Vapor Intrusion Snapshot of Updates

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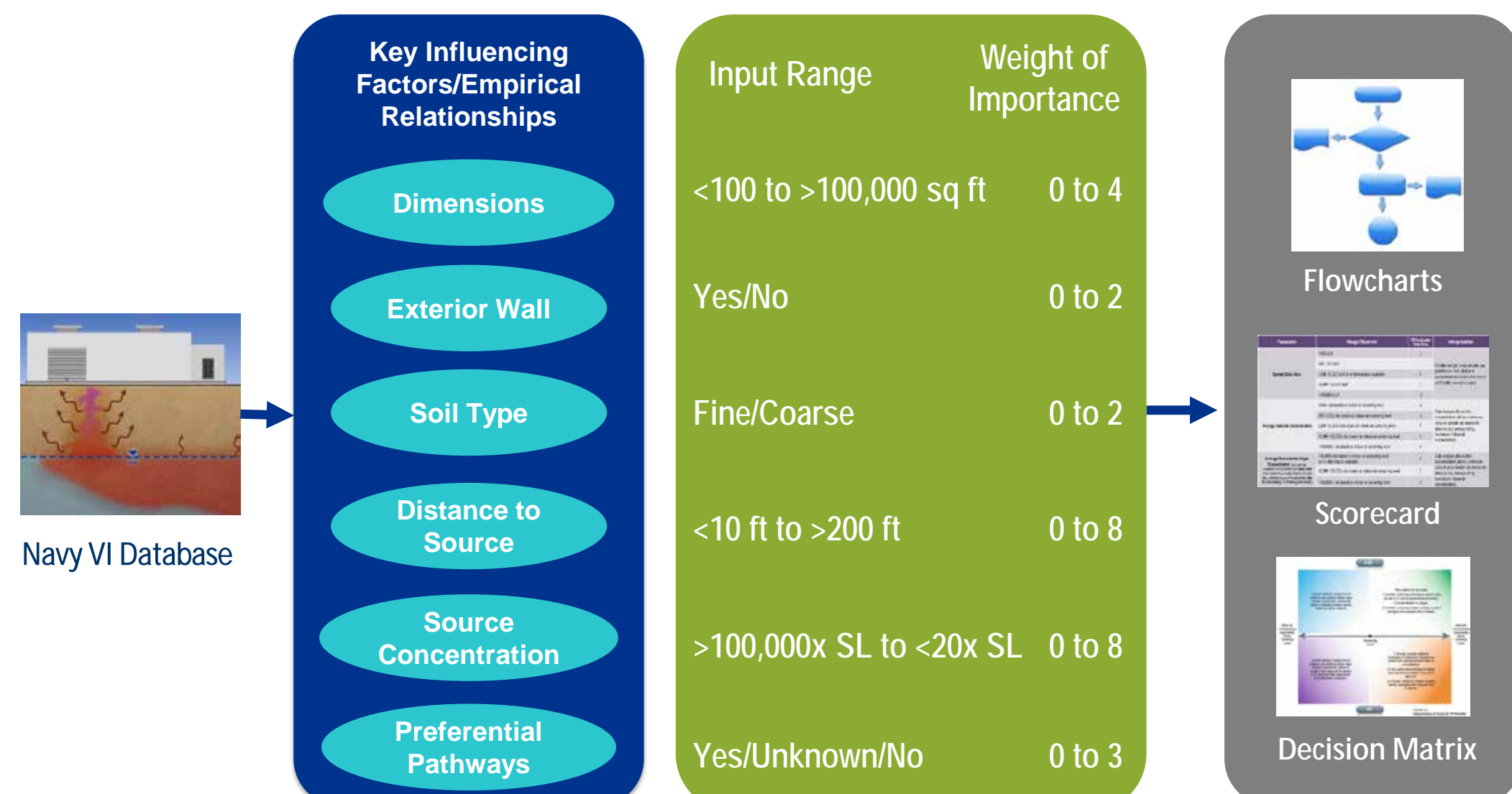
Introduction

The U.S. Navy and Department of Defense (DoD) are working to keep pace with the evolving science of vapor intrusion (VI). The DoD is updating their VI Handbook with Factsheets, which are available on the DENIX website. The Navy is also updating the DoD VI database of commercial industrial buildings, and developing VI Sampling and Analysis Plan (SAP) templates, protocols for VI data to be captured in a NIRIS Electronic Data Deliverable (NEDD), a GIS VI Screening tool, and a Matrix of Technologies for VI. These efforts provide more defensible and cost-effective tools for remedial project managers (RPMs).

