

VAPOR INTRUSION GUIDANCE: GROUND WATER INVESTIGATION



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November 1, 2005



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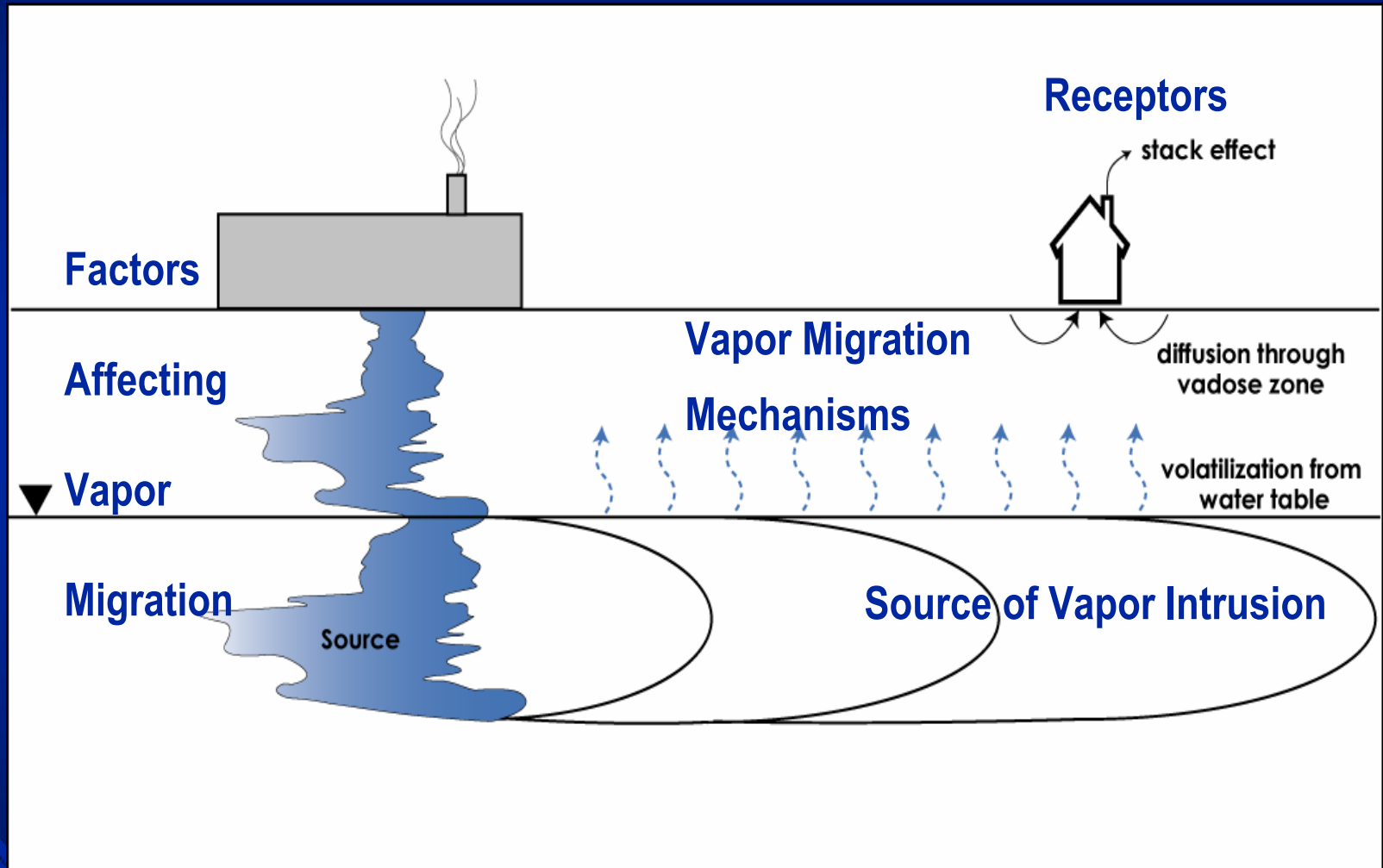


NJDEP Vapor Intrusion Guidance Document (2005)

- ☒ Conceptual Site Model
- ☒ Development of Screening Levels
- ☒ Investigative Procedures
- ☒ Petroleum Hydrocarbons & Biodegradation
- ☒ Background Indoor Air Contamination
- ☒ Data Interpretation
- ☒ Community Outreach
- ☒ Remedial Action



CSM - Issues to Be Considered



GW Investigation & Sampling Procedures (Section 6.2)

