



**Tighe&Bond**

**Quality Site Assessments & Investigations  
Using the  
Conceptual Site Model Approach**



# PART I: WHAT IS A QUALITY SITE ASSESSMENT

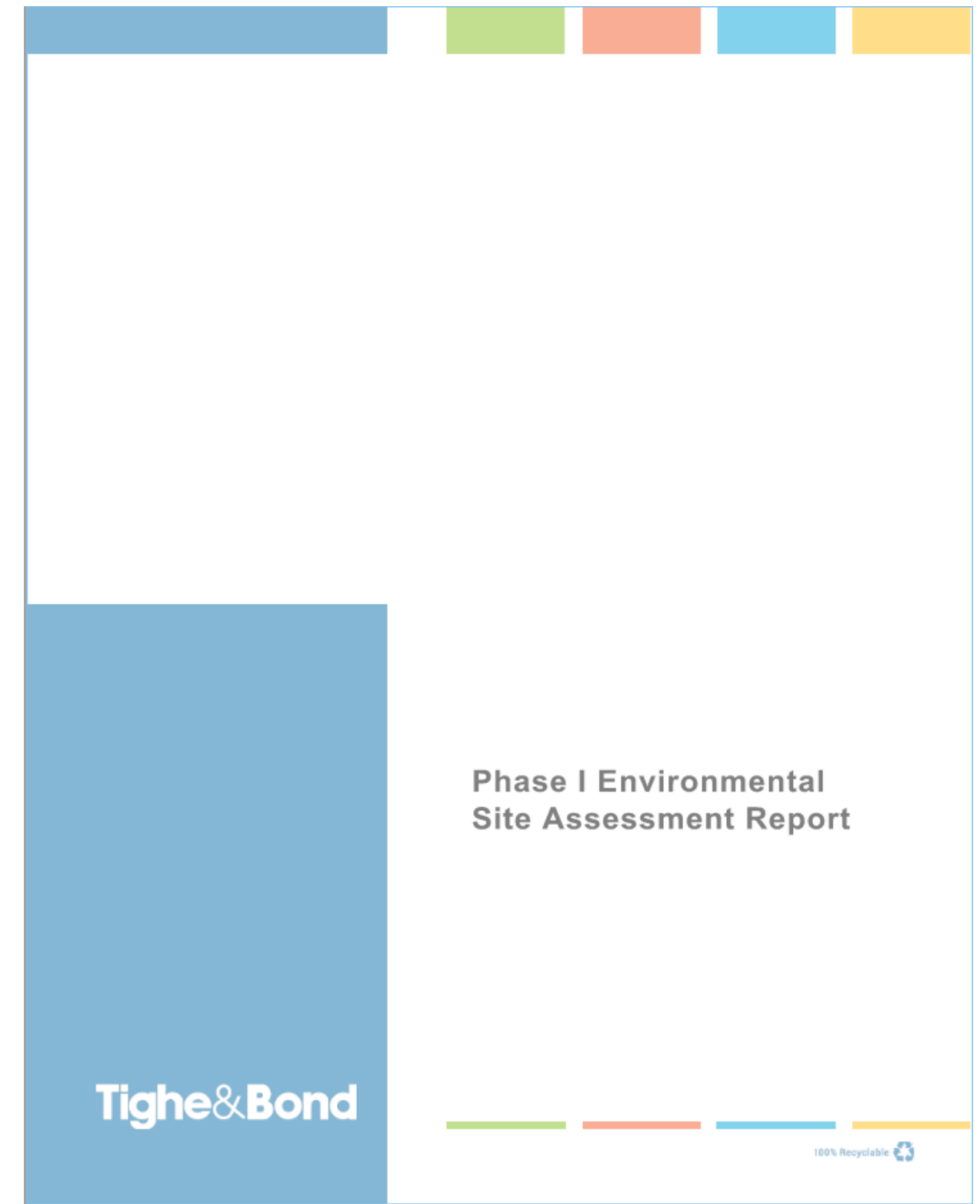
## Using the Conceptual Site Model (CSM) Approach

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# INTRODUCTION

- **ASTM and State Standards**
  - ASTM E1527-21
  - Connecticut Department of Energy and Environmental Management (CTDEEP)
    - *Site Characterization Guidance Document (SCGD)*
  - Rhode Island Department of Environmental Management (RIDEM)
    - *Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (**the Remediation Regulations**) 250-RICR-140-30-1*
- **Sources of Information**
- **Information to include/exclude**
- **Developing the initial CSM**
- **Contaminants**
- **Fate & Transport**
- **Exposure**





