



Seasonal Variation of Soil Gas Concentrations Near and Under a Slab Over a Year

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Program Overview

▶ EPA NERL Sponsored Projects:

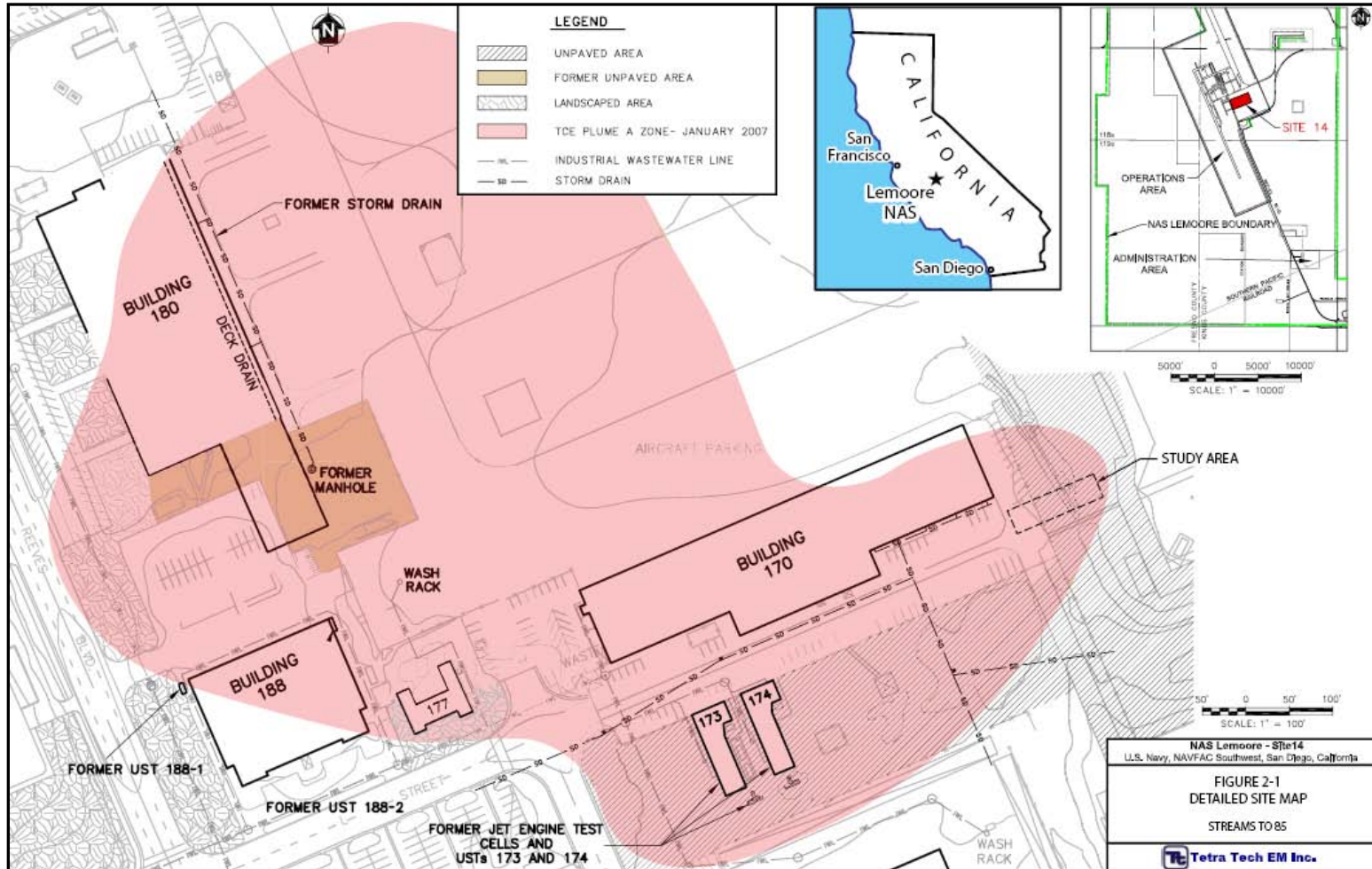
1. Evaluation of the Impact of Sampling Parameters
 - Vandenberg AFB, IRP Site 15 (October 2006)
2. Evaluation of the Impact of Meteorological Variables
 - Vandenberg AFB, IRP Site 15 (March 2007)
 - NAS Lemoore, IRP Site 14 (Winter 2009)
3. Sub-slab and Near-slab Vapor Concentration Profiles
 - NAS Lemoore, IRP Site 14 (February 2008)
4. Long-term Temporal Trends in Vapor Concentration Profiles
 - NAS Lemoore, IRP Site 14 (Nov. 2008 – Oct. 2009)
5. Groundwater Concentration Profiles
 - NAS Lemoore, IRP Site 14 (Spring 2010)



