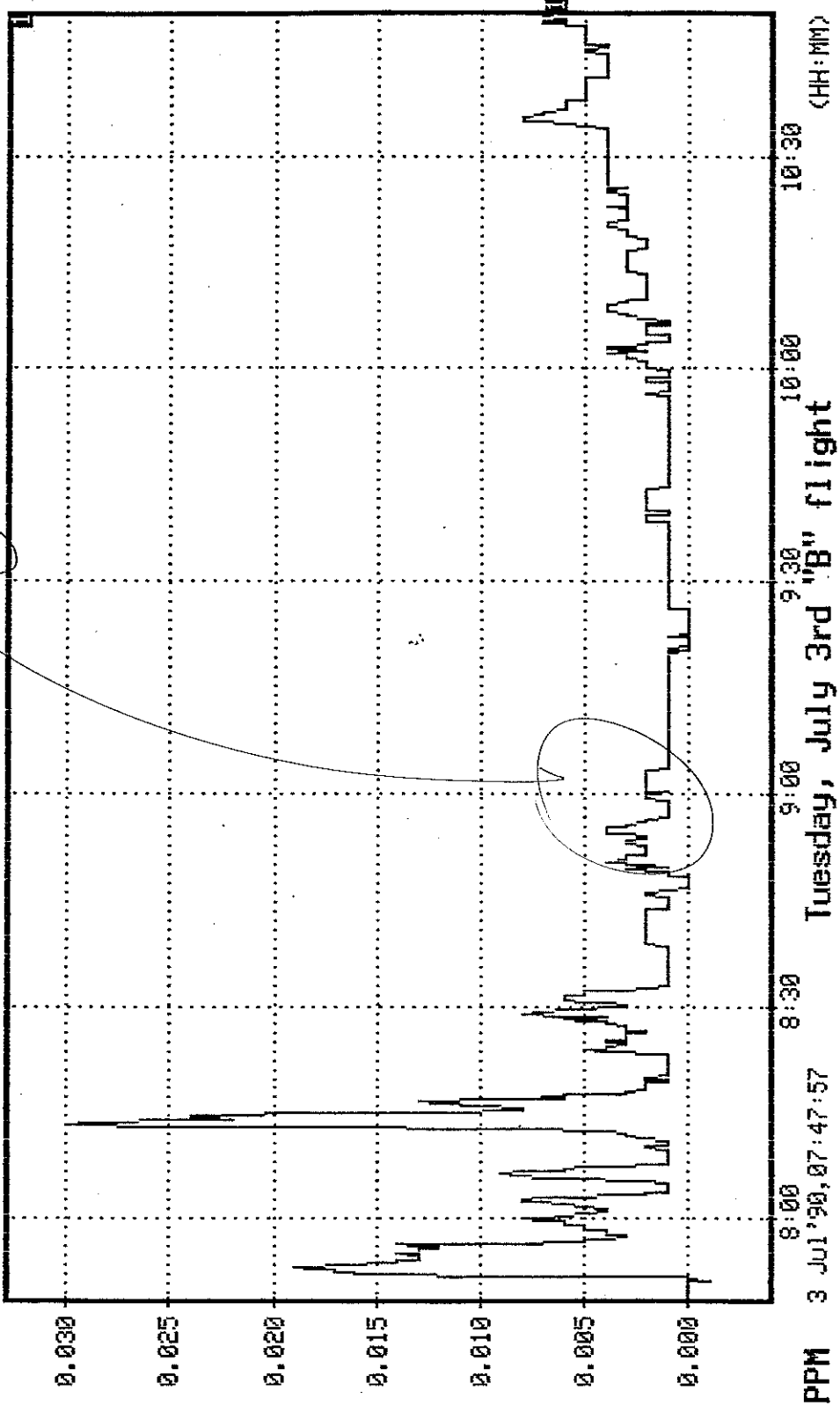


PPM 3 Jul '90, 07:52:00 Tuesday, July 3rd '90 Flight (HH:MM) 10:30

FWA

OSA

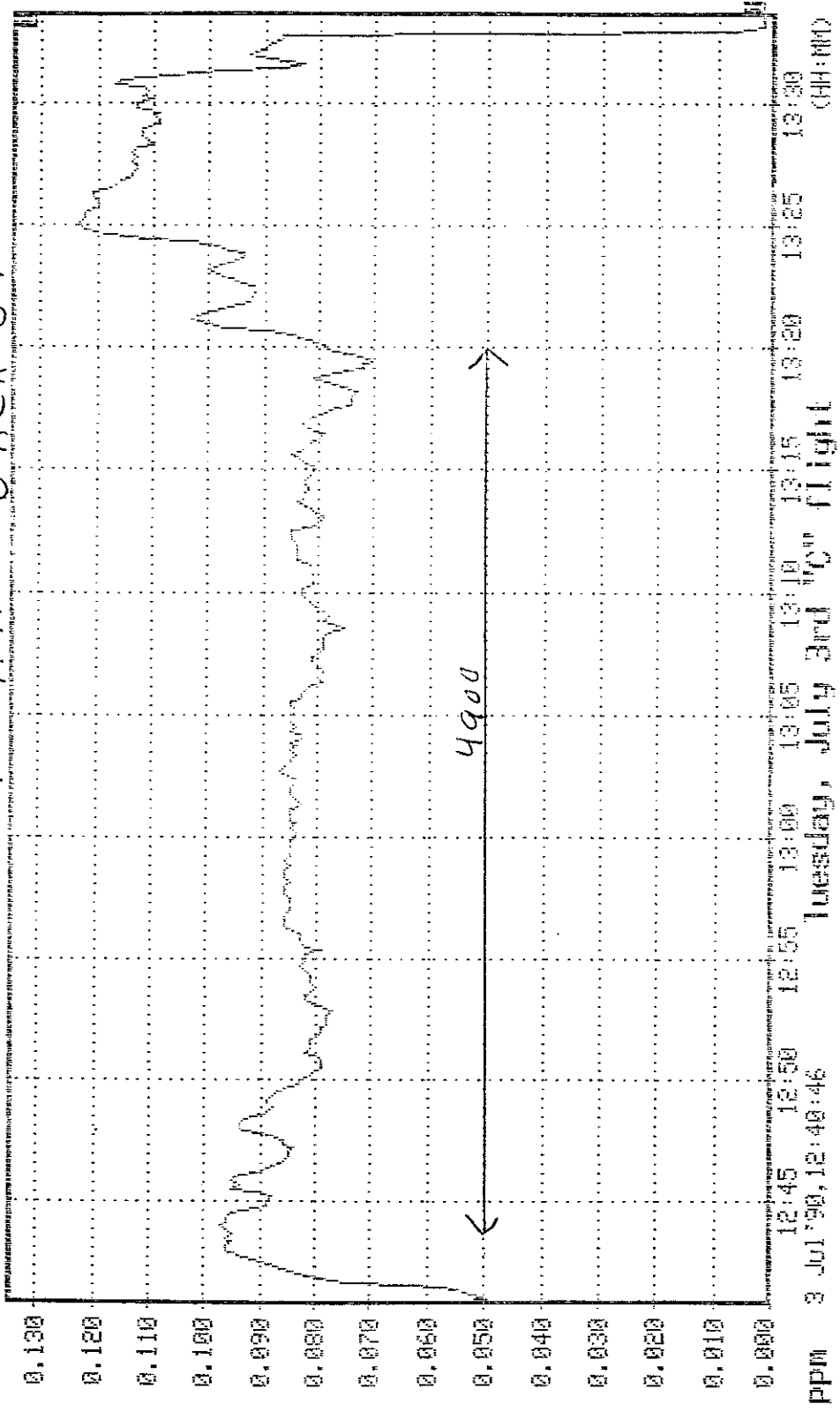
missed 2 para plot
above 505 (probably
plumes)
(samples)



NOX

PPM 3 Jul '90, 07:47:57 8:00 8:30 9:00 9:30 10:00 10:30 (HH:MM)
Tuesday, July 3rd 'B' flight