# THE CONCEPTUAL SITE MODEL

## Definition

# CONCEPTUAL SITE MODEL (CSM)

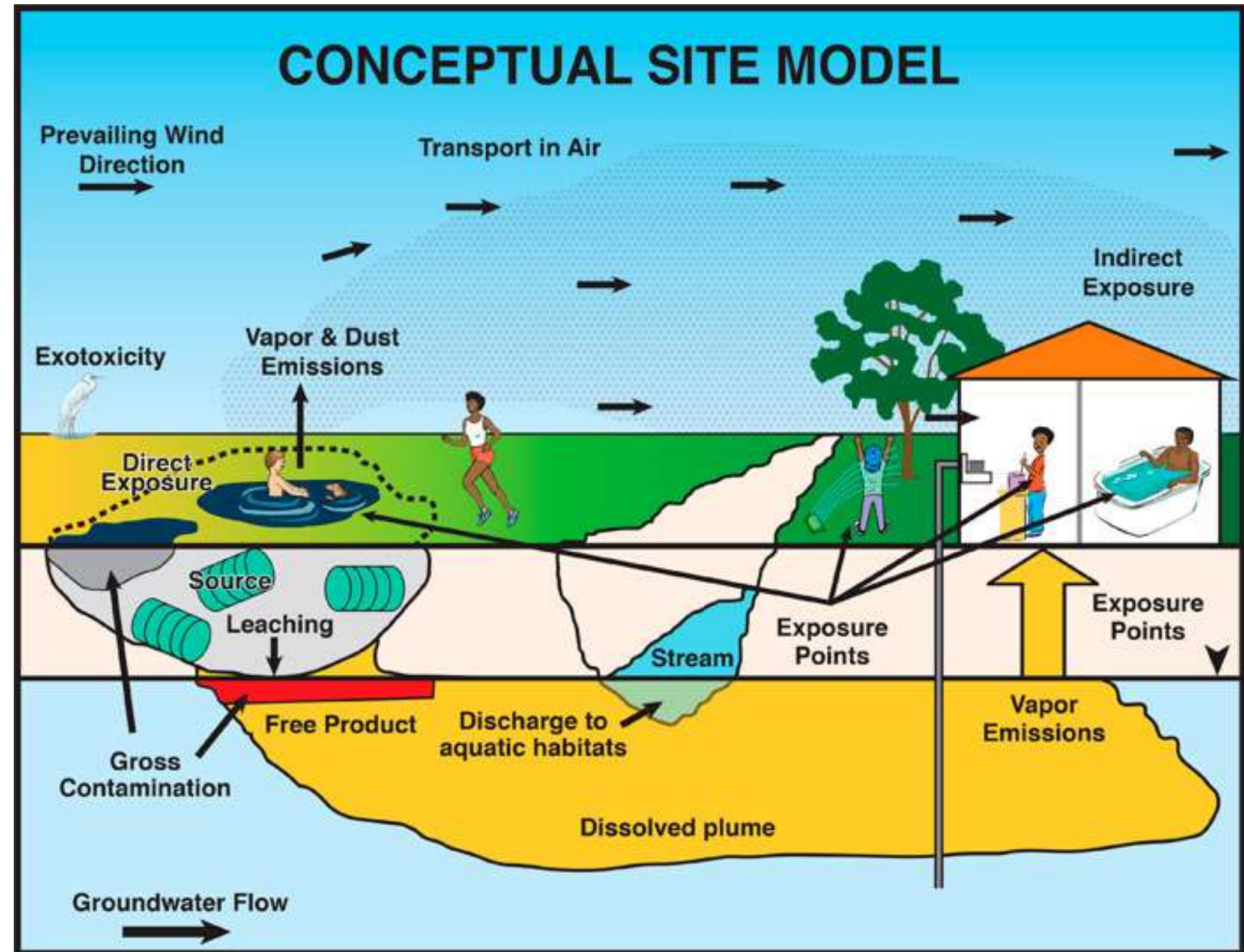
## EPA

“The Conceptual Site Model (CSM) is an iterative, ‘living representation’ of a site that summarizes and helps project teams visualize and understand available information”

- Temporal (time-related)
- Iterative
- Living Model
- Guides assessment
- Informs cleanup objectives
- Exposure pathways

A CSM is continually “redeveloped” using:

- Known Information
- Hypothesized Information



Source: Interstate Technology Regulatory Counsel (ITRC) *TPH Risk Evaluation at Petroleum-Contaminated Sites*



# PHASE I CONTENT

ASTM Phase I, CTDEEP Phase I and RIDEM Site Investigation Report (SIR)

# PHASE I COMPARISONS

## ASTM Phase I ESA is conducted for Real Property Transactions

**Objective:** To identify the confirmed presence, likely presence, or material threat of the presence of hazardous substances or petroleum products at a real property, also known as a Recognized Environmental Condition (REC).

- Prior to property acquisition/refinancing
- Satisfies EPA All Appropriate Inquiry (AAI) and Innocent Landowner Defense
- Gathers “soft” information on Site characteristics (no intrusive work)
- CSM not specifically mentioned, but lays the groundwork to start developing a CSM

## CTDEEP Phase I Environmental Site Assessment:

- CTDEEP Site Characterization Guidance Document (SCGD)
- **Objective:** Evaluate the current and historical uses of a site, and the activities that have been conducted at a site, for the purpose of identifying all **areas of concern (AOCs)** at which a release to the environment has the potential to have occurred.

## RIDEM Site Investigation Report (SIR): Following a release

- RI is **NOT** a privatized system (no LSP/LEP). RIDEM approvals for SI through Closure.
- Remediation Regulations (250-RICR-140-30-1.8)
- **Objective:** Section 1.8.1(B): Determine the nature and extent of the Contaminated Site and the actual and potential impacts of the Release. SIR shall summarize the investigation and include remedial alternatives analysis protective of human health and environment.

