

The background of the slide is a light gray gradient. It is decorated with numerous realistic water droplets of various sizes. Some droplets are at the top left, some are scattered in the middle, and a larger cluster of droplets is on the right side. The droplets have highlights and shadows, giving them a three-dimensional appearance.

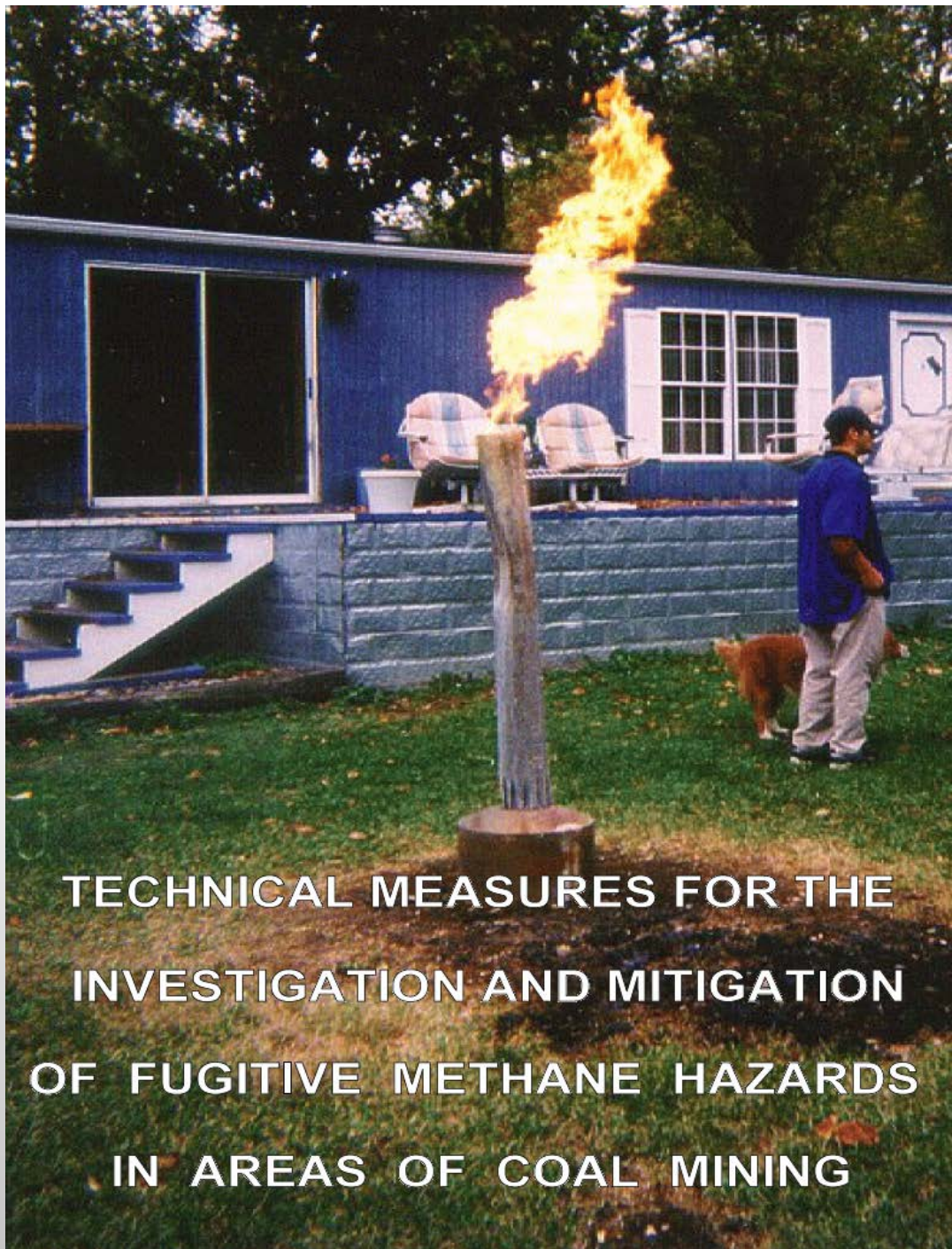
TECHNICAL MEASURES FOR INVESTIGATION AND MITIGATION OF FUGITIVE METHANE

MAY 2016 WSCS CONTRACTORS WORKSHOP

LITERATURE BACKGROUND

- 2001 DEPARTMENT OF INTERIOR (DOI) OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT'S (OSM)
 - *TECHNICAL MEASURES FOR THE INVESTIGATION AND MITIGATION OF FUGITIVE METHANE HAZARDOUS IN AREAS OF COAL MINING*
- EXTENSIVELY REFERENCED
- DISSOLVED METHANE ASSOCIATED WITH COAL MINING AND OIL & GAS EXPLORATION AND PRODUCTION – IN PARTICULAR THE APPALACHIAN PLATEAU

