Ohio Dept. of Natural Resources

Division of Mineral Resources Management

Site-specific Blast Plan Conditions

Presented by

Mike Mann, Blasting Specialist

ODNR Div. of Mineral Resources Mgt.

Site-specific Blast Plan Conditions

- Protect older or historic houses
- Protect major gas lines, HV towers, etc.
- Account for directional vibration effects
- Account for migration of toxic gases
- Prevent interception of flooded UG mine
- Ensure safety of motoring public

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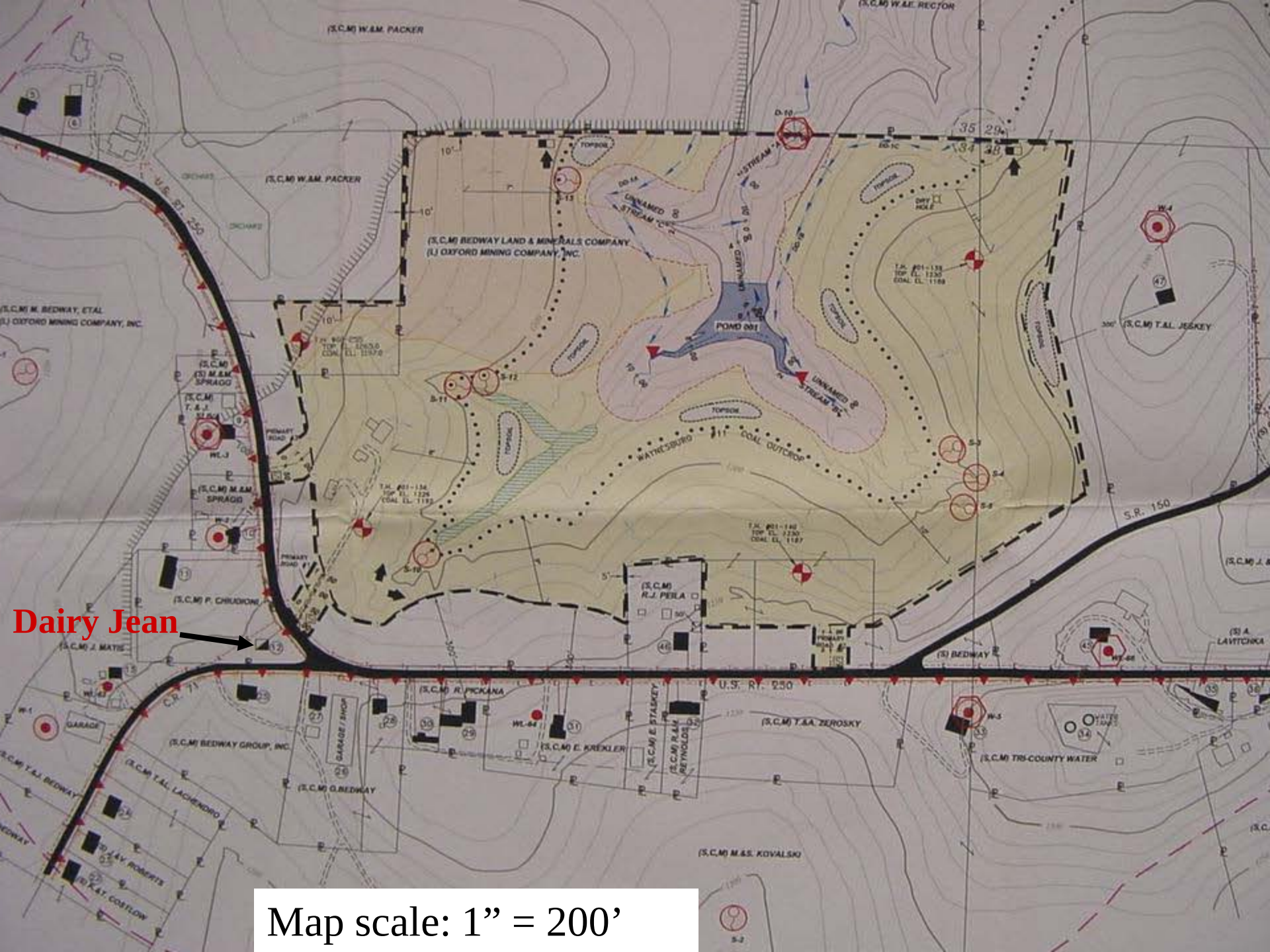
Blast Plan Conditions