# CTDEEP PHASE I ENVIRONMENTAL SITE ASSESSMENTS

## CTDEEP Site Characterization Guidance Document (SCGD)

- SCGD is a Guidance Document and **not** a regulation
- CTDEEP Policy for Phase I ESAs to follow SCGD
- SCGD also provides CSM guidance
- Definition of AOC
  - “The location(s) or area(s) at a property where hazardous waste and or hazardous substances (including petroleum products) have been or may have been used, stored, treated, handled, disposed, spilled, and/or released to the environment.”



# PHASE I CONCEPTS

## CT DEEP Site Characterization Guidance Document (cont'd)

### AOCs Examples



# PHASE I CONCEPTS

## CT DEEP Site Characterization Guidance Document (cont'd)

### AOCs Examples



# PHASE I CONCEPTS

## Connecticut Property Transfer Law (aka Property Transfer Act)

### Connecticut General Statutes (CGS) 22a-134

#### ➤ Applies to Transfer of an Establishment

#### 1. Establishment

- Property or business:

- Dry cleaning, Furniture stripping, Vehicle body repair > May 1, 1967

- OR -

- Hazardous waste generator of > 100 kilogram/month on or after 11/18/1980

- OR -

- Property or business where hazardous waste was recycled, reclaimed, reused, stored, handled, treated, transported or disposed of

#### 2. Transfer

- In general, an Establishment undergoing a change in ownership

# ASTM PHASE I ESA

## Scope:

- Site reconnaissance
- Review historical information
- Interviews (User Questionnaire)
- Review online data sources
  - CTDEEP Online Search Portal
  - RIDEM Environmental Resource Management (ERM) Online Portal
- Review Federal, State, and local files
- Findings, Opinion, Conclusion
  - **Recognized Environmental Conditions (RECs)**
    - Due to a release, conditions indicative of a release, or material threat of future release
  - **Historical RECs (HRECs)**
    - A past release that has been addressed to the satisfaction of the applicable regulatory authority or meeting unrestricted use by a regulatory authority, without subjecting the property to any required controls.
  - **Controlled RECs (CRECs)**
    - A REC resulting from a past release that has been addressed to the satisfaction of the applicable regulatory authority

## RECOGNIZED ENVIRONMENTAL CONDITIONS



Releases from underground storage tank (UST) system



Contamination migrating from off-site properties



Releases to floor drains



Leaks from oil filled equipment



Leaks from chemical storage areas or hydraulic systems



Indications of oil and/or hazardous material being released at the Site



Stressed vegetation

# ASTM PHASE I ESA

## Scope:

RECs/AOCs Examples



# ASTM PHASE I ESA

## Scope:

RECs/AOCs Examples



# CTDEEP PHASE I ENVIRONMENTAL SITE ASSESSMENT

## What to include

- **CTDEEP Site Characterization Guidance Document (SCGD), Section 3**
  - Purpose
  - Site Description
  - Site History
  - File Reviews (Federal, State and Local)
  - Review of Previous Assessments
  - Environmental Setting
    - Physical
    - Cultural
  - Site Reconnaissance Survey
  - Documentation of Findings and Preliminary Conceptual Site Model
    - Areas of Concern (AOCs) and potential RECs
    - List Both in Phase I ESA
      - ❑ Not All AOCs are RECs

# RIDEM SITE INVESTIGATION REPORT (SIR)

## What to include

- **Remediation Regulations Sections 1.8.3, 1.8.4 and 1.8.5**
  - Site Investigation objectives
  - Background information and release summary
  - Site History
  - Summary of environmental investigation and concentration gradients
  - Nature and extent of contamination
  - Environmental resources (on and off site)
  - Maps and Site Plans
  - Proposed property use/remedial objectives
  - Presentation of 3 Remedial Alternatives (minimum)
    - Including no action/natural attenuation
  - Data Quality Assurance/Quality Control (QA/QC)
  - Certification by Responsible Party and Person preparing SIR





# DEVELOPING THE CONCEPTUAL SITE MODEL

Using the “Phase I” Process

# CONCEPTUAL SITE MODEL (CSM)

## CTDEEP SCGD Section 2 Conceptual Site Modeling

- A representation of an environmental system;
- Used as a tool to understand the rationale for site investigation; and
- Serves as a basis for effective site characterizations

## CSM Approach Key Elements

- Define purpose of investigation
- Develop from available information
- Refine based on new information
- Identify and resolve significant data gaps
- Identify unresolved or new significant data gaps

