Update on the OSWER Vapor Intrusion Guidance

Current Status, Direction, & Updates

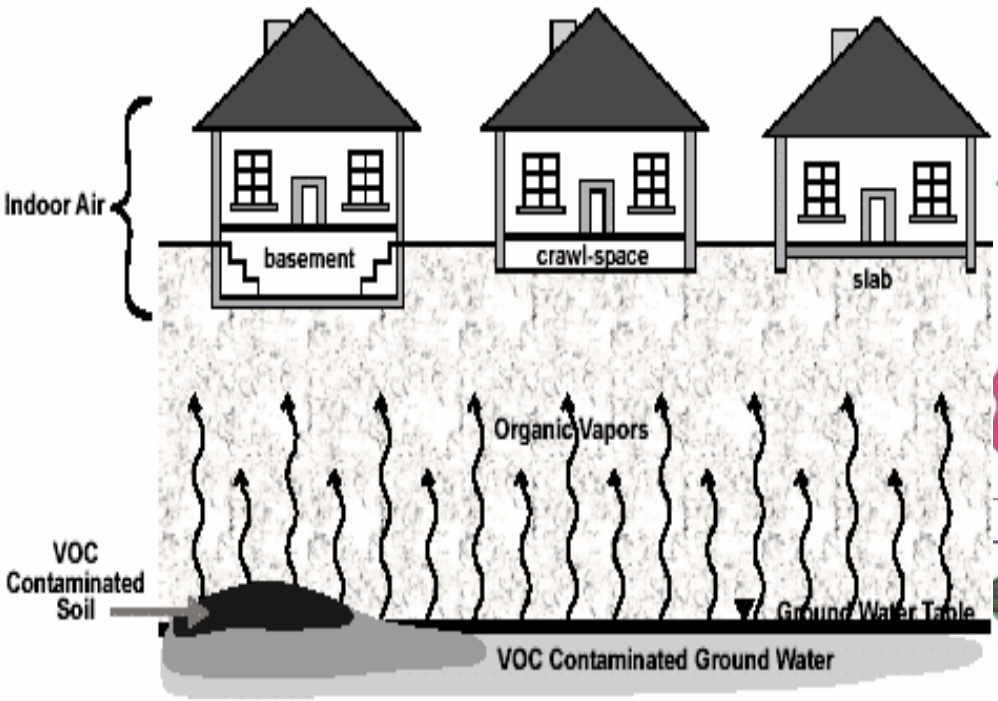
NGWA-API Petroleum Vapor Intrusion Workshop
Aug. 17, 2005, Costa Mesa, CA

Presented by:
Henry Schuver, US EPA – OSW
&
David Cooper, US EPA - OSRTI
Helen Dawson, US EPA - Region 8

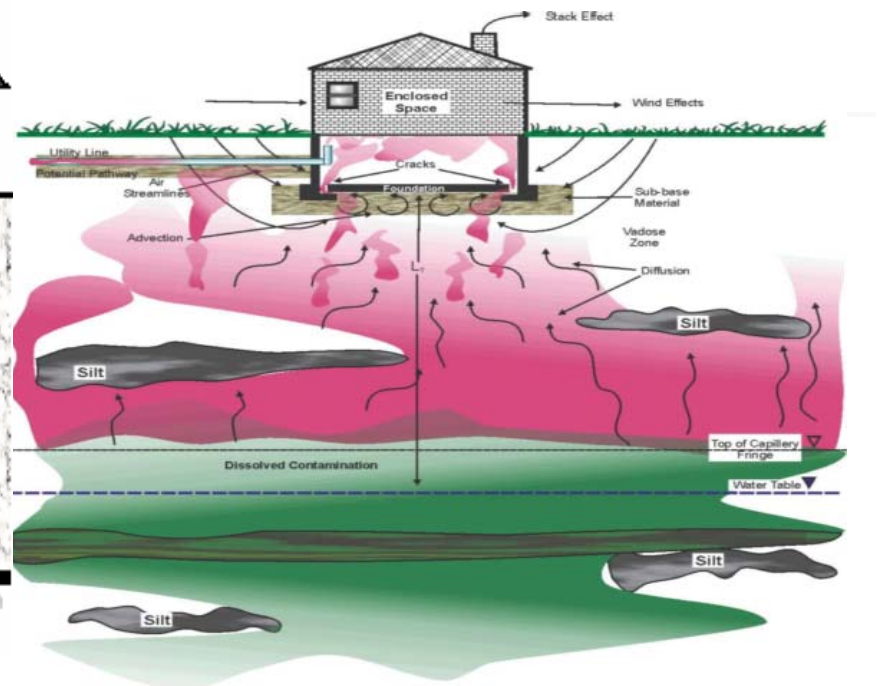
See: http://iavi.rti.org

Conceptual Site Models for Vapor Intrusion (VI)

From Draft-RCRA VI Guidance, 2001



Draft-OSWER VI Guidance, 2002



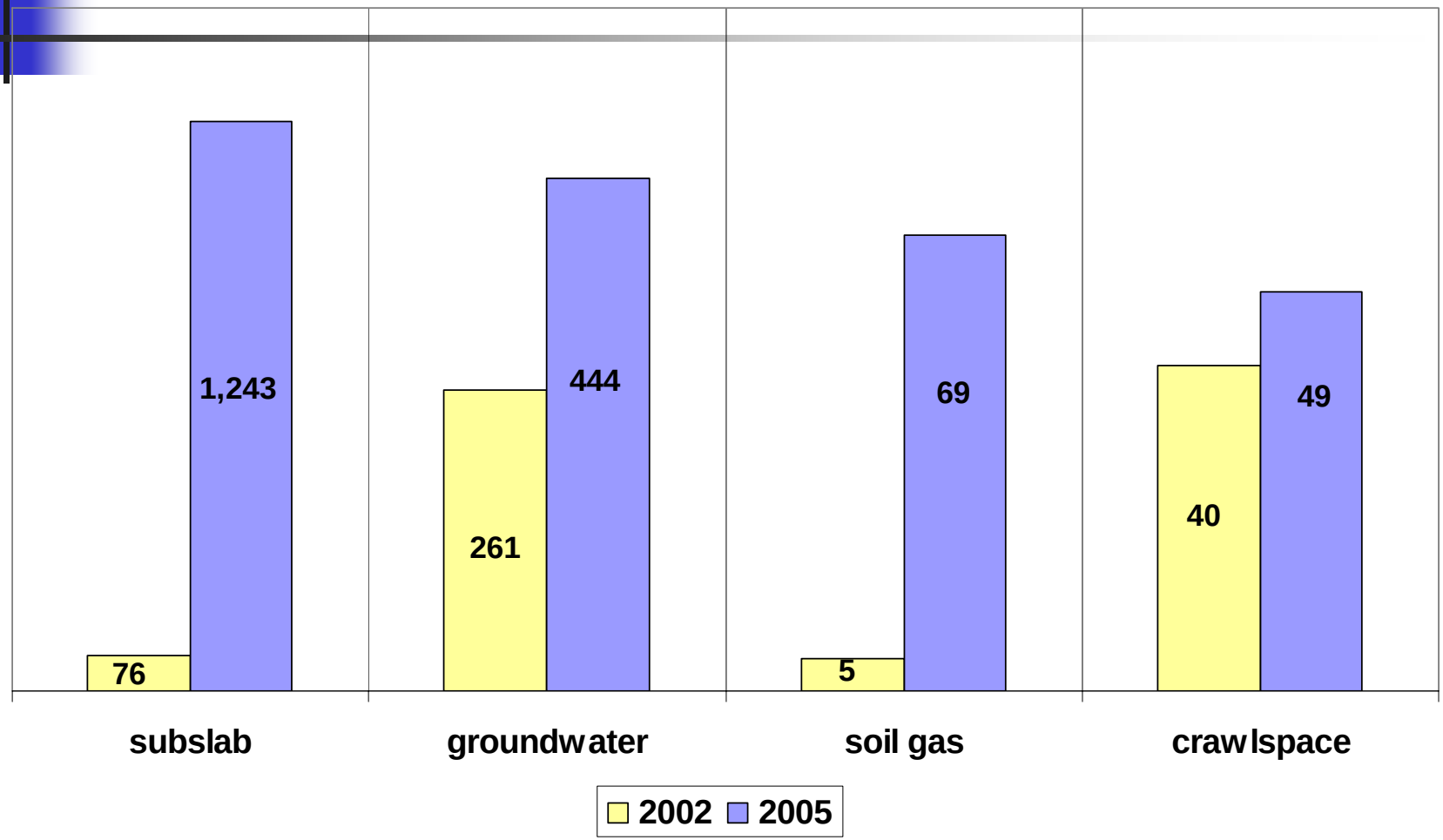
by: D. DiGiulio

Overview of Proposed Changes

(based on the evidence to-date)