Case 1 - Dairy Jean Pit

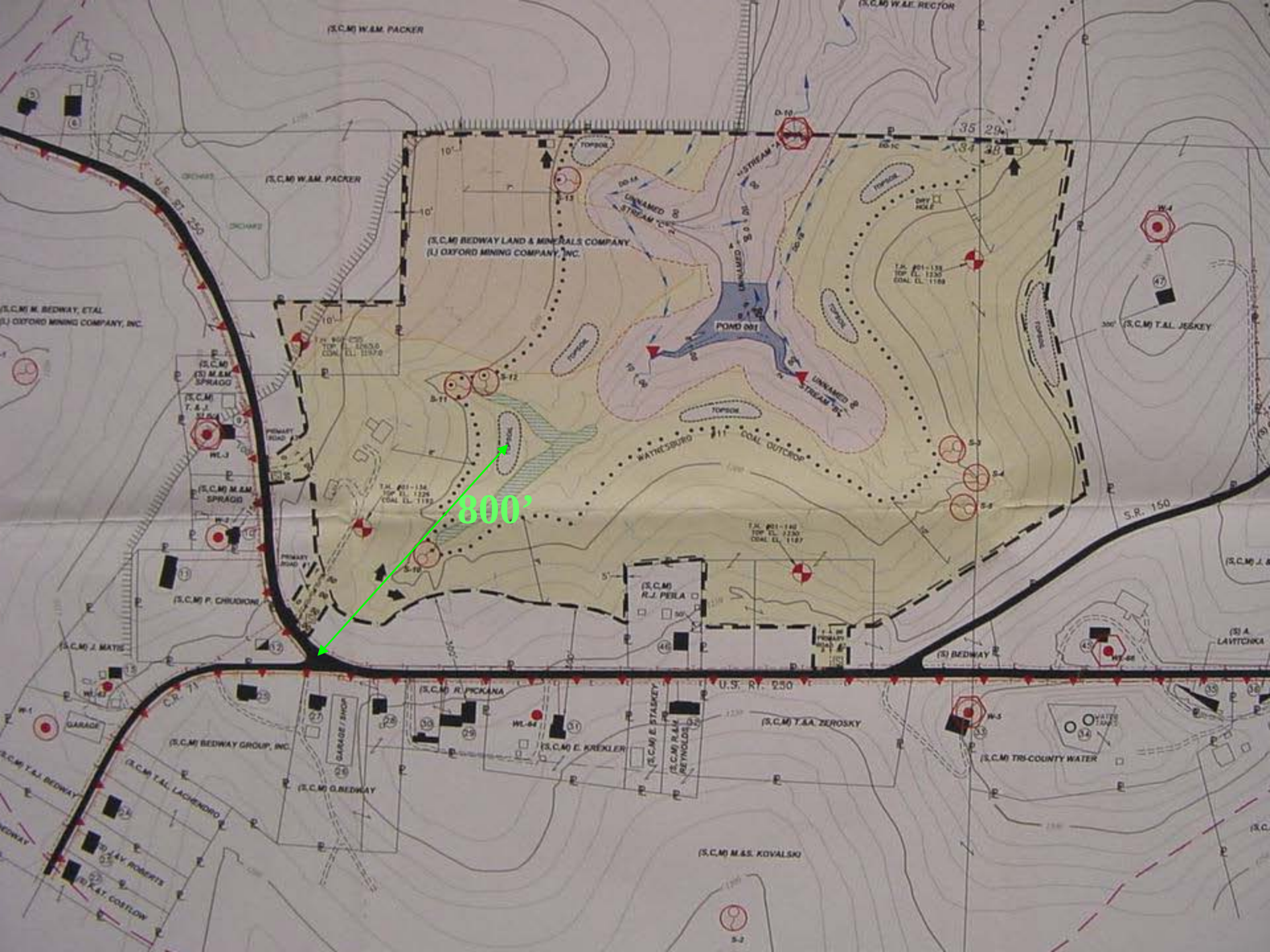
WEST
250

DAIRY
JEAN



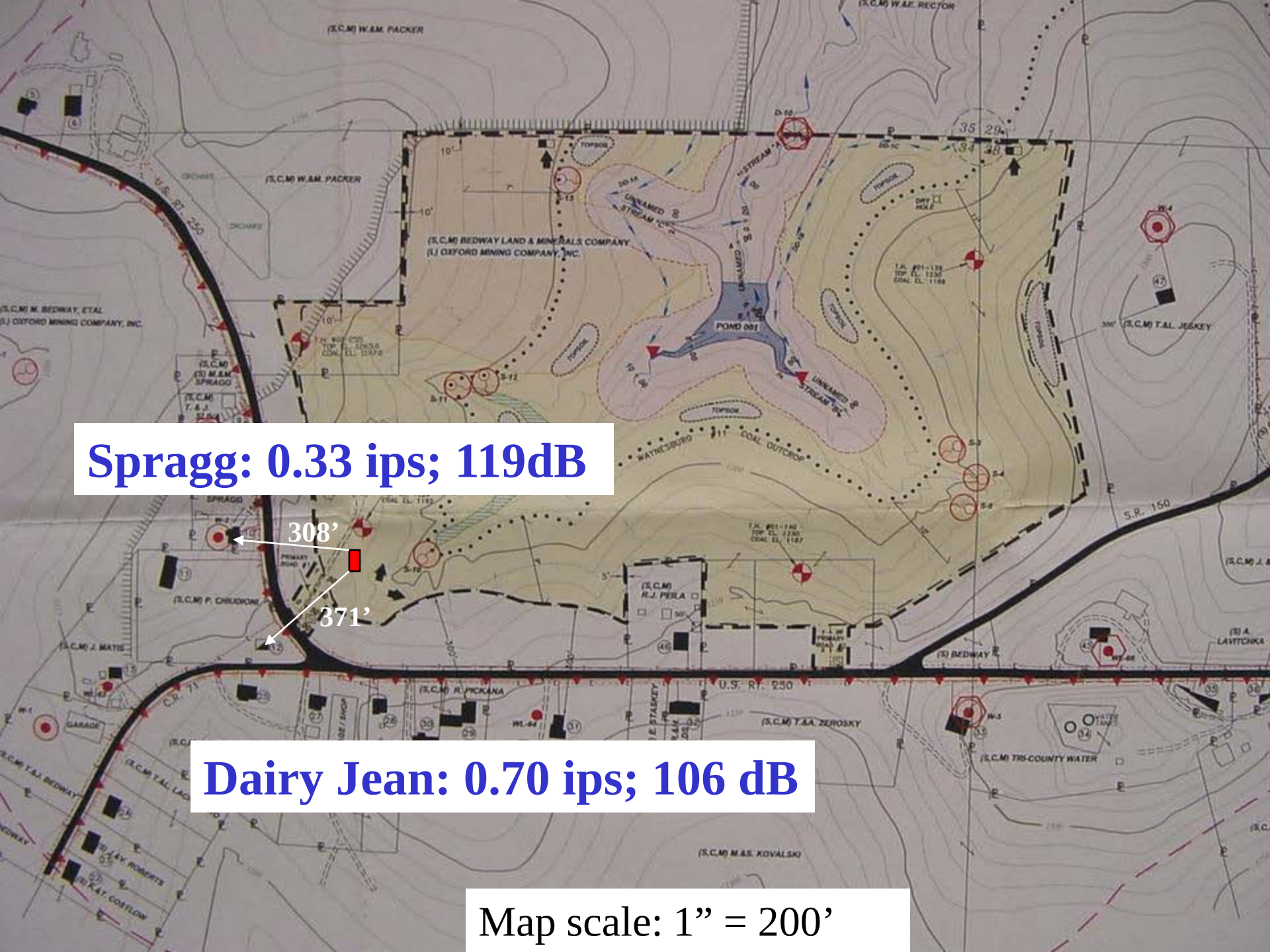
Map scale: 1” = 200’