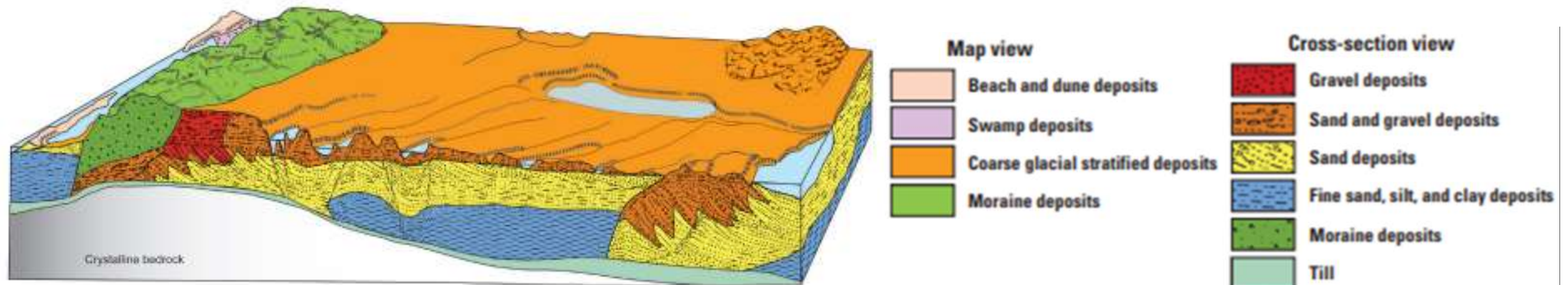
## Continue CSM Process Until Able to Validate

## Document CSM to Demonstrate Site Understanding

# CONCEPTUAL SITE MODEL (CSM)

## Sources of Information

- Establish general use of the property and adjacent property uses
- Population density and human receptors (environmental justice)
- Sensitive environmental receptors (CT ECO)
- Site geology
- Topography
- Hydrogeology

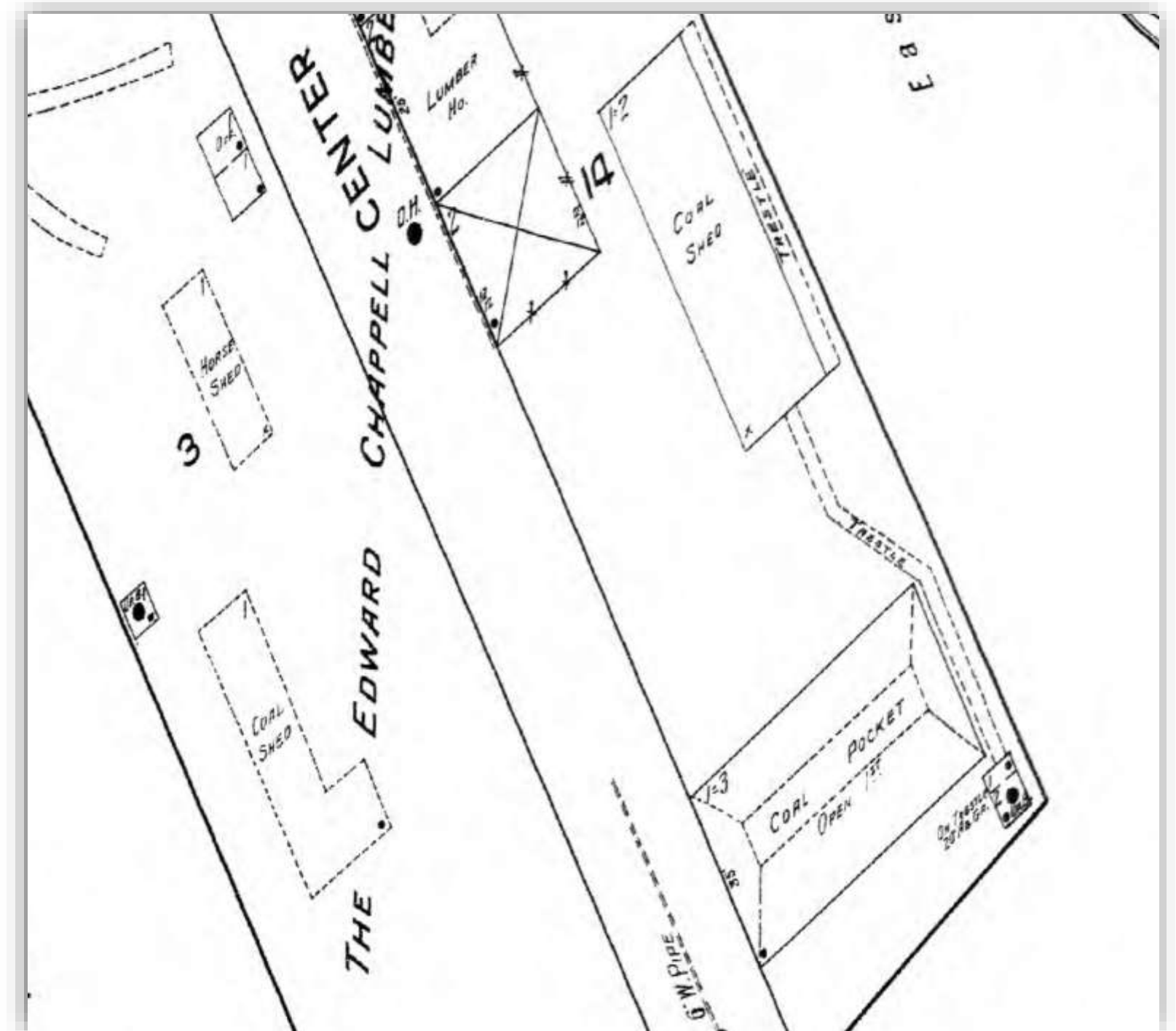


Source: USGS *Surficial Geologic Map of the Heath-Northfield-Southwick-Hampden 24-Quadrangle Area in the Connecticut Valley Region, West-Central Massachusetts* (Janet R. Stone and Mary L. DiGiacomo-Cohen)