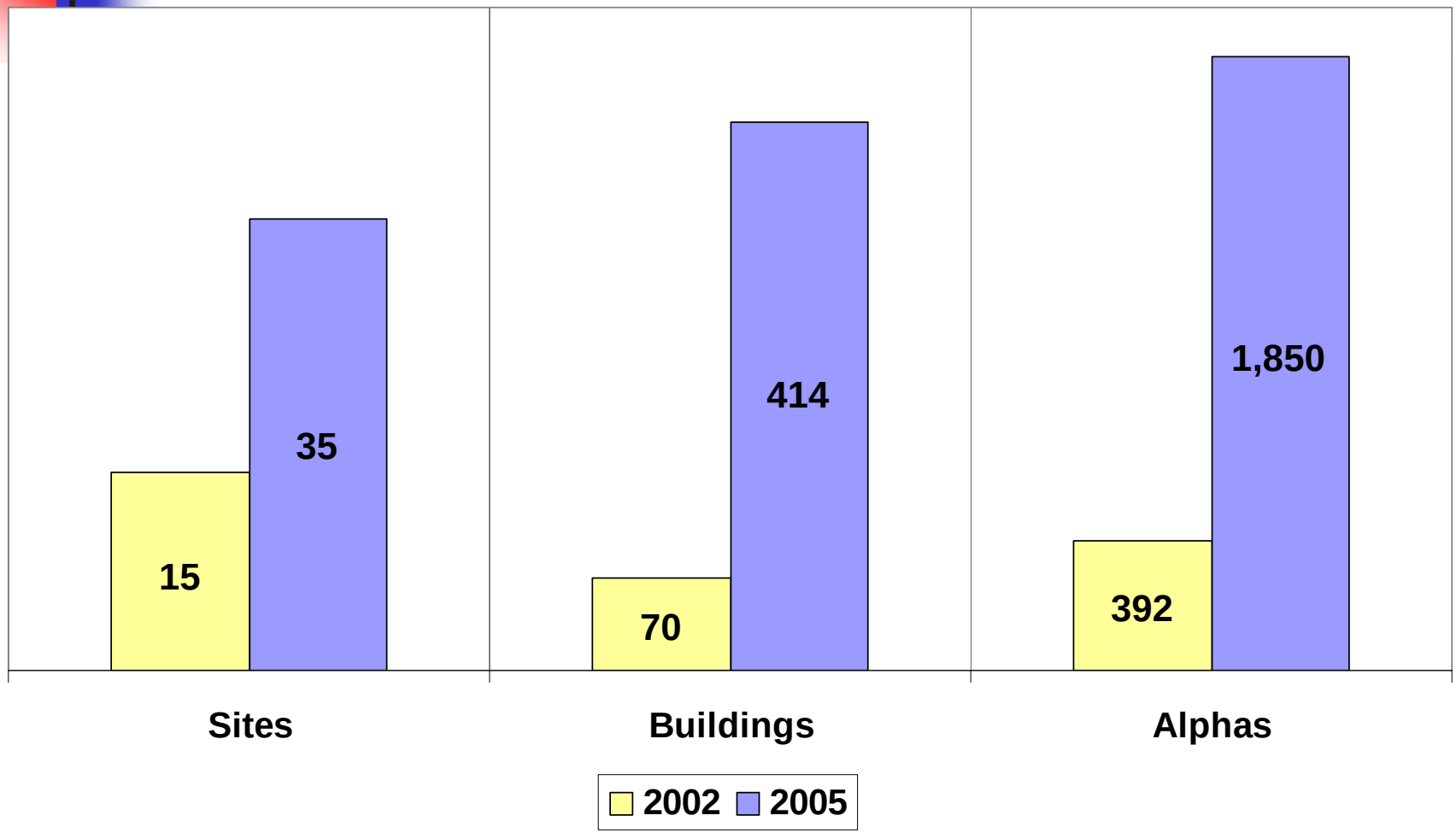
- Eliminate some **precluding factors** (and simplify).
- Recommend less-conservative **attenuation factors**, for:
  - generic screening of some media (e.g., sub-slab). ***& 10x Petrol?***
- Provide **spreadsheet tools**, with:
  - increased flexibility (e.g., residential and commercial settings) for “external” generic screening.
- Provide guidance for
  - evaluation of indoor air data (NY/R2 **matrix**)
  - **multiple lines** of evidence (Conc. grad., COC ratios, spatial, ...)
  - evaluating VI for **future use** scenarios (methods & IC ?)
- Update toxicity information (continuously?).

Comparison of 2002 and 2005 VI Databases - Alphas by Type



By Robert Truesdale, RTI

Comparison of 2002 and 2005 VI Databases – Sites, Buildings, Alphas



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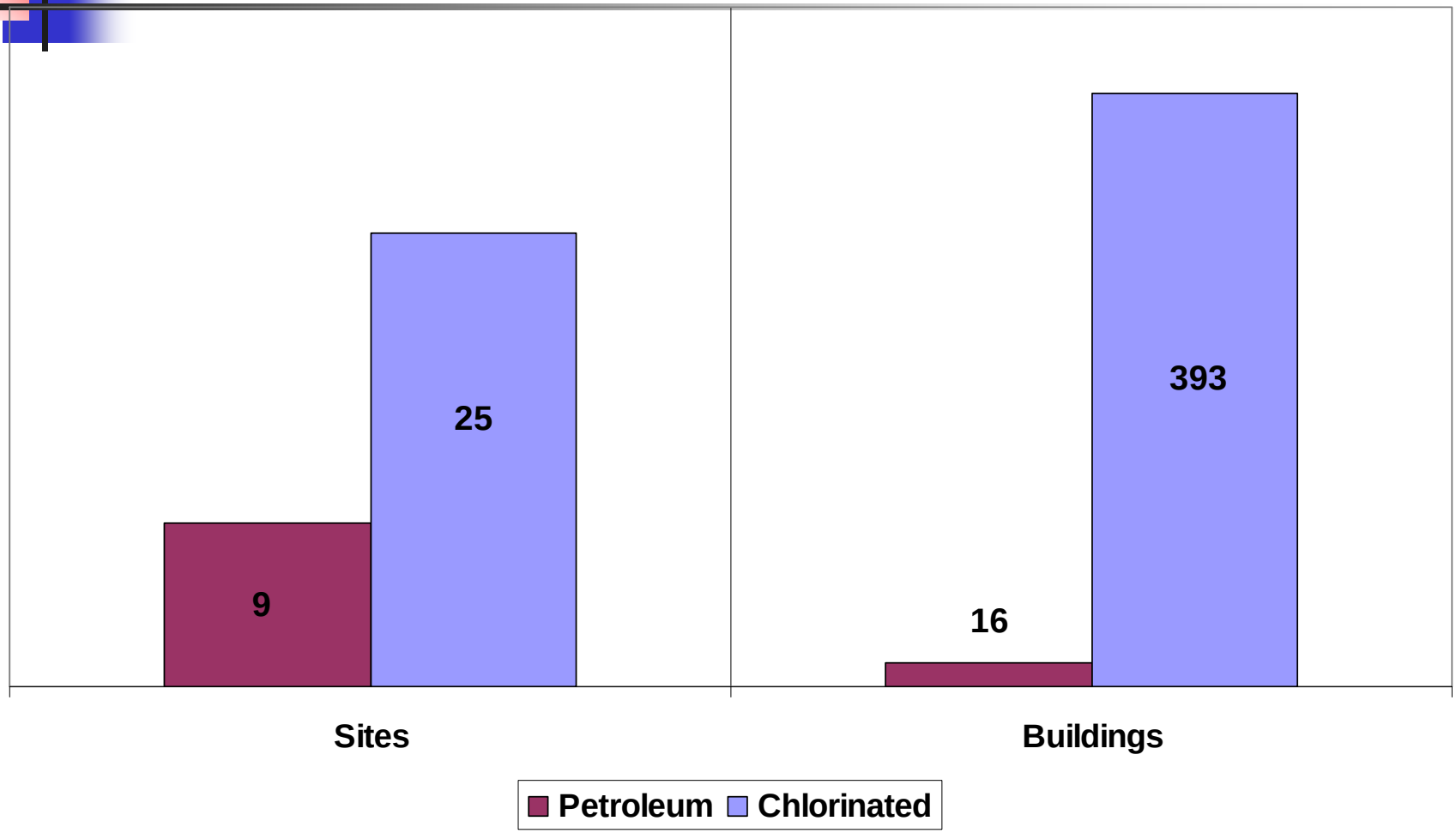
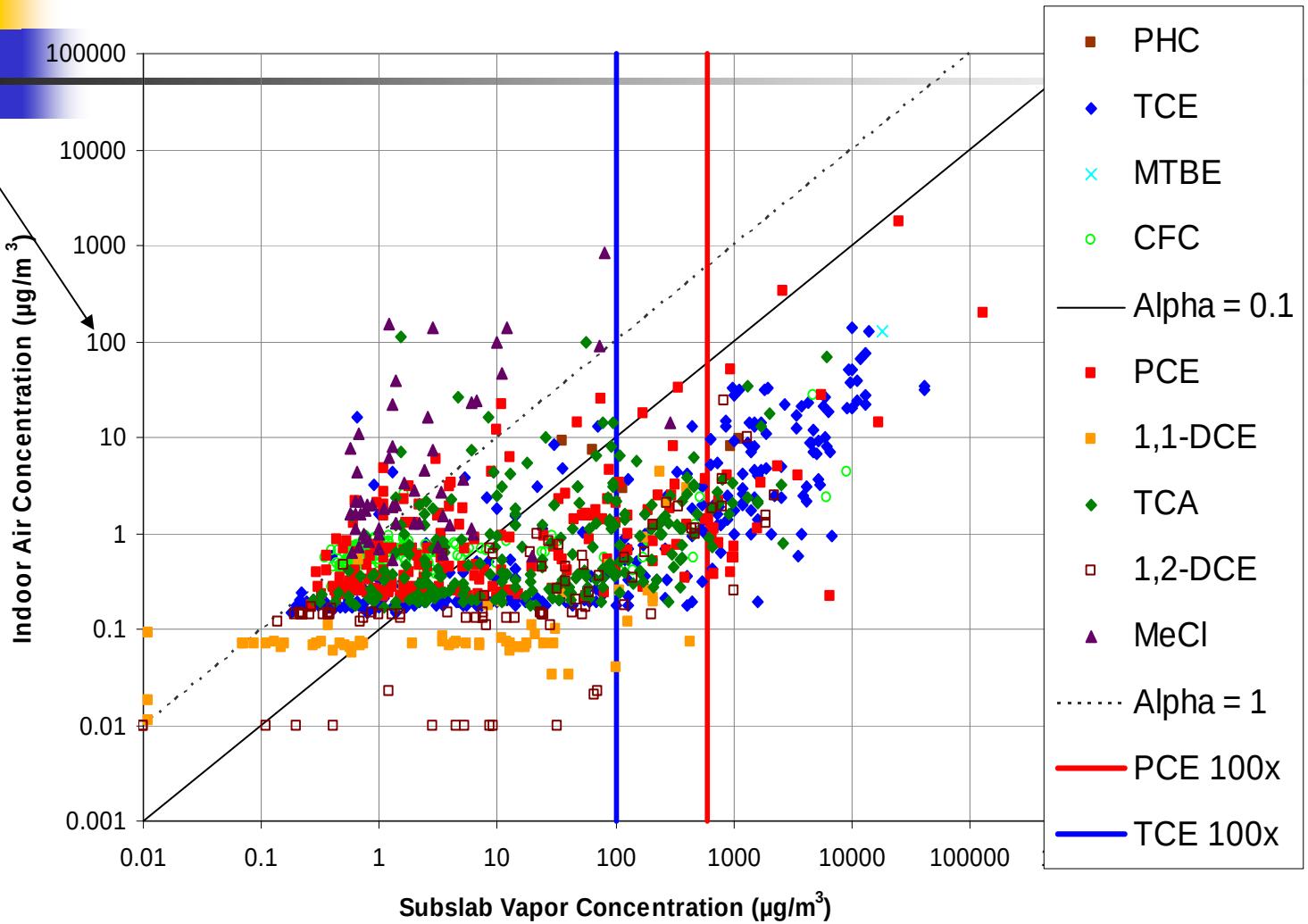
2005 VI Database – Chlorinated vs. Petroleum Hydrocarbons



