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Best Practices to Minimize Laboratory Resources for Waste Characterization During a Wide-Area Release of Chemical Warfare Agents

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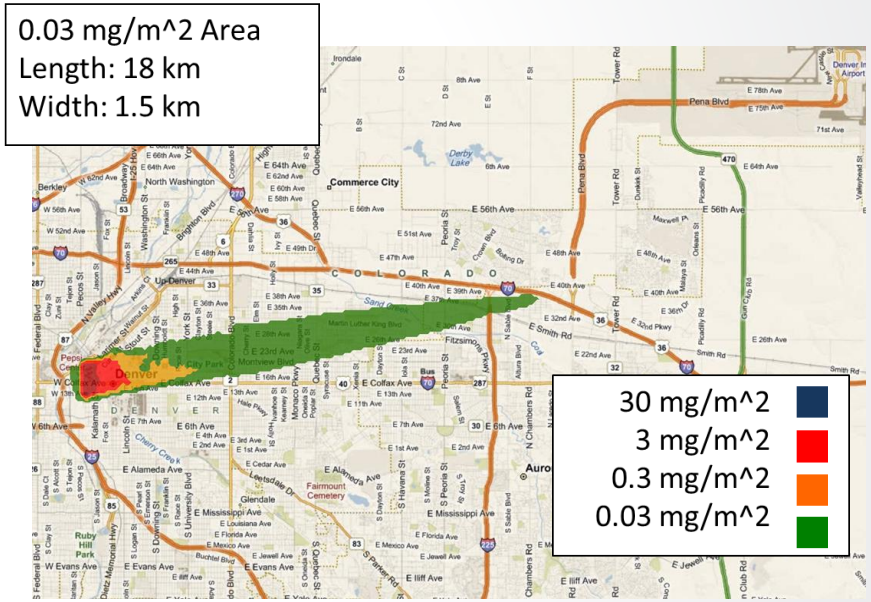
Outline

- **Why the Need?**
- **Defining Waste**
- **Waste Characterization**
- **Reducing Sampling and Analysis Resources**
- **Best Practices for Waste Characterization Document and Associated Resources**
- **Lessons Learned from Exercise and Demonstration**

Example of a CWA Contamination Incident

- Wide-Area Recovery and Resiliency Program (WARRP)
- Urban wide-area release of chemical blister agent in air with transport and movement of contaminated vehicles and individuals
  - Agent is relatively persistent, low volatility and water solubility, rapid hydrolysis, and potentially strong sorption to some materials
- Hundreds of buildings impacted over 5-mile area from release
- Clinical, forensic, environmental samples will be collected from initial response to clearance stages of incident
- Waste is generated during all phases of the incident