# CONCEPTUAL SITE MODEL (CSM)

## Sources of Information

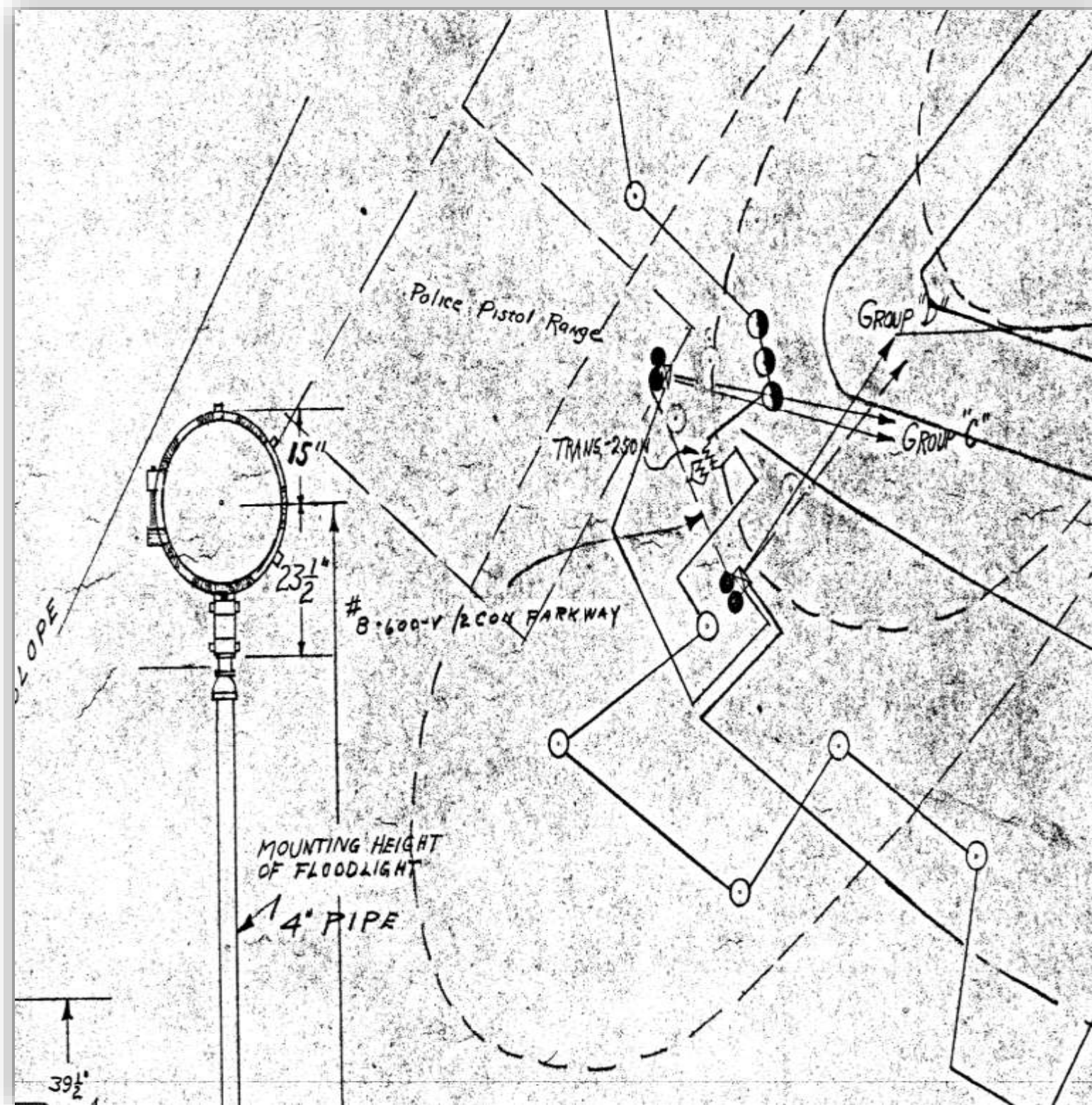
- State Records
  - CTDEEP: Public File Room; Online Search Portal; Online Manifest Portal
  - RIDEM: File Review Request; Online Data & Map Search; ePlover Online Enviro Site Search
  - State Library
  - Historical Societies
- Local Records
  - Municipal Departments
  - Local Libraries
  - Property Owner
- Historical Records/Database Search Company
  - Aerial Photographs
  - Topographic Maps
  - City Directories
  - Sanborn Fire Insurance Maps



Source: The Sanborn Library, LLC

# CONCEPTUAL SITE MODEL (CSM)

## Sources of Information



Source: 1936 Lighting Plan – Planning and Zoning Department

B) Prior to the November 19, 1980 Implementation of RCRA Where; when; what type; Amount; Frequency; How long; and by Who (Transporters, Facilities, Etc.) were wastes disposed of Off-site: \_\_\_\_\_

EVERYTHING WENT TO DUMP PRIOR TO 1980.  
BLACK OXIDE CAKES TO DUMP PRIOR TO 1980.

C) Is there any evidence of On-site disposal?  No,  Yes.

