

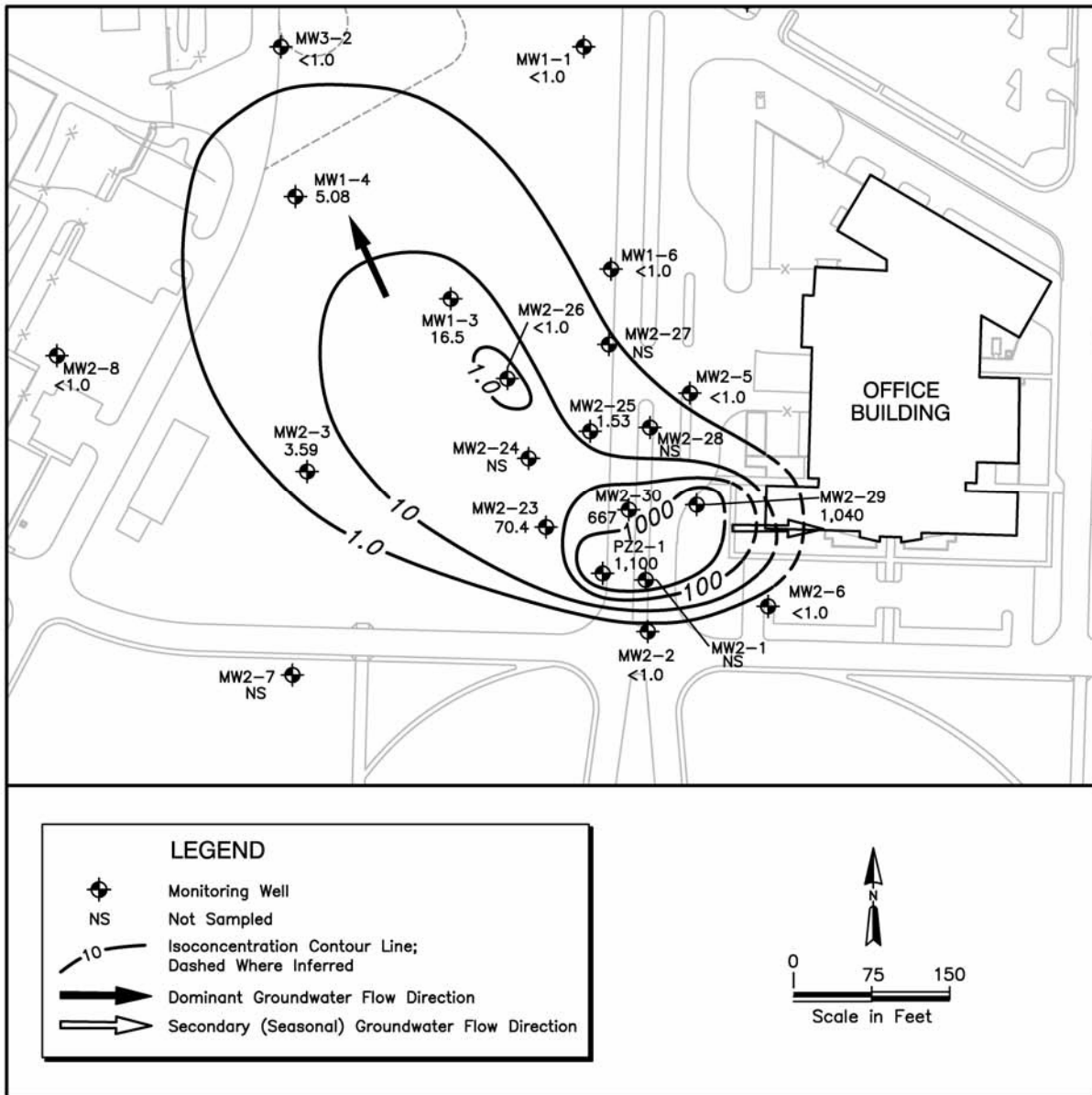
Vapor Flux Measurement
and Risk Assessment at an
Office Building Above a
Dissolved VOC Plume