2001 DOI OSM
STUDY COVER
PAGE >>



TECHNICAL MEASURES FOR THE
INVESTIGATION AND MITIGATION
OF FUGITIVE METHANE HAZARDS
IN AREAS OF COAL MINING

2001 OSM STUDY FINDINGS

- METHANE IS NON-TOXIC AND IS THEREFORE NOT A LONG-TERM HUMAN HEALTH RISK DUE TO EXPOSURE
- THE SOLUBILITY OF METHANE IN WATER IS BETWEEN 28 MG/L AND 30 MG/L AT STP (21.5 MG/L AT 25°C)
- METHANE BECOMES FLAMMABLE IN AIR AT ABOUT 5% BY VOLUME (LOWER EXPLOSIVE LIMIT ~50,000 PPMV)
 - OSM RECOMMENDS THAT METHANE CONCENTRATIONS GREATER THAN 28 MG/L IN WELL WATER BE ADDRESSED IMMEDIATELY BY REMOVING ANY POTENTIAL IGNITION SOURCE AND VENTING THE GAS AWAY FROM CONFINED SPACES
 - OSM RECOMMENDS THAT METHANE CONCENTRATIONS RANGING FROM 10 TO 28 MG/L IN WATER SIGNIFIES AN ACTION LEVEL WHERE THE SITUATION SHOULD BE CLOSELY MONITORED
 - LEVELS OF METHANE <10 MG/L REQUIRE NO IMMEDIATE ACTION. PERIODIC MONITORING IS RECOMMENDED TO VERIFY THAT CONCENTRATIONS DO NOT CHANGE

2001 OSM STUDY FINDINGS

- THE OSM DISSOLVED METHANE ACTION LEVELS ARE BASED ON A 1965 STUDY
 - *METHANE IN THE FRESH-WATER AQUIFERS OF SOUTHWESTERN LOUISIANA AND THEORETICAL EXPLOSION HAZARDS* BY A. H. HARDER ET AL. (1965)
 - HARDER ET AL. CHARTED EXPLOSIVE LEVELS IN CONFINED SPACES USING DISSOLVED METHANE CONCENTRATIONS.
 - EXAMPLE – A SMALL SHOWER STALL IS 3' X 3' X 8' FOR A TOTAL VOLUME OF 72 CUBIC FEET. ASSUMING NO AIR EXCHANGE IN THE STALL, AN EXPLOSIVE ATMOSPHERE WOULD BE OBTAINED AT 28 MG/L WITH 779 GALLONS OF WATER. WHILE THIS IS AN EXCESSIVE VOLUME OF WATER FOR A TYPICAL SHOWER, IT IS BASED ON 5% METHANE IN THE ATMOSPHERE