NOAA BACKUP

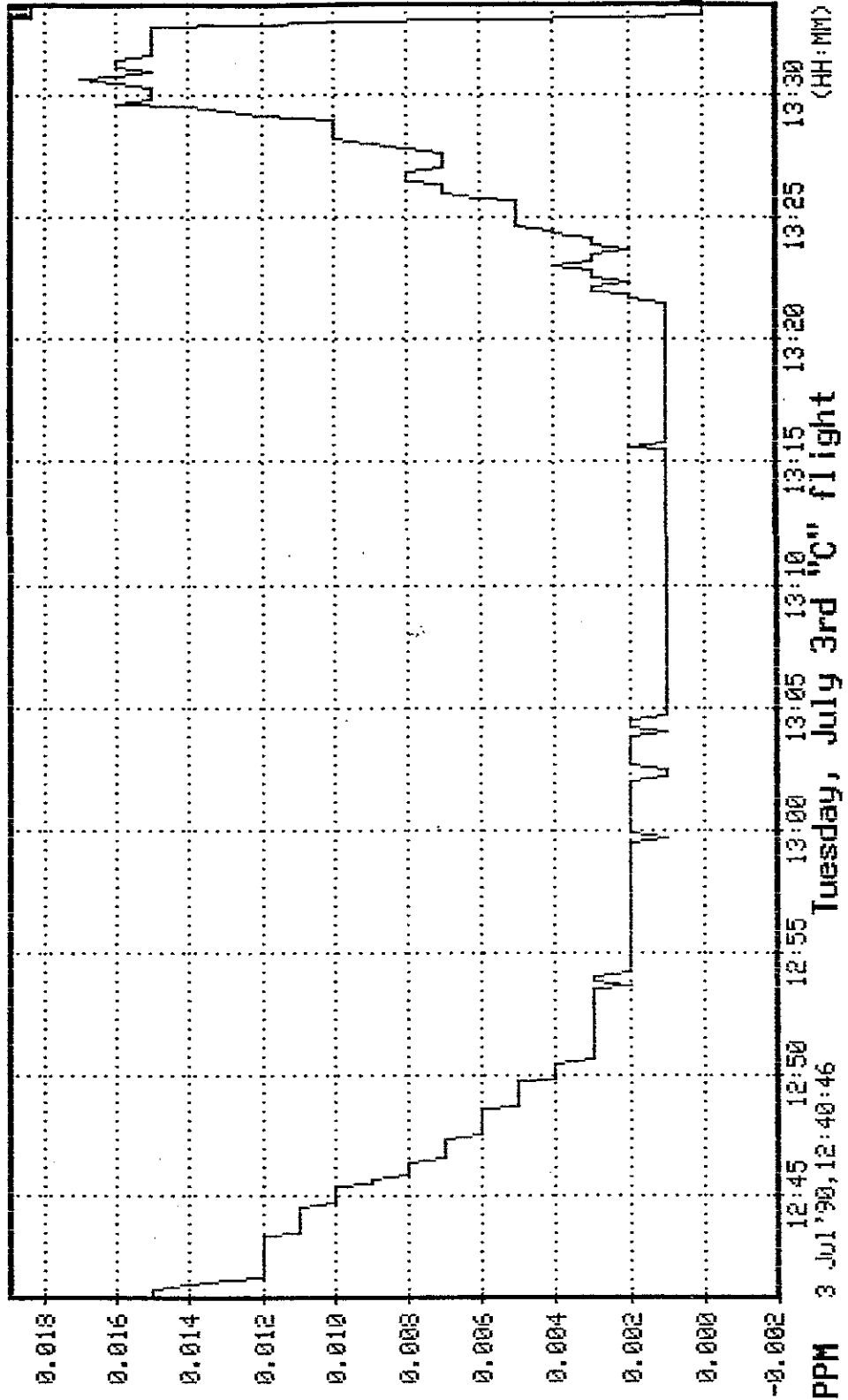


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12:45 12:50 12:55 13:00 13:05 13:10 13:15 13:20 13:25 13:30
Tuesday, July 3rd 1990 flight (HH:MM)

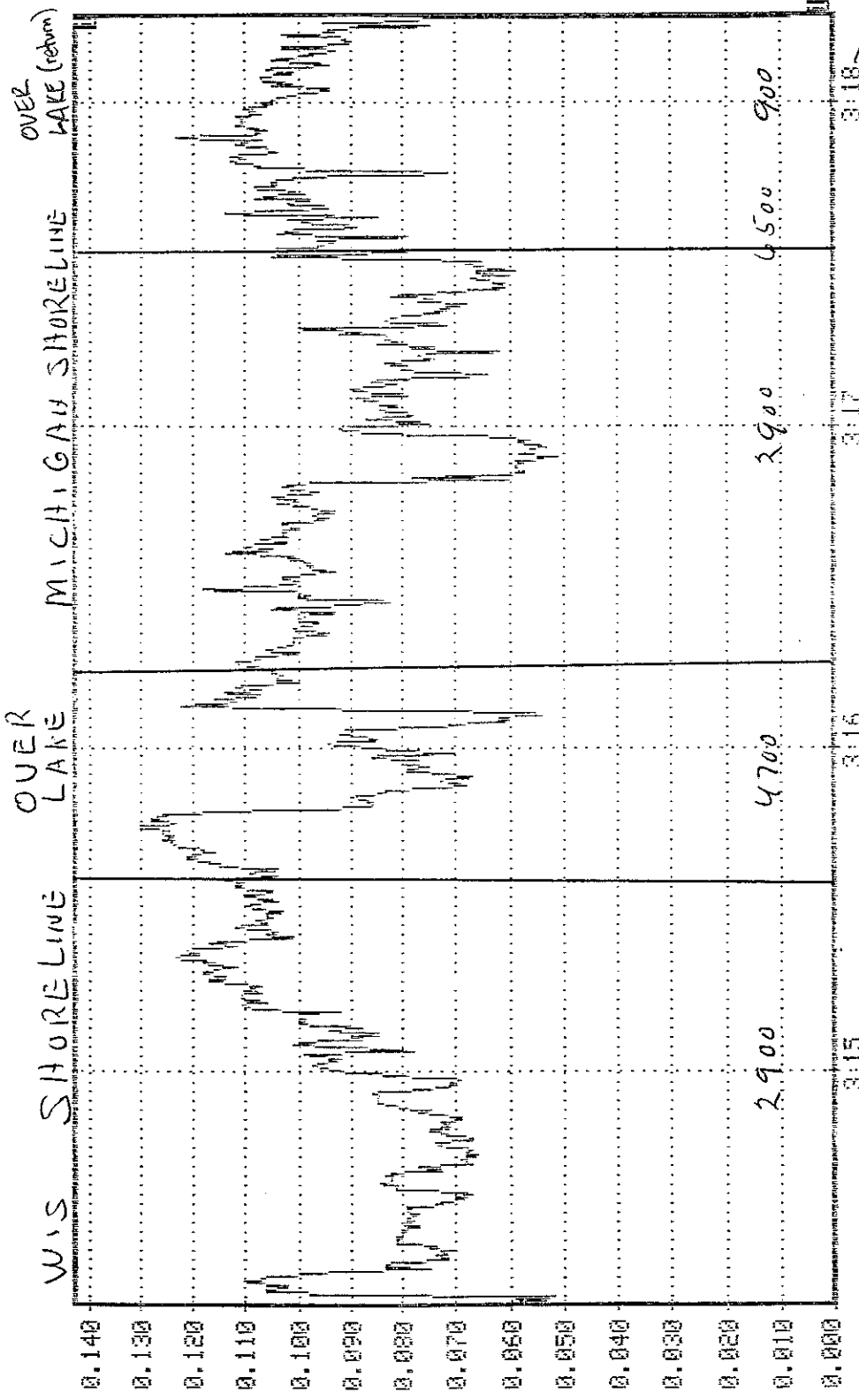
OSH

UGN



Tuesday, July 3rd "C" flight
 3 Jul '90, 12:40:46
 (HH:MM)