Introduction

- ▶ Objective: Measure the spatial distribution and temporal variability of soil vapor and groundwater VOC concentrations in the sub-slab and near-slab environment
- ▶ Approach:
 - Locate a host site with a groundwater source of VOCs, preferably chlorinated solvents
 - Install a series of nested soil vapor probes and collocated groundwater wells over slab and near-slab area
 - Collect monthly soil vapor and groundwater samples

NAS Lemoore IRP Site 14



NAS Lemoore IRP Site 14

- ▶ Interbedded fine- and coarse-grained deposits above the “A” clay @ 45 ft bgs
- ▶ Vadose zone composed primarily of silts and clays
- ▶ Groundwater at 10 to 12 ft bgs
- ▶ Large TCE/PCE plume in groundwater from multiple historical releases
- ▶ Slow-moving groundwater (< 10 ft/yr)
- ▶ Aerobic aquifer (no biodegradation)



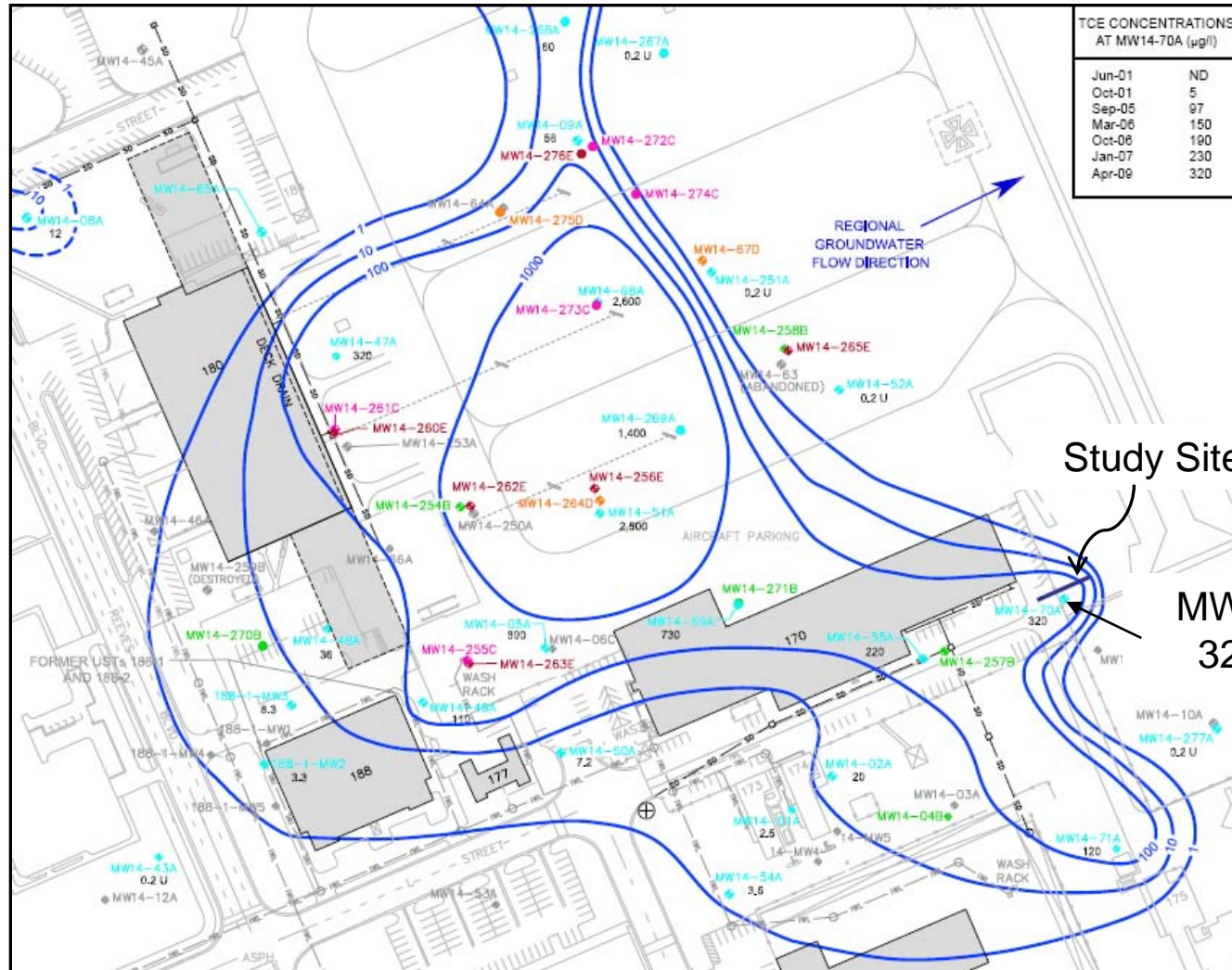
Sampling Transect

- ▶ Established transect of eight sampling locations
- ▶ Four “on-slab” & four “off-slab”
- ▶ Soil vapor probes at 2, 4, 7, and 10 feet bgs
 - Vapor probes in sand filter pack
 - Nylaflo tubing
- ▶ Sub-slab probes installed at slab locations
- ▶ Groundwater monitoring wells installed at each location
- ▶ Vapor samples analyzed on-site (SW8021)
- ▶ Groundwater samples analyzed off-site (SW8260)

