

Planning meeting  
mts w/ [unclear]  
01/14/04

Nuclear

Mitigation  
still developing

EPA  
Zero tolerance

# Braidwood Station Groundwater Tritium Investigation

December 20, 2005

HH-4

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# Agenda

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**Exelon**<sup>SM</sup>

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- Introduction – Scott Humbard
- Braidwood Site Overview - John Moser
- Safety of the Public - John Moser
- Status of Investigation – Scott Sklenar
- Long Term Plan – John Moser
- Summary – John Moser

# Braidwood Site Overview

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- Approximately 4500 acre site with 2500 acre cooling lake
- Tritium generated in reactor coolant from reactor operation
- Circulating water system transfers heat to cooling lake
  - Continuous make-up and blowdown between cooling lake and Kankakee River
  - Vacuum breakers used in blowdown line to prevent damage due to water surges in pipe when flow changes

# Braidwood Site Overview

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- Liquid effluent management
- No tritium (or other liquid radioactive effluents) being released into blowdown line flow until pipe confirmed to be leaktight
  - liquid effluent storage capacity being supplemented with temporary storage tanks

# Safety of the Public

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- Groundwater sampling identified elevated concentrations of tritium in the shallow groundwater
- Drilled over 100 monitoring wells onsite and offsite to determine extent of tritium migration
- Tested 14 private wells of residents north (downgradient) of the site
  - Thirteen private wells measured less than 142 picocuries per liter (pCi/L)
  - Three readings from one private well were 1151, 1524, 1367 pCi/L
- Calculated radiation associated with highest private well reading is 0.3 millirem per year
- Results of private well sample analysis have been communicated to residents

*22 of  
112 wells  
done using  
same  
method*

*1490 / NEC  
1020 / SPIT  
sample  
results  
200 pCi/L  
LLD*

# Status of Investigation

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## Regional Geology

- Fine grained uniform sand – ranges in thickness from 15 to 35 feet
- Regional clayey till – averages 20 feet thick
- Bedrock formations comprising shales, coal, silt stones, limestone, and sandstones
- Uppermost aquifers – uniform sand and bedrock sandstone

## Man-made Features

- Coal mining operations
- Borrow pits

*Strip mining area  
need to id pits or any  
remnants which  
alter migration*

# Status of Investigation

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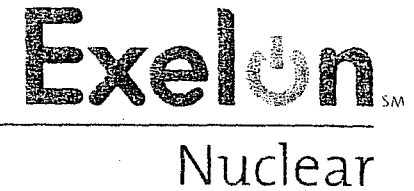
*Pond  
actually  
slows up  
movement*

## Hydrology

- Shallow groundwater flows toward the north
- Geologic barriers exist to vertical downward migration
- Deep bedrock groundwater also flows to the north
- Interaction of groundwater with surface water bodies

# Status of Investigation

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## Extent of Tritium Plume

- Shallow water-bearing sand
- Surface water bodies
- Deeper water-bearing sand
- Bedrock aquifer



# Status of Investigation

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## Potential Sources, Transport of Tritium

- Existing evidence indicates the source of the tritium is the blowdown line
- Further investigations focused to confirm whether source is current leak(s), historic spills, or a combination
- Potential transport mechanisms
  - Influence of pond on tritium transport

*RW-2*  
*220,000 pCi/l*  
*246,000*

*27 ft*  
*explanation*

*9*  
*Not explanation*  
*by release*  
*... were 100K*

# Status of Investigation

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## Regional Investigation

- Historical review of coal mines and local quarries
- Review of historical aerial photographs
- Survey of public and private drinking water systems north of site
- Development of regional hydrogeologic cross-sections

# Status of Investigation

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## Field Investigation

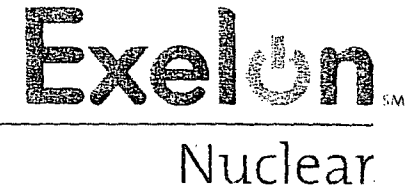
- Two onsite shallow sand wells
- 21 onsite deeper sand wells
- 10 offsite shallow wells
- 12 offsite deep wells
- Synoptic round of water level measurements
- Comprehensive round of groundwater samples
- Will sample selected wells weekly
- Installing staff gauges in surface water bodies