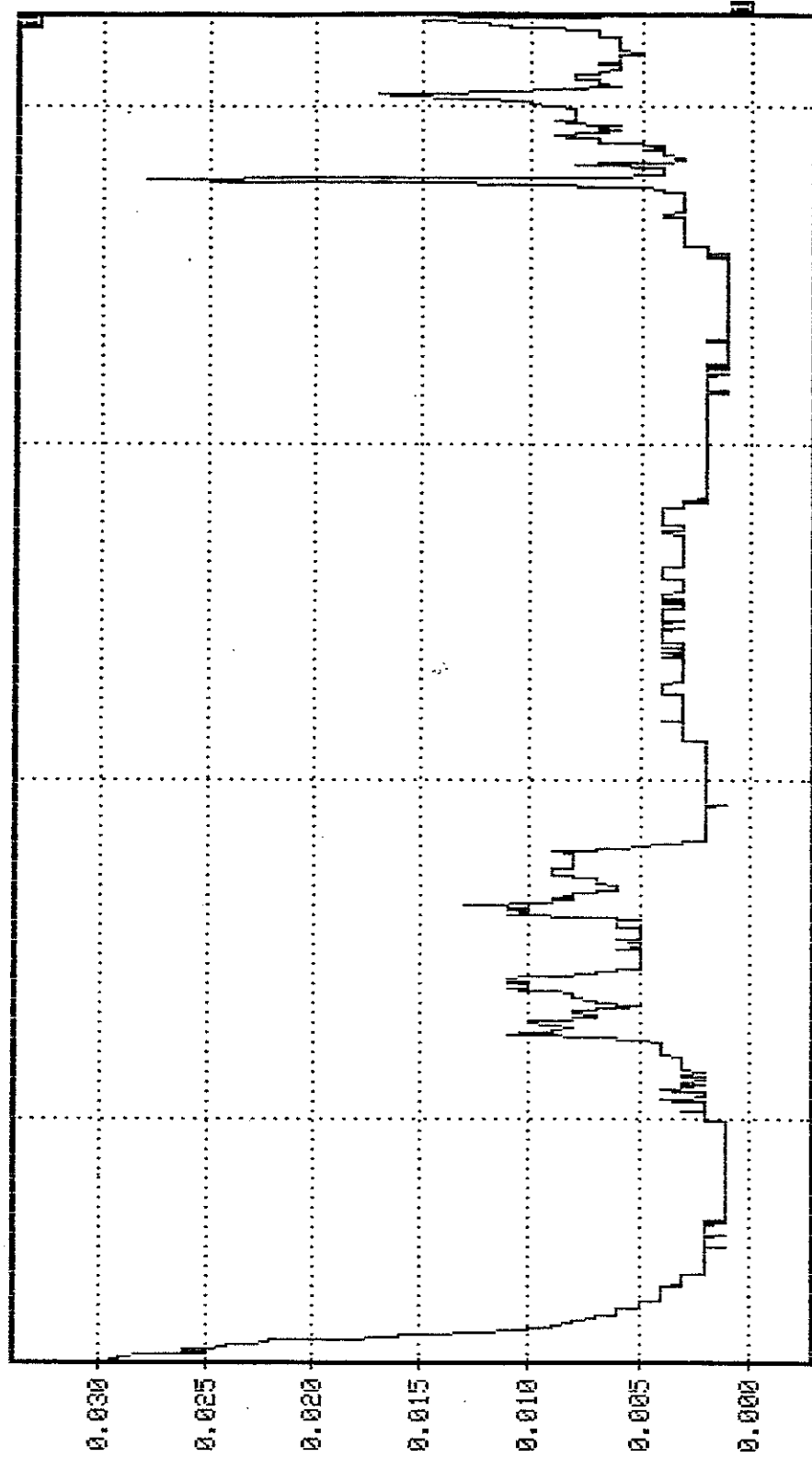
O
Z
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Tuesday, July 3rd "D" flight