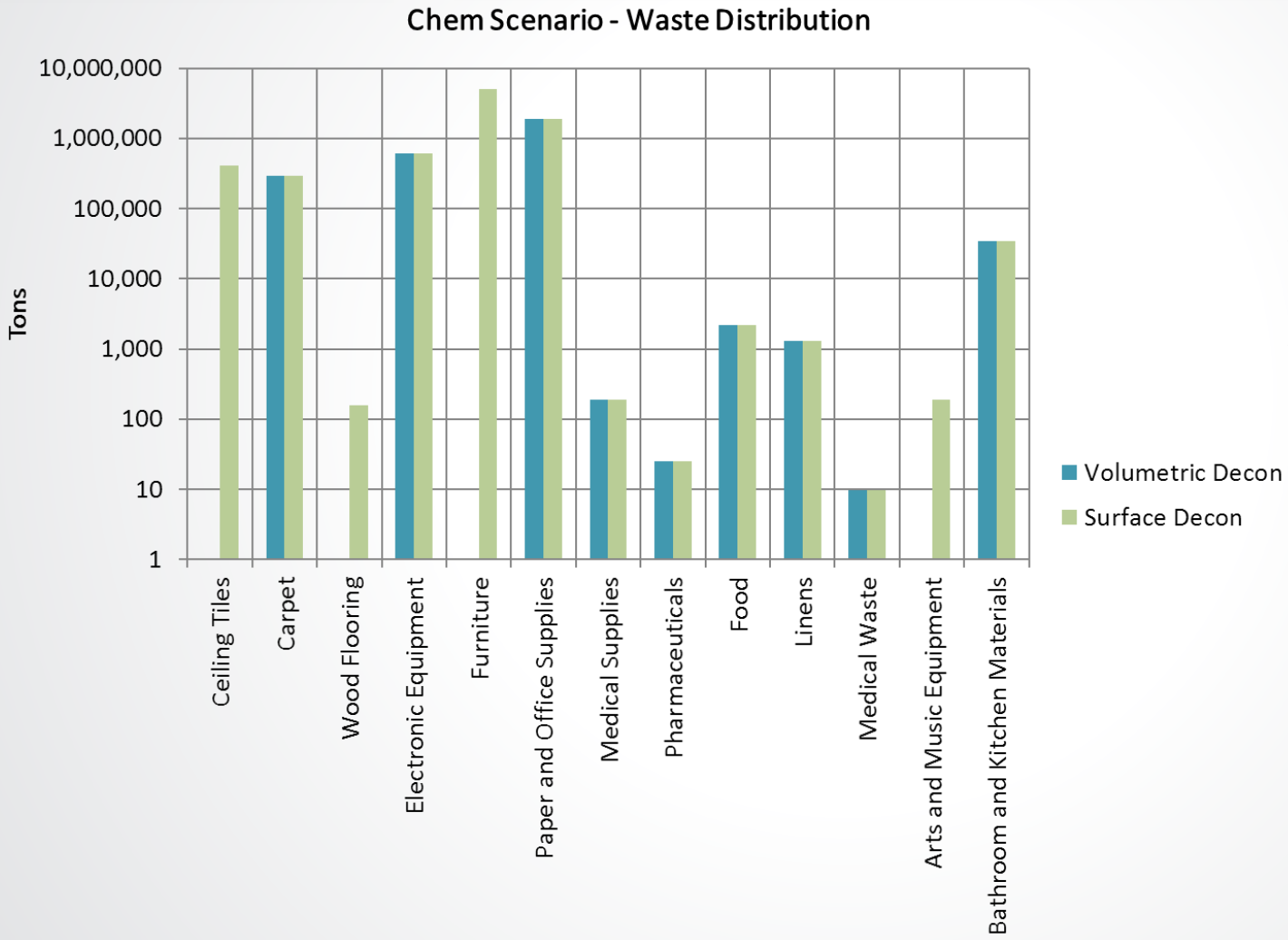
Agent surface concentrations

Defining "Waste" from a Wide-Area Incident

- Waste defined as any material that is intended for disposal and will not be re-used or recycled

- Examples:
  - Personal Protective Equipment (PPE)
    - Gloves, suits, boot covers
  - Decontaminated items for disposal or further management
    - Office materials, drywall, carpet, ceiling tiles, cubicles, furniture
  - Decontamination rinsate

Wide-Area Waste Volumes

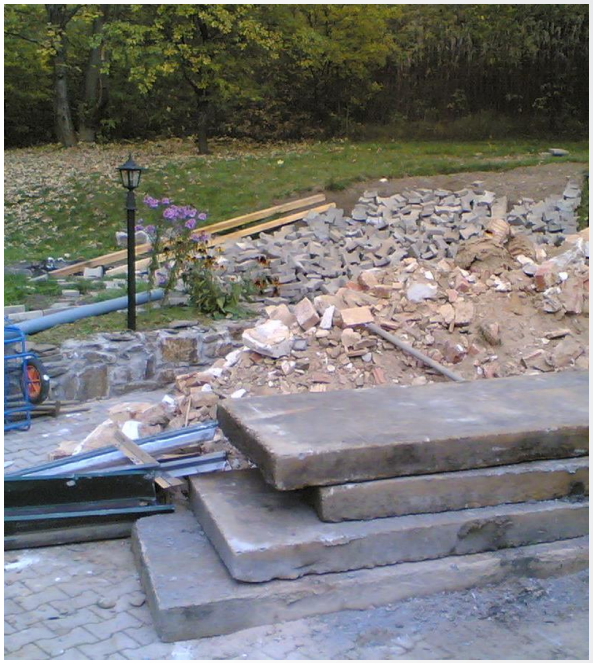


Generated from WEST and i-WASTE simulation of the WARRP Scenario

Estimated total aqueous waste of 15 to 36 million gallons and 3 to 8 million tons of solid waste

So What's the Issue?