- ◆ Saturated Zone Features Affecting Vapor Intrusion
- ◆ Use of Pre-Existing Ground Water (GW) Data
- ◆ Obtaining New Ground Water Data to Evaluate the Vapor Intrusion Pathway



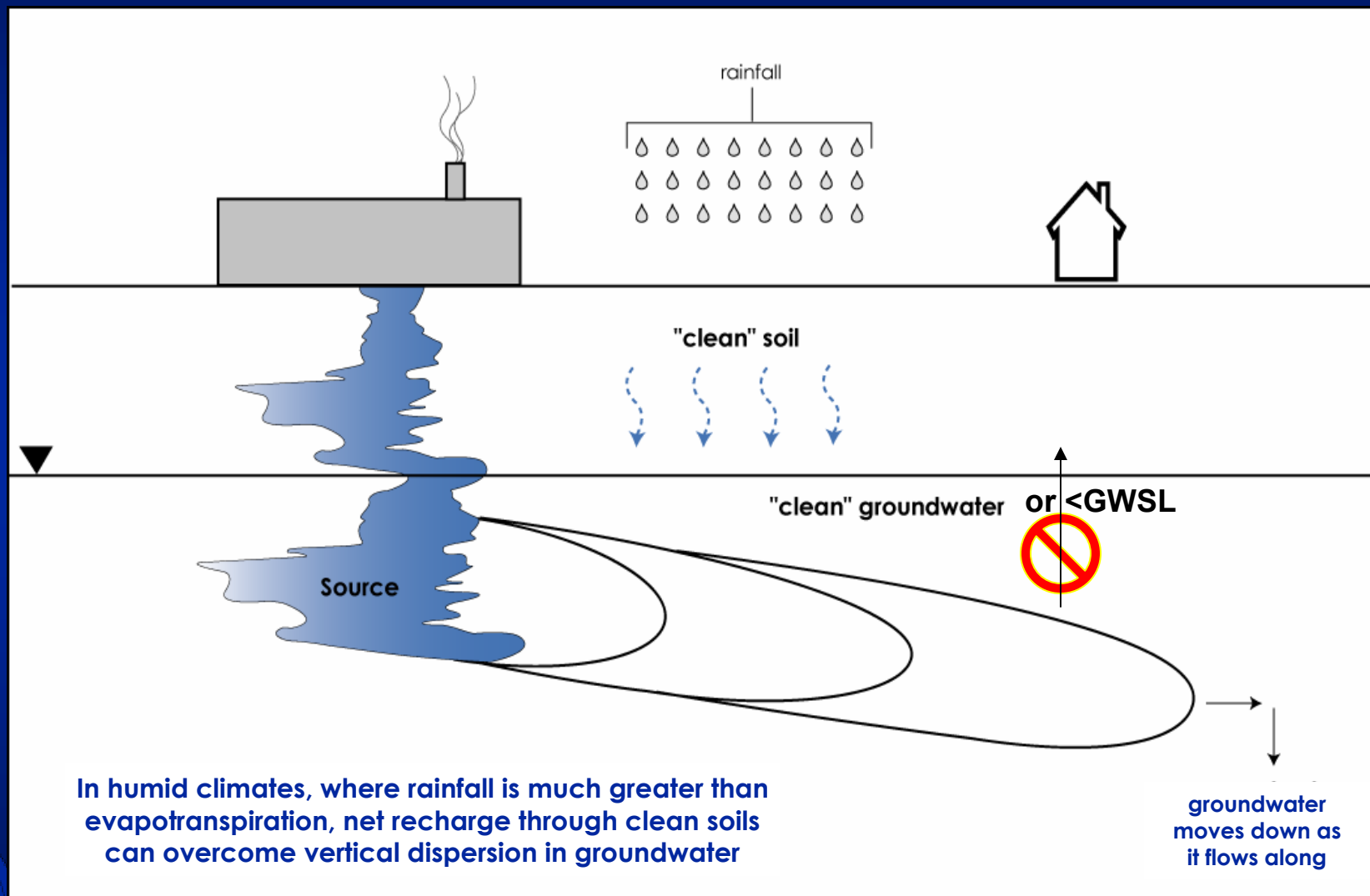
Saturated Zone Features Affecting VI

(Section 6.2.1)