3:18
3:17
3:16
3:15
Date
Hour
UGN

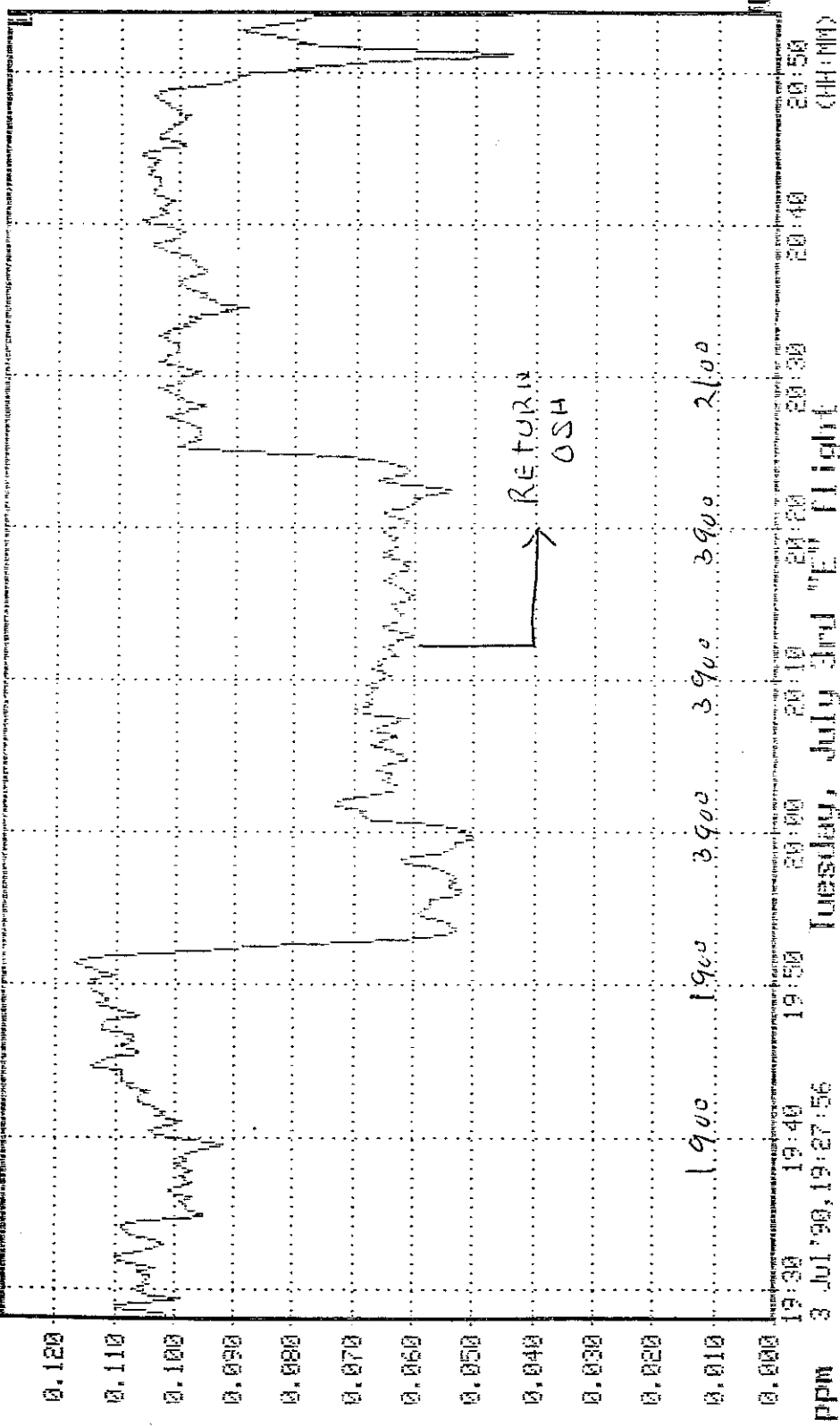
UGN



NOX

PPM 3 Jul '90, 14:16:03 3:15 Tuesday, July 3rd "D" flight 3:17 3:18 (OO:HH)

WIS. SHORELINE



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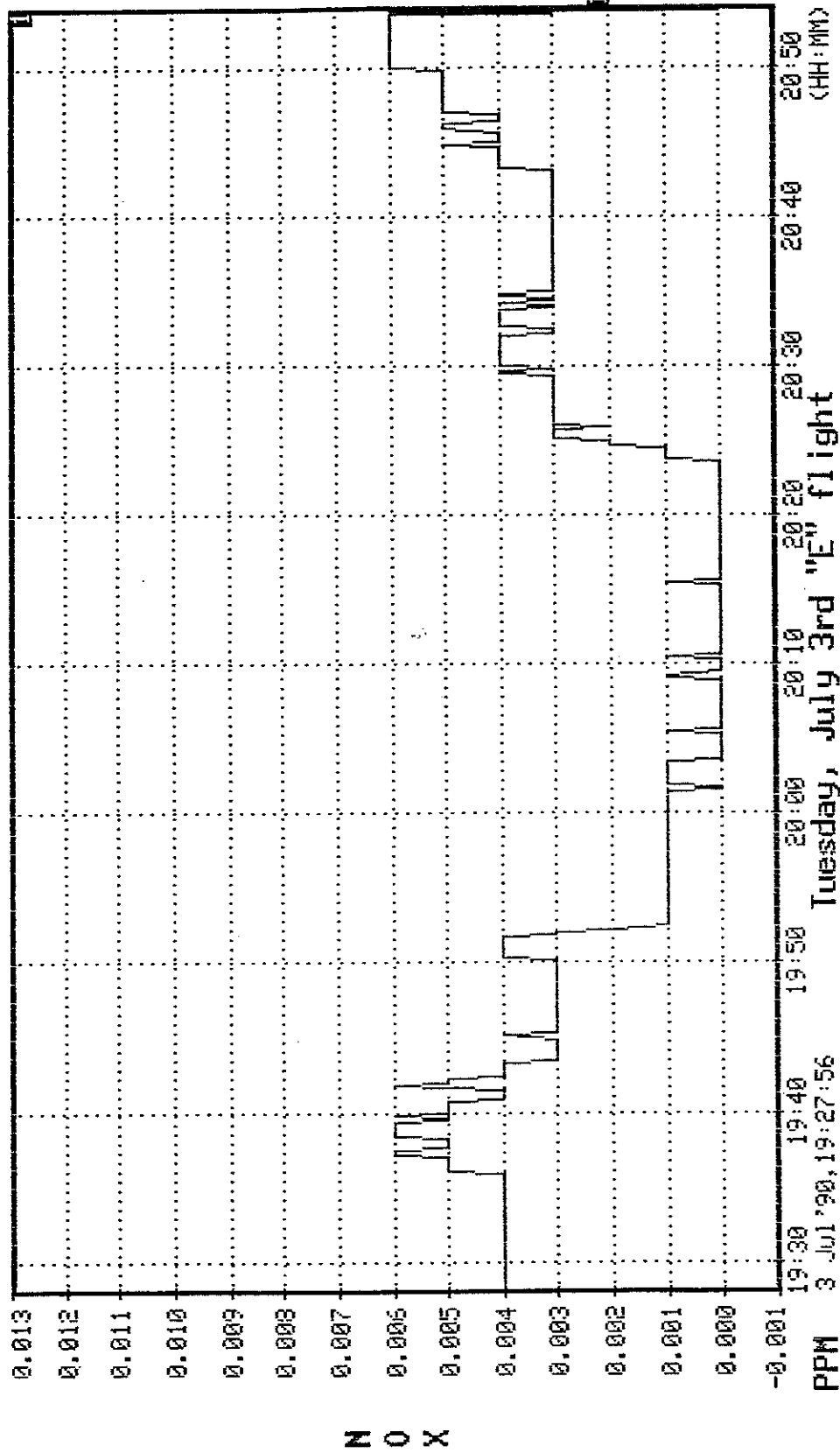
ppm