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Outline

- Problem
- Study Methods
- Sampling Program and Testing Results
- Risk Assessment
- Conclusions

Figure 1
 Vinyl Chloride Concentrations in Shallow Groundwater (ug/l)
 March-September 2003



Study Methods

- Measured vapor flux and ambient air concentrations of VOCs inside and outside building
- Estimated indoor air VOC concentrations using vapor flux and building ventilation data
- Used sampling data to assess potential vapor intrusion and health risks

Sampling Program

- Sample types:
 - *Vapor flux*
 - *Ambient air*
 - *Groundwater*
- Performed two sampling rounds to evaluate possible seasonal effects: March (wet season) and early October (dry season)

Figure 2
Vapor Flux and Ambient Air Sampling Locations

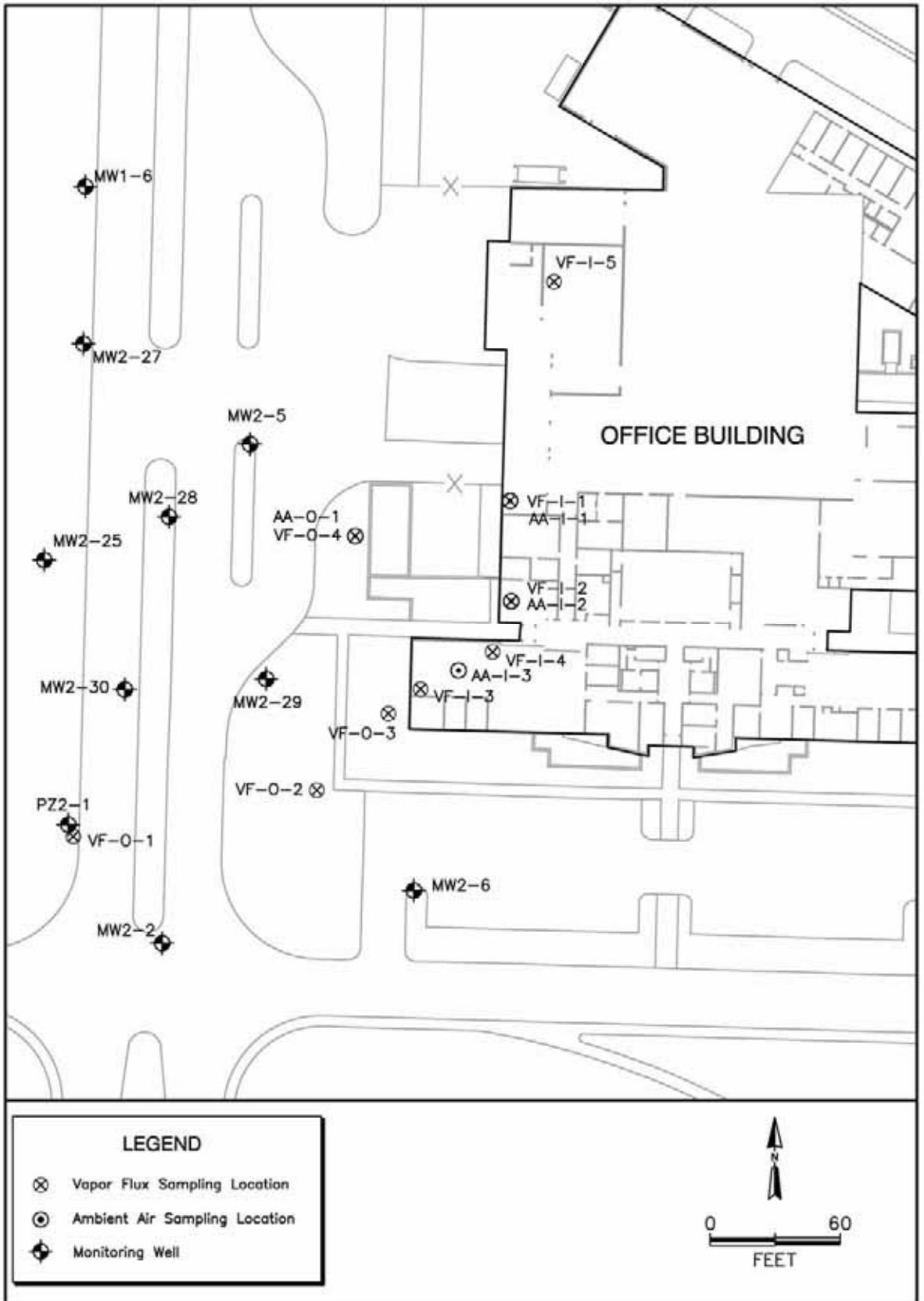


Figure 3
Outdoor Ambient Air Sample



Figure 4
Outdoor Vapor Flux Sample



Figure 5
Indoor Ambient Air Sample



Figure 6
Indoor Vapor Flux Sample



Sample Analysis

- Vapor flux and ambient air samples analyzed for 15 VOCs by USEPA TO-14
- Groundwater samples analyzed by USEPA 8260B

Testing Results

- Nine target compounds detected in at least one vapor flux or ambient air sample
- Poor correlation between vapor flux/air sampling data and groundwater data (sampled well may not be representative of VOC vapor source)
- Vinyl chloride not detected in vapor flux or ambient air samples
- Wet and dry season sampling results similar - no significant seasonal influence

Risk Assessment

Two components:

- Qualitative - *Infiltration potential of individual VOCs*
- Quantitative - *Health risks from VOC infiltration*

VOC Infiltration Potential

- Assessed by reviewing vapor flux and ambient air data
- For each compound, complete pathway for infiltration indicated if:
 - 1) detected in outdoor flux;
 - 2) detected in indoor flux; **and**
 - 3) detected in indoor air at concentration greater than 2x the outdoor air concentration

VOC Infiltration Potential (cont.)

Each target compound ranked as:

- 1 (probable infiltration) – *met all three criteria*
- 2 (possible infiltration) – *met only two criteria*