- Waste management begins from the moment the incident occurs and continues to the very end of the response
- Unlike for natural disasters, waste is not co-mingled debris, but regular contaminated materials that can be segregated
- A sufficient number of samples will need to be collected to characterize the waste, but not overwhelm laboratory and sampling resources



States have primary decision-making authority; facilities can refuse to accept even if granted permission from the state

What is Waste Characterization?

- Waste Characterization is the use of sampling and/or knowledge of the waste (i.e., lines of evidence) to document that waste meets regulatory and waste receiver requirements

- Lines of Evidence
  - Information or data from various sources that can be used to support waste characterization decisions
  - Examples:
    - Technical data (agent fate and transport)
    - Persistence in defined environmental conditions
    - Efficacy of decontamination technologies

Potential Waste Characterization Complications

- Must meet Federal/state/local regulatory requirements
  - [e.g., treatment, storage, and disposal facility (TSDF) personnel]
- Characterization strategies and waste volumes must be acceptable to regulators and waste receivers (e.g., Landfill or publicly-owned treatment works [POTW] operators)
- Waste segregation is critical for efficient waste characterization

- Cost, political, public concern, decontamination strategy, lower priority for waste sample analysis

Purpose and Objectives

Purpose

- To develop and test a waste characterization document aimed at reducing resources used for sampling and analysis of waste samples collected during a wide-area Chemical Warfare Agent (CWA) contamination incident.

Objectives

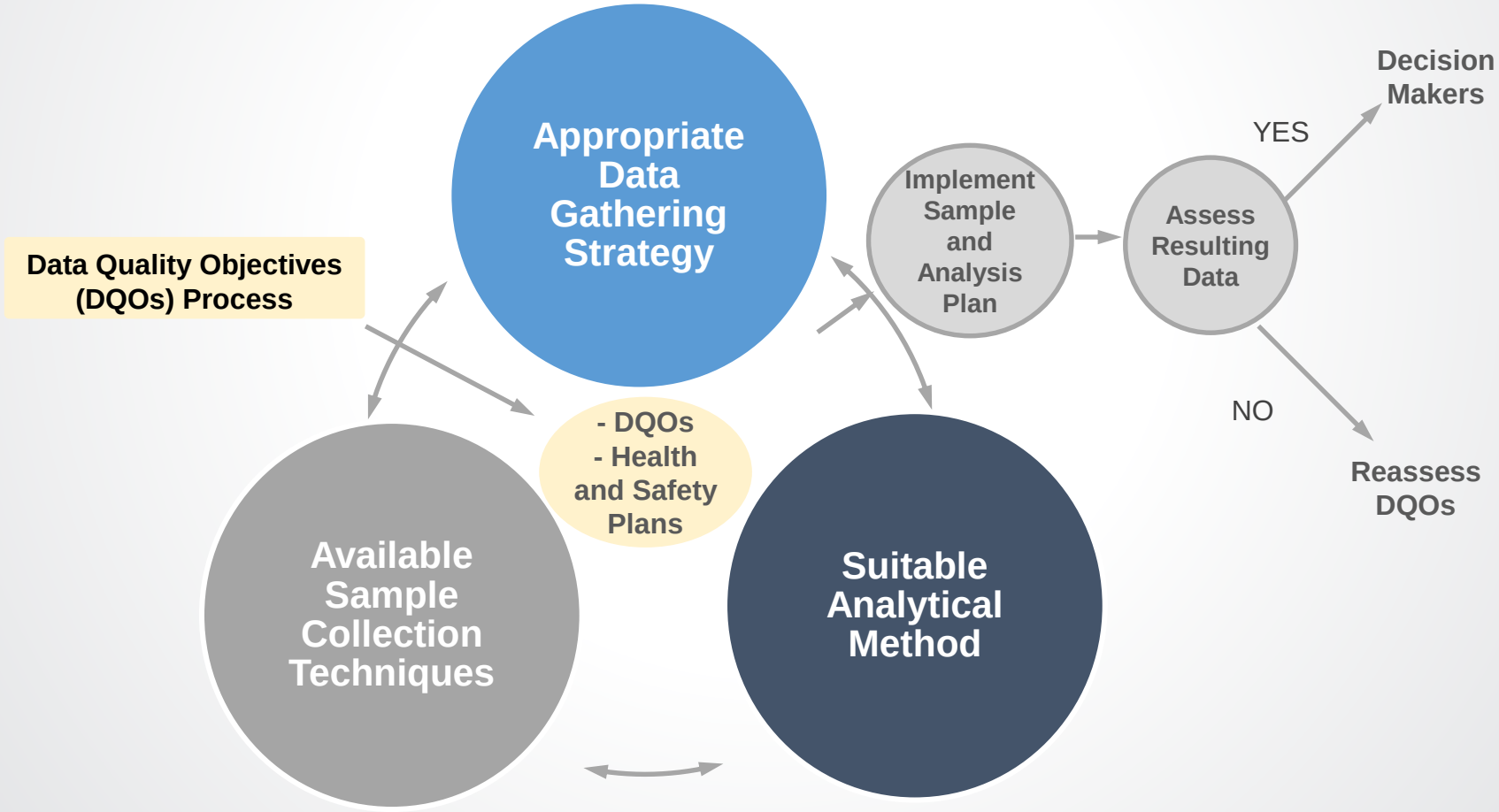
- Many strategies, techniques, and approaches are described within the document to optimize waste sampling and analytical resources associated with a response to a wide-area incident.

