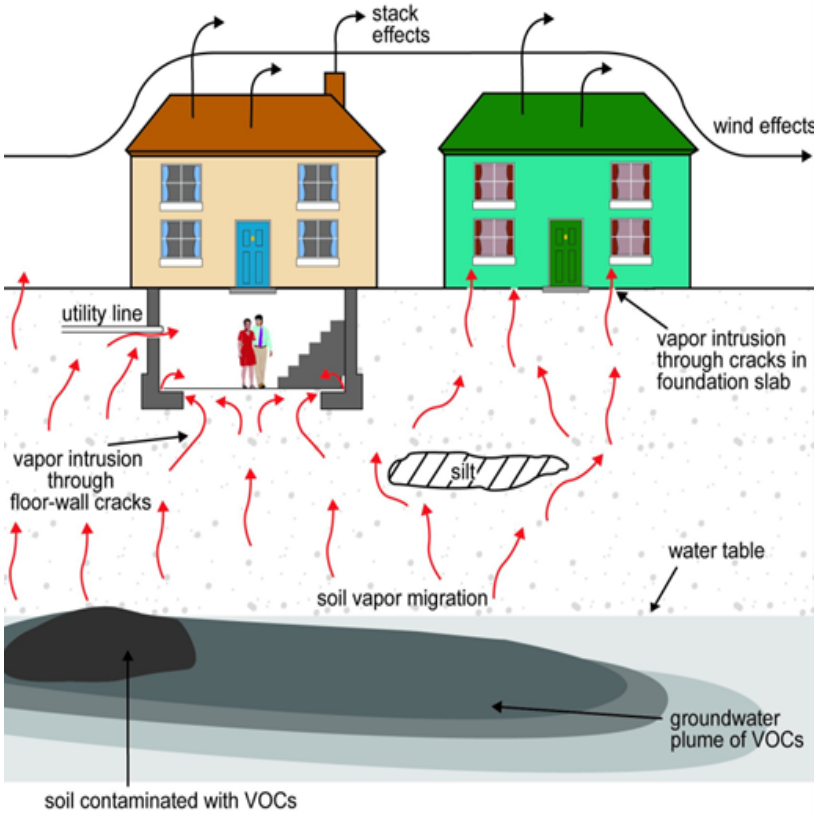
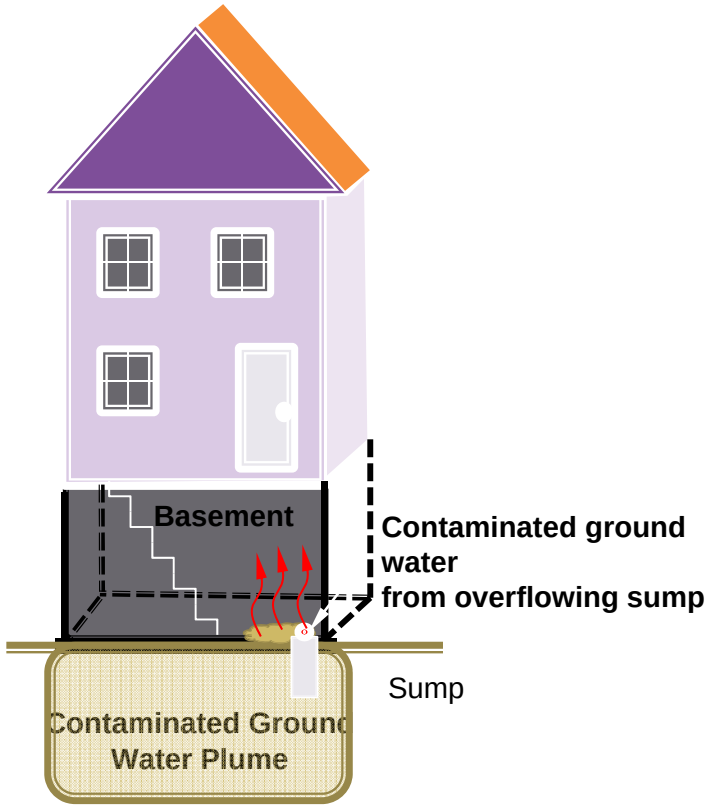
Rulemaking for the Addition of a Subsurface Intrusion