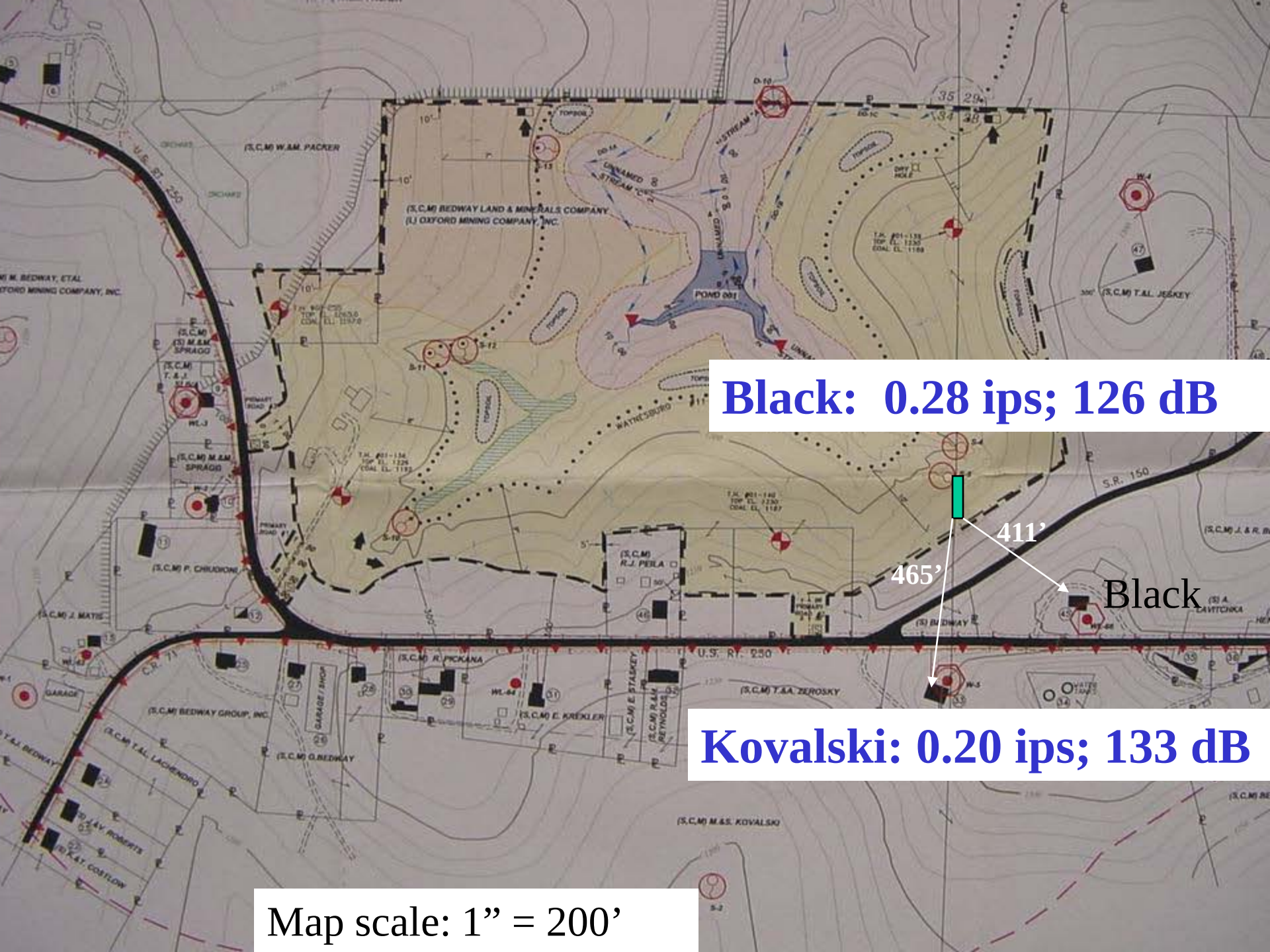
Dairy Jean


(S,C,M) W.&M. PACKER
(S,C,M) W.&E. RECTOR
(S,C,M) W.&M. PACKER
U.S. RT. 250
(S,C,M) BEDWAY LAND & MINERALS COMPANY
(L) OXFORD MINING COMPANY, INC.
(S,C,M) M. BEDWAY, ETAL
(L) OXFORD MINING COMPANY, INC.
(S,C,M) T.&L. JESKEY
(S,C,M) M.&M. SPRAGG
(S,C,M) M.&M. SPRAGG
(S,C,M) P. CHIUDIONI
(S,C,M) J. MATIS
POND 001
UNNAMED STREAM "C"
UNNAMED STREAM "B"
UNNAMED STREAM "A"
WAYNESBURG "A" COAL OUTCROP
TOPSOIL
800'
S.R. 150
(S,C,M) R.J. PERLA
(S) BEDWAY
(S) A. LAVITCHKA
U.S. RT. 250
C.R. 71
(S,C,M) R. PICKANA
(S,C,M) E. STASKEY
(S,C,M) R.&M. REYNOLDS
(S,C,M) T.&A. ZEROSKY
(S,C,M) TRI-COUNTY WATER
(S,C,M) BEDWAY GROUP, INC.
GARAGE / SHOP
GARAGE
(S,C,M) E. KREKLER
(S,C,M) G. BEDWAY
(S,C,M) T.&L. BEDWAY
(S,C,M) T.&L. LACHENDRO
(S,C,M) D.&V. ROBERTS
(S,C,M) D.K.&T. COSTLOW
(S,C,M) M.&S. KOVALSKI

Blast Plan Conditions
Case 1 Summary

- Monitor 90% of all blasts at nearest dwelling or business
- For blasts within 800’ of US 250 intersection (at Dairy Jean), monitor at a second dwelling or business in a different direction to assess directional effects
- Stop traffic on US 250 if blasting within 300’, and any time certified blaster determines it necessary


Spragg: 0.33 ips; 119dB
308’
371’
Dairy Jean: 0.70 ips; 106 dB
Map scale: 1” = 200’
(S,C,M) W.&M. PACKER
(S,C,M) W.&E. RECTOR
(S,C,M) BEDWAY LAND & MINERALS COMPANY
(L) OXFORD MINING COMPANY, INC.
(S,C,M) M. BEDWAY, ETAL
(L) OXFORD MINING COMPANY, INC.
POND 001
WAYNESBURG #11 COAL OUTCROP
(S,C,M) T.&L. JESKEY
(S,C,M) P. CHIUDIONI
(S,C,M) J. MATIS
(S,C,M) R.J. PEILA
(S,C,M) R. PICKANA
(S,C,M) T.&A. ZEROSKY
(S,C,M) TRI-COUNTY WATER
(S,C,M) M.&S. KOVALSKI
(S) BEDWAY
(S) A. LAVITCHKA
U.S. RT. 250
S.R. 150
C.R. 71
GARAGE


Black: 0.28 ips; 126 dB
411’
465’
Black
Kovalski: 0.20 ips; 133 dB
Map scale: 1” = 200’
U.S. RT. 250
S.R. 150
(S,C,M) W.&M. PACKER
(S,C,M) BEDWAY LAND & MINERALS COMPANY
(L) OXFORD MINING COMPANY, INC.
POND 001
WAYNESBURG
(S,C,M) T.&L. JESKEY
(S,C,M) R.J. PEILA
(S,C,M) P. CHIUDIONI
(S,C,M) J. MATIS
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(S,C,M) M.&S. KOVALSKI
(S) BEDWAY
(S) A. CAVITCHKA
GARAGE
GARAGE / SHOP
C.R. 71

Reasons/Justification for Additional Monitoring

- We know there are strong directional effects
- Liability protection
- The RA "…may require seismic monitoring of any or all blasts, and may specify the location…and degree of detail necessary."
- Anticipated blast design (w/in 1,000')

Blast Plan Conditions

Case 2 – Village of Flushing

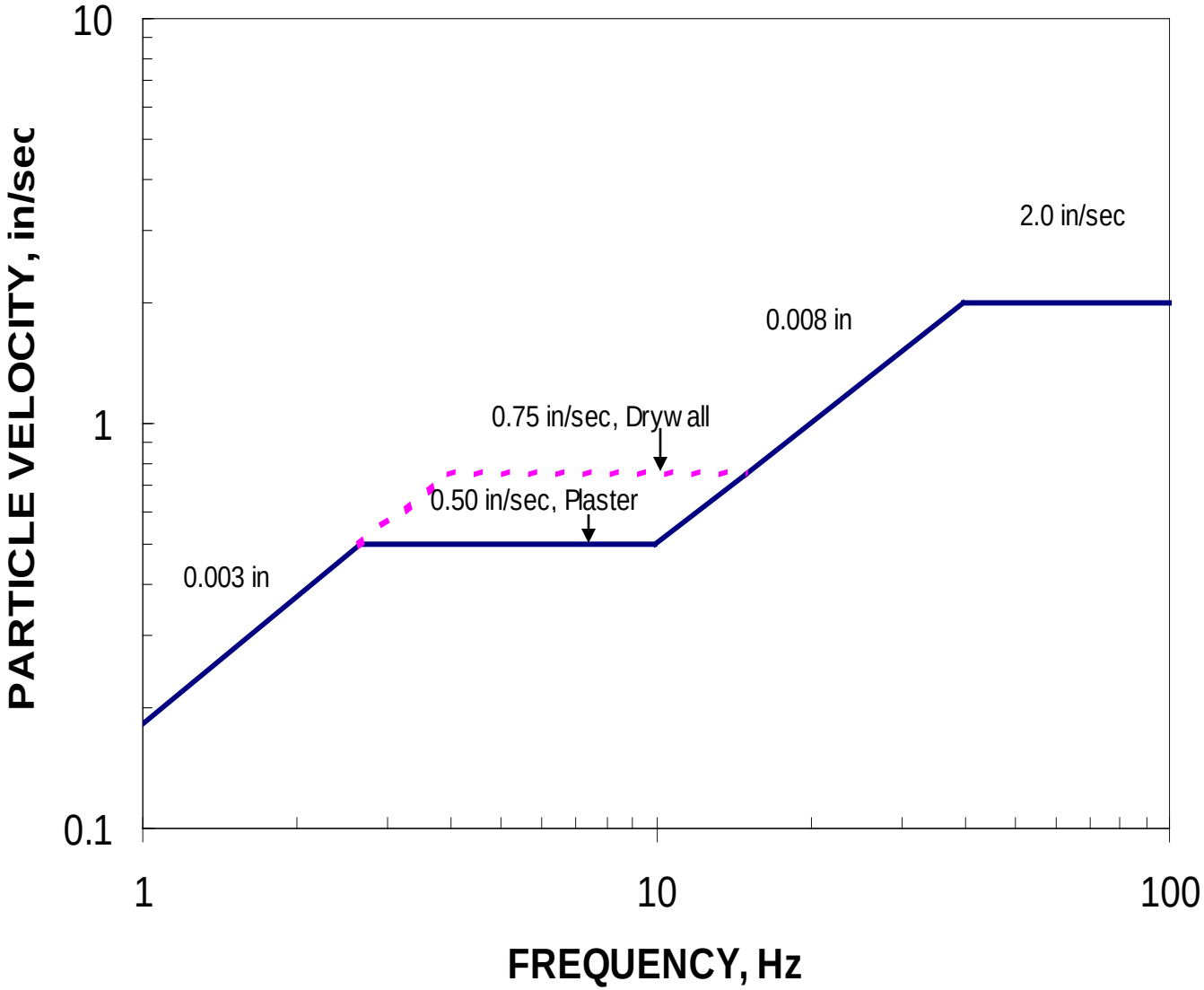
Map Scale: 1” = 400’

- Directional Effects?
- Old Houses?