19:30 19:40 19:50 20:00 20:10 20:20 20:30 20:40 20:50
Tuesday, July 3rd '90 Flight

(HH:MM)

OSH

UGN



NOX

PPM

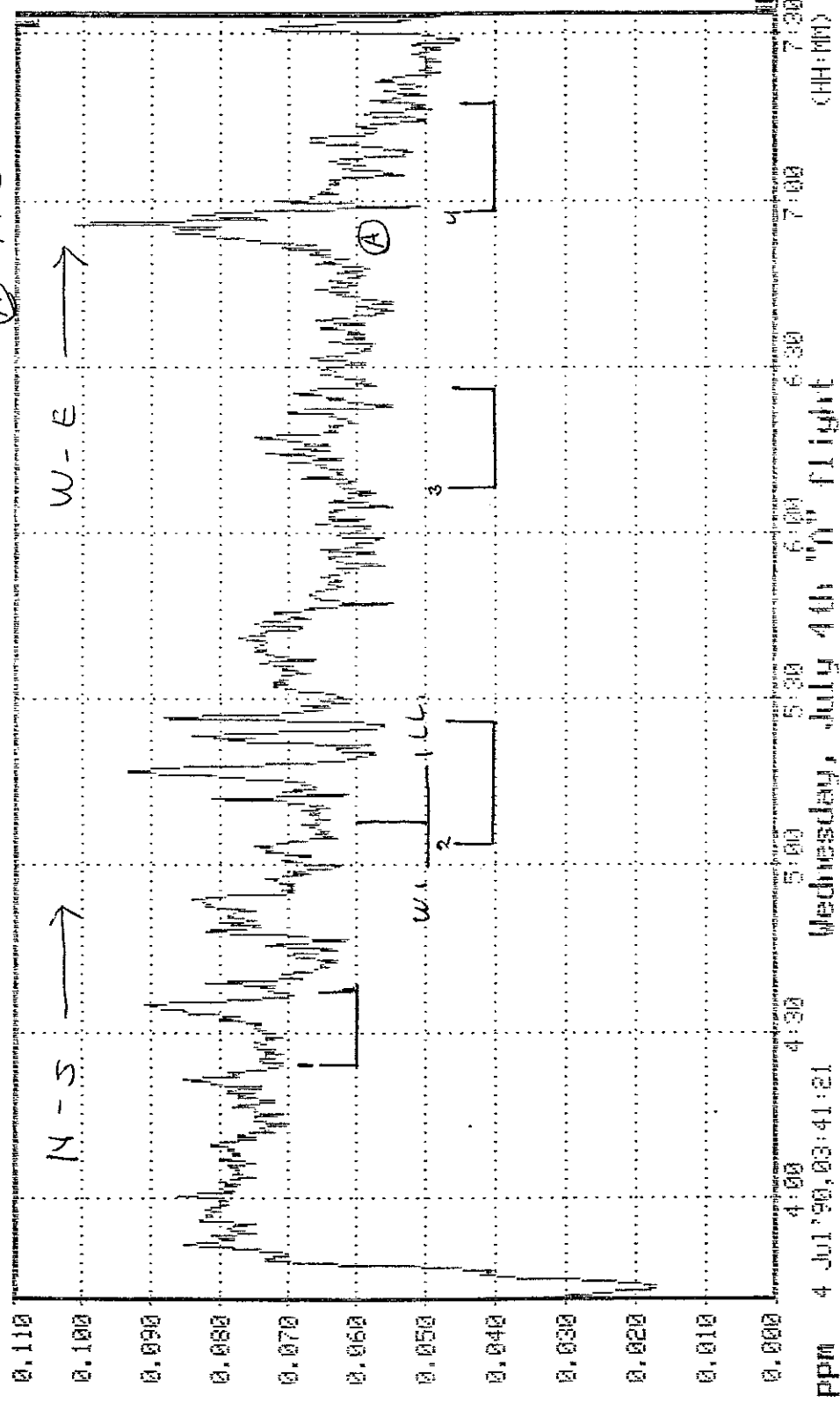
19:30 19:40 19:50 20:00 20:10 20:20 20:30 20:40 20:50
(HH:MM)

Tuesday, July 3rd "E" flight

SPIRAL LOCATIONS

- 1) LAKE WISCONSIN
- 2) ROCK GROVE, ILL.
- 3) STREATOR, ILL.
- 4) JASPER CO., IND.