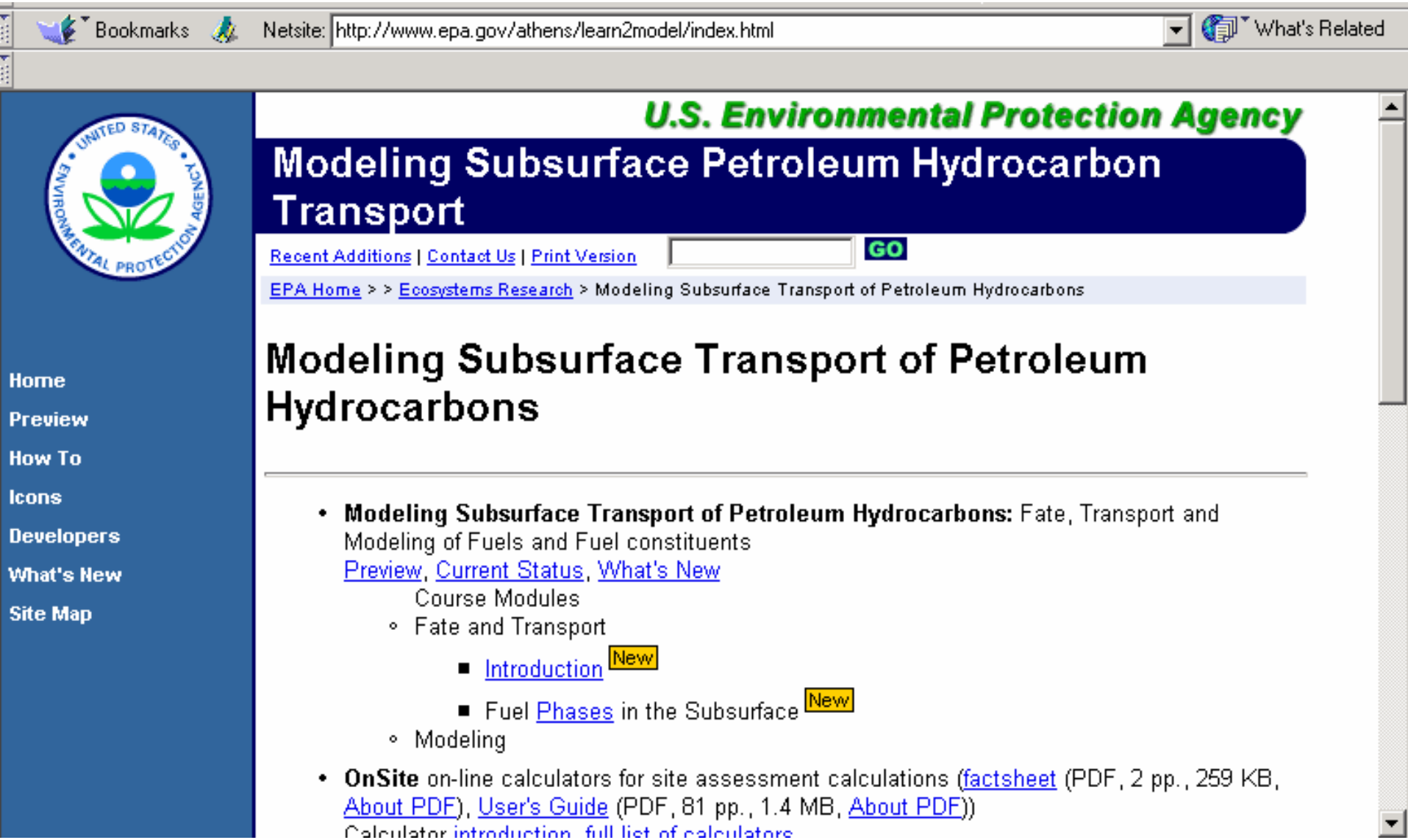
By Robert Truesdale, RTI

2005 VI Database – *"The real world"* Subslab Alphas by Chemical (all data)

Note



By Helen Dawson & Ian Hers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U.S. Environmental Protection Agency

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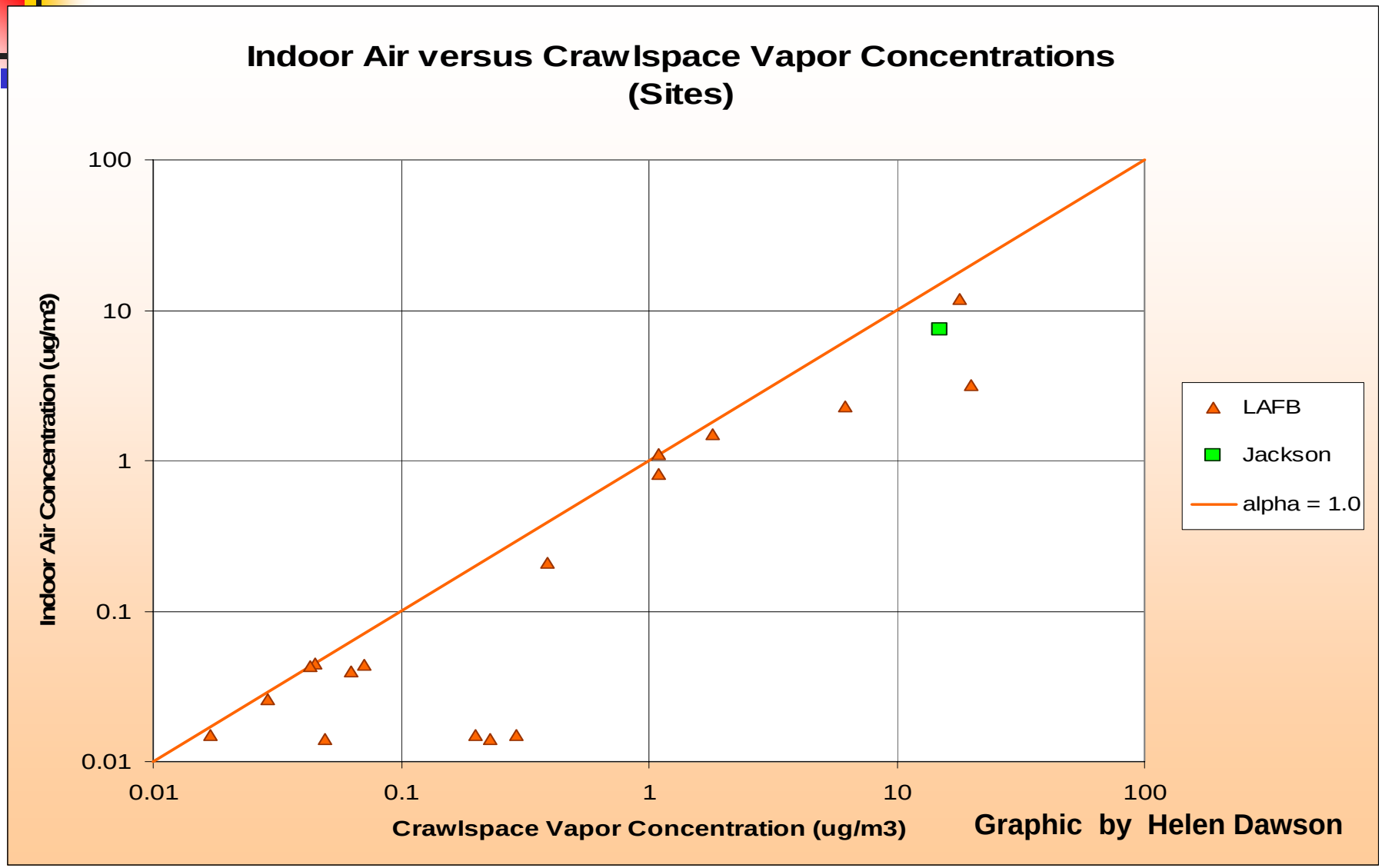
SPARC Estimates of Petroleum Hydrocarbon Properties

This page allows searches of a data set created by the SPARC Performs Automated Reasoning in Chemistry (SPARC) chemical property estimator. The data set was created for estimating the environmental impacts of petroleum hydrocarbons and oxygentated additives. Chemicals were included in the data set if they were found or anticipated from detailed hydrocarbon analysis of gasoline samples obtained from around the United States. Although the SPARC calculator can be run to generate values as needed, use of the data set on this web page saves effort for the chemicals and temperatures included in the gasoline study.