Blast Plan Conditions
Case 2 Summary

- Monitor ***every*** blast at nearest dwelling
- Monitor at a second dwelling in a different direction “behind” the blast site
- Apply USBM Z-curve (for plaster) to ***all*** houses

FROM USBM RI 8507, APPENDIX B
ALTERNATIVE BLASTING LEVEL CRITERIA



Reasons/Justification for USBM Z-curve at Older Houses

- Published in RI 8507; threshold cracks in plaster are theoretically possible below 0.75 ips
- Used by consultants and lawyers
- Liability protection
- The RA "…shall reduce the maximum allowable ground vibration limits…if …necessary to prevent damage."
- Older houses identified in anticipated blast design

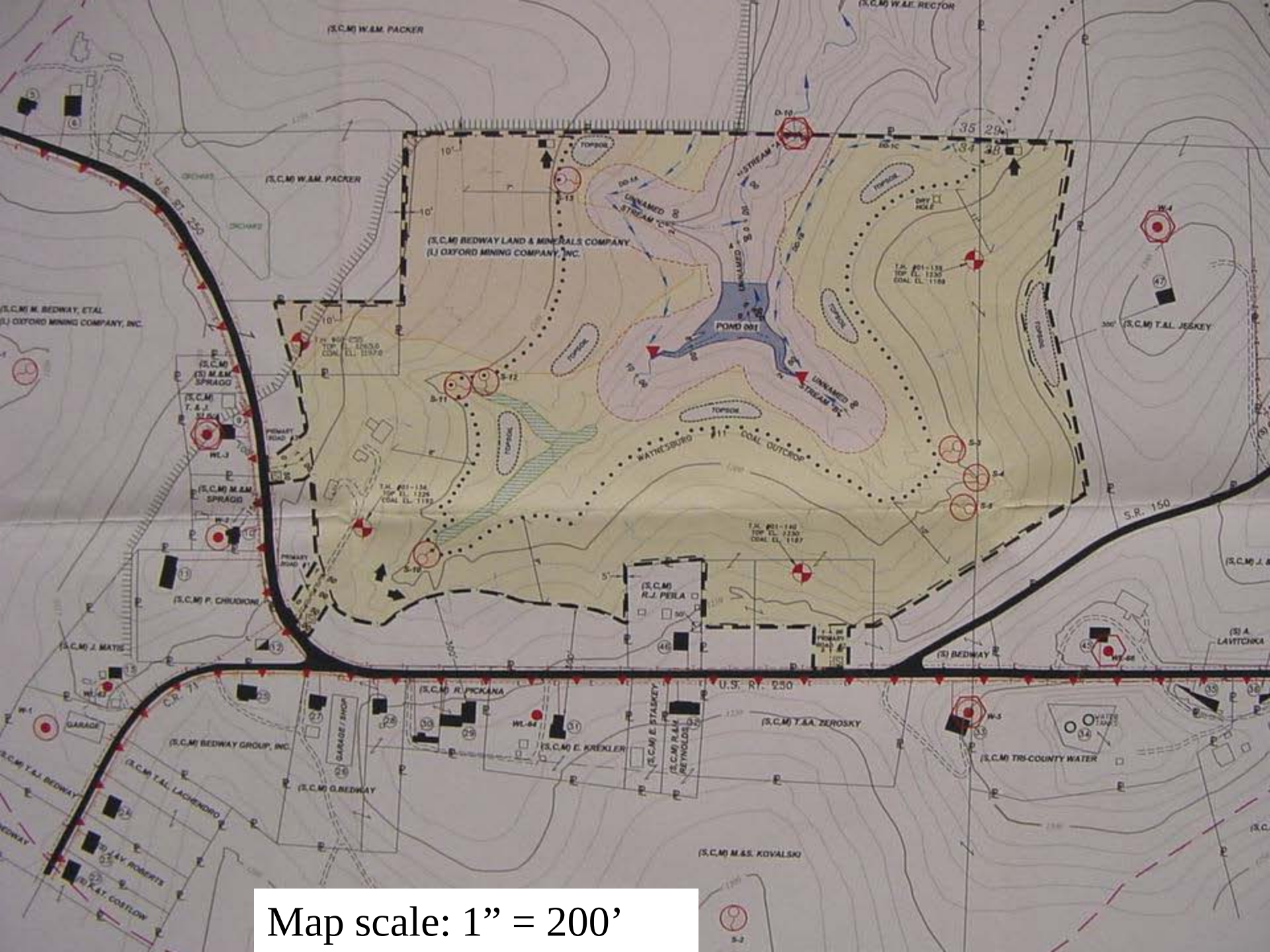
What about Quarries? (Industrial Minerals)

- IM law/rules are simpler, with no federal counterpart
- Mine plan and blasting section are simpler, BUT:
- If SD < 90, seismo. monitoring is required
- USBM z-curve (with 0.5 ips plateau at low f)
- Monitoring in 2nd direction is common
- Some quarries have ***multi***-directional monitoring by independent consultants

Afterthought:

What about underground migration of carbon monoxide into houses?

300'
J. & L. TWISER (S,M)
M. MERRITT (S,M)
M. ROUSH (S,M)
W. & M. RALSTON & D. MARSHALL (S,M)
VILLAGE OF FLUSHING
K. MORRIS (S,M)
(S,M) C. STARR
G. SHOPPNER (S,M)
(S,M) C. STARR
(S,M) E. HUML
CEMETERY
Water tower
U-2B
U-2A
P-006
UNNAMED STREAM "1"
UNNAMED STREAM
EI-50
W.E. 1066
0.3 Ac T/S
EXIST 48" DIA CMP
1250
1200
1150
1100
1300
Map Scale: 1" = 400'



Map scale: 1” = 200’

Since 1988, 17 cases have been reported where blast-generated CO moved through the earth into basements or other enclosed spaces.

- 39 suspected or medically verified poisonings
- One fatality
- (How many have gone unreported?)

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- Most CO poisonings were from construction blasts < 150’ from houses or a manhole, **<u>but</u>**…

Kittaning, PA Incident April 2000

- Surface **coal** mine – Upper Freeport coal
- CO migrated about 450’ into house
- Three people suffered from CO poisoning