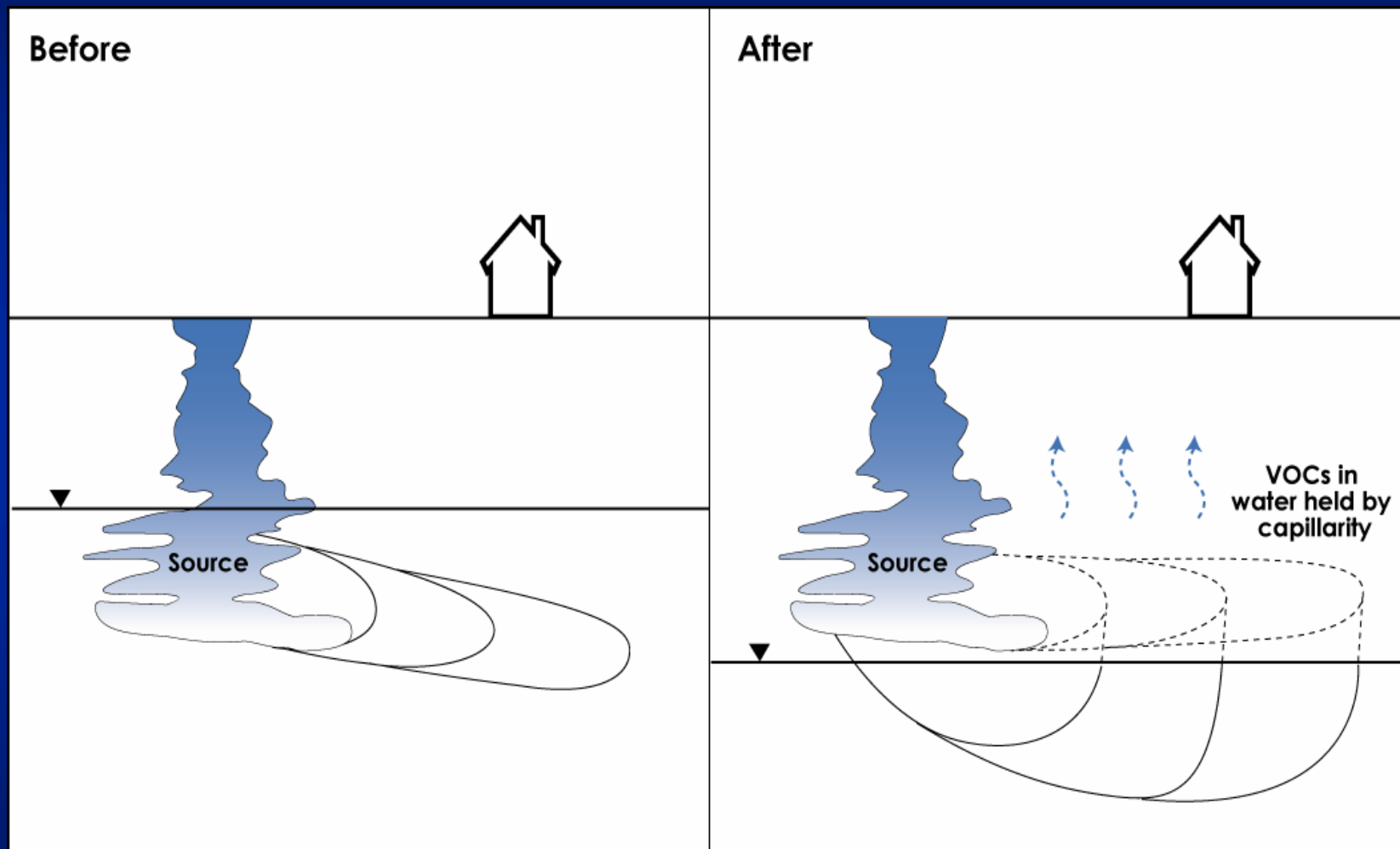
- ◆ Clean Water Lens
- ◆ Depth to Saturated Zone and Stratigraphy
- ◆ Fluctuations in Depth to Saturated Zone
- ◆ Complex Hydrogeologic Settings
- ◆ Proximity to Preferential Pathways
- ◆ Potential for Contaminant Degradation