## Blowdown Line Integrity

- Periodic surveillance of blowdown line vacuum breaker valves to verify no leakage
  - December 9, 2005 surveillance confirmed no leakage
- Special acoustic monitoring test being performed on blowdown pipe to determine if pipe has underground leak
  - Sensor (“microphone”) attached to umbilical cable inserted in pipe; water flow pulls sensor through pipe to identify location of leak
  - Test scheduled to be completed December 30, 2005

# Status of Investigation

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- **Data evaluation and reporting**
  - Evaluate data from field investigations and pipeline integrity test in order to:
    - Determine source or sources
    - Define lateral and vertical extent of plume
    - Evaluate risk to human health and environment
    - Develop appropriate future actions including monitoring
- **Prepare summary documents of evaluations for regulatory review**
- **Establish periodic informational update meetings**

# Long Term Plan

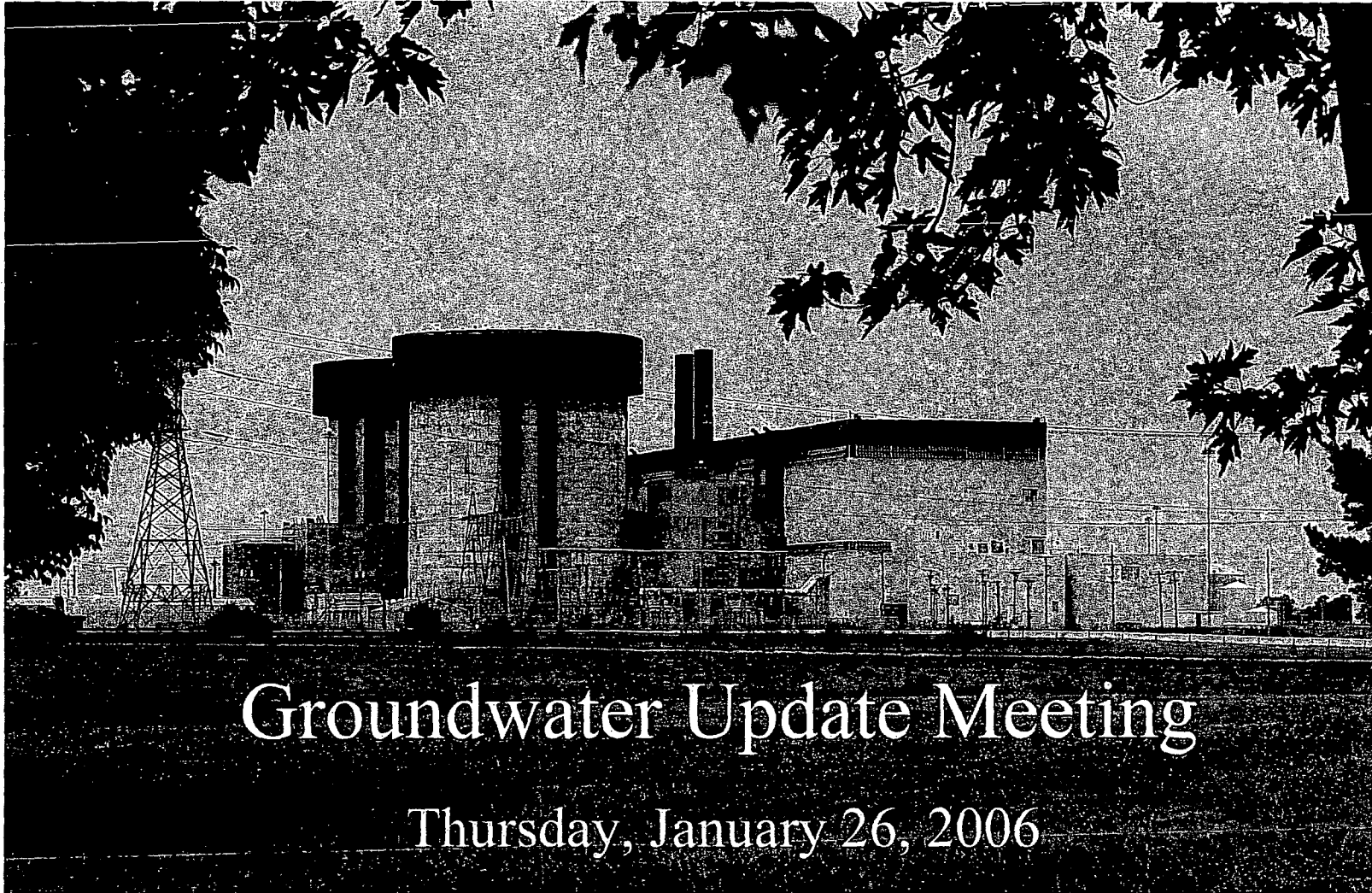
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- Project underway to significantly reduce overall liquid tritium discharge from Braidwood
  - Reduce tritium production through enhanced reactor core design
  - Optimize management of tritium inventory in reactor operations
  - Enhance gaseous release capability
  - Research tritium separation technology