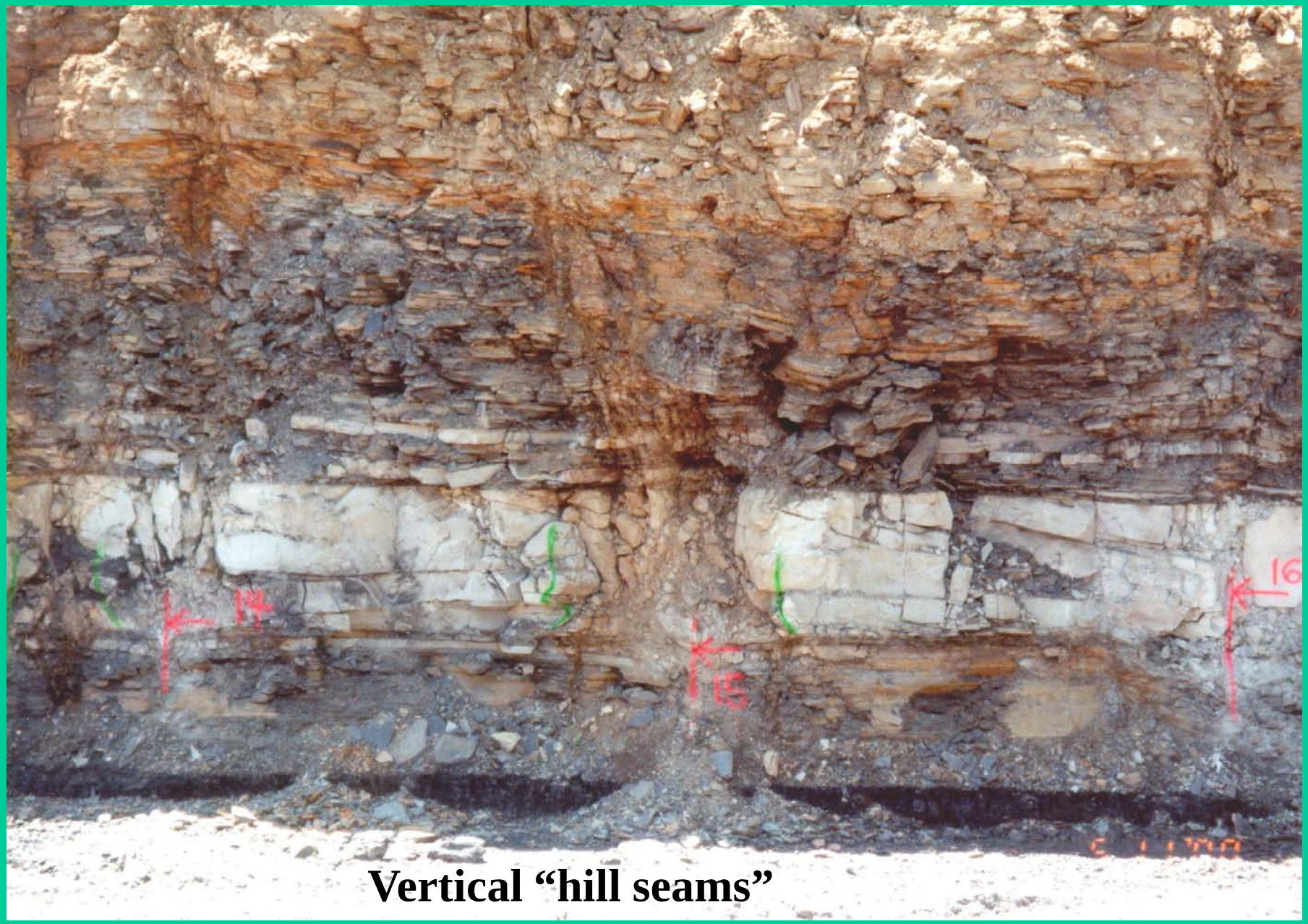
CO Poisoning – Kittaning, PA

- Husband, wife and infant were treated at hospital
- Infant was placed in hyperbaric chamber
- Husband – 28% carboxyhemoglobin level
- Wife – 17%
- Infant (11 days old) – 31%
- All were released later that day

S

S

S



Vertical “hill seams”

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Carbon Monoxide Facts

- **ALL** blasts produce some CO (1% to 3% of gases)
- It is colorless, odorless, and tasteless
- Its density is about the same as air
- **35 ppm** TWA is considered safe over 8 hours per NIOSH
- **1,200 ppm** is Immediately Dangerous to Life and Health (IDLH) per NIOSH
- Effects: headache; nausea; dizziness; fatigue; death from asphyxiation (at prolonged high concentrations)

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Primary Causes of Excessive CO

- Overfueled ANFO-based explosives (too much carbon; too little nitrate)
- Use of molecular explosives, such as pelletized TNT, that are “heavy” on the fuel side of the oxygen/carbon equation (not a likely choice of explosives for surface mine blasts, but sometimes used for construction blasts)

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Factors Conducive to Underground CO Migration

- Unbalanced (overfueled) explosives
- Heavily confined blast
- Leave muck pile sit
- Conduit from blast to house: vertical fractures (“hill seams”), buried waterlines, old wells, basement sumps and drains
- Distances generally 500’ or less (?)

Blast Plan Conditions to Prevent CO Migration/Poisoning

- Apply to blasts within 500’ of houses (with basements) above or in strata being blasted?
- Maintain at least one open face?
- Delay patterns that promote some lateral movement?
- Immediate removal of muck pile?
- Mandatory preblast inspection for conduits?
- Offer to install and maintain CO alarms in houses?
- Mitigation measures?

Reasons/Justification for Preventing CO Migration

- Liability protection
- "Blasting shall be conducted in a manner to **prevent injury to persons**, damage to public or private property…."

Amerikohl Mining – “Threading the needle”

OXIDIZER
5.1
D11R

REED
SK-35

Filter
1-20"x20"x1"
When not using
coal furnace for
heating.
Be sure 2 dampers
on back side of
coal furnace are
shut off.
Filters 2-16x25x1"
Air Flow

Old Drain

Actual Blast Plan Conditions

- Before blasting begins within 500 feet of the Bowman house at W-5, carbon monoxide detectors with alarms will be installed in the basement and on the 1st floor and 2nd floor levels, and maintained for at least 14 days after the last blast.

- If dangerous levels of CO are detected in the Bowman house, appropriate mitigation measures will be taken immediately to safeguard the occupants and eliminate the hazard. Such mitigation measures may include any or all of the following:

CO Mitigation Measures

- Immediately vacate persons and pets
- Ventilate house and basement with windows and exhaust fans
- Install exhaust fans over drains, sumps, and wells with high CO levels
- Drill and ventilate closely spaced holes between blast site and house
- Other appropriate measures

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TEST/RESET
OPERATE
ALARM
Move to
Fresh Air
KIDDE
CARBON MONOXIDE
ALARM

DELTA

Barn & Fence
PAINT

Blast Plan Conditions

Case 3 – Village of Barnesville

Where History Meets Progress
Welcome
To
Barnesville

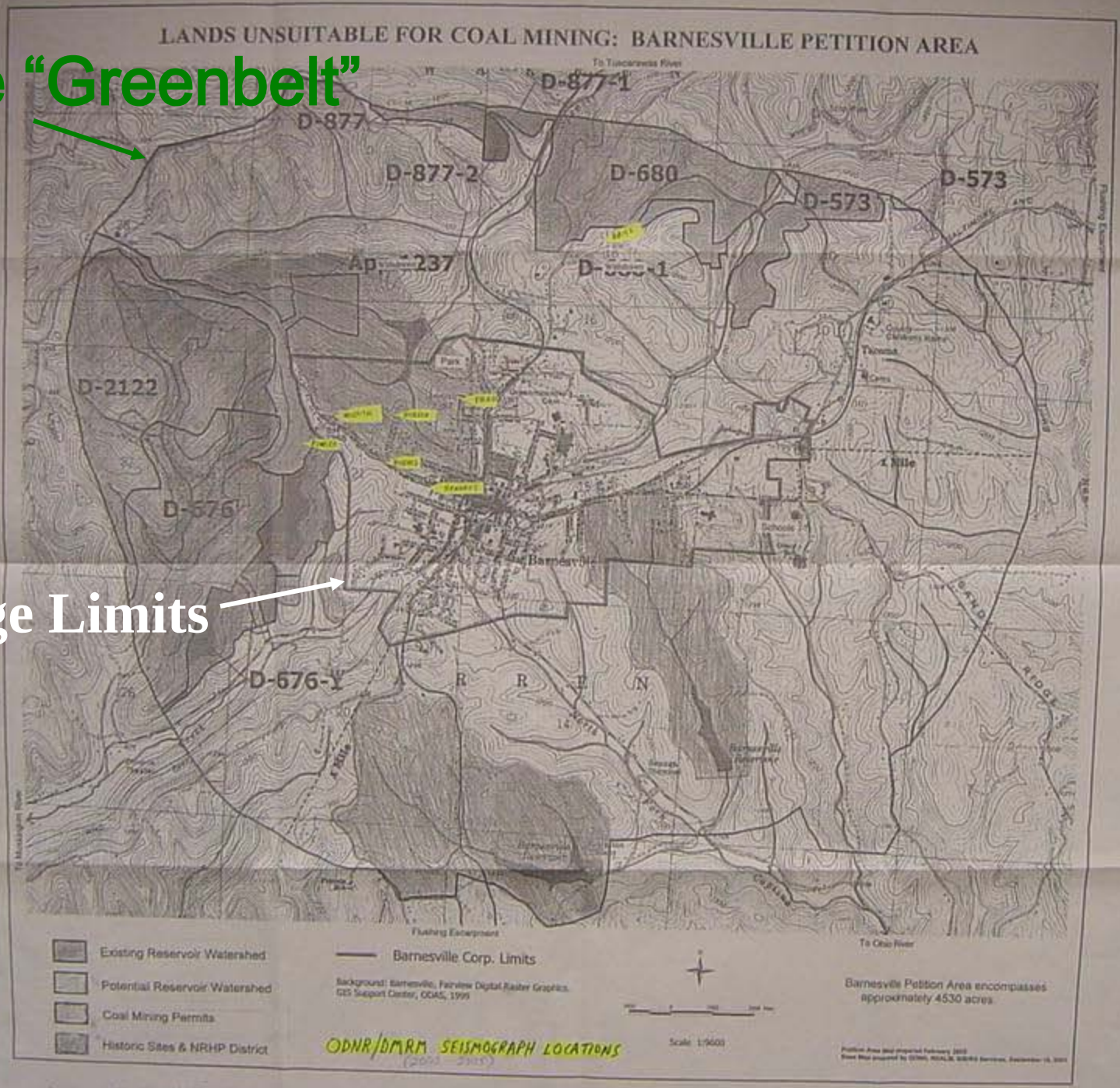
atrick's
ESTAURANT

1890.

