Liberty RadEx RDD
A Case Study

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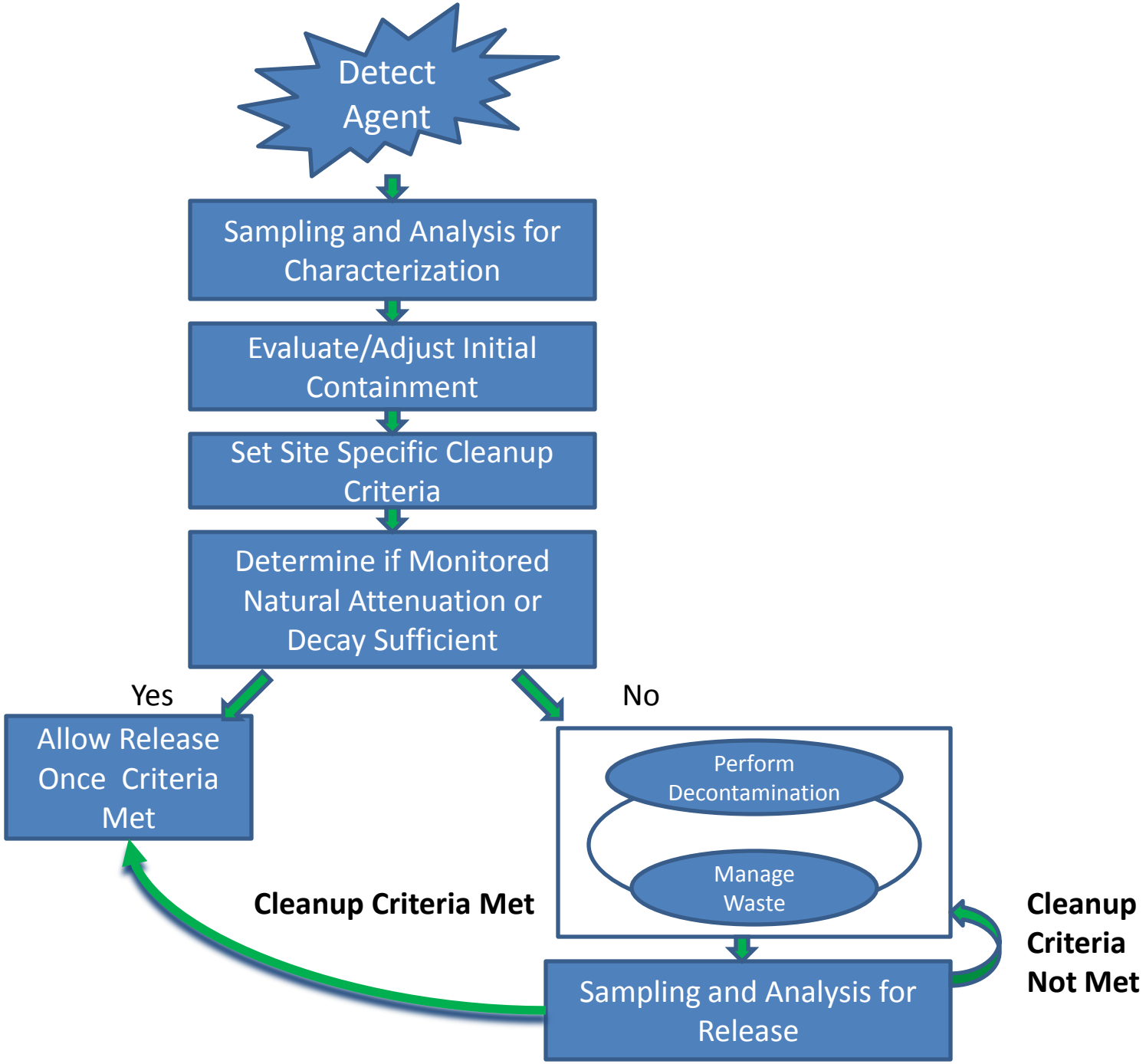
07-14-11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