Sampling Transect



Site Groundwater Plume



Study Site

MW14-70A
320 µg/L

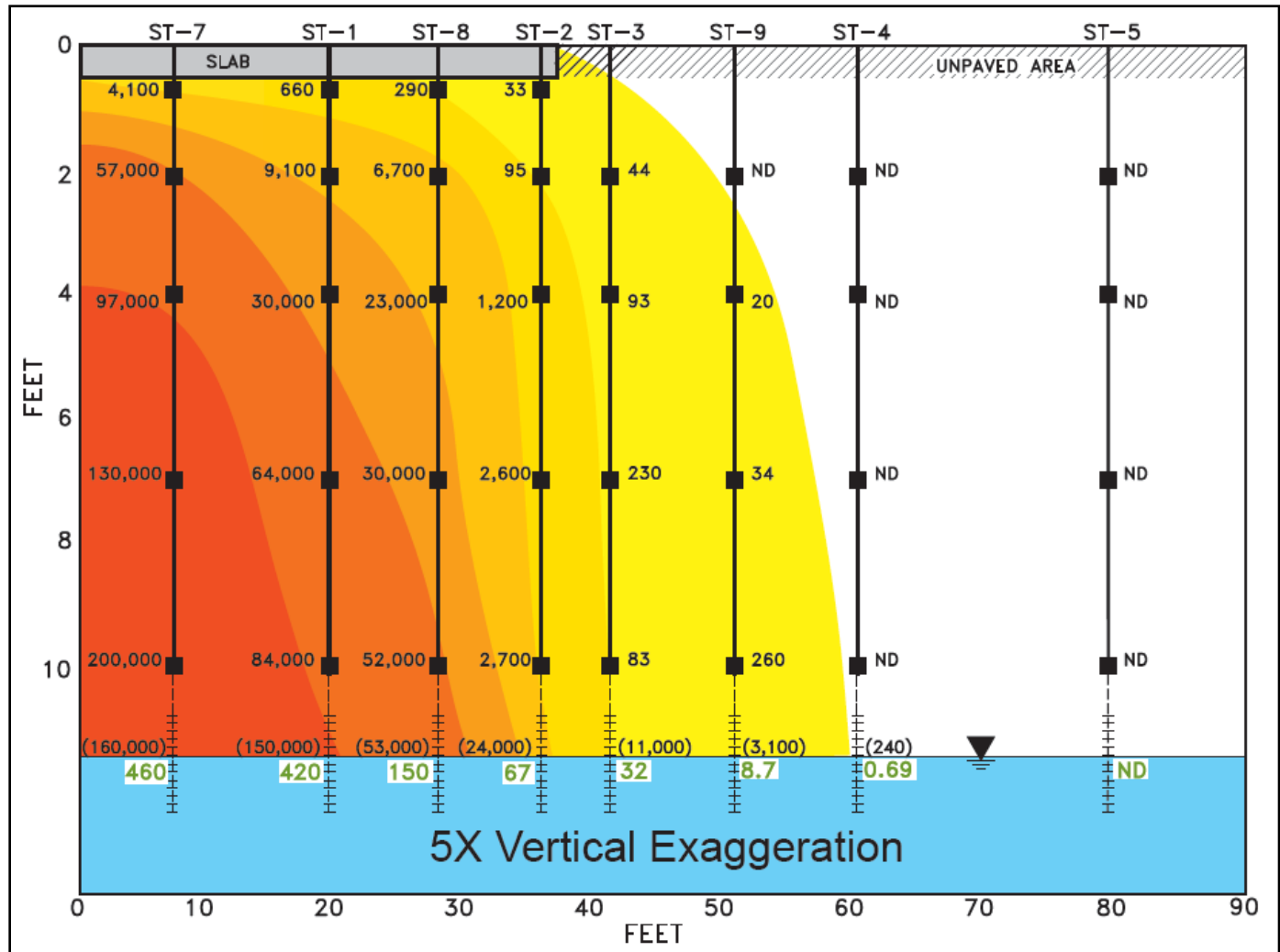


TCE Soil Vapor Profile

TCE:
1,200 Vapor
($\mu\text{g}/\text{m}^3$)

(3,100) Henry's
law equilibrium
concentration
($\mu\text{g}/\text{m}^3$)