**Exelon.**

Nuclear

# Braidwood Generating Station



Groundwater Update Meeting

Thursday, January 26, 2006

## What You Will Hear

- Updated status
- What Exelon is doing to:
  - Stop the problem now
  - Prevent future releases
  - Clean up
- Eli Port, health physicist



## Current Status

- 14 of 15 private wells show no sign of tritium beyond background
- 15<sup>th</sup> private well shows tritium at fraction of federal drinking water limit (1,524 picocuries per liter)
- Health and safety impact of these elevated levels is insignificant

## Update

- Sampled 158 test wells
- Analyzed 211 groundwater samples
- 11 off-site sample wells tested above federal drinking limit for tritium (20,000 pCi/L)
- No additional radionuclides found in groundwater

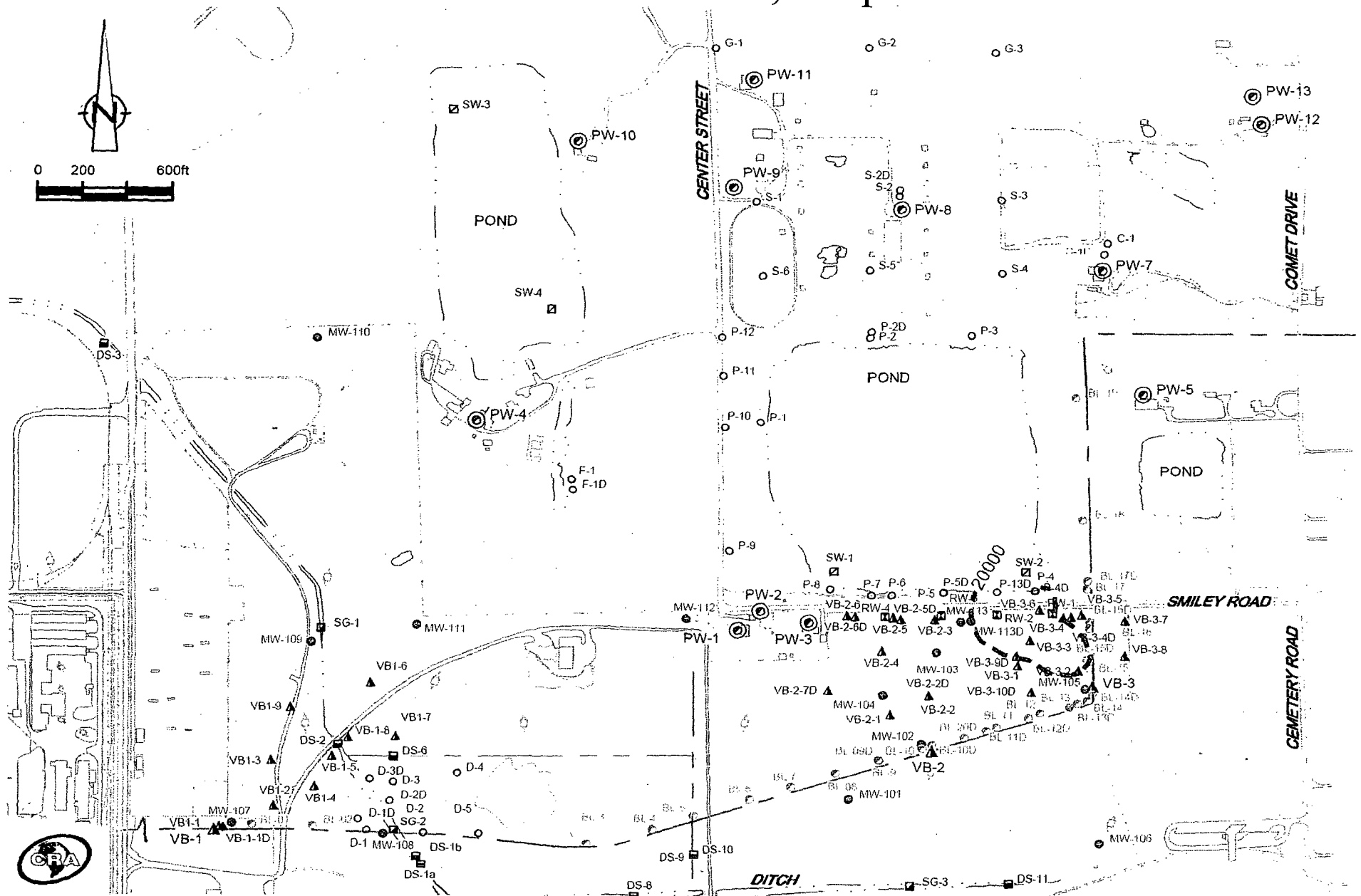
## Update

- Acoustical pipe integrity testing provided assurance of no significant leak in pipe
- Sunday, Jan. 15, 2006 leak at vacuum breaker 7
- Have not introduced tritium into the pipe since Nov. 23