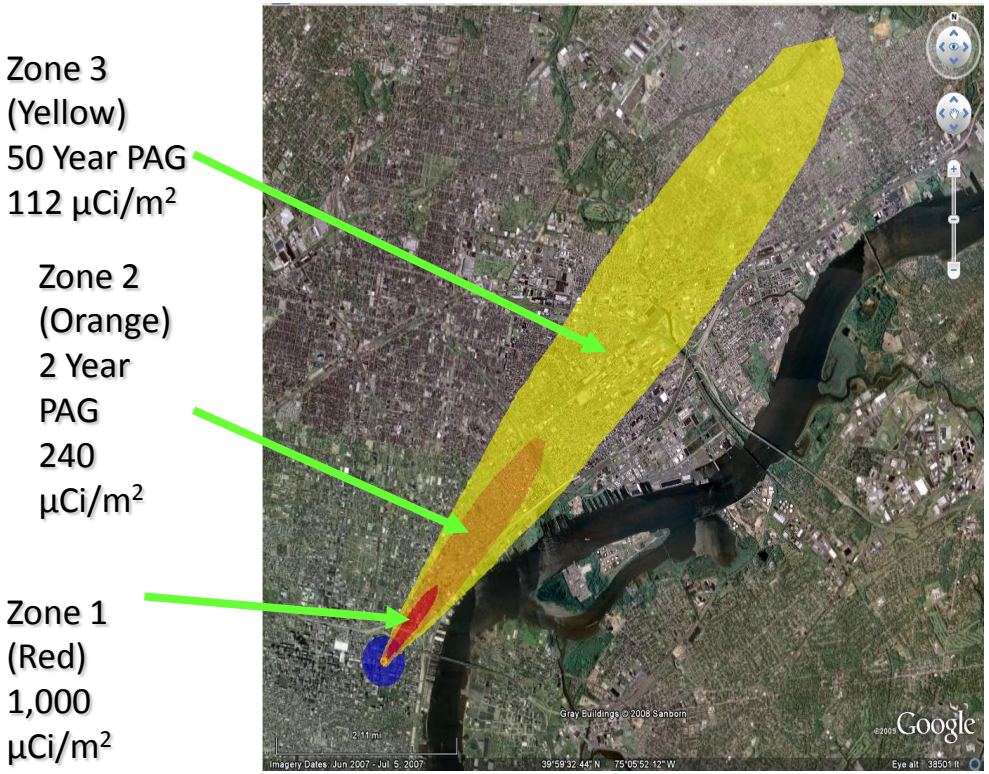
Perform Decontamination
Manage Waste
Cleanup Criteria Met
Cleanup Criteria Not Met
Sampling and Analysis for Release