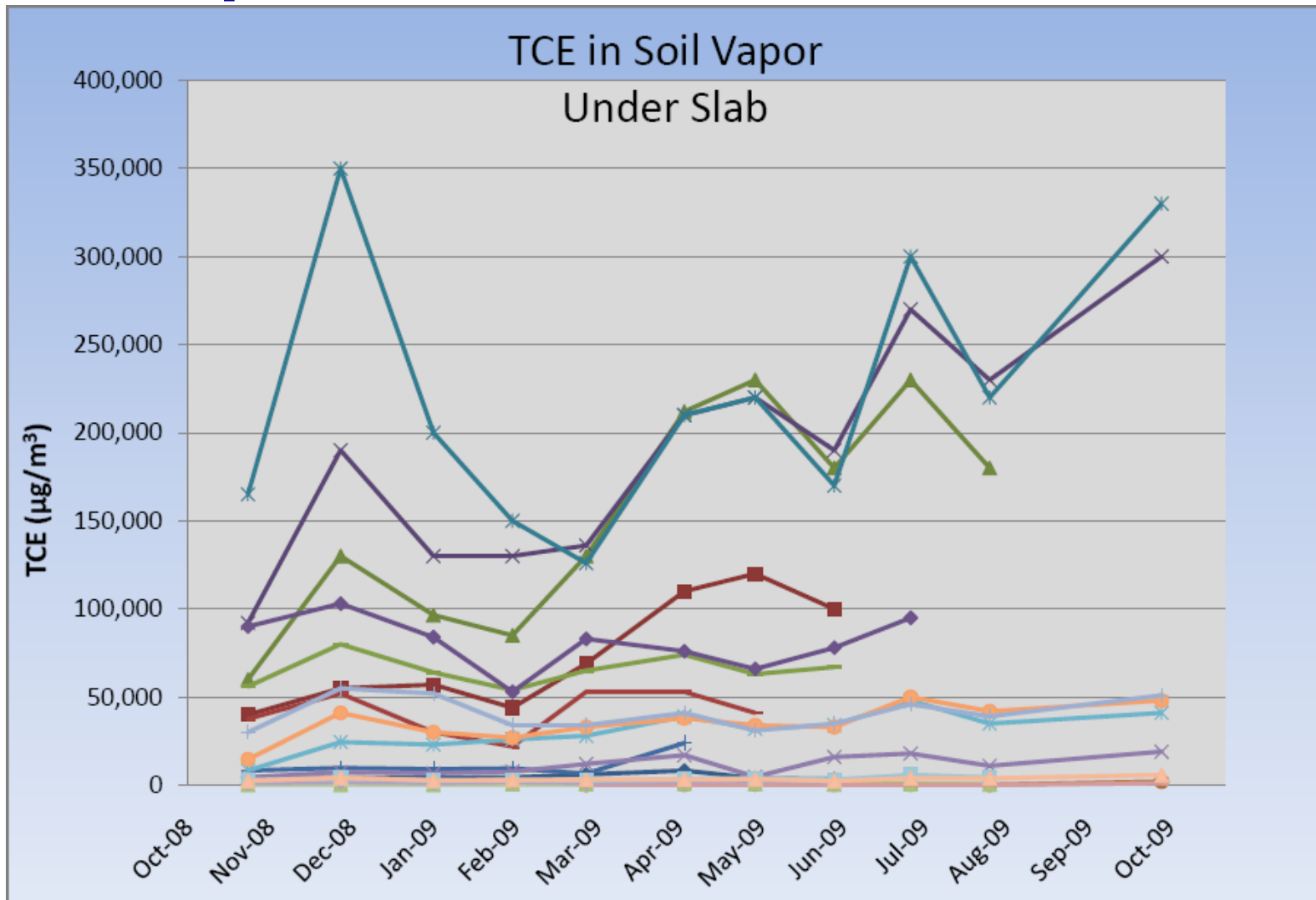
420
Groundwater
($\mu\text{g}/\text{L}$)