- Document could be utilized to help identify a specific waste characterization sampling strategy and the advantages and disadvantages of such strategy.

Development of Best Practices Document (BPD)

- Consists of:
  - Targeted literature search to identify published, open-source data available
  - Wide-area event sampling considerations and waste characterization
  - General waste characterization approaches that may be applied or customized for use
  - Flow charts of the waste characterization process
- Important pre-planning activity to identify and address data gaps

Data Gathering Strategies, Collection Techniques, and Analysis Paradigm

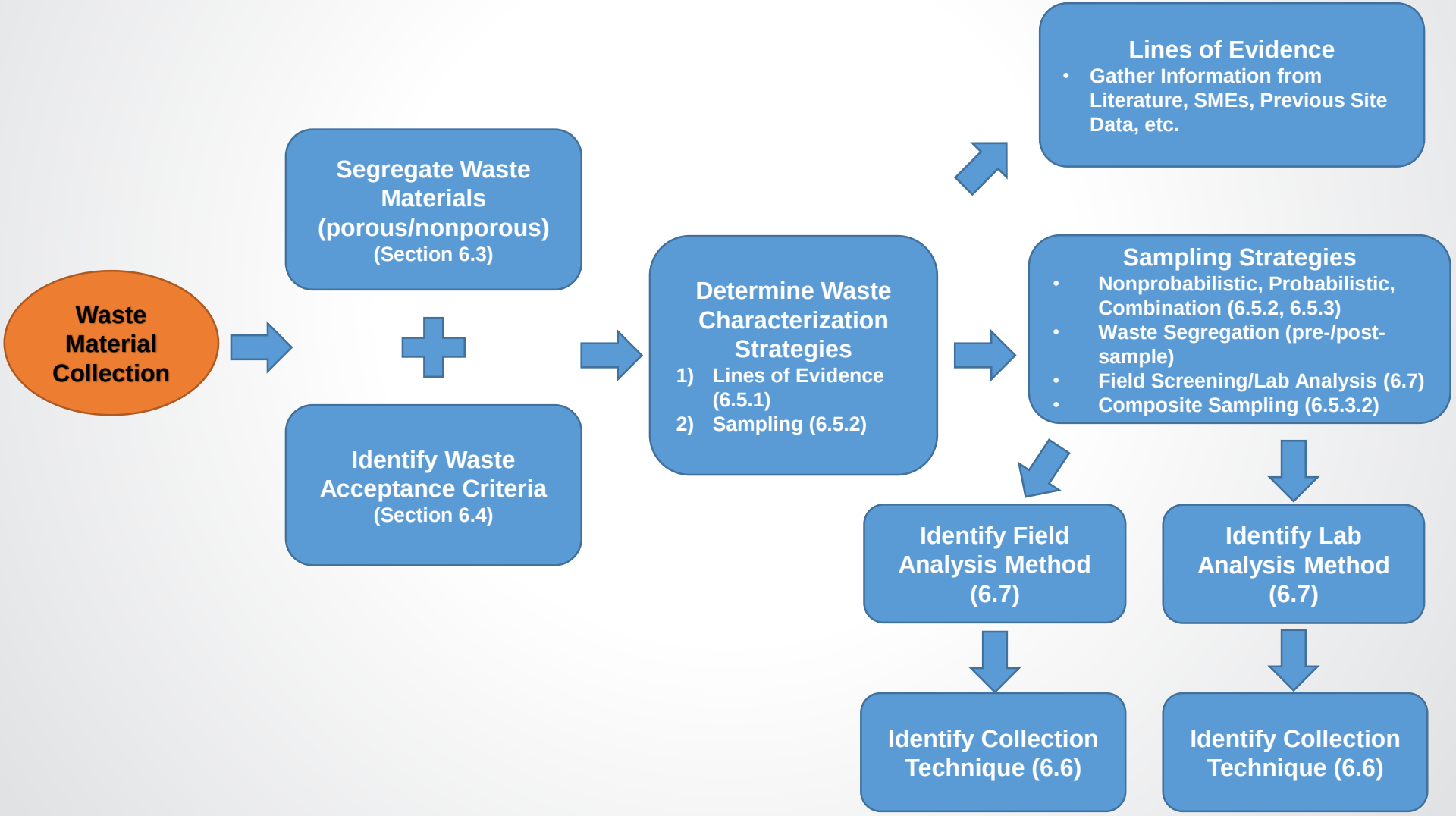


Best Practices Assumptions

Operational Assumptions

1. Regulatory requirements at the federal, state, and local level must be met in the waste characterization process
   - Identify end user of data or decision-maker early on (e.g., waste receiver and federal, state or local regulators)
2. Pre-incident waste management plan (WMP) has been performed
   - WMP includes waste types/quantities, facilities and resources needed, acceptance criteria, health and safety plan, community outreach, etc.
3. Laboratory resources and capabilities are known
4. Generalized DQOs have been identified
5. The chemical contaminant(s) of concern (including potential breakdown products or impurities) have been identified

Waste Characterization Flow Chart



Overview of Waste Characterization Worksheet

Best Practices for Waste Characterization Worksheet