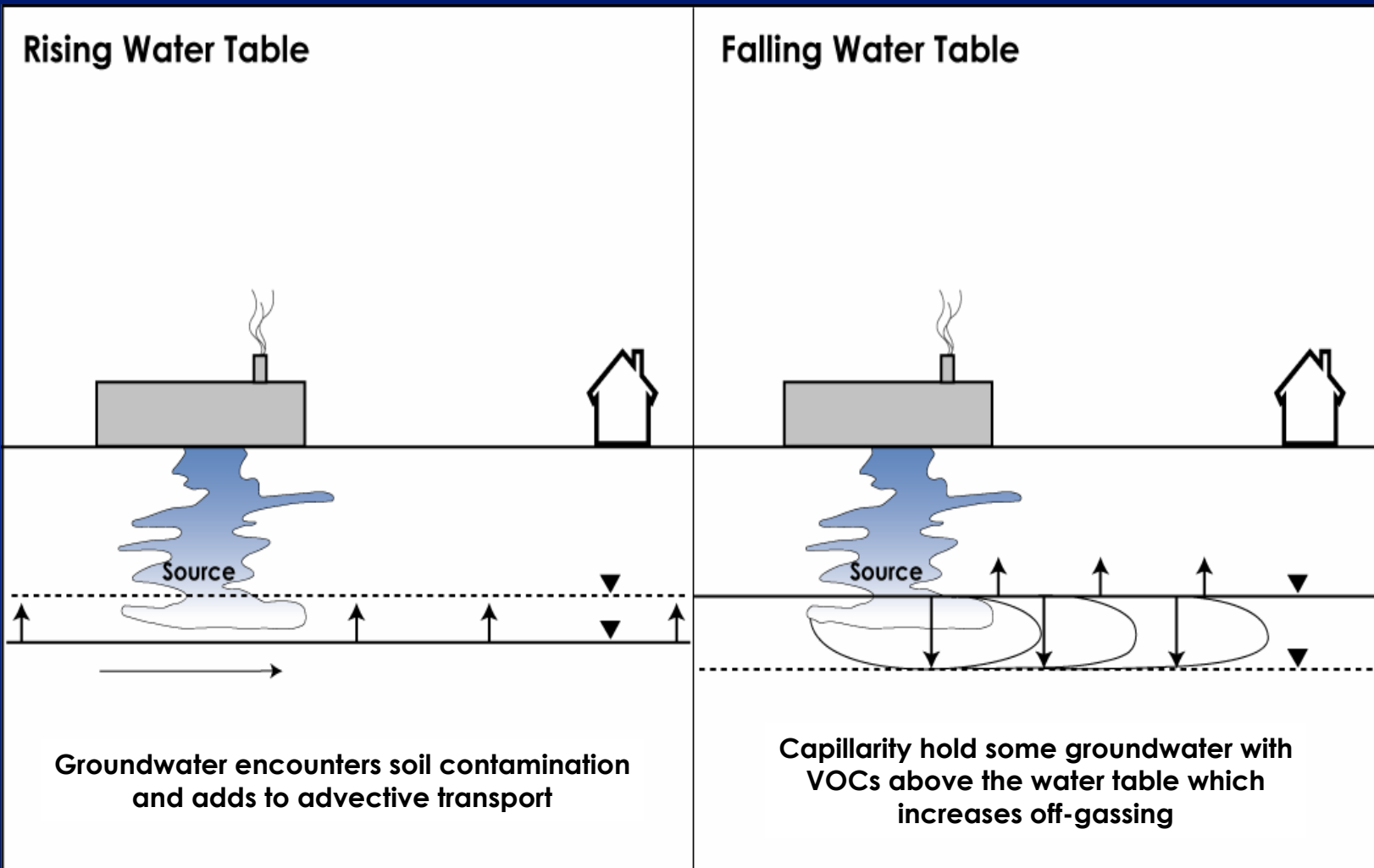
Clean Water Lens



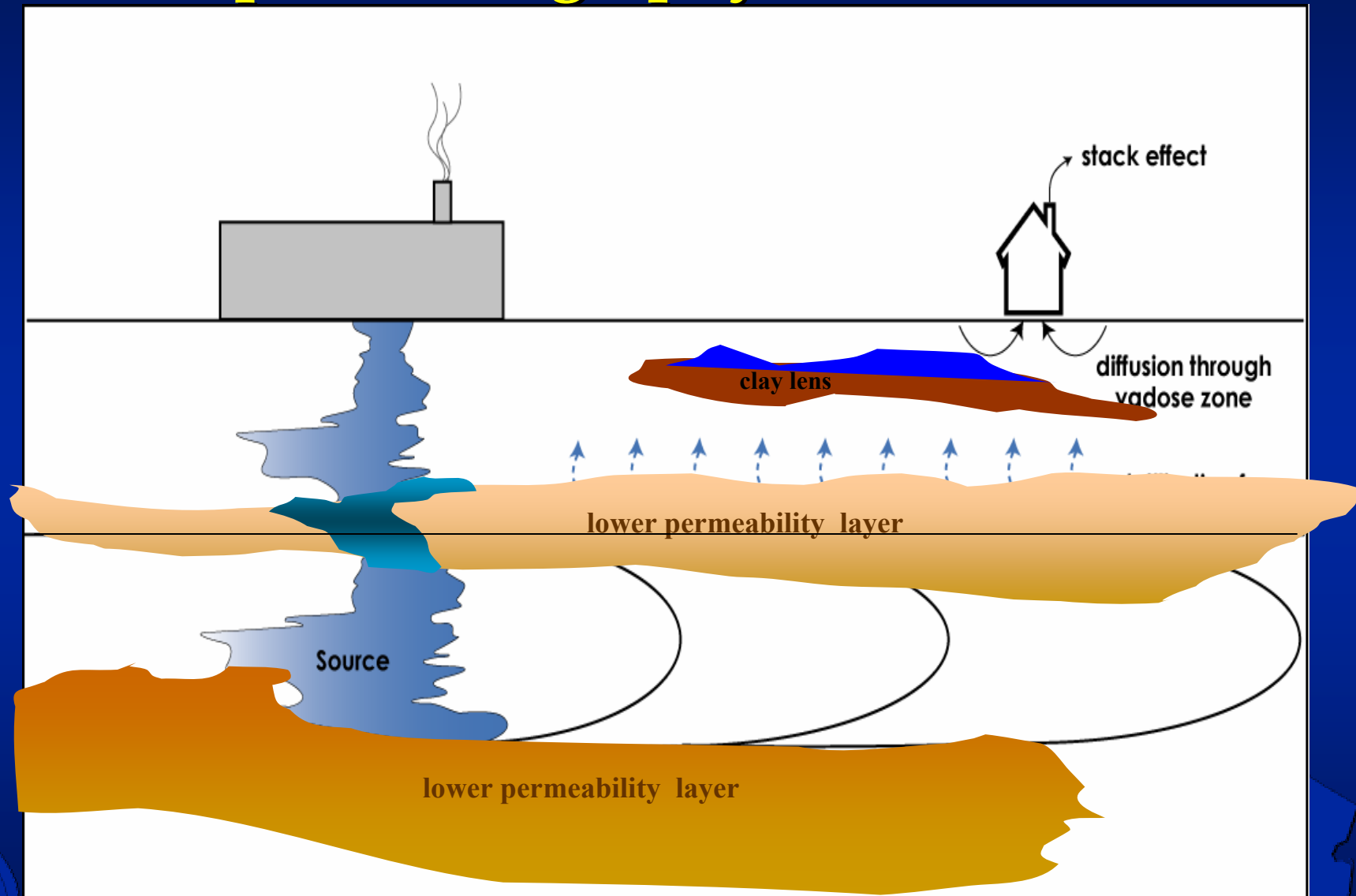
Falling Water Table



Water Table Fluctuations



Complex Stratigraphy



Application of GWSL

(Section 4.2.1)

GWSL should not be used if, at time of sampling:

- ◆ Water table (WT) is < 2 feet below building foundation
- ◆ WT is at 2 ft. below foundation *AND*:
 - 1 seasonal high WT reaches foundation
 - 2 WT is in fill directly under building, or
 - 3 if no fill, top of capillary fringe expected to reach foundation.

⇒ For 3rd scenario, can field determine soil texture and use Table 4-1 to predict capillary fringe height



Application of GWSL (continued)

(Section 4.2.1)

GWSL should not be used if:

- ◆ first water is in massive, competent bedrock with very discrete fractured zones *AND*
- ◆ the building foundation is directly on bedrock (no fill is in between)