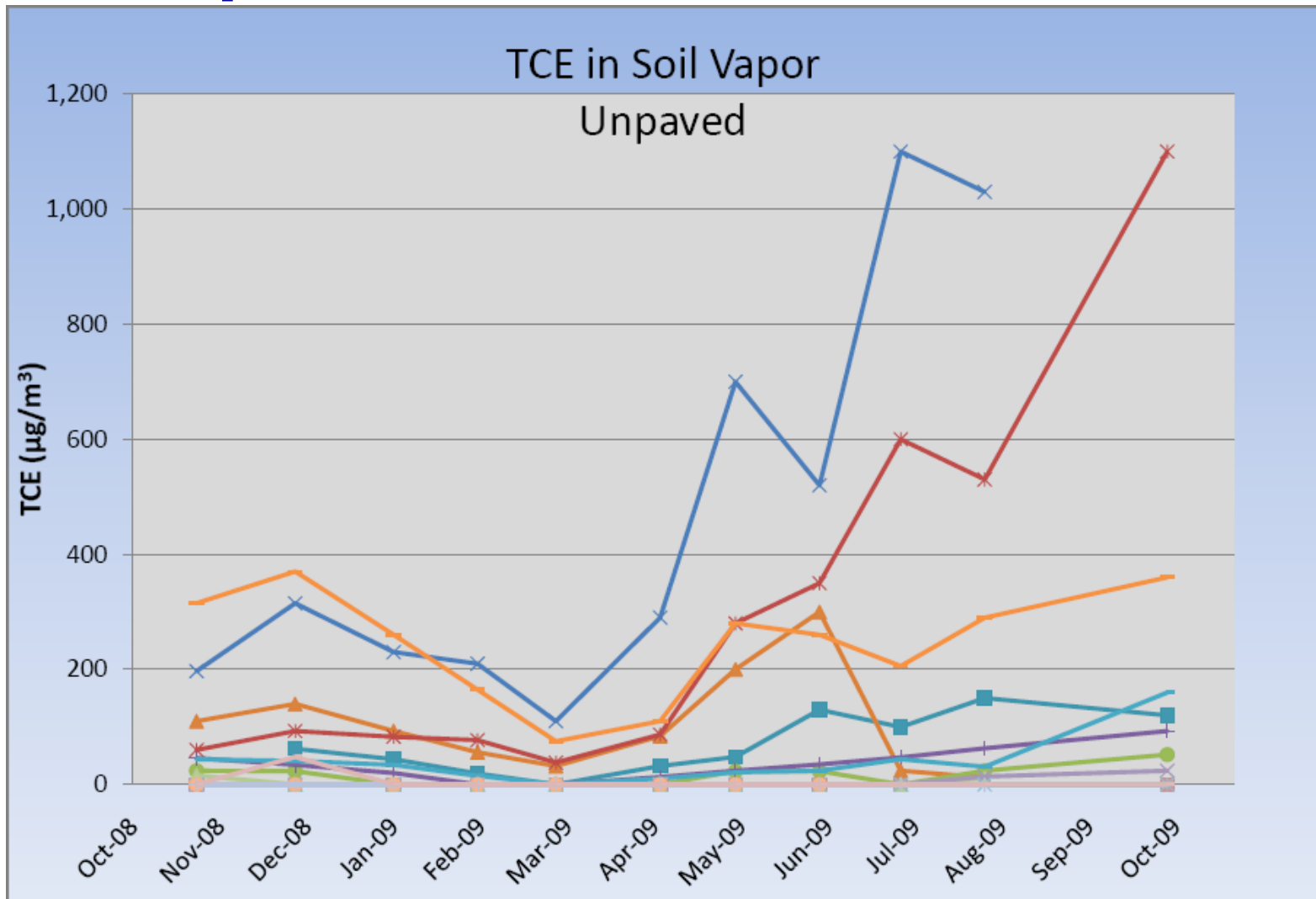
Observations

- ▶ Vapor concentrations decrease with increasing distance from groundwater and with increasing horizontal distance away from the slab
- ▶ Surface groundwater (top ~1 foot) concentrations decrease sharply away from the slab
- ▶ 10-foot vapor concentrations under slab \approx Henry's Law []
- ▶ 10-foot vapor concentrations away from slab \approx 0.1 Henry's Law []
- ▶ Near-slab concentrations in the lower range of sub-slab