# Area Above 20,000 pCi/L



0 200 600ft

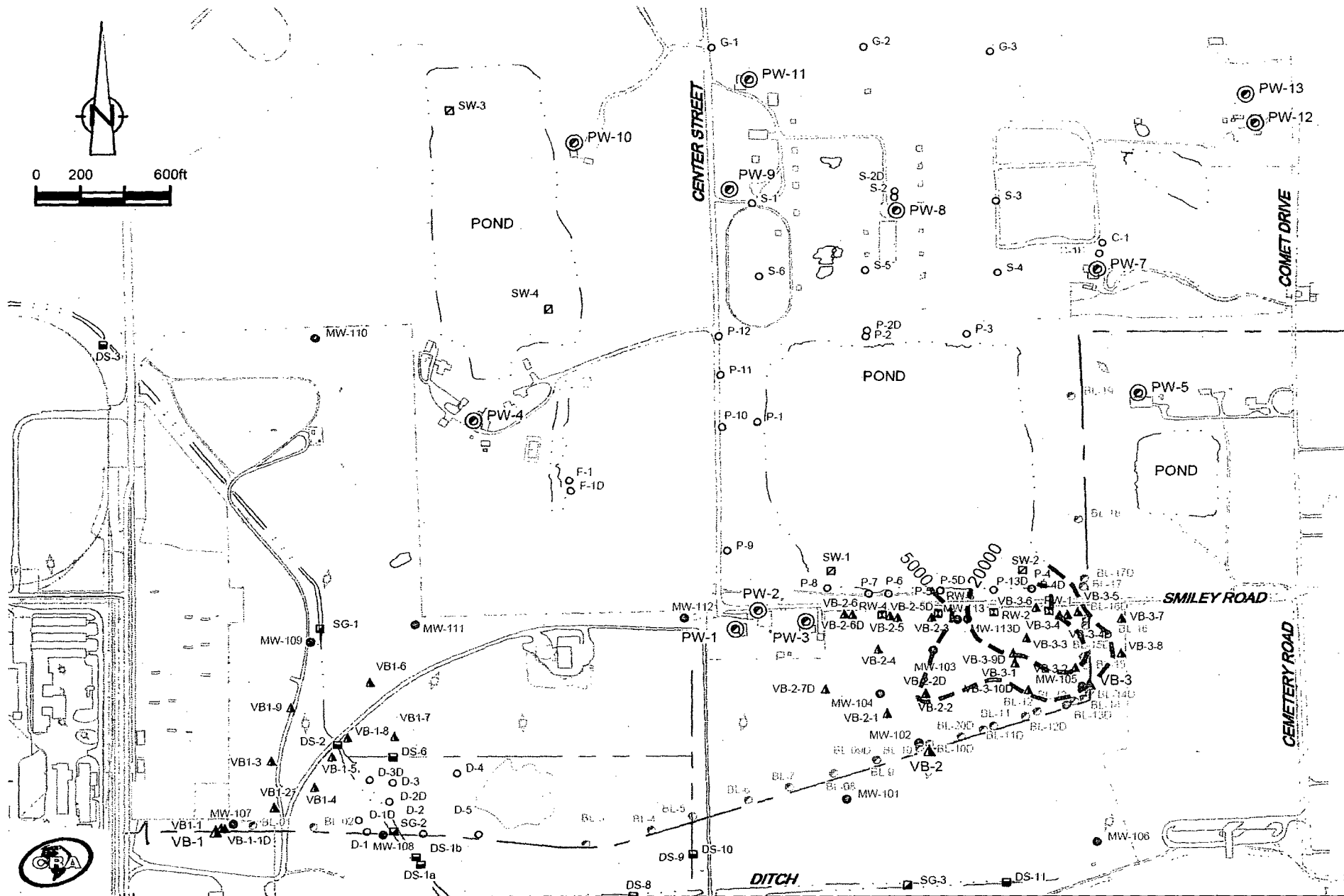


1/26/2006

Groundwater Update

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# Area Above 5,000 pCi/L

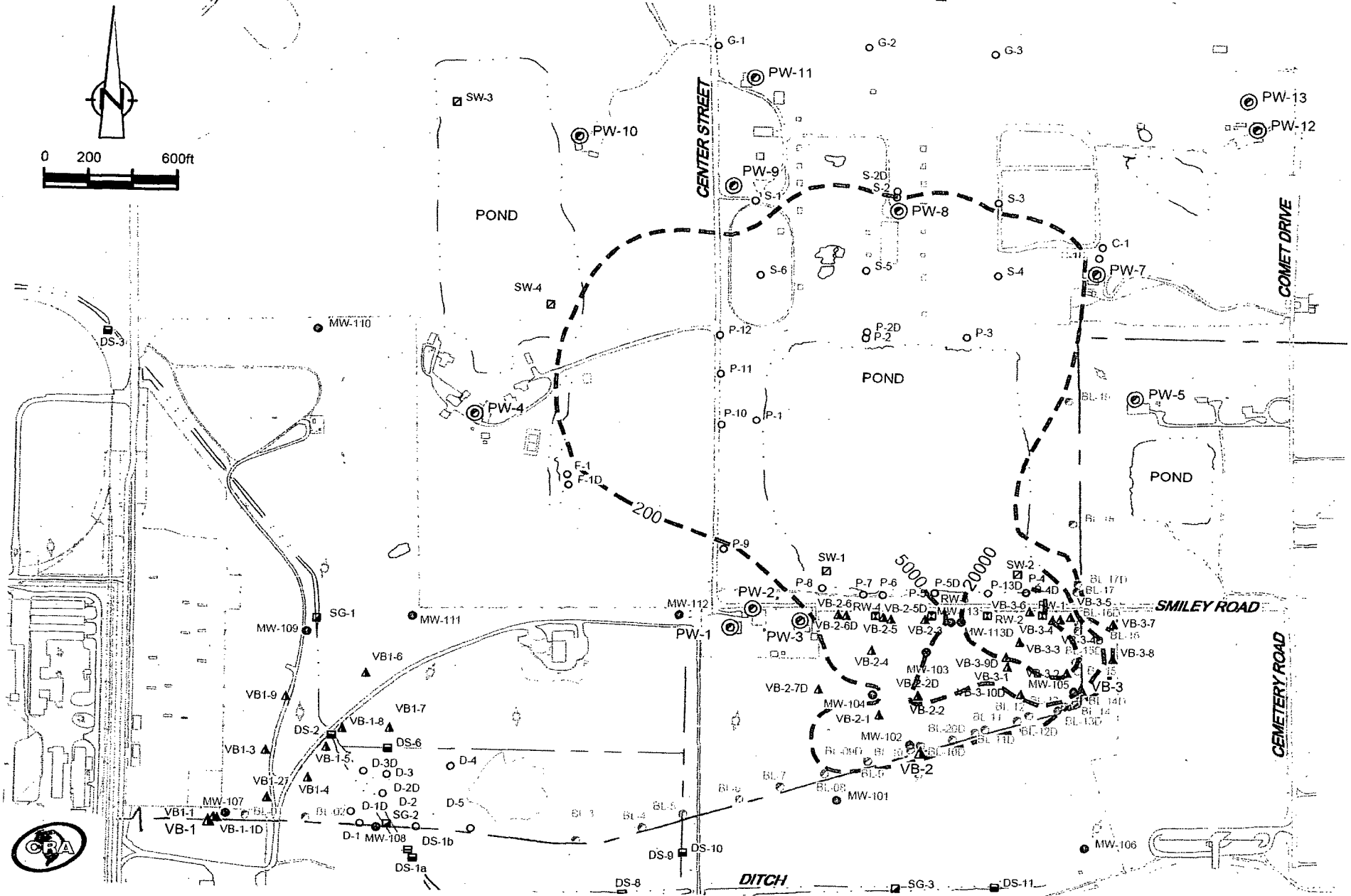


1/26/2006

Groundwater Update

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# Area Above Background—200 pCi/L