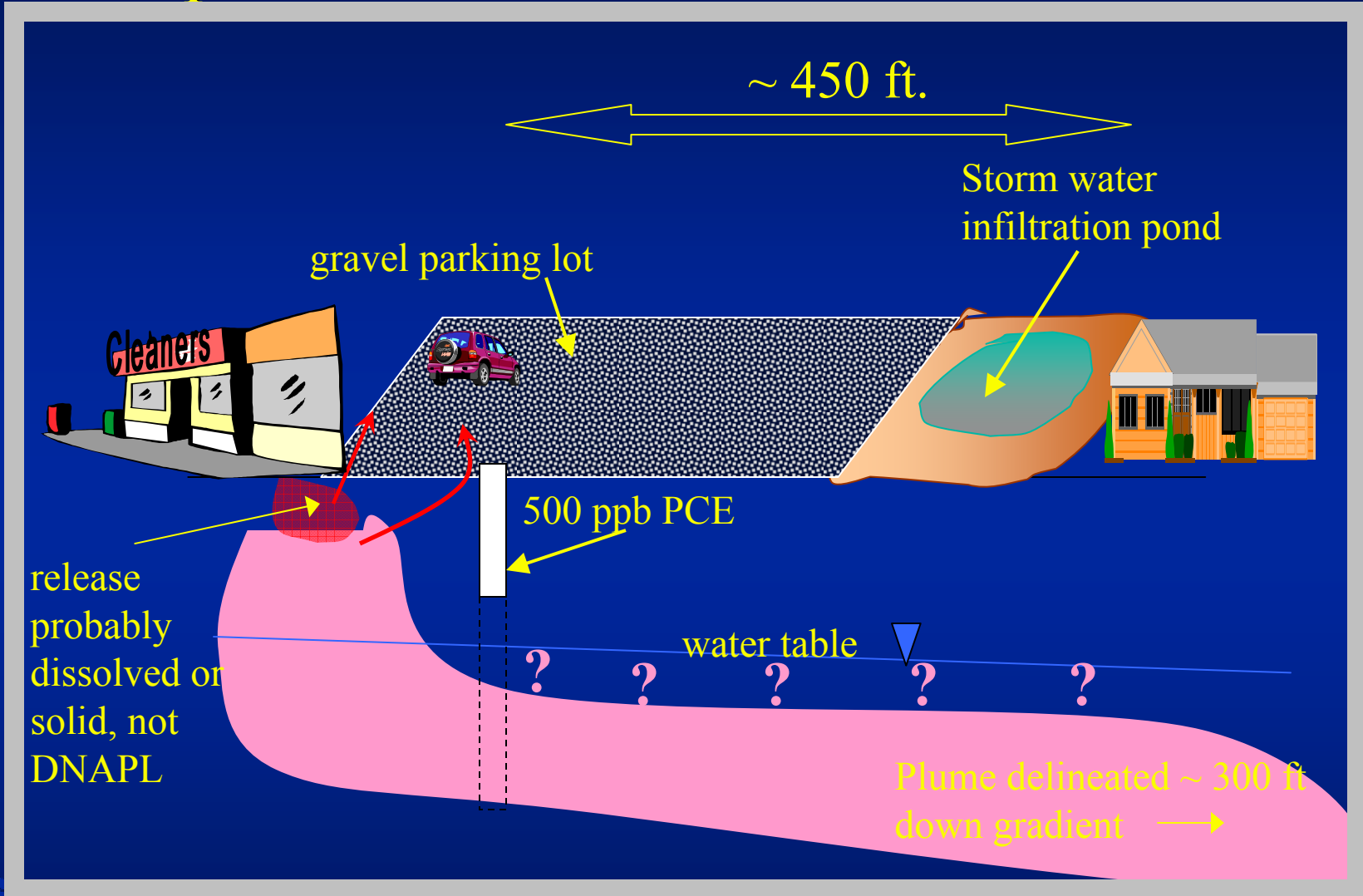
Use of Pre-Existing Ground Water Data

(Section 6.2.2)