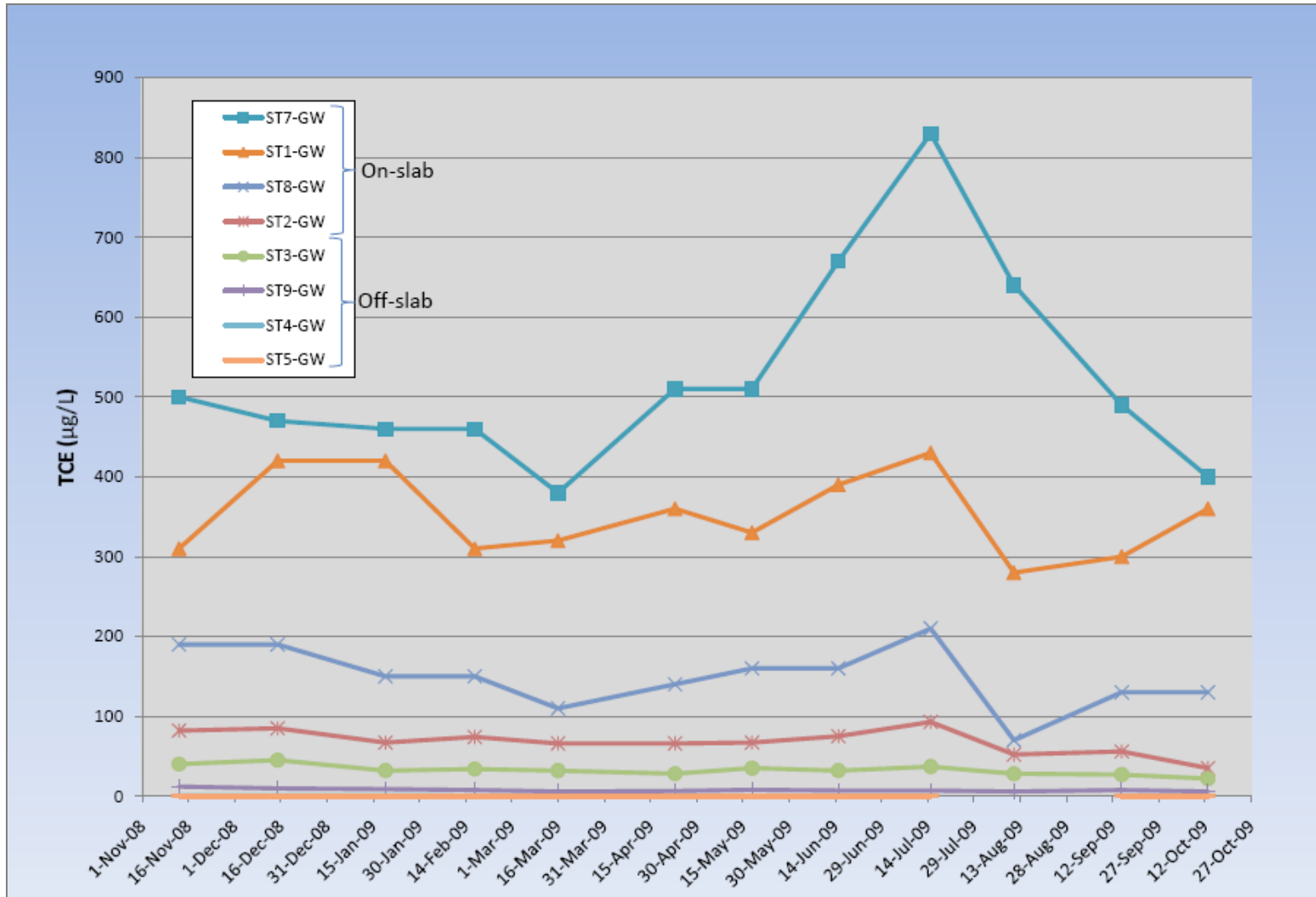
Temporal Trends



Temporal Trends



Temporal Trends in Groundwater



Observations

- ▶ Groundwater concentrations generally vary by less than 50 percent
- ▶ Vapor concentrations vary by less than 3X over 12 months
- ▶ Variability does not appear to be seasonal
- ▶ Individual spikes in vapor concentration not always correlated with other soil gas wells or with groundwater