1/26/2006

Groundwater Update

# 1998

- Release from blowdown line vacuum breaker
- Contained on-site property
- Treated as a water spill, not as a tritiated water spill
- Inadequate response

2000

- Leak from blowdown line vacuum breaker
  - Contained on site property
  - Sampled and removed surface water
- 
- Responses to water spills were inadequate due to a lack of integrated procedural guidance

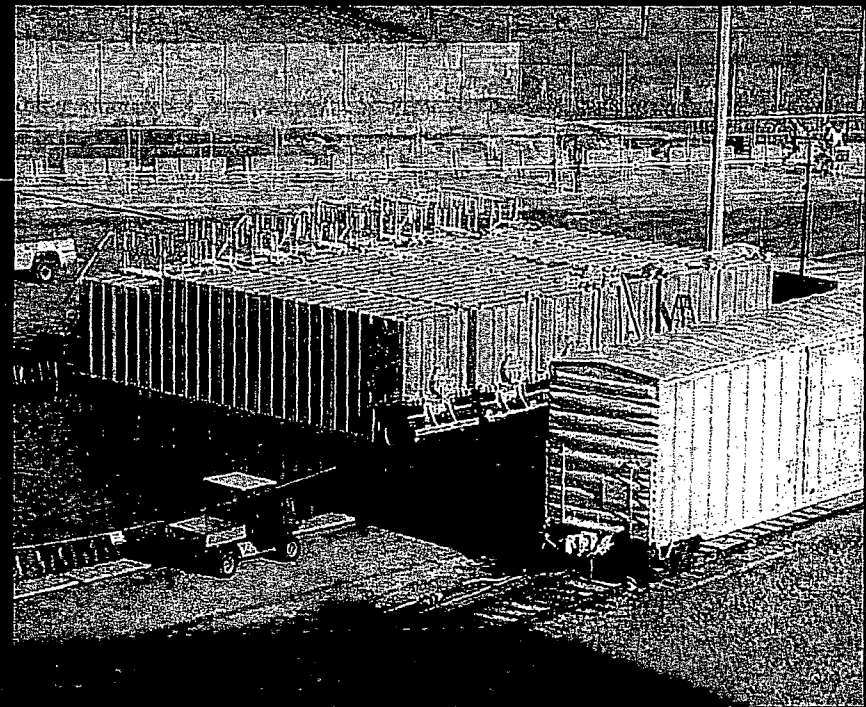


## Lessons Learned

- To prevent vacuum breaker failures
  - Replaced vacuum breakers
  - Increased surveillance program
  - Exploring additional leak detection devices
- Looking to take vacuum breakers out of play