Give Approximate Location; Type; Amount/Frequency; Length of Time On-site disposal has been used, etc. (Specify any historical On-site disposal): \_\_\_\_\_

HAD SEPTIC SYSTEM UNTIL 1973 WHEN HOOKED TO CITY. ALL RINSES FROM MIXING AND CLEANING LINES MUST HAVE GONE TO SEPTIC.

IV RECORDS

262.11/  
25-54cc(c)-  
2(a)(3)(A)-7.

aa) Hazardous Waste Determination

NEEDS FOR THE FLOOR SWEEPINGS

Source: 1983 Hazardous Waste Inspection – CTDEEP Public File Room

# RECORDS REVIEW

## Private Records - Current and Historical Records

- Past site assessments
- Facility as-built drawings, stormwater pollution prevention (SWPP) plans
- Safety Data Sheets (SDS) indicating use of hazardous substances on the property
- Waste handling records (SQG, LGQ)
- Process diagrams/schematics
- Engineering controls

## Public Records - Current and Historical

- Ownership records
- Newspaper articles, local history
- Municipal records

## Cross-Reference as Much as Possible!

- Use multiple records to confirm/bolster CSM hypotheses



# CONCEPTUAL SITE MODEL (CSM)

## Sources of Information



# CONCEPTUAL SITE MODEL (CSM)

## Sources of Information

### – Site Reconnaissance

- Current property use
- Construction of the property
- Former structures
- Heating sources
- Underground/aboveground storage tanks (USTs/ASTs)
- Air emission sources
- Hazardous substances
- Petroleum products
- Bulk chemical storage
- Unlabeled suspect containers
- Equipment that may contain polychlorinated biphenyls (PCBs)
- Interior staining/corrosion
- Discharge/wastewater features
- Pits, ponds, lagoons
- Sanitary sewer/septic
- Stormwater management
- Solid waste/dumping/landfills
- Municipal water/private well
- Wells
- Surrounding area

**Note any limiting conditions!**



# CONCEPTUAL SITE MODEL (CSM)

## Hypothesized Information

- From Observations
  - Contaminant source locations
  - Land topography
  - Groundwater flow direction
  - Building remnants
  - Contaminant distribution, transport, and fate



Source: 2018 United States Geographical Survey

# CONCEPTUAL SITE MODEL (CSM)

## What Resources are Important?

- **ASTM specifies which records to review**
  - Not a “one size fits all” situation
  - It is up to the LEP/Environmental Professional to decide which records deserve detailed analysis based on site-specific conditions
  - Focus on records that will materially affect CSM development
  - Keep discussions practical

# CONCEPTUAL SITE MODEL (CSM)

## What Makes a Good CSM?

- **Adequate Site Characterization: How, When, What, and Where**
  - Contaminants of concern and source(s) identified
  - General contaminant behavior discussed and hypothesized in CSM
  - Site physical characteristics
  - Extent of release
  - Potential exposure pathways identified
  - Preferential pathways contemplated
  - Potential receptors are identified
- **Refine with New Information**
  - New data means time to update CSM
  - Discussion of data is incorporated
  - CSM assumptions are refined each report
  - Confounding sources discussed as needed (indoor air)
  - Discuss deviations from CSM and implications



# EXAMPLES OF COMMON CONTAMINANTS

Characteristics, Transport and Fate

# COMMON CONTAMINANTS

## ASTM Phase I ESA

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Hazardous Substances - 800 substances and 1,500 radionuclides
- Common EPA analytical methods: TPH, VOCs, SVOCs, “RCRA 8” metals, PCBs
- New ASTM 2021 standard identifies non-CERCLA substances (i.e. emerging contaminants) as “Non-Scope” items
  - PFAS is not a CERCLA Hazardous Substance
  - PFAS is regulated by CTDEEP
  - Additional information on the 2021 changes to the ASTM E-1527 standard available (contact Jen Griffith)

## Connecticut

- Remediation Standard Regulations (RSRs)
- EPA analytical methods apply
- Connecticut analytical methods:
  - CT Extractable Total Petroleum Hydrocarbons (CTETPH)
  - CT 15 RSR Metals

## Rhode Island

- Remediation Regulations 250-RICR-140-30-1
  - Section 1.16 Analytical Methods for Reporting
  - Section 1.9.3 Groundwater Objectives
    - Section 1.9.3(F)(a) *Refer to Groundwater Quality Rules*
- Groundwater Quality Rules 250-RICR-150-05-3
  - Section 3.12(A): Compliance determined via analysis of **unfiltered** groundwater samples.