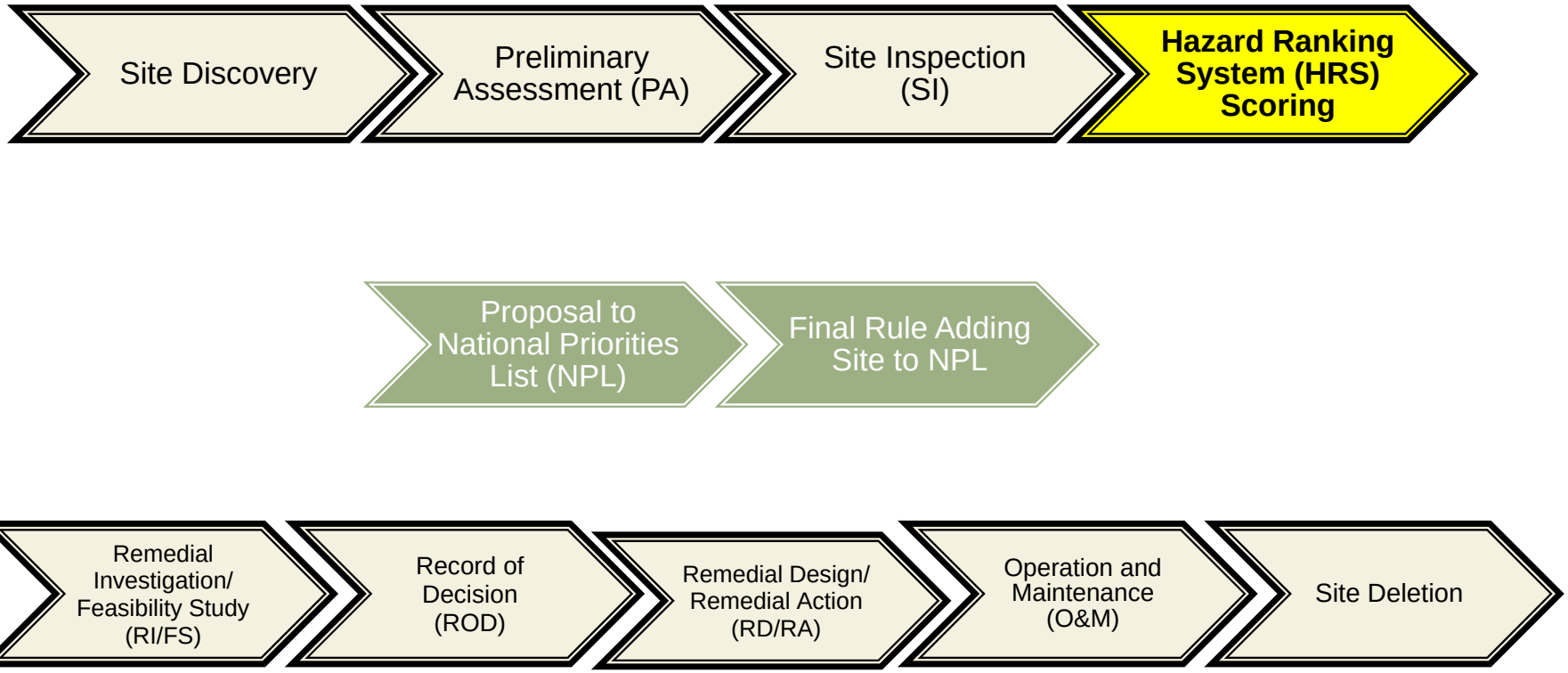




Catalyst for Hazard Ranking System (HRS) Addition

- The Government Accountability Office (GAO) report of May 2010 recommended that EPA consider vapor intrusion (VI) as part of the Superfund National Priorities List (NPL) process
- By adding a subsurface intrusion component to the Hazard Ranking System (HRS), sites previously not eligible for the NPL based on the other pathways, could be eligible for NPL listing
- This proposed addition to the HRS, together with the VI guide, will provide a comprehensive framework to guide evaluation of subsurface intrusion sites across the country