(1) **Segregate the waste into homogeneous groups relevant for waste characterization and complete this worksheet for each segregated waste group that was identified. (Section 6.3)**

Segregated Waste Group Name: _____

(2) **Please consider the following questions collectively before identifying your final response to each.**

(a) Identify Waste Acceptance Criteria for the segregated waste group (Section 6.4 and Pre-incident Waste Management Plan).

Waste Acceptance Criteria: _____

_____

(b) Identify relevant DQOs for the segregated waste group (Section 6.4 and Summary Table).
For exercise purposes, consider using these example DQOs:

- Acceptable waste characterization strategies can take the form of concentration-based or performance-based criteria,
- The detection limits must be at or lower than the identified waste acceptance criteria, and
- For acceptance of the waste, none of the samples from a segregated waste group can exceed the waste acceptance criteria.

DQOs: _____

Overview of Waste Characterization Worksheet

(a) Determine Waste Characterization Strategy (Section 6.2 including Figure 3, Section 6.5)
(Note: More than one strategy can be used)

Will Lines of Evidence be Used? (Section 6.5.1) **Yes** **No**

Will Sampling be Used? (Section 6.5.2) **Yes** **No**

If Lines of Evidence will be used, describe the basis for the determination:

_____

_____

If sampling will be used, determine the sampling strategy. (Section 6.5.2, Table 1)

(b) Which sampling strategy will be used?