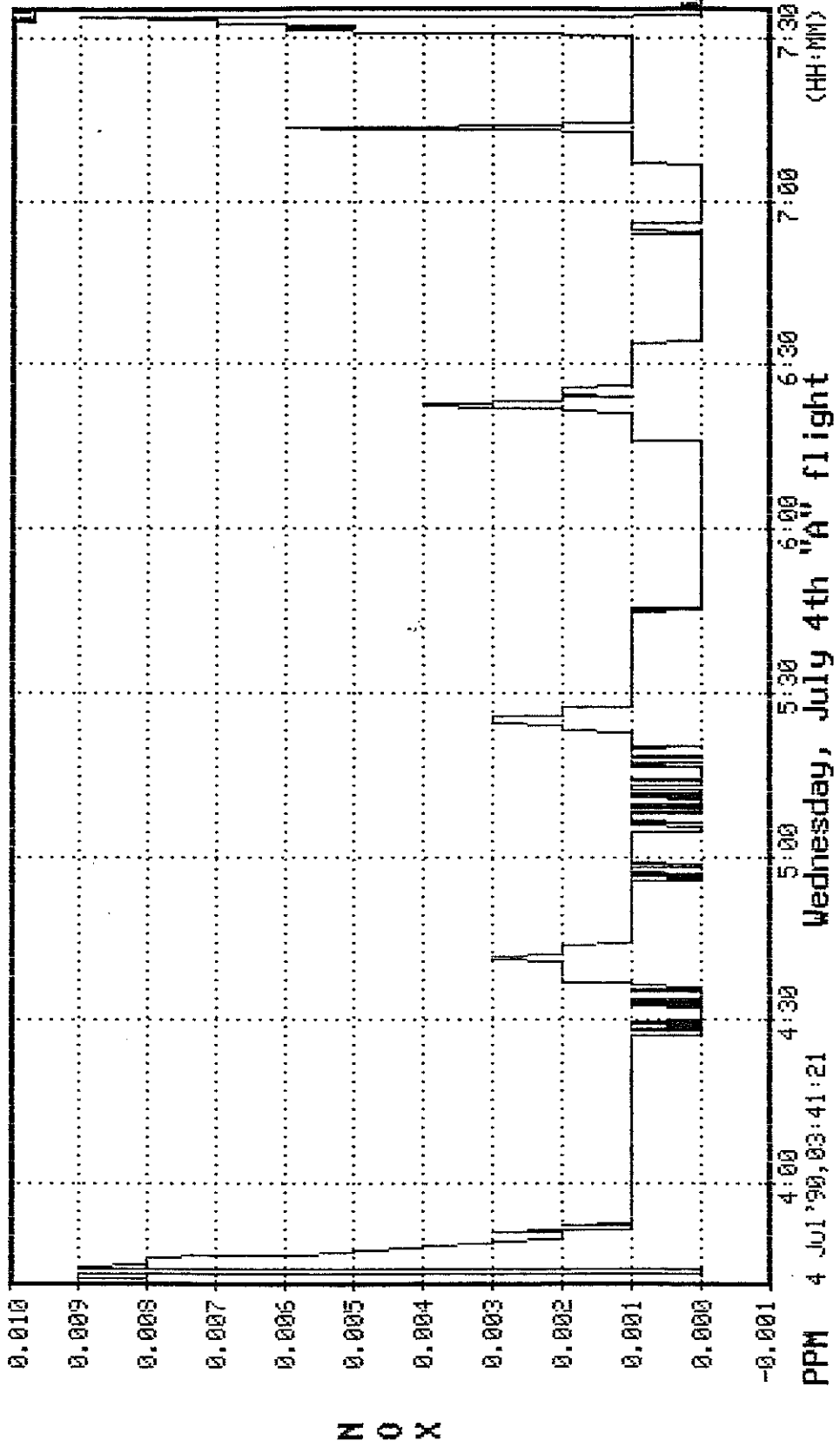
① 17 SE KANKAKEE



Wednesday, July 4th '01 flight

LSAF

OSH



7:30
(HH:MM)