Superfund Process and the HRS



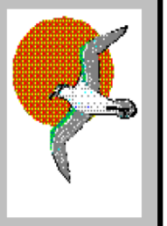
The Hazard Ranking System (HRS)

- The HRS is a screening tool and not a risk assessment
- The HRS is simply a set of rules for assigning values to pathway factors to arrive at a site score
- A minimum HRS cut-off score of 28.50 was established as an eligibility requirement for NPL listing
- The HRS score is the primary criterion EPA uses to determine whether a site qualifies for placement on the NPL
- Just because a site qualifies does not automatically mean it will be placed on the NPL

Calculating the HRS Score

- **The HRS Score Answers the Following Core Questions:**
  - Has Anything Escaped? (Likelihood of Release)
  - How Bad and How Much? (Waste Characteristics)
  - Who And What Could It Hurt? (Targets)

Proposed HRS Structure Including Subsurface Intrusion

HRS Pathways	Ground Water	Surface Water			Soil Exposure and Subsurface Intrusion			Air
					Soil Exposure		*Subsurface Intrusion*	
Factor		 DW	 HFC	 ENV	 RESIDENT	 NEARBY		
LR / LE Likelihood of Release / Exposure								
WC Waste Characteristics								
T Targets								
	S_{GW}	$S_{SW} = DW + HFC + ENV$			$S_{SESsI} = Soil\ Exposure + Subsurface\ Intrusion$ $(where: Soil\ Exposure = Resident + Nearby)$			S_A

Why the Soil Exposure (and not air) pathway?

- Does not require changes to the existing four pathway structure
- Methods and science are more advanced in measuring the probability of vapor migration from the subsurface into structures than ambient air to indoor air
- Would not change how the other pathways, including the current soil exposure pathway components are scored – VI could be additive to the current pathway
- Soil exposure pathway is already designed as an “exposure” pathway, thus requiring less modification than trying to fit SsI exposure scenarios into one of the “migration” pathways

Why the Soil Exposure (and not air) pathway?

- Exposure from subsurface intrusion is easier to document than attributing vapor migration to a facility release; this minimizes site specific sampling and data collection needs and potential sampling costs

- Limits public comment to just the new Subsurface Intrusion (SsI) component

- The Superfund law (CERCLA) definition of the HRS air pathway only includes releases to ambient air; whereas vapor/subsurface intrusion affects indoor spaces

Scope of the HRS Addition

- SsI results in actual exposure and risk, therefore sites with potential SsI are a high priority
- EPA does not intend to increase the number of sites on the NPL
- Proposed and final NPL sites and accompanying potential response actions are not directly affected by this proposed rulemaking
- There is neither a plan in place, nor resources for a systematic re-evaluation of legacy sites; as with EPA's current strategy, reassessments may be undertaken if new information is brought to our attention

Scope of the HRS Addition, cont.

- The addition only identifies the scoring mechanism for including SsI in an overall HRS score
- Consistent with the other HRS pathways, there is no dictation of sampling methods or procedures
- Data quality requirements will remain comparable those for other pathways

Who Will Be Impacted?

- The rule will affect only how EPA and its state and tribal Cooperative Agreement partners conduct site assessments and HRS scoring
- No direct regulatory impact to nongovernmental entities
- Listing determinations can only be made by EPA (states, tribes and other federal agencies may have input)
- Minimal impacts to other federal agencies who already identify and address SsI as part of their environmental programs
- For communities with SsI threats, this addition will afford more opportunities for investigation and potential future remediation of SsI

Scientific Integrity

Testing the Model

- Completed Sensitivity Analysis of factors and resultant scores
- Applied “real site” data for sites identified as NPL caliber but unable to score based on current model
- Conducted field pilot study of sites to include evaluation of the new Subsurface Intrusion Pathway

Peer Review

- Peer Review was conducted of selected technical topics
- A panel consisting of six individuals representing a range of expertise evaluated the technical topics and provided comments to the EPA
- The current HRS, of which this proposed rule is an expansion, was peer reviewed by EPA’s Science Advisory Board in 1988
- This proposed addition adheres to the basic structure and concepts of the current HRS so is consistent with the recommendations of the SAB

HRS SsI Addition and the VI Guide

- **The VI Guide and HRS SsI proposed rule both address the threat posed by vapor intrusion and are based on the same scientific principles, such as:**
  - Reliance on a similar conceptual model
  - Consideration of the same key factors and processes
  - The possibility of indoor sources of contaminants when evaluating indoor concentrations
  - Multiple lines of evidence when identifying the origin of the indoor contaminants
  - Giving high priority to sites with documented exposure
  - Evaluation of potential intrusion under circumstances other than those during the sample collection events.
  - The episodic nature of vapor intrusion due to the significant variation in vapor intrusion rates with site-specific factors such as daily and seasonal weather changes.