BARNESVILLE
HOME OF
"GAY 90's MANSION"
THE
BELMONT COUNTY
MUSEUM

WALTON
BELMONT COUNTY
MUSEUM
OPEN
MAY 1 - OCT. 1

1-mile "Greenbelt"

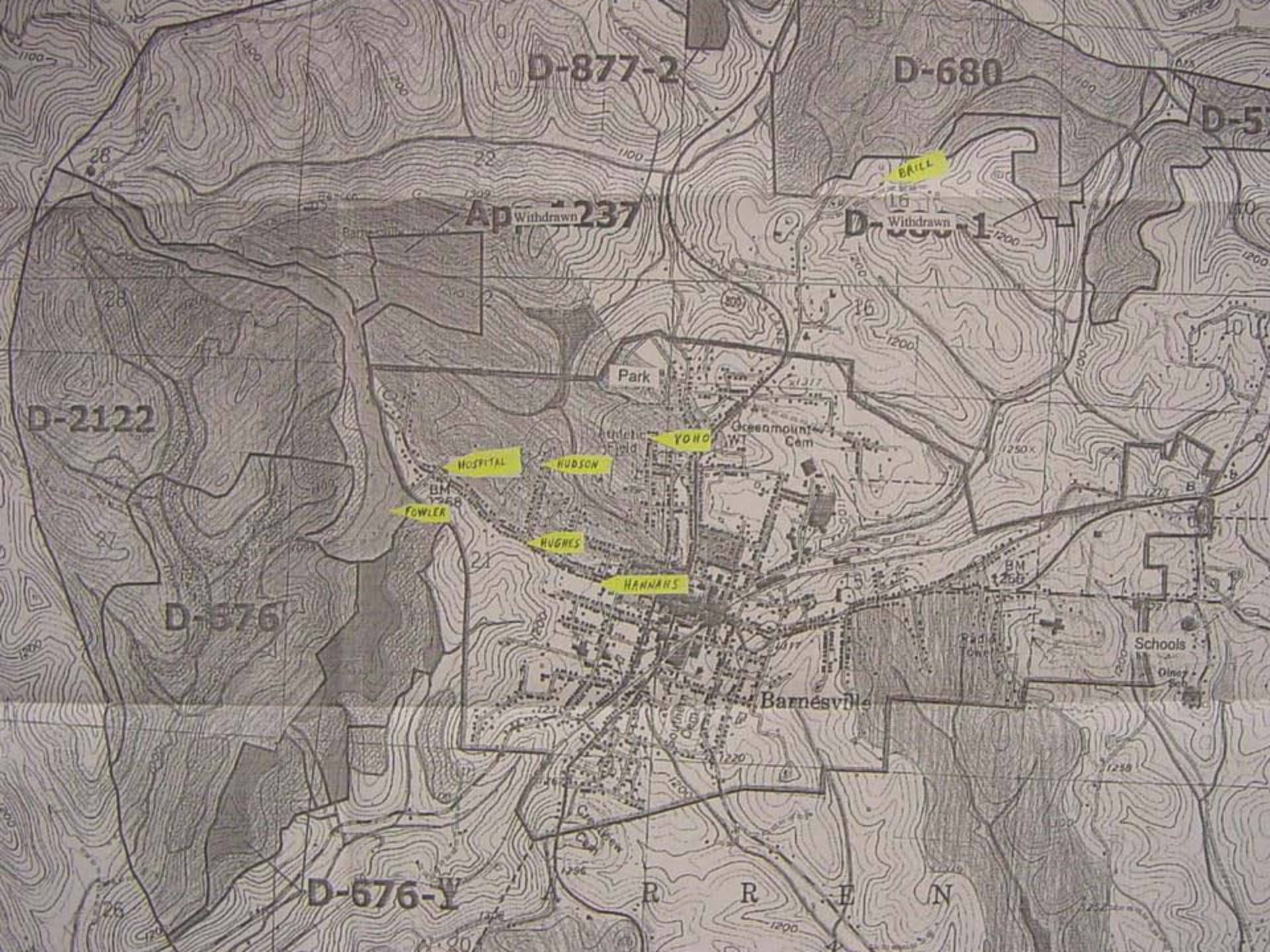


Village Limits

COPY OF EXHIBIT

Barnesville Hospital

Emergency



D-877-2
D-680
D-57
BRILL
Withdrawn
Withdrawn
Park
D-2122
YOHO
Greenmount Cem
HOSPITAL
HUDSON
FOWLER
HUGHES
HANNAHS
D-676
Schools
Barnesville
D-676-Y
A R R E N

Blast Plan Conditions
Case 3 Summary

- Monitor 90% of all blasts at nearest dwelling (within 1,000’)
- Apply USBM Z-curve when w/in 1000’ of older homes on W. Main St.
- Apply SD $\geq$ 90 or USBM Z-curve at a specific dwellings (regardless of distance)
- Daily notification to hospital, and delay blast if necessary

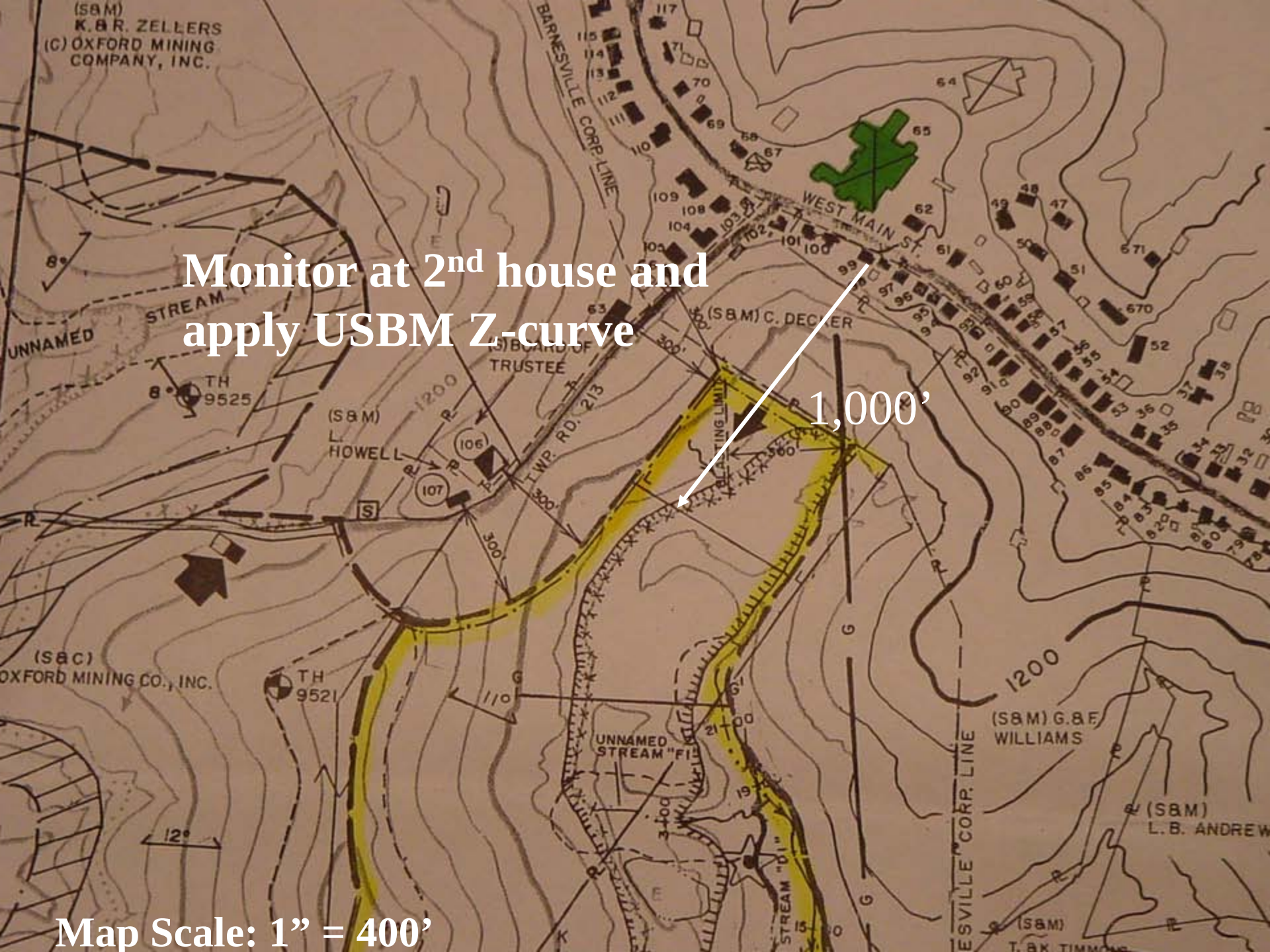
Why an SD of 90 (or greater)?