# COMMON CONTAMINANTS AND SOURCES

## Volatile Organic Compounds (VOCs)

- Light, organic solvents (industrial manufacturing/degreasing)
- Light petroleum distillates (gasoline storage)
- Chlorinated solvents (military bases, dry cleaners)

## Semi-Volatile Organic Compounds (SVOCs)

- Heavy petroleum distillates (fuel tanks, automotive waste oil, hydraulic fluid)
- Polycyclic Aromatic Hydrocarbons (PAHs) (coal fill, combustions)

## Per- and Polyfluoroalkyl Substances (PFAS)

- Fire-fighting foam (AFFF)
- Plastics/non-stick coating manufacturing

# COMMON CONTAMINANTS AND SOURCES

## Metals

- Electroplating (chromium [III, VI], nickel, zinc, arsenic)
- Firing ranges (antimony, lead)
- Machining (chromium, vanadium)
- Paint (lead)
- Mining, smelting (all)
- Coal combustion powerplants/boiler rooms (arsenic, lead, mercury, vanadium)

## PCBs

- Substations and switchyards
- Transformers
- Industrial wastes: dumped/degraded or incinerated building materials
- Caulking, paint, gasket manufacturing

## Pesticides and Herbicides

- Application, Manufacturing, Storage

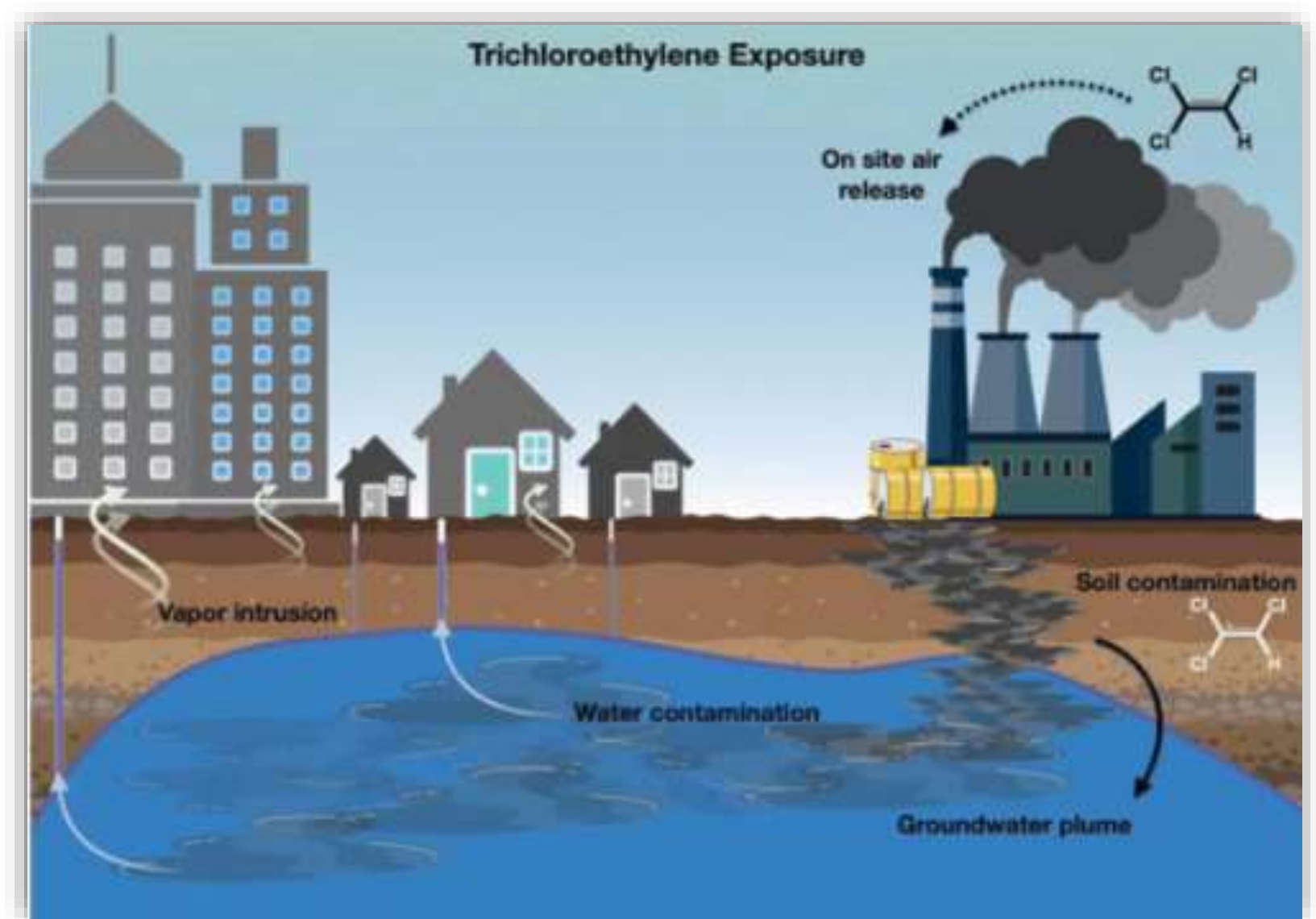
# COMMON CONTAMINANTS – FATE & TRANSPORT

## Physical Characteristics

- CSM should include physical and chemical factors for each substance being assessed
- Not all contaminants behave similarly in the environment (or at the same site)
- Include known/anticipated contaminant behavior in the environment

## Contaminant Characteristics

- Mobility
- Density
- Solubility
- Volatility
- Toxicity
- Persistence
- Bioaccumulation



Source: University of Rochester Medical Center: *Common Drycleaning Chemical Linked to Parkinson's Disease*