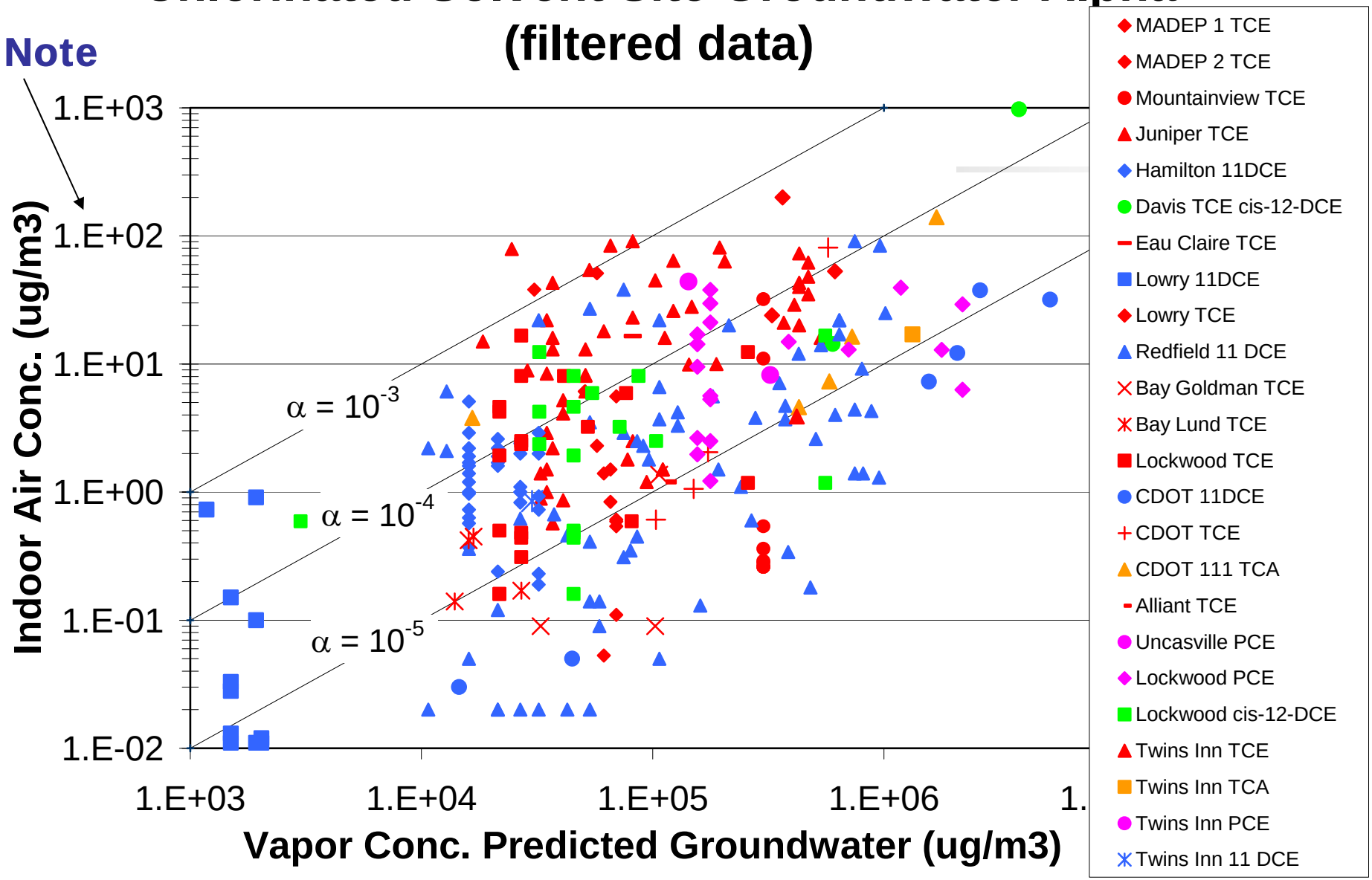
SPARC was used for the gasoline study, because it provided a means to obtain values for almost all components and at temperatures covering the range of shallow ground water temperatures (roughly 5 ^{0}C to 25 ^{0}C). In contrast, literature values are normally available for only a few temperatures and for many petroleum hydrocarbons few experimental data exist. Since the values are calculated, they should be viewed as estimates that may differ from published data. For more information on calculated and measured parameter values see our chemical properties page.

Crawlspace-IA: Based on limited data, generic screening alpha of 1.0 is a good upper bound value.

+ radon evidence & heating ducts



Chlorinated Solvent Site Groundwater Alpha (filtered data)



Slide by Dr. Ian Hers, AEHS 2005

Petroleum Hydrocarbon Sites

- Eleven residential sites analyzed
- Data for 1 to 8 buildings per site (many sites 1 to 2)
- For all but two sites, measured indoor air concentrations could not be distinguished from background
- BTEX chemical ratios often highly variable

By: Hers, Dawson, & Truesdale from March 2005 AEHS West Coast Conf. See iavi.rti.org