7:00

6:30

6:00

5:30

5:00

4:30

4:00

PPM

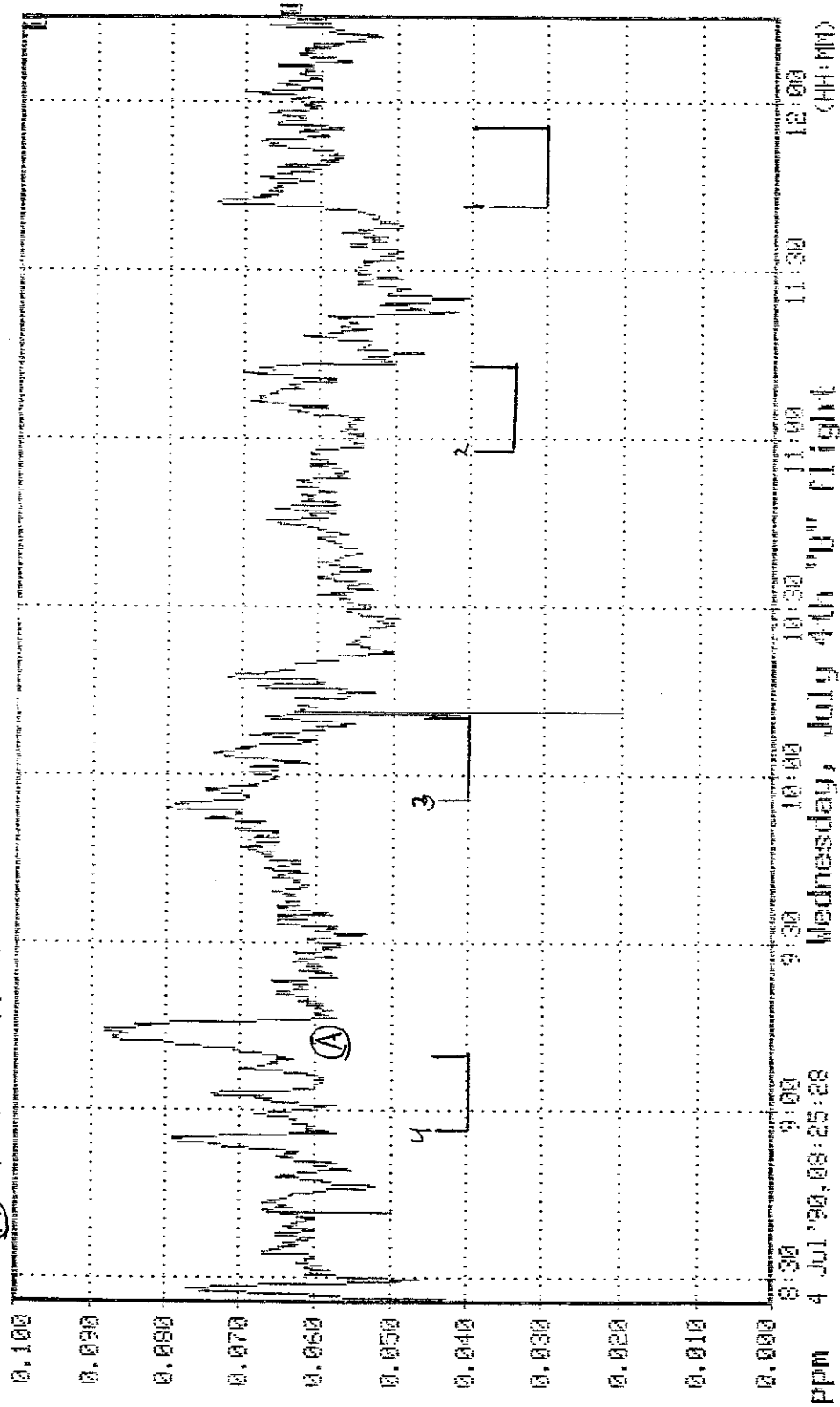
4 Jul '90, 03:41:21

Wednesday, July 4th "A" flight

SPIRAL LOCATIONS

- 1) LAKE WISCONSIN