Explosive Atmospheres in Confined Spaces from Dissolved Methane

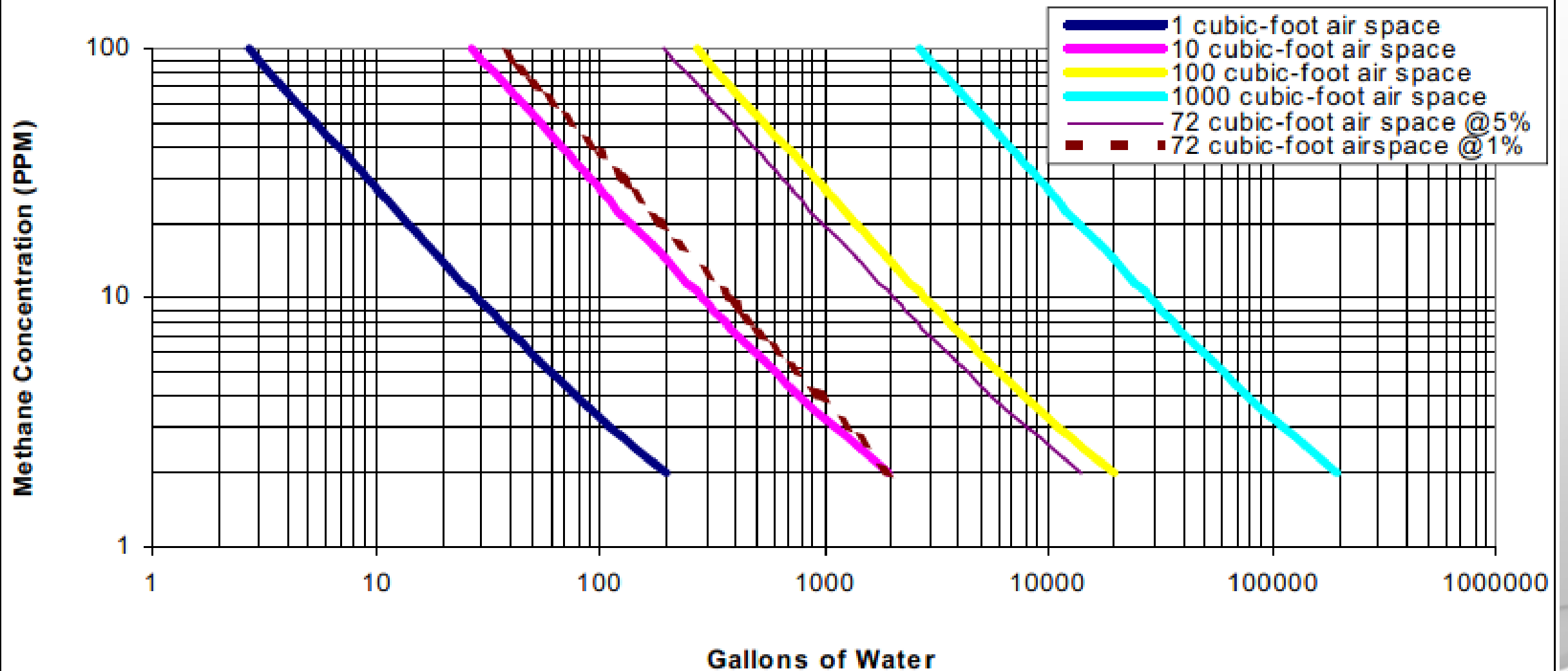


Figure 11. Explosive Atmospheres in Confined Spaces from Dissolved Methene.

2001 OSM STUDY SUMMARY

- THREE OSM DISSOLVED METHANE ACTION LEVELS
 - >28 MG/L – IMMEDIATE ACTION, FLAMMABLE OR EXPLOSIVE CONDITIONS COULD OCCUR
 - >10 MG/L BUT <28 MG/L – WARN OCCUPANTS, MONITOR
 - <10 MG/L – NO IMMEDIATE ACTION REQUIRED
 - CAVEAT – ALL OF THE ABOVE IS BASED ON METHANE OFF GASSING FROM RUNNING **WELL** WATER INSIDE A STRUCTURE (SHOWER HEAD, WASHING MACHINE, FAUCETS, ETC.)
- 10 MG/L METHANE ACTION LEVEL ADOPTED BY OHIO
- 7 MG/L METHANE ACTION LEVEL ADOPTED BY PENNSYLVANIA
- NO METHANE GCTL FOR FLORIDA



FUGITIVE METHANE AT DSCP SITES

- BIOGENIC METHANE FROM CELEBRITY CLEANERS
- DEEP DNAPL SITE (35 FT TO 65 FT BLS)
- TREATMENT TRAIN APPROACH
 - ISCO W/ SODIUM PERCARBONATE
 - BIO-STIM W/ 3DME
 - BIO-AUG/BIO-STIM W/BDI & 3DME



FUGITIVE METHANE AT DSCP SITES

- CELEBRITY CLEANERS
- PRE-REMEDIATION (2001 & 2003) DISSOLVED METHANE CONCENTRATIONS
 - 0.009 MG/L TO 3.21 MG/L
 - AVERAGE = 0.96 MG/L (N = 11)
- POST-REMEDIATION (OCTOBER 2015) DISSOLVED METHANE CONCENTRATIONS
 - 2.9 MG/L, 10 MG/L, & 11 MG/L
 - THREE TO TEN-FOLD INCREASE IN DISSOLVED METHANE CONCENTRATION

FUGITIVE METHANE AT DSCP SITES

- 60 MINUTE CLEANERS
 - BIO-STIM W/ 3DME
 - POST-REMEDIATION (APRIL 2016) DISSOLVED METHANE CONCENTRATIONS
 - 0.0026 MG/L TO 4.6 MG/L
 - AVERAGE 1.5 MG/L (N = 5)
 - SOME OF THE HIGHEST DISSOLVED METHANE CONCENTRATIONS FROM INTERIOR MONITOR WELLS
 - AVG DTW 5 FT BLS



FUGITIVE METHANE AT DSCP SITES

- FUGITIVE METHANE IS A CONCERN AT DSCP SITES – ABSOLUTELY
- THE OSM RECOMMENDS ACTION WHEN DISSOLVED METHANE >10 MG/L
 - HOWEVER THIS IS BASED ON METHANE OFF GASSING FROM RUNNING WELL WATER INSIDE A STRUCTURE
- FUGITIVE METHANE VIA VAPOR INTRUSION
 - 50,000 MG/L = THE LOWER EXPLOSIVE LIMIT
 - ACTION LEVELS BETWEEN 1,000 MG/L AND 10,000 MG/L (0.1% TO 1% METHANE) APPEARS TO BE A PRUDENT PRECAUTION

MEASURES & MITIGATION

- MEASURE WELL HEAD GAS WITH CGI
- SAMPLE ADJACENT WELLS TO SEE IF DISSOLVED METHANE IS MIGRATING
- INCREASE DISSOLVED METHANE SAMPLING IF CONCENTRATION TRENDS WARRANT
- RUN THE SVE SYSTEM (IF $<LEL$)
- INSTALL VENTED WELL CAPS ON EXTERIOR MONITOR WELLS



QUESTIONS?



Photograph by Matthew Conheady (www.nyfalls.com)

Figure 1. Gas flame from natural gas seep at Chestnut Ridge County Park, Eternal Flame Falls, Erie County, New York.