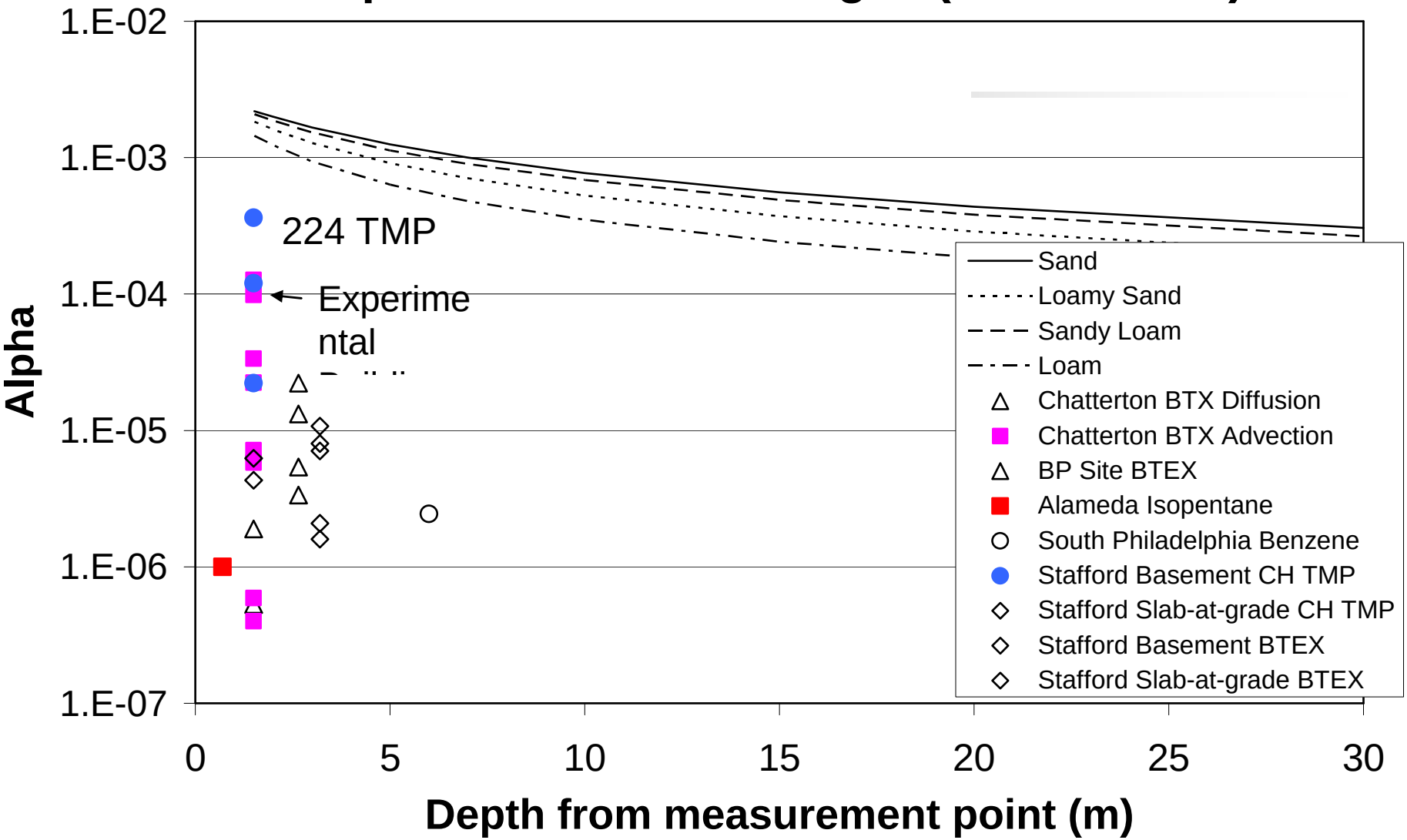
Petroleum Hydrocarbon Summary

By: Hers, Dawson, & Truesdale

SITE	CHEMICALS	COC Ratio's	FOUN-DATION	DEPTH (m)	SOIL TYPE	EVIDENCE BIO BELOW BUILDING	EVIDENCE BIO BESIDE BUILDING
MADEP 3	BTEX	>10X	Basement	2.4	f.-m.Sand	N/A	N/A
MADEP 4	BTEX	>10X	Basement	3.4	Sand, sm. gravel	N/A	N/A
MADEP 5	BTEX	>10X	Basement	2.5	Sand	N/A	N/A
MADEP 6	BTEX	<10X	Basement	0.8	Sand, sm. gravel	N/A	N/A
MADEP 7	BTEX	>10X	Basement	2.7	Sand	N/A	N/A
BP SITE	BTEX	<10X	Basement	2.7	Loamy Sand	No?	Yes
STAFFORD	CH, 224 TMP	N/A	Basement	1.5	Sand	Limited	Limited
	BTEX		Basement	1.5	Sand	Yes	Yes
ALAMEDA	Isopentane	N/A	Slab-on-grade	0.7	Sand	Yes	Yes
	BTEX	>10X	Slab-on-grade	0.7	Sand	Yes	Yes
MOTIVA	BTEX	>10X	Basement	0.5	Saprolite	N/A	N/A
CHATTERTON[1]	BTX	<10X	Slab-on-grade	1.5	Sand	No	Yes
CHATTERTON[2]	BTX	<10X	Slab-on-grade	1.5	Sand	Yes	Yes
SOUTH PHILY	BTEX	N/A	N/A	5-7	Sand, overlain Silt	N/A	Yes

1 $\Delta P >= 10$ Pa, 2 $\Delta P <= 2.5$ Pa

Petroleum Hydrocarbon Site Soil Vapor Alpha Comparison to USEPA Fig. 3 (filtered data)



By: Hers, Dawson, & Truesdale

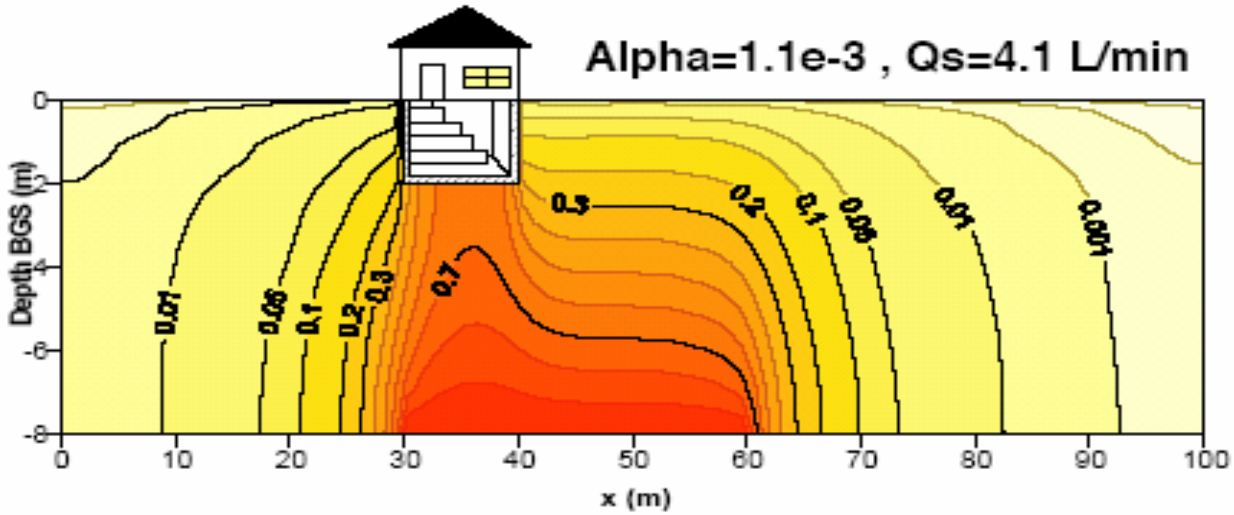
Petroleum Hydrocarbon – Closer Look at Biodegradation

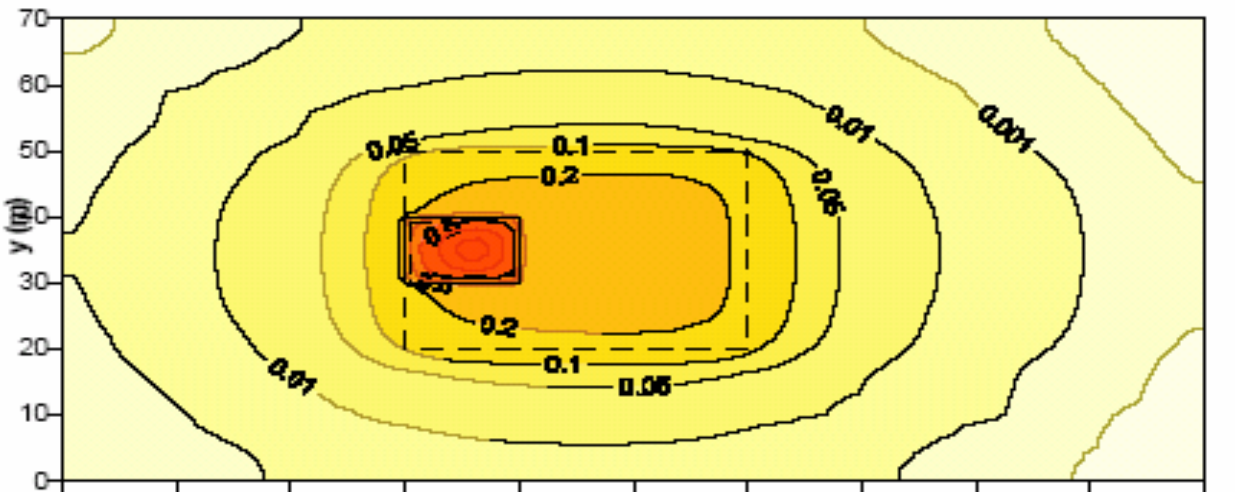
- Five sites at least some evidence BTEX vapor biodegradation
  - BTEX profiles indicate significant vapor attenuation
  - Oxygen profiles consistent with vapor attenuation
  - At two sites, fine-grained soil layers also likely contributed to vapor attenuation
- At one site, BTEX biodegradation observed adjacent to building, but little bio below building
- At one site, BTEX biodegradation observed adjacent & below building; however, limited biodegradation for cyclohexane and 224-trimethylpentane (more on this later)

3-D J&E Modeling: by L. Abreu & P. Johnson, EST, 2005

Recent work suggest buildings (surface cover) can interact w/ distrib. of contamination.

Changes in α with Source Position and Depth…





Note: Assuming a site without horizontal soil-gas flow - Recent observations of horizontal flow of tracers (at least beneath buildings), Sweeney & Hartman

Overview of Proposed Changes, Cont'd

Nov. 2002

- Tier 1: **Primary** Screening
  - Q1: VOCs present?
  - Q2: Near buildings?
  - Q3: Immediate concern?
- Tier 2: **Secondary** Screening
  - Q4: Generic screening
  - Q5: Semi-site specific screening (alphas from charts & tables)
- Tier 3: Site-Specific Pathway Assessment
  - Q6: Indoor air (and/or subslab)

Fall 2005

- Tier 1: **Preliminary** Screening
  - Q1: COPCs present?
  - Q2: Near buildings? (now or later?)
  - Q3: Immediate concern?
- Tier 2: **Generic** Screening
  - Q4: Generic residential and non-residential screening levels
- Tier 3: **External** Site-Specific Screening
  - Q5: More site-specific parameters (alpha from spreadsheet)
- Tier 4: **Internal** Site-Specific Assessment
  - Q6: Indoor air or subslab or both
  - Multiple lines of evidence

Draft AEHS 3/05 by H. Dawson (minor mod. 8/3/05)

Preliminary Screening

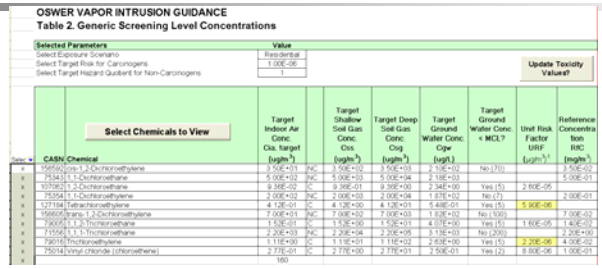
Generic Screening

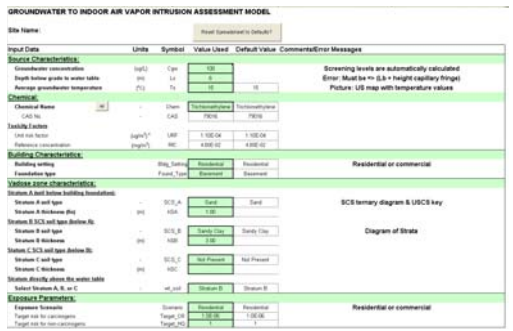
External Site-Specific Screening

Internal Site-Specific Assessment

OSWER VAPOR INTRUSION GUIDANCE
Table 1. Chemicals Sufficiently Toxic to Pose an Inhalation Risk via Vapor Intrusion