Nonprobabilistic **Probabilistic** **Combination of Both**

Further define sampling strategy (e.g., judgmental, simple random)

_____

(c) Will composite sampling be performed? (Section 6.5.3.2) **Yes** **No**

(d) If sampling will be used, describe sample number(s) and location/material

_____

Overview of Waste Characterization Worksheet

(g) Identify the sample collection method(s). (Section 6.6 and Table 2)
(Note: More than one strategy can be used)

Field Analysis **Collection Method: _____**

Laboratory Analysis **Collection Method: _____**

Identify type of sampling and the analysis method. (Section 6.7)
(Note: More than one strategy can be used)

Field Analysis **Yes** **No** **Method: _____**

Laboratory Analysis **Yes** **No** **Method: _____**

Waste Characterization Summary Box

Segregated Waste Group Name: _____

Describe Approach to Segregation: _____

_____

Waste Characterization Strategy: _____
(Identify Lines of Evidence, Sampling or Combination)

Total Sample Number Sent to Laboratory for Analysis: _____

Total Number of Field Samples Collected: _____

Sampling Design for Waste Characterization

Sampling Strategy	Non-Probabilistic	Probabilistic	
	Judgmental	Simple Random	Stratified Random
Definition	Selection of samples based on professional judgement without randomization. Biased sampling (a type of judgmental sampling) is intended to collect samples with the highest contamination.	A set of sampling units are independently selected at random from a population.	Prior information is used to determine groups (lots) that are sampled independently.

Includes:

- **Definition**
- **Application**
- **Description**
- **Pros**
- **Cons**
- **Anticipated strain on lab resources**
- **Cautions/additional critical information**
- **References**

Sampling Design for Waste Characterization

	Extractive (Solid Material) Sampling	Wipe (Surface) Sampling	Liquid (Surface) Sampling	Liquid (Drum) Sampling – Discrete Depth Samplers	Liquid (Drum) Sampling – Profile Samplers	Air Sampling
Description	Extractive sampling refers to whole objective sampling or the cutting/removal of a portion of the material sampled. Might also be referred to as bulk sampling or direct extraction.	Surface sampling techniques using wipes, cotton-balls/wipes, or gauze sponge.	The collection of liquid samples from the surface (or shallow depths) might be obtained with various devices including a bailer, dipper, liquid grab sampler, swing sampler, or solid phase microextraction fibers.	Liquid samples might be obtained from discrete depths with a variety of devices include a syringe sampler, discrete level sampler, lidded sludge/water sampler, or solid phase microextraction fibers.	Liquid samples might be obtained from throughout a vertical column of liquid or sludge with a variety of devices include a composite liquid waste sampler (COLIWASA), drum thief, valved drum sampler, plunger type sampler or solid phase microextraction fibers.	Air sampling devices, such as headspace of waste container for VOCs could include solid phase adsorbent media (tubes), solid phase microextraction fibers, or air samplers (e.g., SUMMA® canisters).

Includes:

- **Description**
- **Application**
- **Pros**
- **Cons**
- **Anticipated strain on lab resources**
- **Cautions/additional critical information**
- **References**

Includes Data Quality Objective (DQO) Process Case Study

- Case study based off WARRP scenario of an urban wide-area release of agent Yellow – 55 gallons of 50/50 mixture of Mustard and Lewisite
  - Provides general scenario set-up
- Provides general walk through of 7 steps of the DQO process for both Decision and Estimation Problems

Other Resources Included in the BPD

- Includes general information on:
  - CWA persistence and breakdown products
  - Features of sampling designs
  - Features of sample collection methods
  - References additional Agency documents
    - [Office of Land and Emergency Management (OLEM)]

BPD Evaluation

- Table-Top Exercise
  - Set of waste barrels containing decontamination rinsate, used PPE and other materials to characterize
  - Apply best practices to characterize with limited number of samples