## How We are Stopping the Problem

- No tritiated water released into the ground since Nov. 23
- Currently storing 80,000 gallons
- Short term: Continue to store as needed



## Preventing Future Releases

- Enhanced surveillance and monitoring maintenance
- Vacuum breaker inspection twice per year
- Preventative maintenance
- Alternative release path
  - Installing separate double-walled, stainless steel pipe
  - Reduce releases by recycling water
  - Evaporate water that is not recycled
- **Improve response of possible future releases**

# Clean Up

- Site Investigation Report
- Alternatives:
  - Containment
    - slurry wall
    - vegetation
  - Collection/Treatment
    - Pump and treat
    - Freeze and remove
    - IN-SITU
    - Spray Field
  - No action
    - Monitoring
    - Alternative water supply

- No additional tritium being introduced
- No future releases until pipe integrity is assured
- Drinking water levels well below federal standards; insignificant health risk
- Monitoring to ensure no additional wells affected
- Continual communication

Questions?

# Radiation and Sources of Internal Dose

Eli A. Port, CHP, CIH, P.E..

# What is Tritium (H-3) ?

- An isotope of Hydrogen with two neutrons



# How much H-3 is in the environment ?

- Cosmic rays produce 4,000,000 curies per year
- The total tritium in the environment is about 70,000,000 curies

# Quantity of Radioactive Material

- Traditional unit - curie (Ci)
- Sub-unit - picocurie (pCi)
- Comparison
  - 1 pCi =  $10^{-12}$  Ci or a trillionth of a curie

# Sources of Radiation

Natural	~ 292 mrem
- Radon	~ 200 mrem
- Cosmic ray	~ 27 mrem
- Rocks and Soil	~ 30 mrem
- Food and drink	~ 35 mrem

Man-made	~ 65 mrem
- x-rays	~ 40 mrem
- Nuclear med	~ 13 mrem
- Consumer products	~ 10 mrem
- Research	~ 2 mrem

Average Total  
Background  
Radiation  
357 mrem/year

# EPA Drinking Water Limit

- 20,000 pCi/l
- At this concentration, drinking 2 liters of water per day will result in a dose 4 mrem per year

# Tritium in Well Water

- The highest concentration of tritium found in a well supplying drinking water is:

1,524 pCi/l

- At this concentration, drinking 2 liters per day will result in 0.3 mrem per year.

# Other Sources of Internal Dose

# Dose from C-14

- The concentration of C-14 in natural carbon is 7 pCi/g
- Human Reference Diet = 300 g carbon/day
- Resulting in 1.9 mrem per year from carbon in food

# Potassium-40 (K-40) Dose

- The concentration of K-40 in natural potassium is 820 pCi/g
- Human Diet = 2 - 5 g/day
- Resulting in a K-40 dose between 10 mrem per year and 25 mrem per year



# Annual Dose from K-40 In Specific Foods

- 1 banana per day = 2.6 mrem
- 1 8 oz. glass of orange juice per day = 2.5 mrem
- 1 medium baked potato per day = 4.3 mrem
- 1 cup Total raisin bran per day = 1.8 mrem
- 1 double burger sandwich per day = 2.9 mrem
- 1 large order of fries per day = 4.7 mrem
- 1 cup cantaloupe per week = 0.4 mrem
- 1 cup spinach per week = 0.6 mrem
- 6 oz halibut fillet per week = 0.7 mrem

# Smoking

- The average annual dose from Po-210 in tobacco is 2000 mrem
- Hot spots (bronchial bifurcations) may receive up to 16,000 mrem per year

# Biological Effects

- We know that radiation may cause damage in tissue
- No effects have been found from low doses, under 10,000 mrem
- To be conservative, limits are set below doses where effects are detected

# Questions ??