Navy Industrial VI Database/Decision Framework

- Objectives
  - Create a DoD-specific VI database for industrial buildings
  - Understand attenuation and key VI influencing factors
  - Create a framework to evaluate multiple lines of evidence (MLEs)
- 22 installations, 27 sites, and 79 buildings
  - Majority of sites have depth to water <15 feet
  - Large (50%), medium (35%), and small (15%) buildings
- Statistical analysis of database to guide:
  - Building prioritization (planning)
  - Likelihood of VI occurrence (investigation)
  - Planning for long-term stewardship

Key Influencing Factors/Empirical Relationships	Input Range	Weight of Importance
Dimensions	<100 to >100,000 sq ft	0 to 4
Exterior Wall	Yes/No	0 to 2
Soil Type	Fine/Coarse	0 to 2
Distance to Source	<10 ft to >200 ft	0 to 8
Source Concentration	>100,000x SL to <20x SL	0 to 8
Preferential Pathways	Yes/Unknown/No	0 to 3

Navy VI Database → Flowcharts → Scorecard → Decision Matrix

Adapted from www.nesdi.navy.mil/Files/FinalReports/FR_476.pdf

DoD (2009) VI Handbook 2017 Factsheet Updates

Objective: Update DoD (2009) VI Handbook with new technologies
- Passive sampling
- Real-time monitoring
- High-volume soil gas sampling
- Building pressure cycling
- Tracers, surrogates, and indicators
- Influence of background sources

DENIX — DEFENSE ENVIRONMENTAL RESTORATION PROGRAM — INSTALLATION RESTORATION PROGRAM — Vapor Intrusion

DoD VAPOR INTRUSION HANDBOOK — JANUARY 2009

www.denix.osd.mil/irp/vaporintrusion/
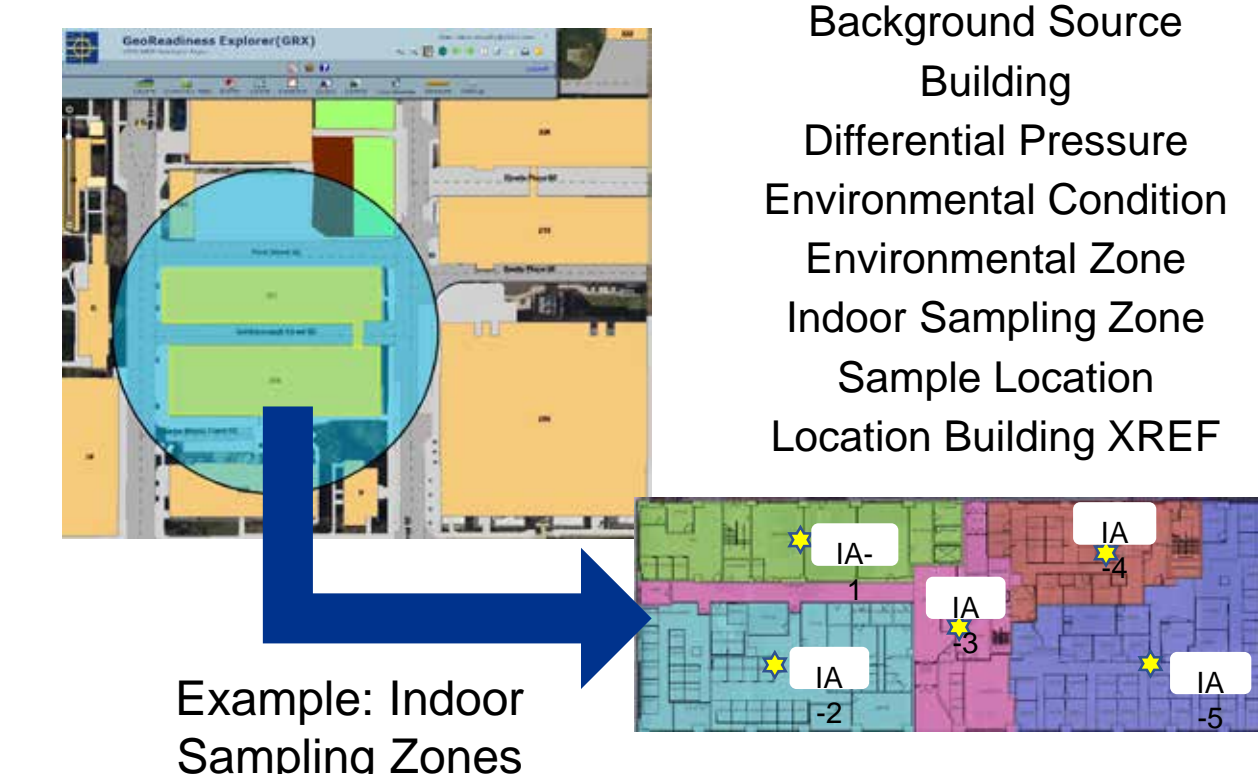TSERAWG: Tri-Service Environmental Risk Assessment Workgroup
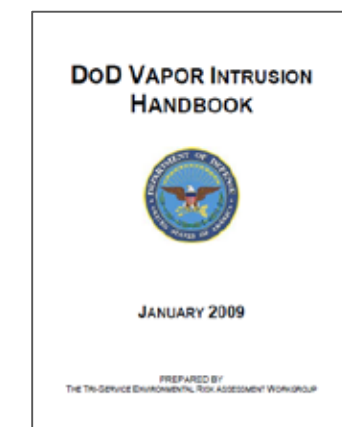
NIRIS Electronic Data Deliverable (NEDD)