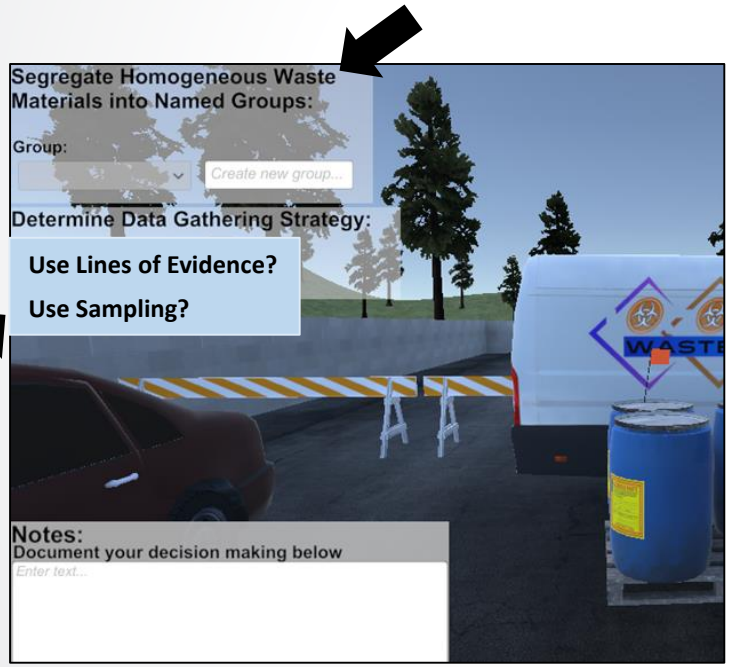
- Computer Simulation
  - Realistic Adaptive Interactive Learning System (RAILS)
  - Increased complexity in waste characterization task in three computer generated scenarios

RAILS Demonstration

RAILS-Sample Capture Process

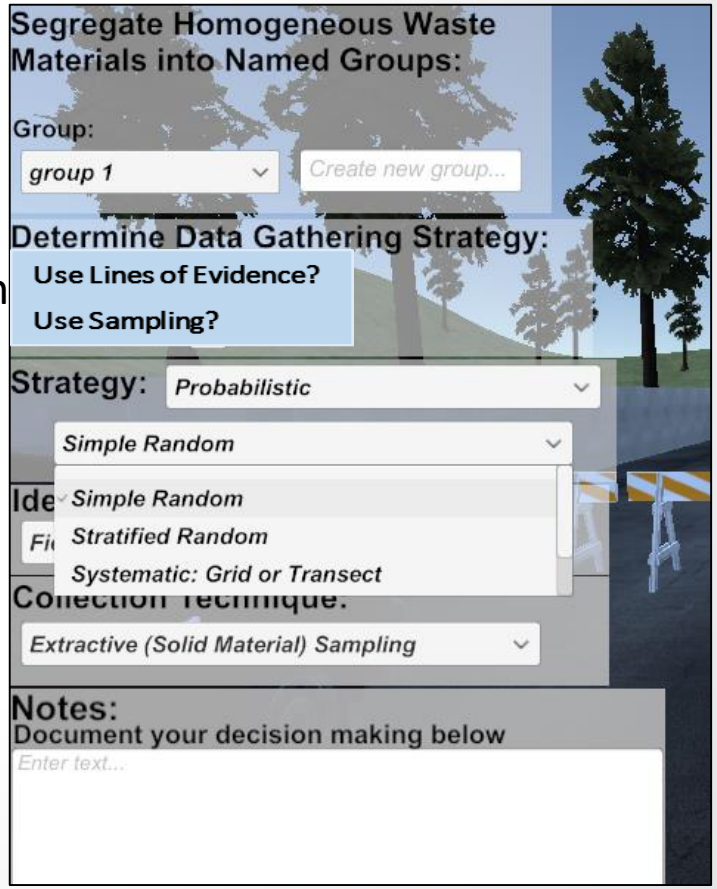
- Simulation mirrors waste characterization flow chart
- When you choose sampling, follow drop downs

BP Section 6.5.1 and 6.5.2



BP Section 6.5.2

BP Sections 6.6 and 6.7



Notes to document process

Conclusion

- Identifies important information to consider prior to sampling begins
  - Identifies already developed EPA-developed tools/programs [e.g., Quick reference guides (QRGs), Selected Analytical Methods Program (ESAM), Emergency Response Laboratory Network (ERLN), OLEM]
  - Identify waste receivers/regulators (TSDF)
  - Establish DQOs
  - Identify appropriate sampling strategies and methods for waste characterization
- Important planning and training tool for those responding to contamination incidents
  - RAILS- interactive learning guide to familiarize user with sampling strategies
- Quick reference developed for quick use of the larger BPD

Acknowledgements

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Disclaimer

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