- **The June 2015 EPA OSWER VI Guide and this HRS SsI rule work in concert to establish national consistency in the evaluation of SsI threats**

HRS SsI Addition and the VI Guide

Purpose of the OSWER VI Guide

- Recommendations for identifying and considering key factors when assessing vapor intrusion, making risk management decisions, and implementing response action plans related to the exposure pathway under OSWER programs. Examples include:
  - Undertaking removal actions, remedial actions, pre-remedial investigations, remedial investigations, and five-year reviews (FYRs) under CERCLA; and
  - Undertaking RCRA facility investigations and corrective actions and site investigations and cleanups at federal facilities and brownfield sites.
- Appropriate when evaluating any of a large number and broad range of vapor-forming chemicals that potentially can provide subsurface sources for vapor intrusion into buildings.

HRS SsI Addition and the VI Guide

Purpose of the HRS

- Screening tool to evaluate the potential of uncontrolled hazardous substances to cause human health problems or environmental damage at one site relative to other sites that are being considered for possible remedial actions under CERCLA.

- The addition of a subsurface component to the HRS allows for consideration of the threat posed by SsI into regularly occupied structures when ranking sites for placement on the NPL.

- The HRS addition is not guidance and uses data collected from VI investigations to rank the relative threat posed by sites.

- Does not address such subjects as data collection and sampling procedures: the guidelines in the OSWER VI guidance are appropriate for these purposes.

Important Points to Remember

- Rule is currently final but not yet in effect. No changes to site assessment program until rule is in effect.
- The addition only identifies the scoring mechanism for including SsI in an overall HRS score
- Timing of HRS SsI Guidance
- No expectation of additional funding to address subsurface intrusion sites

Subsurface Intrusion in the Real World

APPLICATION

SsI Component Structure

- **SsI Addition Structured in the Same Manner as Other Pathways**
  - Maintains the relative weightings among pathways
  - Same general level of relative risk required to qualify for the NPL as other pathways
    - The proposed structure maintains approximately the same number of target receptors required to achieve a site score sufficient for listing as the existing pathways
  - Data collection process during PA/SI stages will use similar strategies as other pathways
    - Possible increased number of ESIs to fill data gaps

SsI Gets Mapped to the HRS

HRS Factor Categories for All Pathways	HRS SsI-Specific Metrics
Likelihood of Release/Exposure • Observed Release/Exposure • Potential for Release/Exposure	• Evaluation of indoor air exposure • Evaluation of potential exposure from subsurface contamination • Do not consider possible future migration
Waste Characteristics • Toxicity/Mobility/Persistence/Bioaccumulation • Hazardous Waste Quantity	• Considers amount of contamination in a regularly occupied structure • Toxicity of substance with associated with exposure • Defines eligible volatile substances • Consideration of Degradation
Targets • Nearest/Exposed Individual • Population • Workers • Resources • Levels of Exposure (Level I or II or Potential)	• Exposed Individuals - Residents, students, workers etc. in regularly occupied structures • Populations – Exposed individuals living, working or attending school in an AOE or ASC • Considers subunits within regularly occupied structures • Resources – similar to other pathways • Benchmarks – Evaluate using inhalation exposure route (same as Air Pathway)