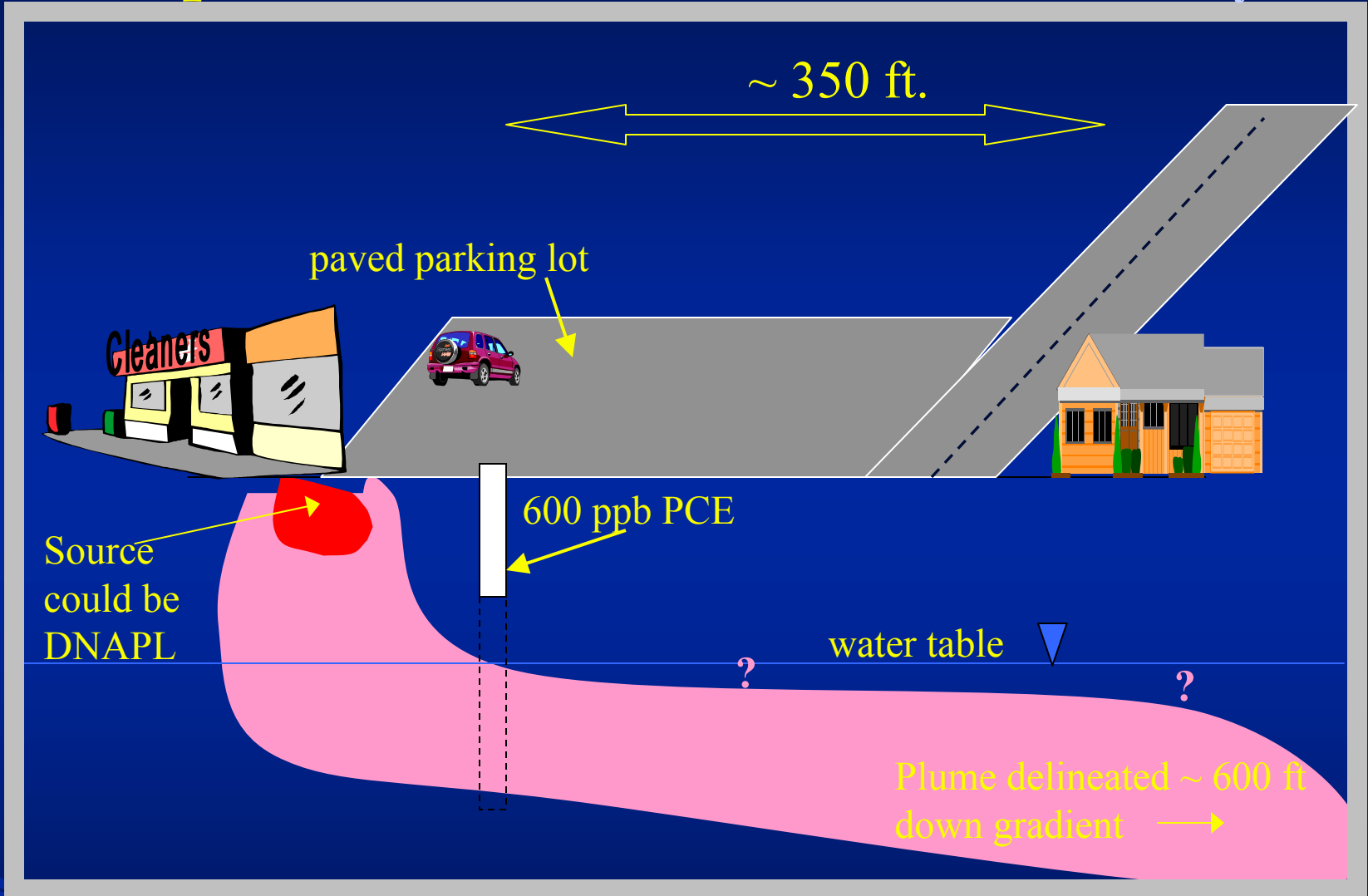
- ◆ Consider site specific CSM issues
 - Clean water lens likely below receptors ?
 - Concentration and type of VOCs present ?
 - Existing data points near enough to receptors ?
 - Soil/geology suggests soil gas sampling next?
- ◆ Are data from water table wells with water column thickness (vertically) of about 10 ft. or less?
- ◆ What sampling method was used?



Example 1 - Collect new ground water data? Yes.



Example 2 - Collect new ground water data? **Probably not.**



Obtaining New Ground Water Data

(Section 6.2.3)

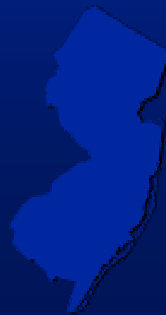
Main Objective - sample interval close to the water table

- ◆ Ground Water (GW) Sampling Location
- ◆ Sampling Depth Intervals
- ◆ Direct Push and Alternative GW Sampling Methods
- ◆ Monitoring Well Sampling Methods
- ◆ Installation of New Monitor Wells
- ◆ Ongoing GW Monitoring



Ground Water Sampling Location

- ◆ as close as possible to structures due to:
 - 30 ft. & 100 ft. distance criteria
 - non-isotropic distribution & heterogeneity
 - ✦ steep concentration gradient, horizontally (especially if side gradient) or vertically
 - ✦ buried stream channels, highly fractured zones, etc.
- ◆ consider changes in surface cover/infiltration in choosing locations



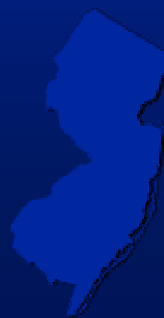
Sampling Depth Intervals

- ◆ Existing wells:
 - Screened across water table (WT)
 - Vertical thickness of water column in well ~10 ft. or less
- ◆ New WT wells - 5 to 10 ft. screen (unless ...)
- ◆ Perched zones - sample if possible
- ◆ Vertical profile - possible “exit ramp”
 - May be warranted if clean water lens, use SS option, or use discrete interval sampling methods
 - At least two samples in **0 to 6 ft.** interval below WT (bwt)
 - If expect drop in WT, one sample from **6 to 10 ft.** bwt
- ◆ Profile in at least one boring or well