$$\text{Predicted PPV} = 438(\text{SD})^{-1.52}$$

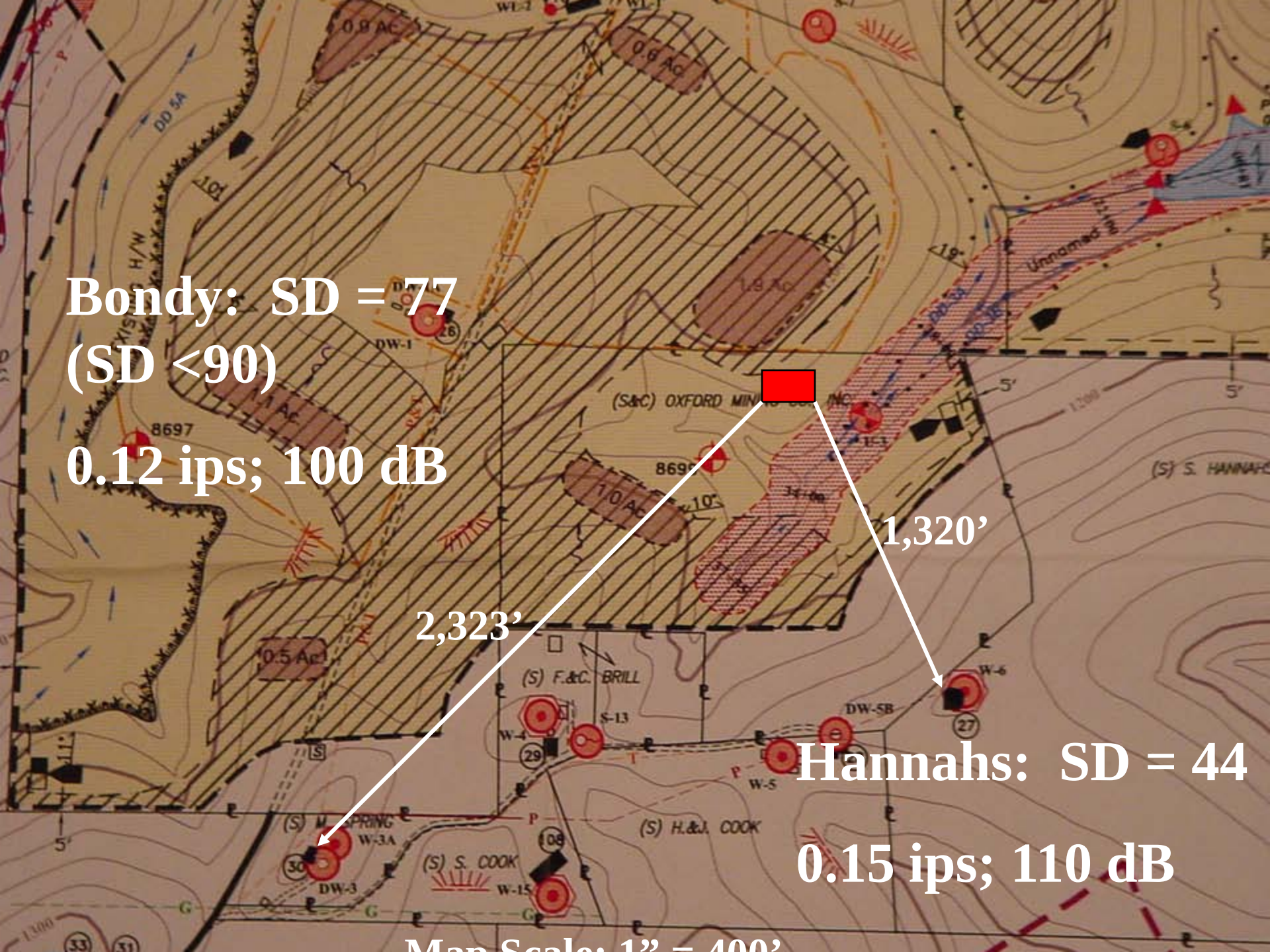
(95% confidence equation from RI 8507)

$$\text{PPV} = 438(\mathbf{90})^{-1.52} = 0.47 \text{ ips}$$

h
(S) B. HARTLEY
(S&M) K.&R. ZELLERS
(C) OXFORD MINING COMPANY, INC.
UNNAMED STREAM "F"
UNNAMED STREAM "D"
UNNAMED STREAM "E"
TWP. RD. 213
TH 9525
TH 9527
TH 9521
(S&M) L. HOWELL
(S) BOARD OF TRUSTEE
(S&M) C. DECKER
WEST MAIN ST.
BARNESVILLE CORP. LINE
(S&C) OXFORD MINING CO., INC.
(S&M) G.&F. WILLIAMS
(S&M) L.B. ANDREWS
(S&M) F.D. STARR
(S&M) C.&A. SELLERS
(S,C&M) OXFORD MINING CO., INC.
#9 COAL SEAM
MEIGS CREEK
D-0676
1200
1100
N


Monitor at 2nd house and apply USBM Z-curve
1,000'
Map Scale: 1" = 400'
(S&M) K.&R. ZELLERS
(C) OXFORD MINING COMPANY, INC.
BARNESVILLE CORP. LINE
WEST MAIN ST.
UNNAMED STREAM
TH 9525
(S&M) L. HOWELL
TWP. RD. 213
(S&M) C. DECKER
(S&C) OXFORD MINING CO., INC.
TH 9521
UNNAMED STREAM "F1"
STREAM "D1"
(S&M) G.&F. WILLIAMS
(S&M) L.B. ANDREW
1200
300'
12°

Bondy House
>100 years old
Plaster-on-wood lath interior


Bondy: SD = 77
(SD <90)
0.12 ips; 100 dB
1,320'
2,323'
Hannahs: SD = 44
0.15 ips; 110 dB
Map Scale: 1" = 400'
(S&C) OXFORD MINING
(S) F.&C. BRILL
(S) H.&J. COOK
(S) S. COOK
(S) S. HANNAHS
DW-1
DW-3
DW-5B
W-3A
W-4
W-5
W-6
W-15
S-13
8697
Unnamed