Check (x) If Present	CASN	View Selected Chemicals / Chemical	Target Indoor Air Conc. Cia, target (ug/m³)	Basis C = cancer NC = noncancer	Saturated Vapor Conc. Cv (ug/m³)	Sufficiently Toxic? CV.Cia,target? (yes/No)
x	83329	Acenaphthene	2.10E+02	NC	2.07E+04	No
x	75070	Acetaldehyde	1.11E+00	C	2.14E+09	Yes
x	67641	Acetone	3.50E+02	NC	7.19E+08	Yes
x	75058	Acetonitrile	6.00E+01	NC	2.01E+08	Yes
x	156592	cis-1,2-Dichloroethylene	3.50E+01	NC	1.06E+09	Yes
x	75343	1,1-Dichloroethane	5.00E+02	NC	1.21E+09	Yes
x	107062	1,2-Dichloroethane	9.36E-02	C	4.20E+08	Yes
x	75354	1,1-Dichloroethylene	2.00E+02	NC	3.13E+09	Yes
x	127184	Tetrachloroethylene	4.12E-01	C	1.66E+08	Yes
x	156605	trans-1,2-Dichloroethylene	7.00E+01	NC	1.74E+09	Yes
x	79005	1,1,2-Trichloroethane	1.52E-01	C	1.67E+08	Yes
x	71556	1,1,1-Trichloroethane	2.20E+03	NC	8.88E+08	Yes
x	79016	Trichloroethylene	1.11E+00	C	5.19E+08	Yes
x	75014	Vinyl chloride (chloroethene)	2.77E-01	C	1.00E+10	Yes





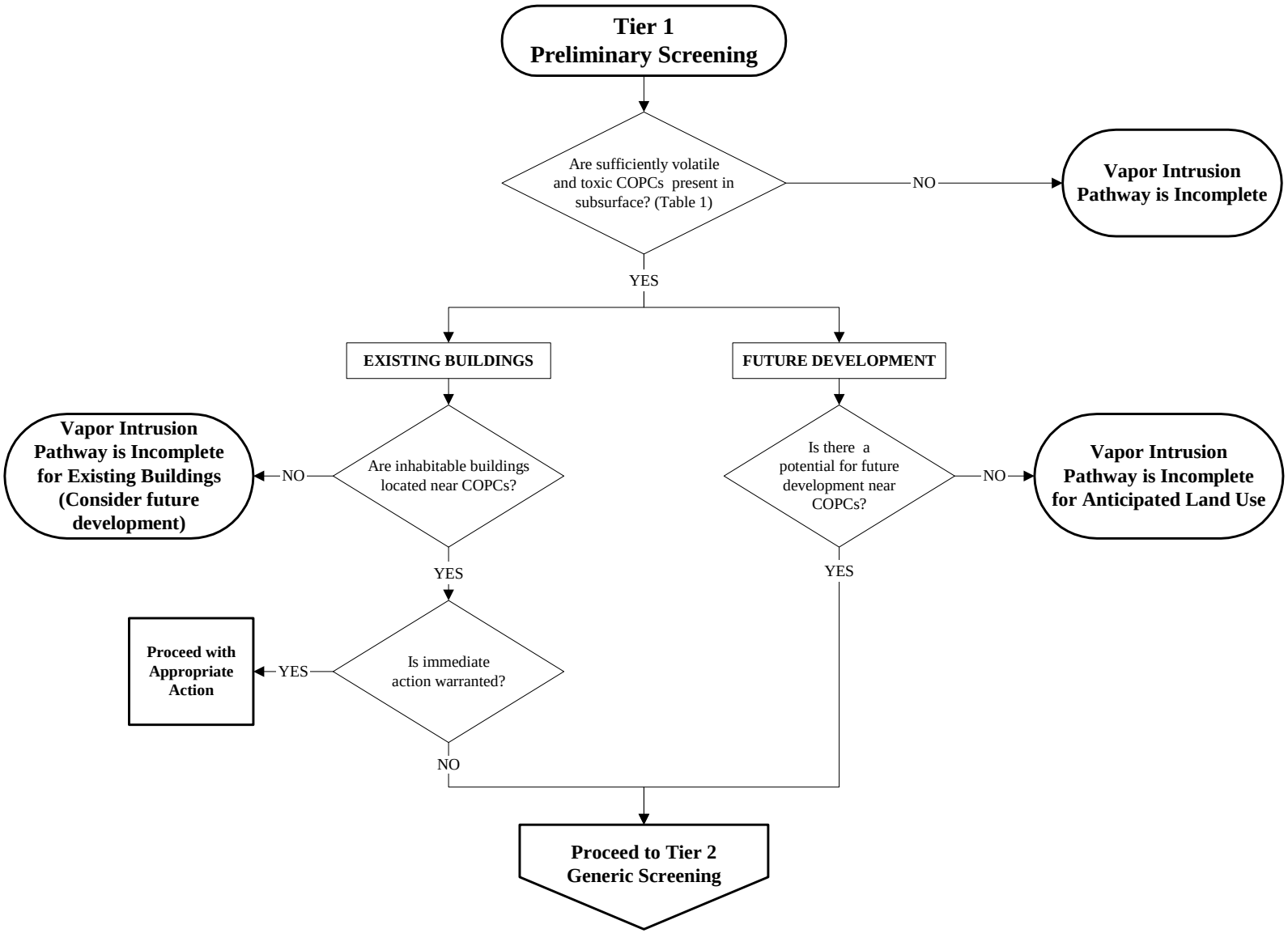
Considering: NJ

- Min. 1 boring / house
- 75% soil " as fine as"
- Near-slab 3 x 10 ft
- I.C. if not Unrestricted
- Delineate for future

In-Building Concentrations		Indoor Air Conc. < 0.1 TL	Indoor Air Conc. > 0.01 TL to < TL	Indoor Air Conc. > TL	No Indoor Air Data
Sub-Slab Conc.	< 0.1 TL/AF	No Action	No Action or Investigate IA Sources	Investigate IA Sources	No Action
	> 0.1 TL/AF to < TL/AF	Resample SS or No Action	Investigate IA Sources or No Action	Investigate IA Sources and Monitor IA	Resample SS or Sample IA
	> TL/AF	Monitor IA or Mitigate	Monitor IA or Mitigate	Mitigate	Monitor IA or Mitigate
No Subslab Data		No Action**	Resample IA or Sample SS	Investigate IA Sources or Mitigate	Sample IA and/or SS

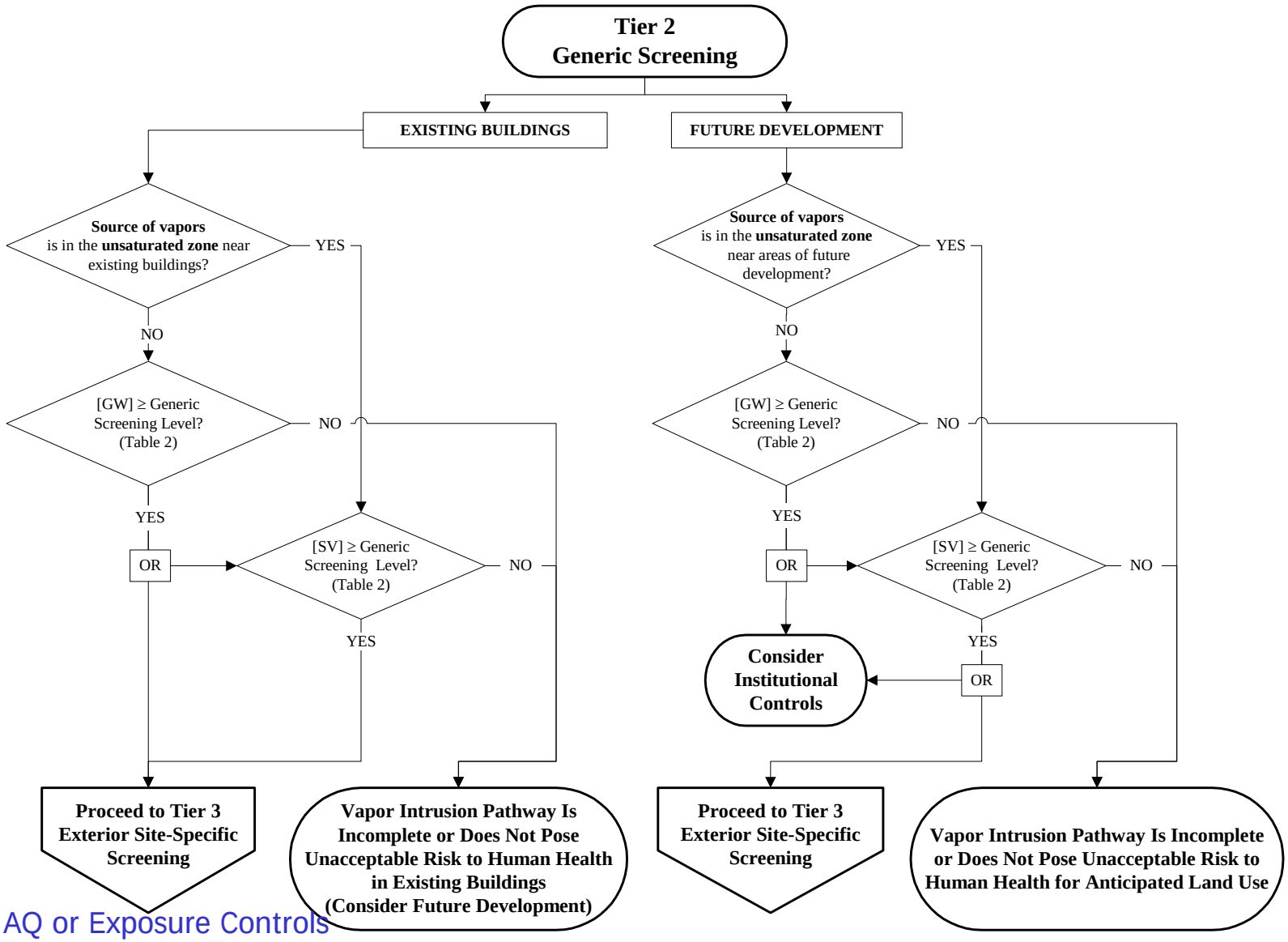
By Helen Dawson (minor mod. 8/3/05)