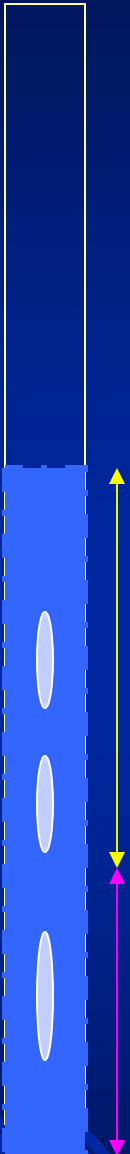


Direct Push Technology & Alternative ...

- ◆ DPT OK instead of wells for evaluating VI
- ◆ good for vertical profiling, can get discrete interval sample from defined depth
- ◆ rapid sampling in multiple locations horizontally
- ◆ sample intervals? 0-3 & 3-6 ft bwt
 - also one sample from 6 to 10 ft. bwt if WT likely to drop by ~4 ft. or more
- ◆ accurately map & document sampling locations
- ◆ mark boring locations in field if possible



Monitoring Well Sampling Methods for VI

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- The diagram shows a vertical monitoring well. A blue shaded region represents the water column. A yellow double-headed arrow indicates a sampling interval from the top of the water column down to a point labeled '6 ft. bwt'. A pink double-headed arrow indicates a sampling interval from the '6 ft. bwt' point down to a point labeled '10 ft. bwt'. The well is shown with three white oval shapes representing sampling bags or filters.
- ◆ PDBS: use 2005 FSPM (but alter as *indicated below*)
 - not for MTBE, acetone, styrene, MIBK
 - bag length ~20 inches
 - *two, potentially three, bags in 0 to 6 ft. interval bwt*
 - *one bag in central portion of 6 to 10 ft. bwt*
 - ◆ LFPS: if water column > 10 ft. not recommended
 - can differ from FSPM if data quality objective (DQO) VI only
 - ✦ set pump intake at ~1.5 to 2 ft. bwt
 - ✦ purge 2x sampling array volume (tubing & pumps only)
 - ◆ Other discrete interval well sampling methods
 - ◆ Volume-averaged purge & sample? Not for new data



Installation of New Monitor Wells

- ◆ Short screens, preferably 5 ft., but up to 15 ft OK if place so water column is about 10 ft.
 - Longer screen if: long term monitoring; large WT fluctuation likely; and/or multiple DQOs
- ◆ If water table in transition zone between overburden and bedrock, deviation request needed
- ◆ If first water in bedrock but shallow bedrock is highly fractured/weathered, wells OK for VI
- ◆ If first water in massive, competent bedrock with discrete fractured zones, wells probably not most reliable indicator of VI risk (soil gas...)



Ongoing Ground Water Monitoring

- ◆ Initial VI investigation may indicate longer term monitoring needed to evaluate changes in conditions that can change VI risk
 - If plume hasn't reached receptors but CSM says it could
 - If vertical profiling indicated VOC could off-gas to vadose zone if water table drops slightly
 - If implementing a remedial action may change conditions affecting VI pathway
- ◆ Wells probably best but could use DPT if vertical profiling important & frequency can be low
- ◆ Include ongoing evaluation of VI in RAW



Ground Water Data Interpretation

(Section 7.2)



If exceed GWSL, further investigation needed:

- ◆ evaluate CSM and data specifics to decide on next step
- ◆ further GW delineation horizontally or vertically
- ◆ monitor GW to evaluate changes over time
 - can statistically analyze data if exceedances are minor and sporadic
- ◆ soil gas investigation could be next step
- ◆ in some situations may also immediately initiate indoor air sampling



GW Data Interpretation (continued)

(Section 7.3)



Guidelines for interpreting vertical profile data:

- ◆ If no vertical changes update CSM & continue RI
- ◆ $> \text{ or } = 6 \text{ ft.}$ thick clean water or $< \text{GWSL}$ lens
 - If exists all year, no more VI RI. If not likely to persist, include monitoring or general reevaluation in RAW.
- ◆ 3 to 6 ft. thick $< \text{GWSL}$ lens
 - If exists all year, VI risk low but do ongoing GW monitoring
 - if not persistent, more VI RI & ongoing monitoring
- ◆ $< 3 \text{ ft.}$ thick lens
 - more VI RI needed (probably soil gas sampling), more rigorous monitoring requirements in RAW