SsI Gets Mapped to the HRS

Factor Categories and Factors	Maximum Value	Value Assigned
Subsurface Intrusion Component		
Likelihood of Exposure:		
1. Observed Exposure	550	
2. Potential for Exposure		
2a. Structure Containment	10	
2b. Depth to contamination	10	
2c. Vertical Migration	15	
2d. Vapor Migration Potential	25	
3. Potential for Exposure (lines 2a * (2b+2c+2d), subject to a maximum of 500)	500	
4. Likelihood of Exposure (higher of lines 1 or 3)	550	
Waste Characteristics:		
5. Toxicity/Degradation	(a)	
6. Hazardous Waste Quantity	(a)	
7. Waste Characteristics (subject to a maximum of 100)	100	
Targets:		
8. Exposed Individual	50	
9. Population:		
9a. Level I Concentrations	(b)	
9b. Level II Concentrations	(b)	
9c. Population within an Area of Subsurface Contamination	(b)	
9d. Total Population (lines 9a + 9b + 9c)	(b)	
10. Resources	5	
11. Targets (lines 8 + 9d + 10)	(b)	
Subsurface Intrusion Component Score		
12. Subsurface Intrusion Component (lines 4 x 7 x 11)/82,500[c] (subject to a maximum of 100)	100	
Soil Exposure and Subsurface Intrusion Pathway Score		
13. Soil Exposure Component + Subsurface Intrusion Component (subject to a maximum of 100)	100	

[a]Maximum value applies to waste characteristics category.
[b]Maximum value not applicable.
[c]Do not round to the nearest integer.

SsI "Exposed" – Where Conceptually Fits

- **SsI component is being added as an exposure route not migration route**
  - Targets come in direct contact with contamination

- **SsI will be a component of the existing Soil Exposure Pathway**
  - Renamed Soil Exposure and Subsurface Intrusion Pathway

- **The contribution of the pathways to the overall site score will not change**

Have the Map, Now We Drive

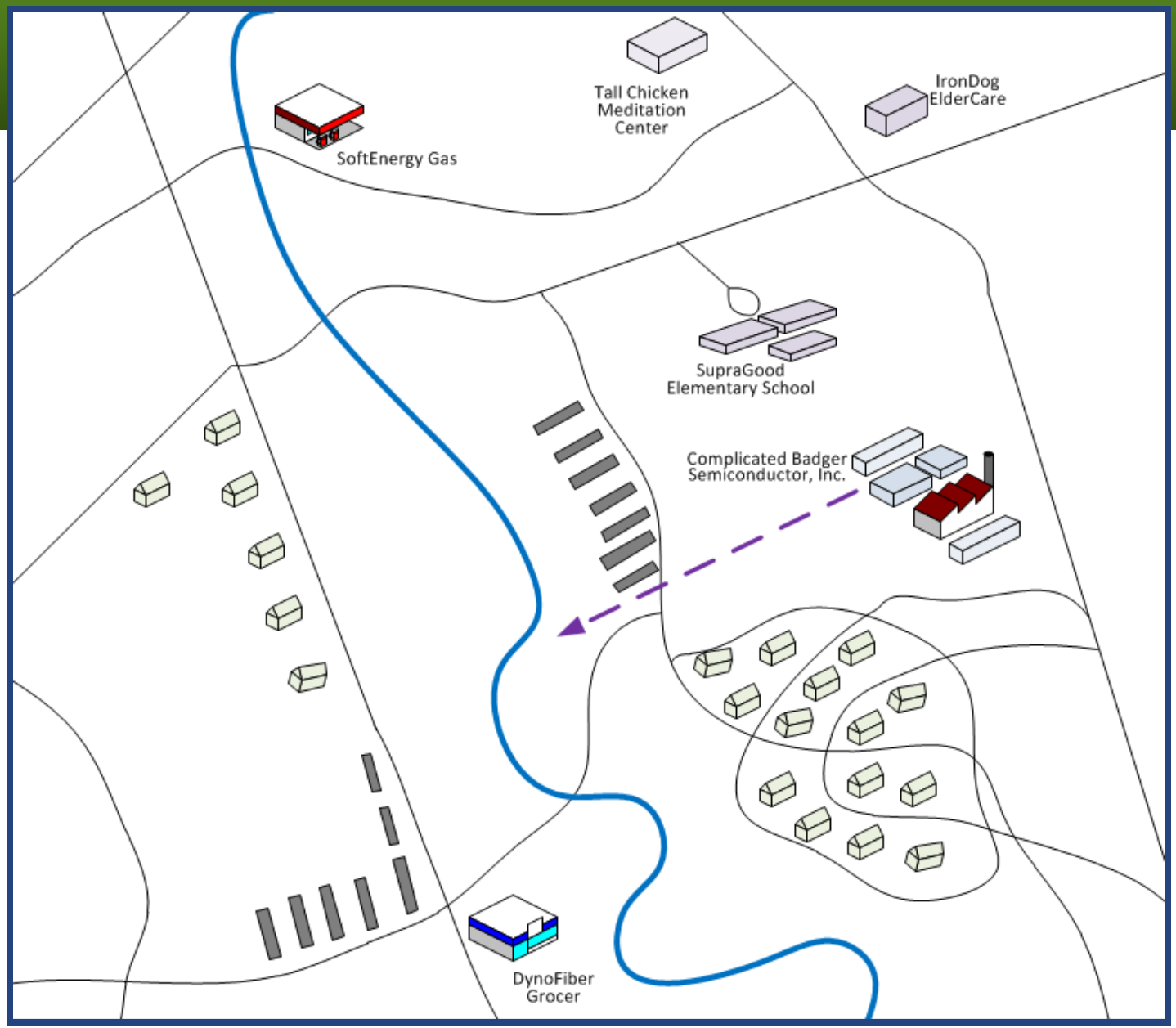
SsI-specific main drivers for determining further investigation are:

- A documented or potential release; probability for indoor exposure
- Extent of plume
- Eligible hazardous substances
  - Volatile hazardous substances
  - Substances documented in observed exposure or observed release
- **Targets**
  - Population density
  - Regularly occupied structures (residences, schools, daycare, cultural facilities, commercial structures)
  - Benchmark (source strength)

Example SsI Site – How it All Plays Out

- **Details about Site**
  - Semiconductor manufacturing facility present
  - Volatile hazardous substance (TCE) present in the surficial ground water
  - Regularly occupied structures present – elementary school, single-family homes, multi-tenant residential structures

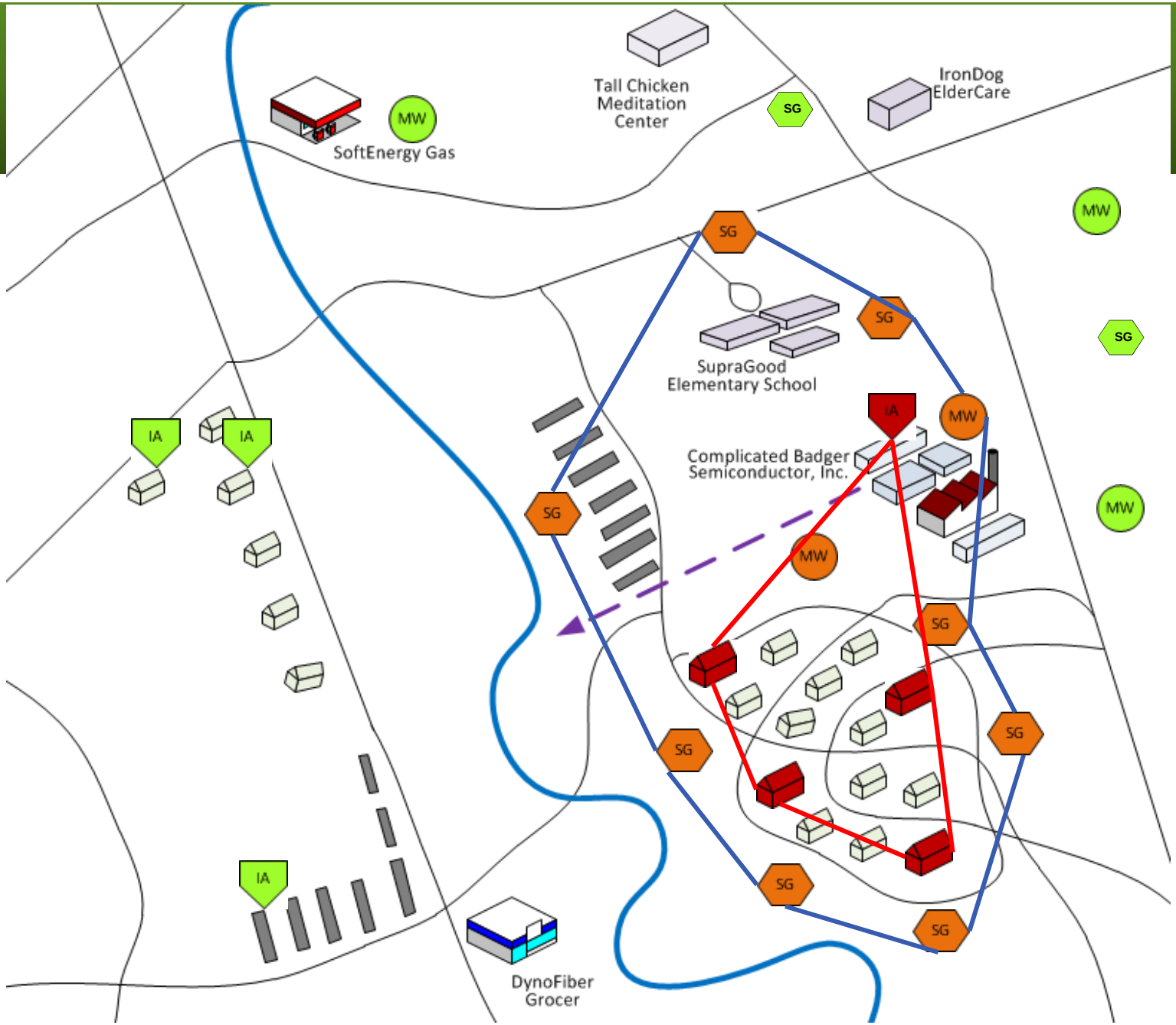
Example Site



Where's the Contamination?

- Area of Subsurface Contamination – Documented subsurface contamination meeting HRS observed release criteria present
  - Example site ASC delineated using ground water and soil gas samples containing TCE at levels meeting HRS observed release criteria

- Area of Observed Exposure – Documented indoor contamination meeting HRS observed exposure criteria present
  - Example site AOE delineated using indoor air samples containing TCE at levels meeting HRS observed exposure criteria


Tall Chicken
Meditation
Center
IronDog
ElderCare
SoftEnergy Gas
MW
SG
SupraGood
Elementary School
IA
Complicated Badger
Semiconductor, Inc.
DynoFiber
Grocer

How Bad, How Long?

- **Toxicity**
  - Assign a toxicity factor value to each eligible hazardous substance present in an ASC or AOE
  - Example site = TCE
- **Degradation**
  - Assign a degradation factor value to each eligible hazardous substance present in an ASC or AOE
  - Example site = factor value of 1 assigned due to TCE documented to be present in an observed exposure
- **Toxicity/Degradation**
  - Assign each substance a toxicity/degradation factor value
  - Use the hazardous substance with the highest toxicity/degradation factor value in scoring the site

How Much?

Hazardous Waste Quantity

- Based on amount of contamination in structures (not amount in subsurface)
- Uses the same four-tiered structure approach found in the 1990 HRS
- Evaluate each regularly occupied structure or regularly occupied subunit space present in the ASC and AOE
  - Minimum ceiling height per structure for Tier C (volume)
  - Minimum square footage per structure for Tier D (area)

How Much Do They Count?