Tier 1: Preliminary Screening



By Helen Dawson

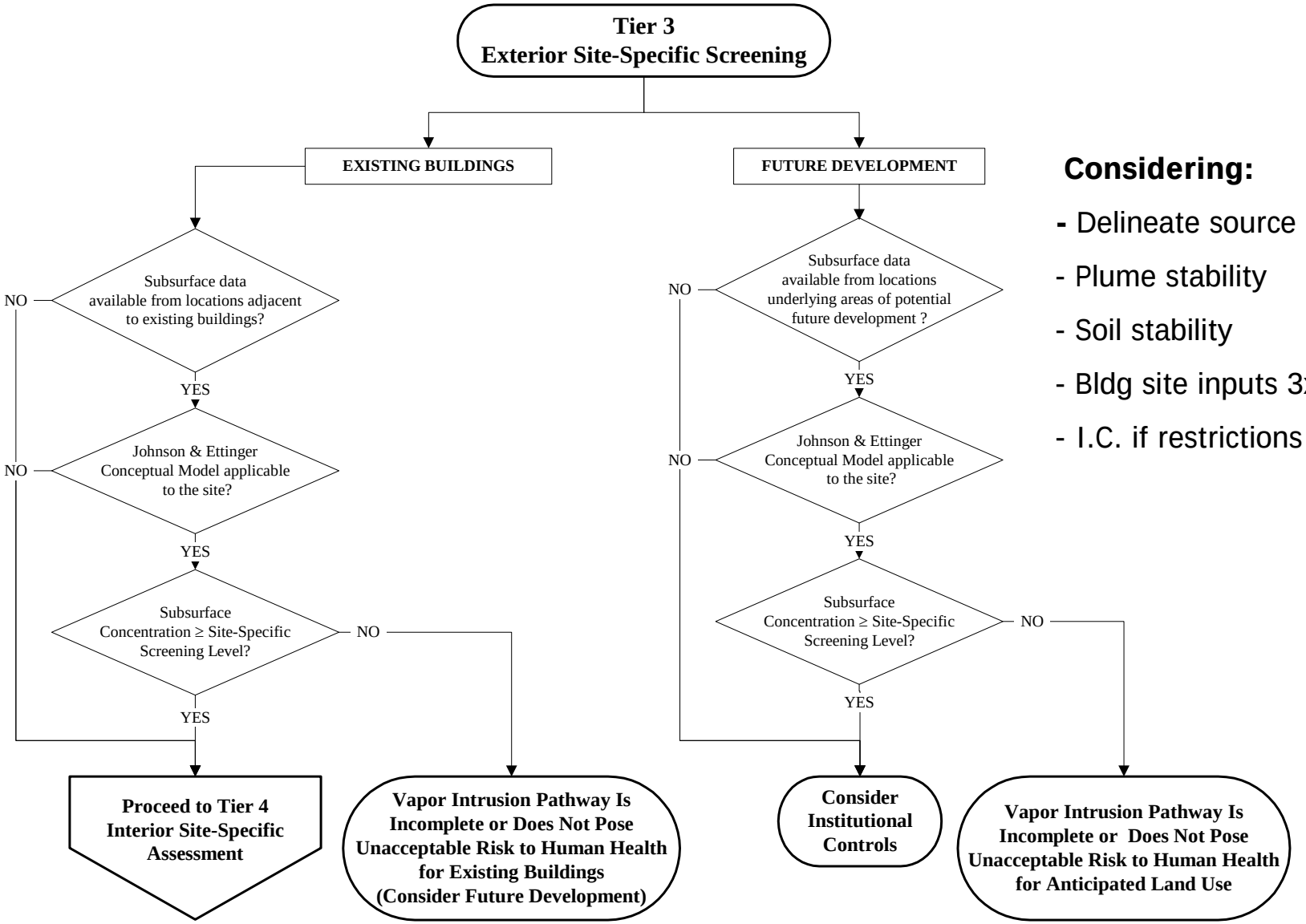
Tier 2: Generic Screening



Or IAQ or Exposure Controls

By Helen Dawson

Tier 3: External Site-Specific Screening



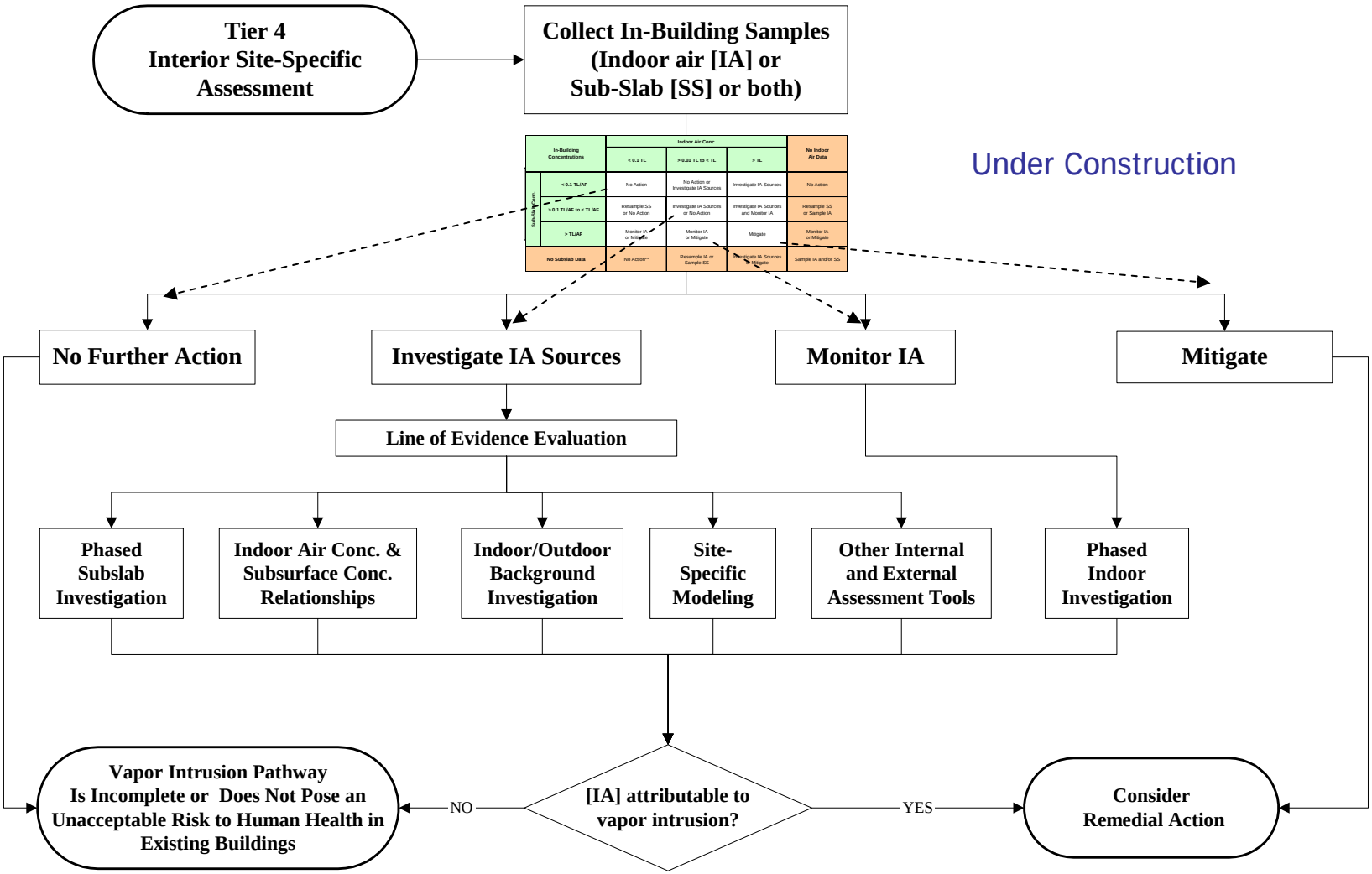
Or Exposure Controls

Considering:

- Delineate source area
- Plume stability
- Soil stability
- Bldg site inputs 3x
- I.C. if restrictions

By Helen Dawson (minor mod. 8/3-14/05)

Tier 4: Internal Site-Specific Assessment



By Helen Dawson (minor mod. 8/3/05)

Sub-Slab / Indoor Air Decision Matrix

Cancer Risk example

In-Building Concentrations		Indoor Air Conc.			No Indoor Air Data
		< 0.1 TL	> 0.01 TL to < TL	> TL	
Sub-Slab Conc.	< 0.1 TL/AF	No Action	No Action or Investigate IA Sources	Investigate IA Sources	No Action
	> 0.1 TL/AF to < TL/AF	Resample SS or No Action	Investigate IA Sources or No Action	Investigate IA Sources and Monitor IA	Resample SS or Sample IA
	> TL/AF	Monitor IA or Mitigate	Monitor IA or Mitigate	Mitigate	Monitor IA or Mitigate
No Subslab Data		No Action**	Resample IA or Sample SS	Investigate IA Sources or Mitigate	Sample IA and/or SS