- 3 (infiltration not likely) – *met only one criterion*
- 4 (no infiltration) – *met none of the criteria*

VOC Infiltration Potential (cont.)

- Four compounds ranked 1 or 2 (probable or possible infiltration) in March and October:
 - *Chloroethane*
 - *Chloromethane*
 - *Methylene chloride*
 - *Tetrachloroethene (PCE)*
- Nine compounds ranked 3 or 4 (unlikely or no infiltration)

Health Risk Assessment

Approach:

- Calculate site-specific, indoor air RBSLs
- Calculate indoor air VOC concentrations from infiltration flux and building ventilation data
- Compare measured and calculated indoor air VOC concentrations to RBSLs

Calculating Indoor Air VOC Concentrations from Infiltration Flux Data

- Used a box model and site-specific input parameters:
 - *Compound-specific infiltration flux*
 - *Slab crack density*
 - *Building volume*
 - *Building air exchange rate*

Calculating Indoor Air VOC Concentrations from Infiltration Flux Data (cont.)

Conservative assumptions:

- Uniform infiltration flux (maximum measured value)
- Uniform building height (minimum ceiling height)

➔ Calculated indoor air VOC concentrations are maximum (worst-case) estimates

Comparison of Indoor Air VOC Concentrations to RBSLs

- PCE and TCE were only compounds with calculated or measured indoor air concentrations above RBSLs
- Calculated PCE concentration in October (8.0 ug/m^3) exceeded RBSL of 2.6 ug/m^3 ; based on single flux detection at uncracked slab location
- Measured PCE concentration was below RBSL

Comparison of Indoor Air VOC Concentrations to RBSLs (cont.)

- TCE detected above RBSL of 0.13 ug/m³ in three indoor air samples (0.14 to 0.37 ug/m³)
- TCE detected at 0.50 ug/m³ in outdoor air; *not* detected in infiltration flux
- Observed TCE concentrations consistent with estimated median ambient concentrations in Portland, Seattle, San Francisco, Los Angeles
- Suggests TCE detected in air samples is not site-related

Conclusions

- Probable or possible infiltration of four VOCs
- No evidence of vinyl chloride infiltration
- Health risks below Oregon/USEPA acceptable risk levels
- Vapor intrusion not influenced by seasonal factors