Changes will help:
- Capture/evaluate analytical and non-analytical VI data
- Identify Navy VI issues
- Develop tools to efficiently address potential future VI
- Bring consistency to data collection
- Develop new assessment methods

Example VI NEDD Tables
Analytical Results
Background Source
Building
Differential Pressure
Environmental Condition
Environmental Zone
Indoor Sampling Zone
Sample Location
Location Building XREF

Example: Indoor Sampling Zones
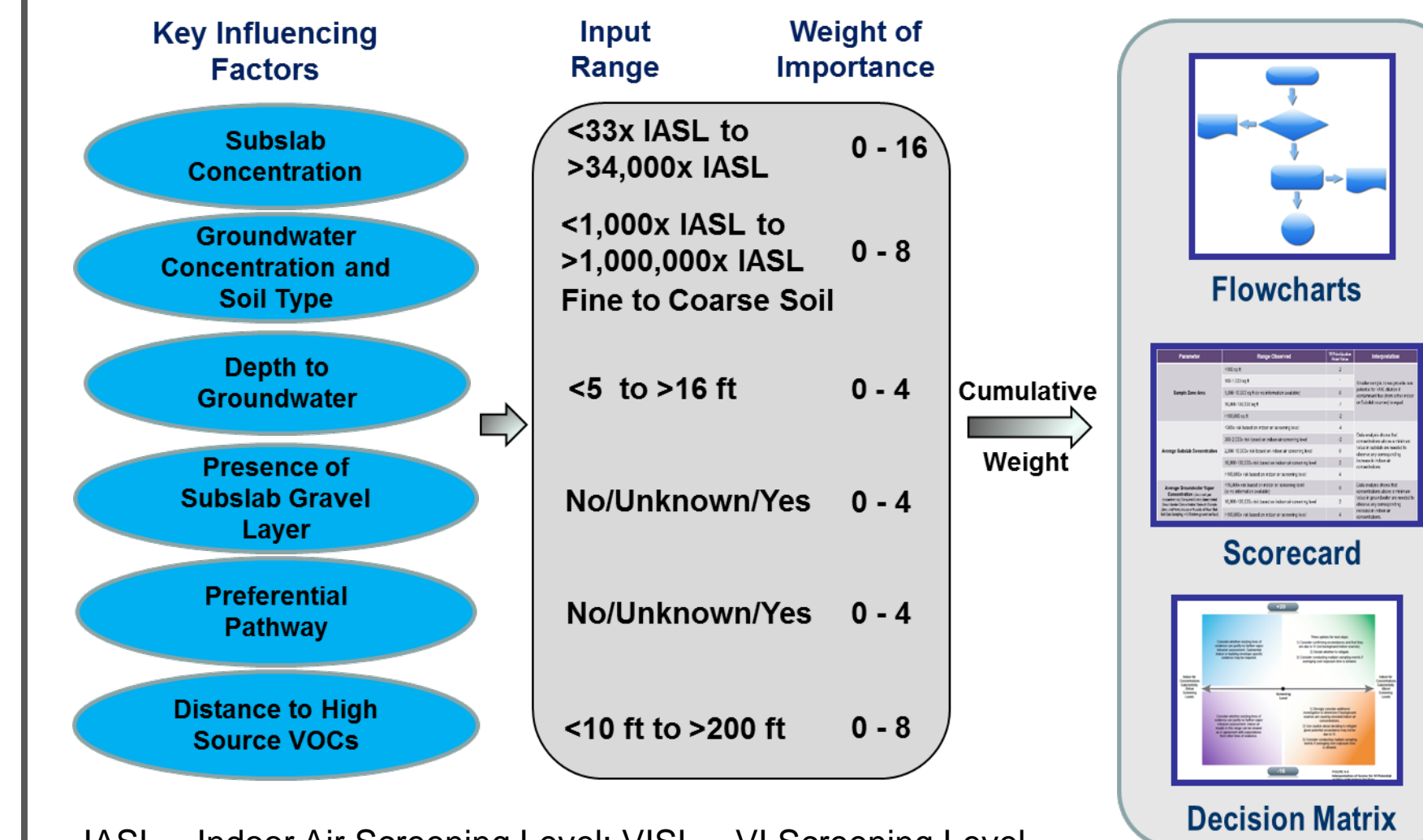
Navy GIS VI Screening Tool