Blast Plan Conditions

Case 4 – New Lexington North

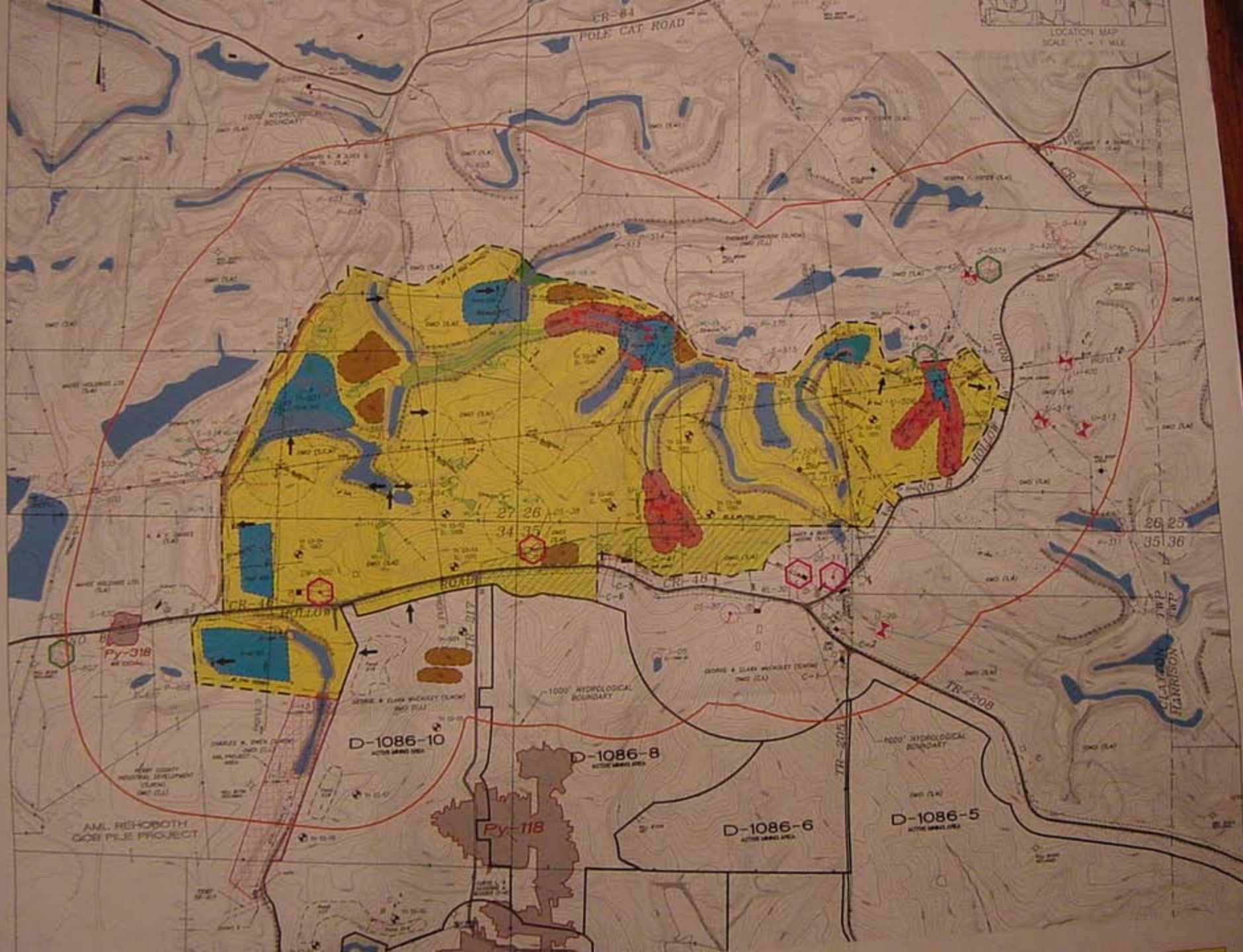
NO_2 Problem

Summary of NOx Complaints (3 Neighbors)

- Orange clouds seen *over 8 months ago* when many blasts were as close as 300’ to 500’
- One neighbor claimed eyes, nose and throat irritated
- Had one photo of orange cloud *over mine area* with handwritten date (but no time)
- Claimed to have video, but wouldn’t show it to us
- Current blasting much farther with little or no orange plume
- Was negotiating to sell property to mining company

NOx Complaint “Kicker”

- Trailer occupant on oxygen 24/7
- House occupant on oxygen 24/7
- New permit application proposes mining close to both residences again!



CR-84
POLE CAT ROAD
LOCATION MAP
SCALE 1" = 1 MILE
1000' HYDROLOGICAL BOUNDARY
CR-84
ROAD
HOLLOW
CR-48
TR-217
TR-208
TR-205
27 26
34 35
26 25
35 36
Py-318
Py-118
D-1086-10
D-1086-8
D-1086-6
D-1086-5
AML REHOBOTH
GOB PILE PROJECT
CLAYTON TWP
HARRISON TWP

Residents on oxygen
OMCI (S,M)
OMCI (S,C,M)
P-350
I-3
P-501
I-4
P-504
I-8
WL-2
WL-3
WL-9
WL-10
WL-11
WL-12
Stream "A"
Stream "B"
Stream "C"
TH 03-52
EL 1008
TH 03-53
EL 1075
TH 03-54
EL 1043
TH 03-60
EL 1000
DW-500
34
35
C-41
C-5
C-6
CR-48
HOLLOW
ROAD
PROFILE B
TR-217
TH-0024
Pond 019
Pond 001
Pond 002
GEORGE & CLARA McCAULEY (S,NCM)
OMCI (C,L)
TH 03-55
1000' HYDROLOGICAL BOUNDARY
I-05
I-13
PROFILE D

Analytical Measurements in Cast Blasting to Identify the Cause and Cure for "Orange Smoke" Formation

Industrial Alchemy
Charles R. Barnhart

The Nitrogen Dioxide Cloud:

After one year of testing it can be stated that we do know and understand a great deal about why the nitrogen dioxide formation is exacerbated in cast blasting. Picture 1 is an example of how concentrated the NOx can be from a cast blast. It has long been felt that 300 or more milliseconds of timing needs to be put between each row of detonations to

Picture 1: Baseline blast #3 at Triton North Rochelle on April 24, 2003.

NO_2 Concentrations by Color (suggested by Barnhart)

- **RED** cloud: 10,000 ppm by volume
- **ORANGE** cloud: 1,000's of ppm
- **YELLOW** cloud: 100's of ppm
- Recommended Limit: **5** ppm
- **CAUTION** – color might not be a good indicator

Nitrogen Dioxide Facts

- **ALL** blasts produce some NO_2
- It has a pungent, acrid odor
- In large concentrations, it is **orange**, **red**, or **rust**-colored
- Its density is about 1.58 (denser than air)
- **5 ppm** is recommended limit per OSHA and ACGIH
- **20 ppm** is Immediately Dangerous to Life and Health (IDLH) per NIOSH
- Effects: irritation of eyes, nose, throat; cough; dizziness; headache; sweating; labored breathing; pulmonary edema (from acidity); death (at high concentrations)

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Effects from inhalation of NO_2 may be delayed for a few hours, and lung damage is **irreversible !**

Primary Causes of NO_2

- Poor blasting mixtures (underfueled)
- Degradation of blasting agents during storage
- Degradation of non-water-resistant products in wet blastholes
- **Inefficient detonation due to loss of confinement (in cracks and voids)**
- Disruption of powder column due to too much time between rows (in large casting shots)

Blast Plan Conditions
Case 4 Summary

- Initial 3 blasts above #5 and #6 coals: detonate when wind will not carry plume to any occupied dwelling within 2000 feet.
- Videotape initial 3 blasts above both seams to observe/document generation/dissipation of any orange or rust-colored fumes.
- Locate/operate camera to follow drift/dissipation of plume.
- Maintain recordings for one year; make available to DMRM staff.

Blast Plan Conditions Case 4 Summary (cont.)

- If NOx fumes are observed from ANY blast, take measures to minimize NOx production and prevent drifting to any occupied dwelling.

NOx Mitigation Measures (any or all of the following)

- Pumping water from wet blastholes
- Selecting field-appropriate water-resistant (and oxygen balanced) explosives and loading methods
- Communicating with driller to locate significant cracks and voids, then stemming through or sealing off those zones
- Using plastic hole liners
- Detonating when wind will not carry the plume to an occupied dwelling
- Vacating occupants of dwellings owned by coal company until plume has passed beyond dwellings

New Orange Cloud Complaint!

- Pumping water from wet blastholes
- Selecting field-appropriate water-resistant (and oxygen balanced) explosives and loading methods **– began using sensitized emulsion**
- Communicating with driller to locate significant cracks and voids, then stemming through or sealing off those zones
- Using plastic hole liners
- Detonating when wind will not carry the plume to an occupied dwelling **– bicycle pennant on blast bench and early AM weather reports**
- Vacating occupants of dwellings owned by coal company until plume has passed beyond dwellings

“The legal ramifications for explosive suppliers and mine operators could have grave consequences in the event of illness or death to nearby homeowners and/or workers alike.”

- Frank Chiappetta (1994)

New Findings on the Impact of an Explosive VOD on Blast Results

(in 1994 ISEE Proceedings)

Questions?

Mike Mann

330-339-2207

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