- 2) ROCK GROVE, ILL.
- 3) STREATOR, ILL.
- 4) JASPER CO., IND.

① 10 NW RENSSELAER

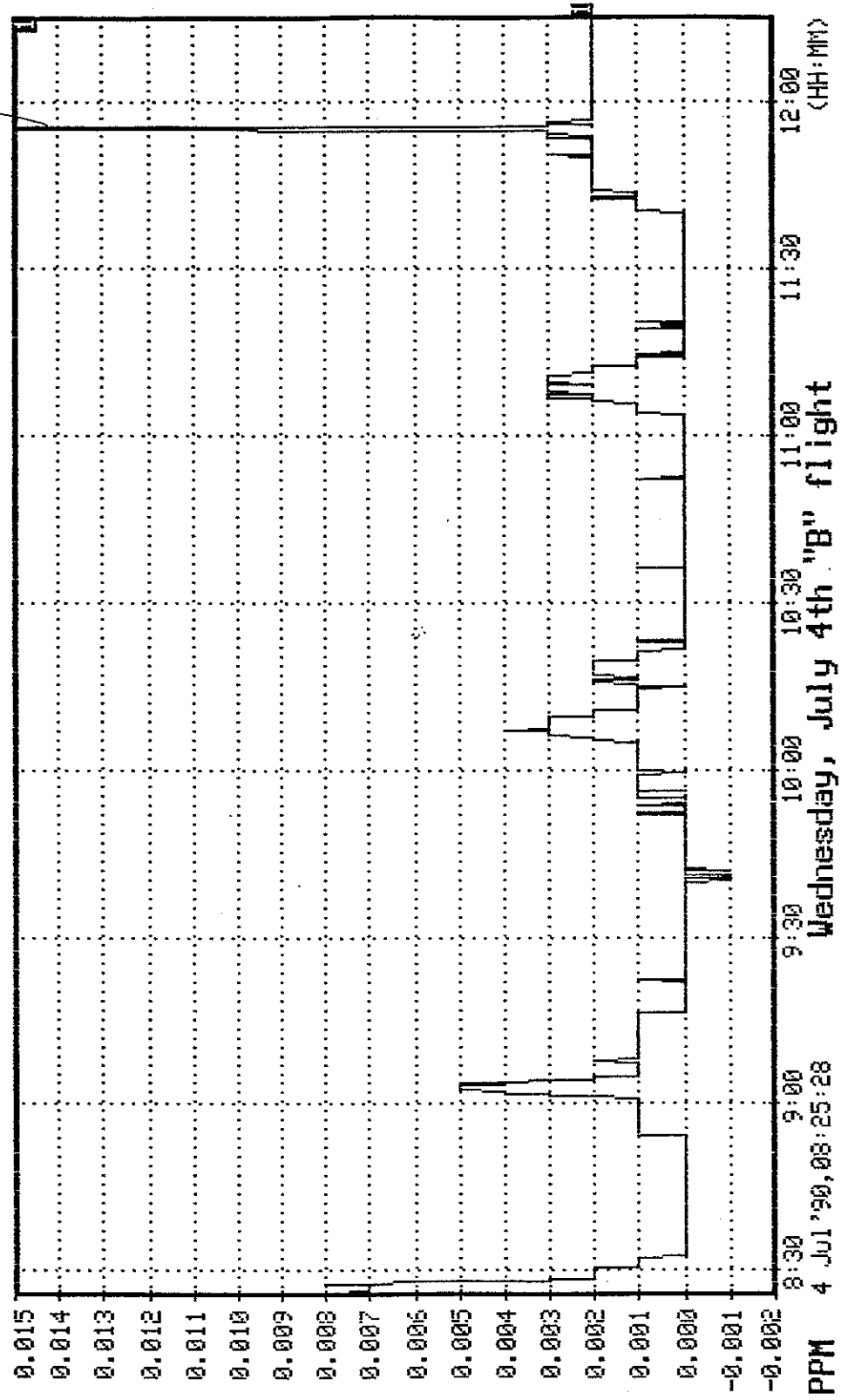


EAFF

(Cafayette, IN)

OSH

WPL
Column
Phone



NOX