Programmatic tool for screening VI potential
- Query groundwater data from Navy data management system (NIRIS)
- Apply Navy VI decision framework weights of importance to score VI potential
- Display/interact with results geospatially

Building | Buffer | Samples and Buffer | Building VI Score

Time Series Plots — TCE
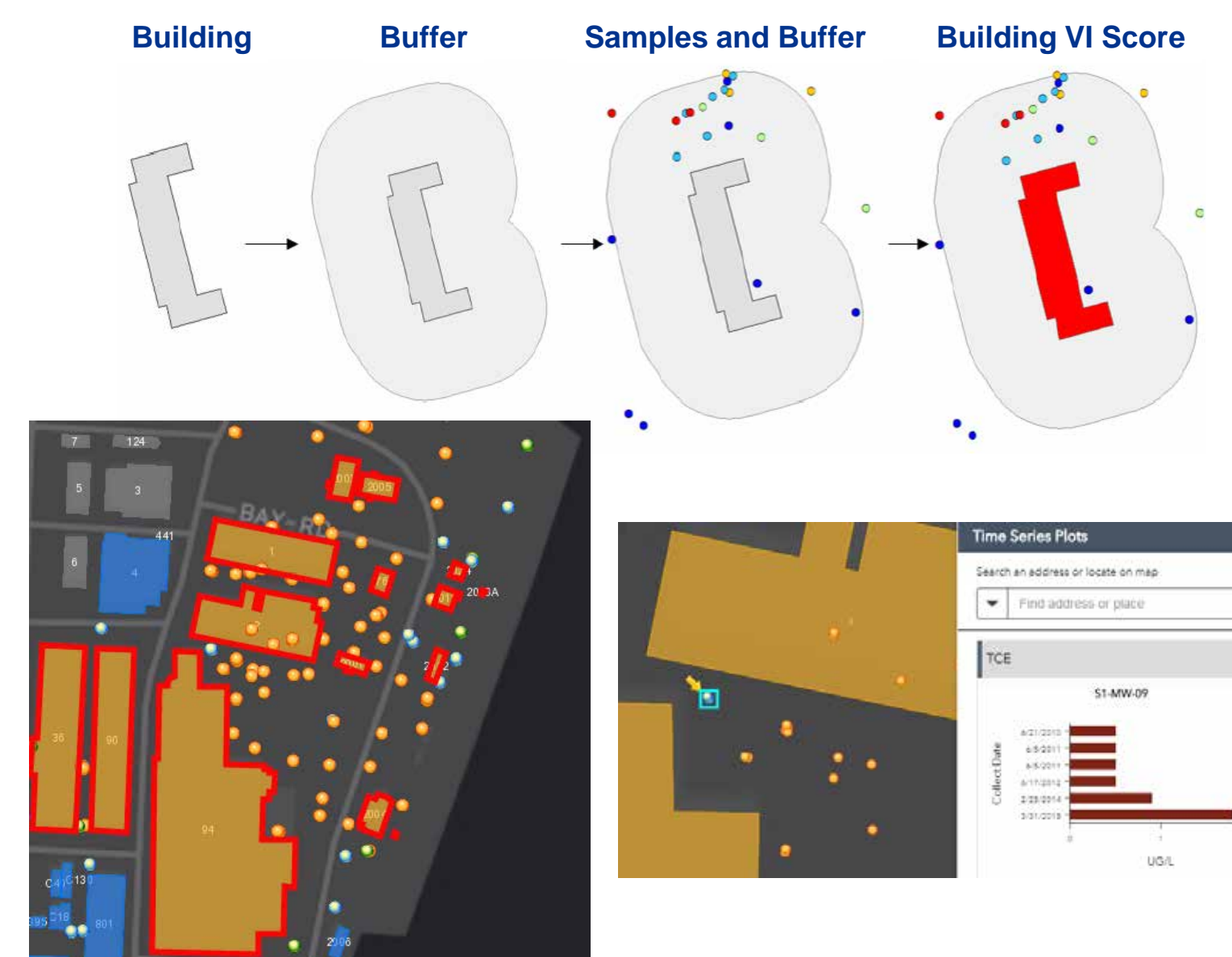
Navy Residential VI Decision Framework