# COMMON CONTAMINANTS – EXPOSURE

## Exposure Routes

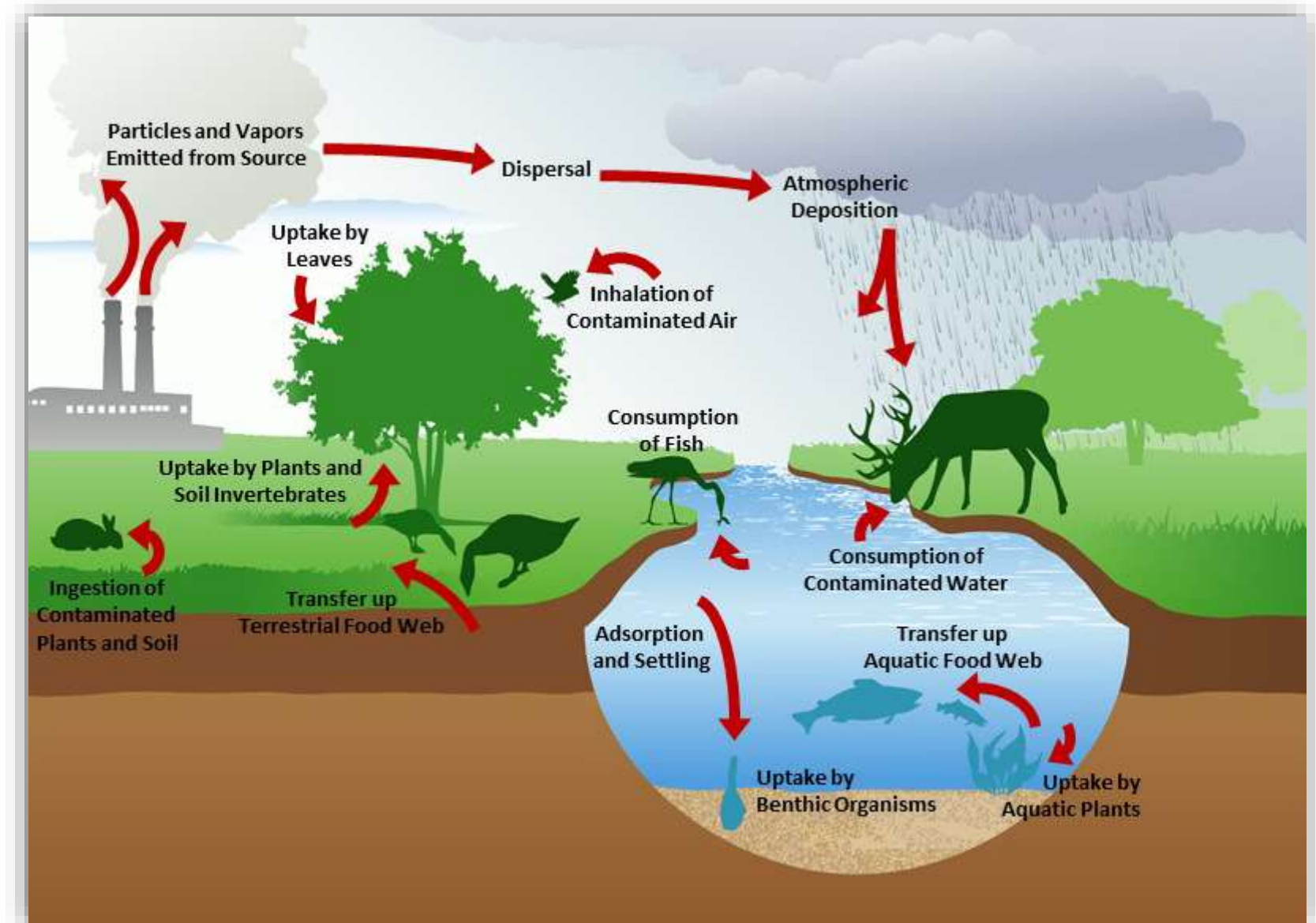
- Inhalation
  - Gases and aerosols
- Absorption
  - Contact with water or soil
- Ingestion
  - Fluids and foods

## Groundwater and Surface Water

- Point Sources
  - Wastewater treatment plant, Tank release
- Non-point Sources
  - Urban runoff, agricultural

## Soil Media

- Mixture of air, water, mineral, and organics in soil



Source: EPA: *EPA EcoBox Tools By Exposure Pathways – Exposure Pathways in ERA, 2023*



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**Questions?**

# CASE STUDY

## CT Site

- Site subject to the Property Transfer Program
- Operations consist of crane storage and maintenance
- Historically filled in 1960/1970s to develop
- Phase I ESA was conducted 2006 by others, lacking details regarding historical site conditions. Site had also been heavily investigated by multiple consultants.
- Bounded by two streams to the west and north
- A Significant Environmental Hazard was reported due to zinc detected in groundwater
- Source of zinc unknown, this is a problem! The CSM was not established for the site.

# CASE STUDY



# CASE STUDY

## CT Site

- Current Phase I ESA not available, need to establish CSM
- Updated site reconnaissance conducted
- Review of potential on-site sources, additional records review. No sources identified on site
- A hunch (hypothesized) zinc could be related to an off-site source but current hydrogeologic setting doesn't seem to support CSM, migration pathways
- Some serious head scratching here! We needed to dive deeper!
- Additional historic site and area research was conducted, which concluded there were historic sources of zinc at area properties.



# CASE STUDY

Key Finding, time to revisit the CSM