IA = Indoor Air
SS = Sub-slab
TL = Target level (indoor air, cancer risk)
AF = Attenuation Factor, e.g., 0.02 generic for sub-slab to indoor air (indoor air / sub-slab)
TL/AF = Target level / Atten. Factor *(sub-slab conc. that could be expected to intrude near TL)*
[Rearranged: SS conc. x AF means IA-vi could be: > TL; or <TL but > 0.1TL, or < 0.1 TL]

** At least two indoor air samples are recommended.

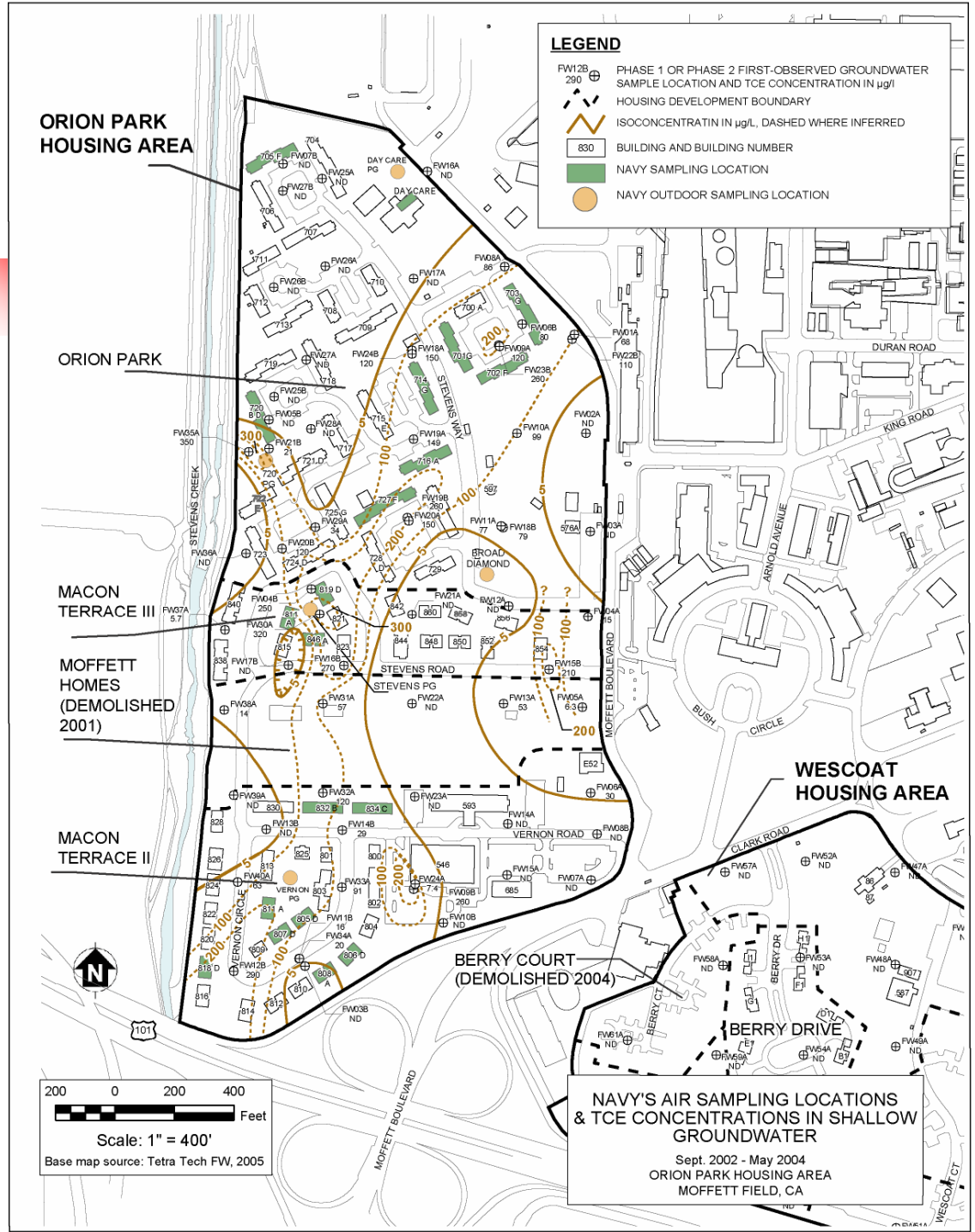
By R2 (minor mod. 8/16/05)

Timeline for OSWER VIG

- Access to VI Database - end of Aug.
- Workgroup registration (at iavi.rti.org)
  - EPA, State, Stakeholders
- Completed Expert-draft Fall 05
- Invited peer review of spreadsheets
  - Revised web & “Users Guide”
- Workgroup & Regional closure
- Issuance & Stakeholder conferences

Recent Observations

- Update from California
- 7/20/05 Public Meeting
- Provided by R9's Alana Lee,
  - 10 out of 26 bldgs over plume ND in SS & IA, = Geology?
  - SS attenuation factors up to 0.035 (in a small population)

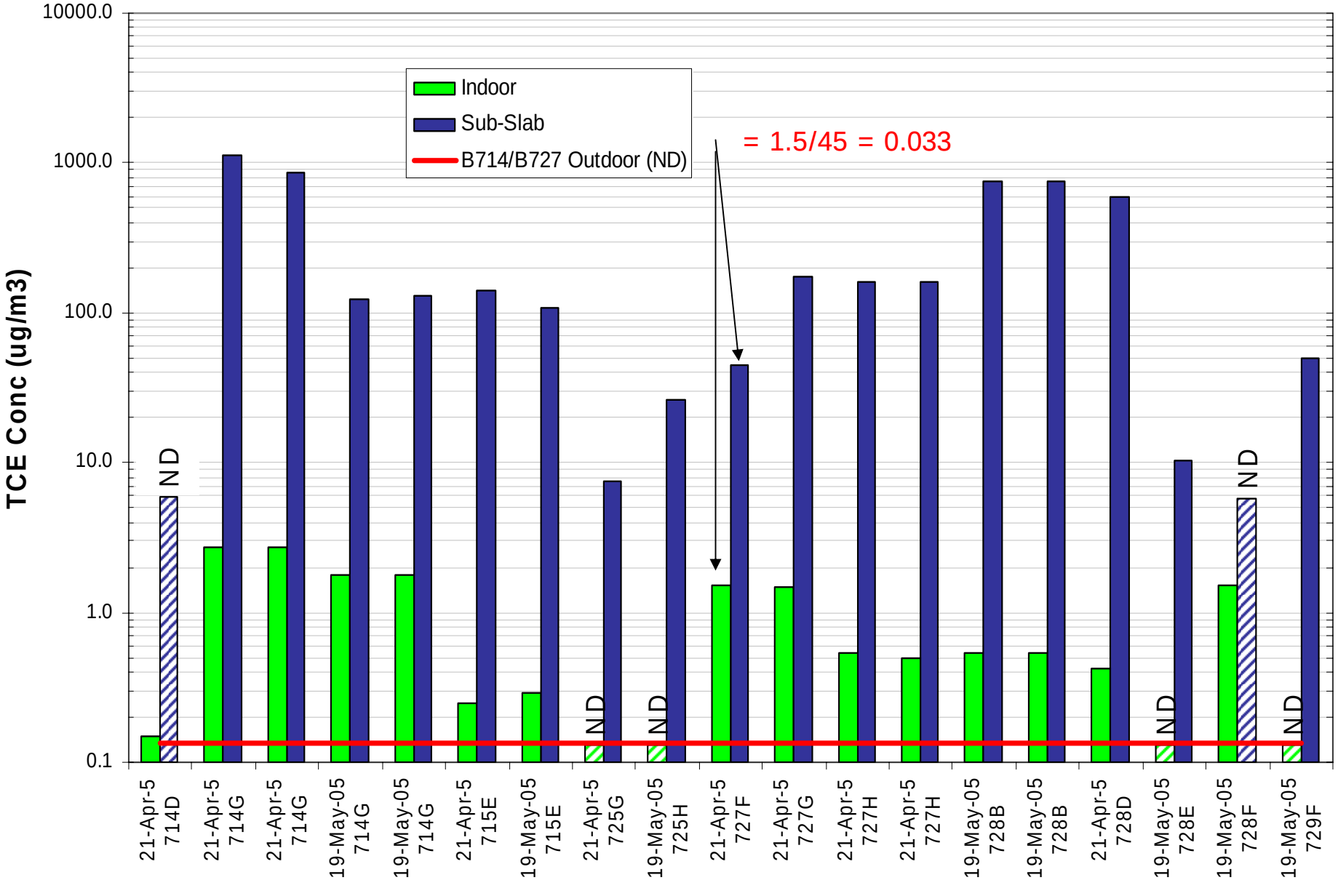


10 out of 26 bldgs over plume ND in SS & IA, = geology or short-circuiting?

Map used w/ permission of Alana Lee, USEPA R9

Orion Park TCE Indoor Air and Soil Gas Results

Used w/ permission of Alana Lee, USEPA R9



Evidence collected since 2002 continues to show:

- Petroleum Hydrocarbons (e.g., BTEX) typically attenuating more than non-PHC
  - Commonly an 'order' or more
  - 5 Conditional Criteria for Aerobic Biodegradation – Ettinger (GeoSyntec)
    - Microbes, O_2, Food, Nutrients, H_2O
- Joe Vescio – EPA/State Regulators Petroleum Vapor Intrusion Work Group is providing input to VIG for petroleum hydrocarbons

Closing Slide by: Mathew Hale, US EPA, Director, Office of Solid Waste