- Developed so RPMs can evaluate MLE (not just VOC > VISL)
- Reviewed VI literature/EPA 2012 residential database re-analyses
- Identified key VI influencing factors
- Applied decision science to weight importance of MLE
- Cumulative weights allow RPMs to:
  - Consider more than just VOC > VISL
  - Plan, implement, and interpret VI investigations
- Incorporating into VI UFP-QAPP template (in progress)

Key Influencing Factors	Input Range	Weight of Importance
Subslab Concentration	<33x IASL to >34,000x IASL	0 - 16
Groundwater Concentration and Soil Type	<1,000x IASL to >1,000,000x IASL — Fine to Coarse Soil	0 - 8
Depth to Groundwater	<5 to >16 ft	0 - 4
Presence of Subslab Gravel Layer	No/Unknown/Yes	0 - 4
Preferential Pathway	No/Unknown/Yes	0 - 4
Distance to High Source VOCs	<10 ft to >200 ft	0 - 8

Cumulative Weight → Flowcharts → Scorecard → Decision Matrix

IASL = Indoor Air Screening Level; VISL = VI Screening Level
VOC = volatile organic compound

Navy VI Matrix of Technologies

Source Type	Sub-Objectives/Study Questions	Sample Matrix (where applicable)	Multiple 8-hr or 24 hr Canister Sampling Events	Multiple 5-min to 15-min Canister Sampling Events	Multiple 1-wk to 2-week Canister Sampling Events	Multiple >3-day Passive Sampling Events	Building Pressure Cycling (with VOC and dP monitoring)	Portable GC/MS	Portable GC/PID	Portable high-sensitivity PID	Field Deployable GC/ECD	Trace Atmospheric Gas Analysis (TAGA) Unit	High Volume Sampling	Indicator, Tracer, and Surrogate Testing	Supplemental Information
Vadose Zone VOC Source within the Inclusion Zone and/or Groundwater VOC Source within the Inclusion Zone (applies to existing/future buildings)	Characterize the migration pathway(s) in vadose zone (spatial/temporal variability)	Subslab vapor, multi-depth soil gas, external preferential pathway vapor	+++	++	++	+	0	+++	++	+	+++	+++	++	+++	
	Address long-term temporal variability of indoor air concentrations	Indoor air	+	0	++	++	+++	+	+	0	+++	0	0	++	
	Address short-term temporal variability of indoor air concentrations	Indoor air	++	+	0	0	+++	+	+	0	+++	+	0	++	
Objective: Determine if the VI pathway is complete and may pose potential unacceptable risk (as defined by the regulatory program)	Identify vapor entry point(s)	Entry point vapor (e.g., sewer lines, cracks, wall cavity, sump headspace, flux chamber)	0	+	0	+	+++	+	+	+	+++	+++	0	+++	CSIA, Compound Specific Ratio Analysis, Meteorological Data, Logging Depth to Water
	Assess mixing/spatial variability within building	Indoor air, vapor migration cavities	+	+	+	+	0	+++	+	0	+++	++	0	+++	
	Determine if background sources (indoor/ambient) are contributing to indoor air concentrations	Indoor/outdoor air, product storage space(s), subslab vapor, soil gas	+	+	+	+	0	+++	+	0	+++	++	0	Supplemental	

Navy-Supported VI Research

- 2018/2019 NESDI Temporal High-Resolution VI Study in Industrial Buildings
  - Continuously monitor indoor/subslab VOCs and other building parameters/characteristics for 1 year
  - Onsite GC/ECD, differential pressure, temperature, wind speed/direction, radon, etc.
  - Determine whether near worst-case VI conditions can be induced by controlled building pressure.
- ESTCP/SERDP VI Research
  - Low-Flow Capillary Canister Sampling (ER-201504)
  - Preferential Pathway VOC Migration (ER-201505)
- Mass Flux Characterization of Attenuation

Guo, et al. (2016) — McHugh & Beckley (2017)

VI QAPP/SAP Template

- Objectives:
  - Provide prioritization strategy for VI investigations
  - Identify and document VI tools and strategies
- Being developed by DoD Environmental Data Quality Workgroup (EDQW)
- Finalizing QAPP worksheets (15, 20-24, 28) for:
  - HAPSITE sampling
  - High-volume sampling
  - TO-15 analysis
  - Pressure cycling
  - Passive sampling
- Worksheets 10, 11, and 17 next
- Target completion date is late December 2018

IDQTF, UFP-QAPP Manual, March 2005

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