Conclusions

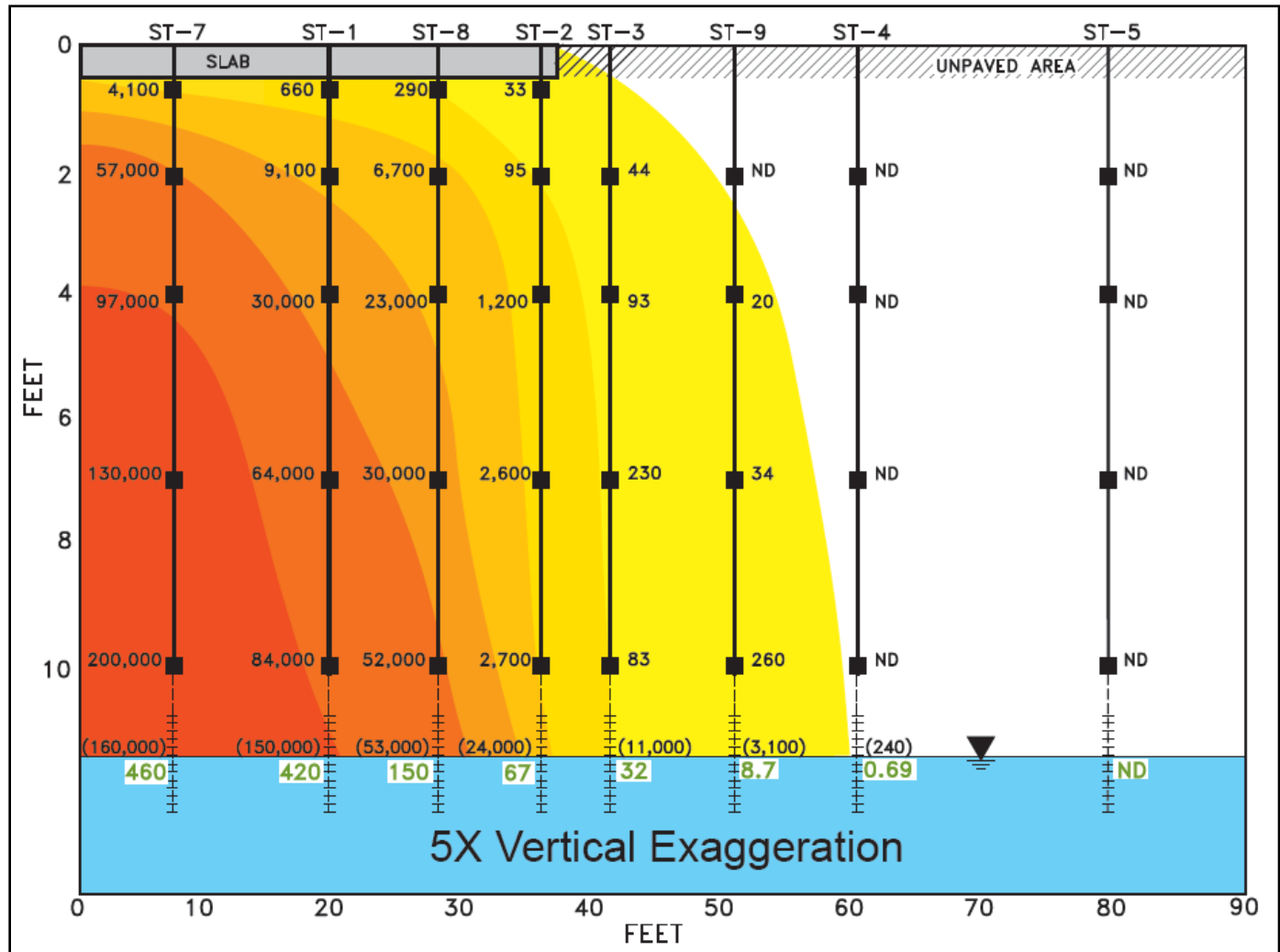
- ▶ Near-slab environment is in a state of dynamic equilibrium
 - Concentration gradients drive VOC mass out from under slab toward surface
 - Slab may affect shallow groundwater concentrations
 - Efficacy of near-slab sampling is site specific
 - Site specific data required to characterize risk of VI
- ▶ Vapor concentrations were relatively stable
 - Variability does not appear to be related to seasons
 - No strong correlation between GW and vapor variability

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($\mu\text{g}/\text{m}^3$)

(3,100) Henry's
law equilibrium
concentration
($\mu\text{g}/\text{m}^3$)

420
Groundwater
($\mu\text{g}/\text{L}$)



Questions?

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