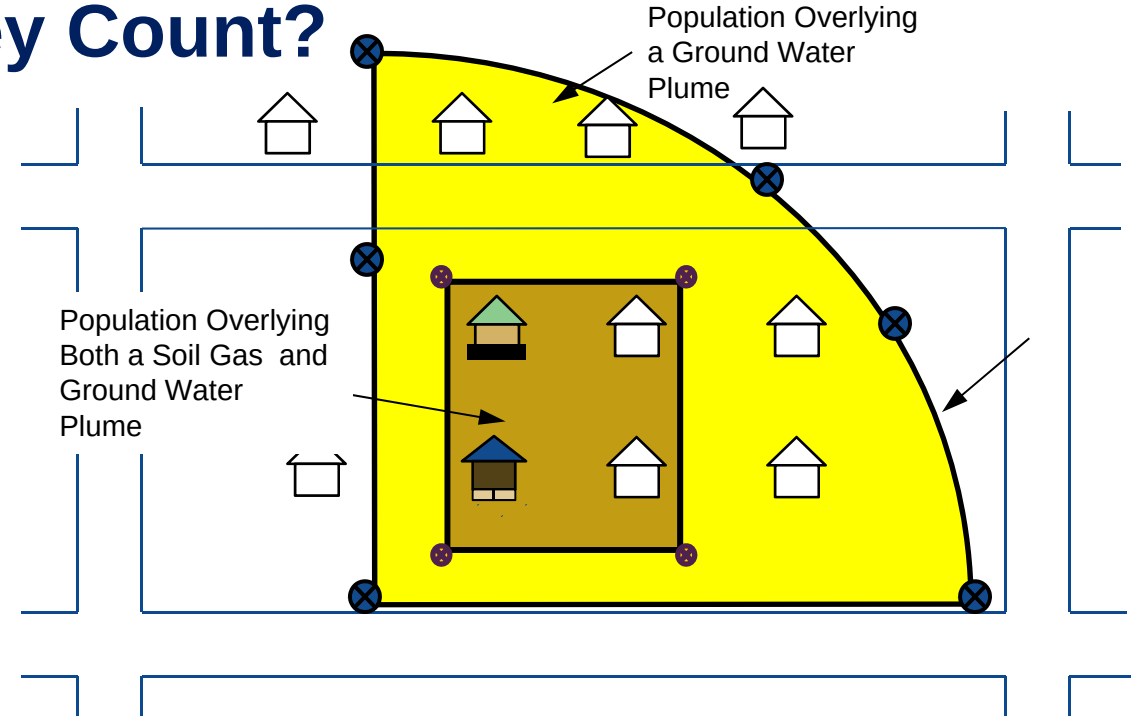
Ground Water Sample Collected from Depths of 5-30ft (BGS) Meeting Observed Release Criteria

Soil Gas Sample Collected from Depths of 5-30 ft (BGS) Meeting Observed Release Criteria

Contaminated Structure with Crawl Space Sample Meeting Observed Release Criteria

Contaminated Structure with Subslab Sample Meeting Observed Release Criteria

Unsampled Structure



Structure	Assigned Population Weighting Factor (Table 5-20)	Number of Homes	Population Value*
Contaminated Structure with a Crawl Space Sample Meeting Observed Release Criteria	0.9	1	2.34
Contaminated Structure with Subslab Sample Meeting Observed Release Criteria	0.4	1	1.04
Unsampled Structure Overlying a Soil Gas Plume Greater than Five Feet from Structure that Meets Observed Release Criteria	0.2	2	1.04
Unsampled Structure Overlying a Surficial Ground Water Plume Greater than Five Feet from Structure that Meets Observed Release Criteria	0.1	4	1.04
Population Value on an Area of Subsurface Contamination			**5.46**

* Assumes a County Average of 2.6 People Per Home

Count the Who

- **Consistent with All HRS Pathways**
- **Actually Exposed Targets**
  - Exposed individual
  - Level I population (exceeding health-based benchmarks)
    - Count exposed individuals present in eligible structure or subunit space
    - Sum eligible individuals and apply a weighting factor of 10
  - Level II population (below a benchmark and inferred contamination)
    - Count exposed individuals present in eligible structure or subunit space
    - Sum eligible individuals and apply a weighting factor of 1
- **Potential Targets**
  - Count exposed individuals present in eligible structure or subunit space
  - Estimate the depth/distance to contamination at each regularly occupied structure
  - Weight the population present in each structure according to HRS Table 5-20

For More Information

EPA Subsurface Intrusion Website

https://www.epa.gov/superfund/hrs-subsurface-intrusion

Rule Contacts

Workgroup Chair	Terry Jeng (HQ's)	jeng.terry@epa.gov
Co-Chair/Technical Lead	Brenda Cook (Region 6)	cook.brenda@epa.gov
Economic Analysis/HRS Expert	Jennifer Wendel (HQ's)	wendel.jennifer@epa.gov
Senior HRS Expert	Lorie Baker (Region 3)	baker.lorie@epa.gov

A special thanks to CSRA for providing contract support.