RDD Scenario – Liberty RadEx

- 3000 pounds of ammonium nitrate mixed with diesel fuel and 2300 curies of Cesium-137 (Cs-137), was detonated in downtown Philadelphia, PA

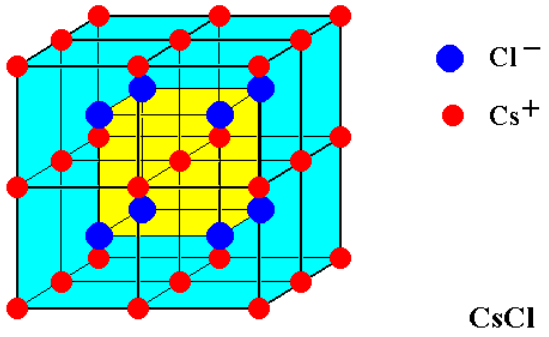
- Wind deposited Cs-137 almost 50 miles through residential, commercial and industrial areas of Philadelphia and suburban and rural areas of Bucks County and central New Jersey impacting major roadways, mass transit, hospitals, schools, and businesses

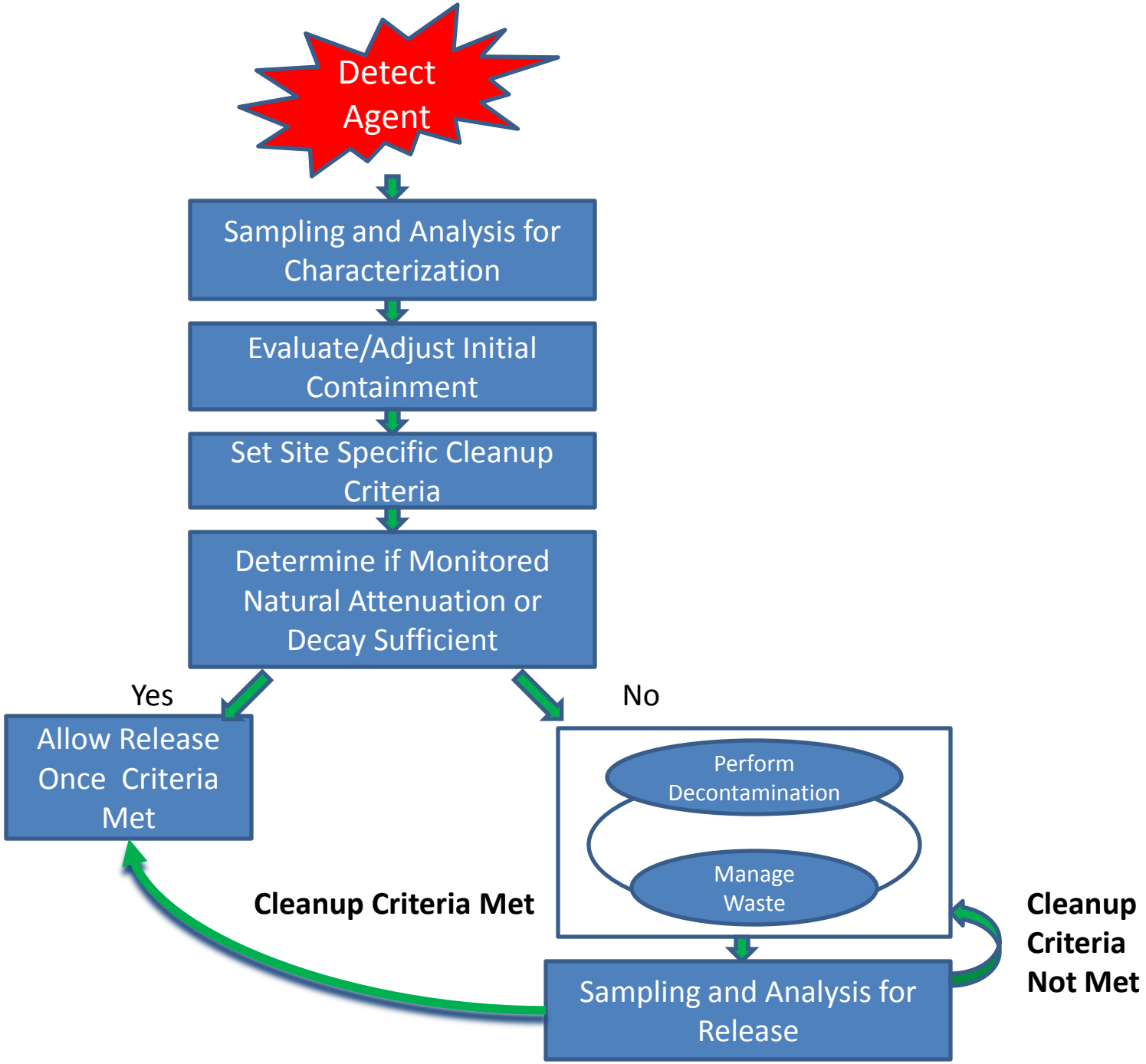
- Major contaminated matrices included: concrete, asphalt, brick, limestone, indoor materials, surface water, soil and vegetation



Properties of Cs^{137}

- Cs^{137} source uses include:
  - Thickness, Flow and Level Gauging
  - Oil Well Logging
  - Medical - used in radiotherapy as a treatment for brachytherapy.
- Half Life of 30 years
- Decays by emission of gamma radiation and a beta particle
- At greater than 68% RH CsCl particles transformed to aqueous phase

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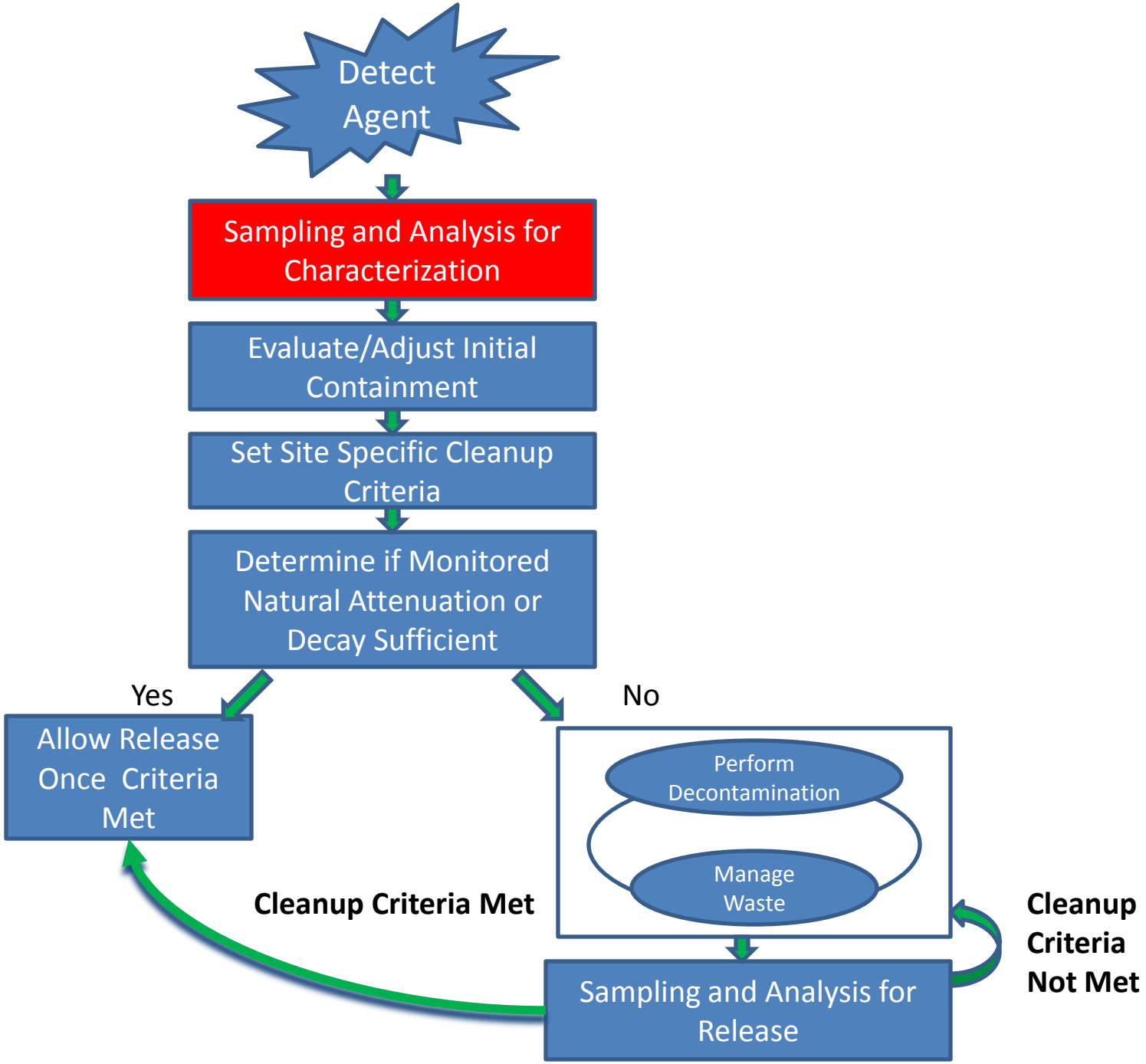
Real-Time Monitor for Gamma Radiation in Drinking Water

- Need:
  - A system for detecting Cs-137 in real time at the protective action level
- Response:
  - Testing commercial systems for detection of Cs-137 at the protective action level (PAL)
- Activities:
  - Tested TA SSS-33-5FT monitoring system and it was not able to detect at the PAL
- Outcomes:
  - Need to scan the market for technologies that could be repurposed for detection at these levels – possible system being developed at ORIA.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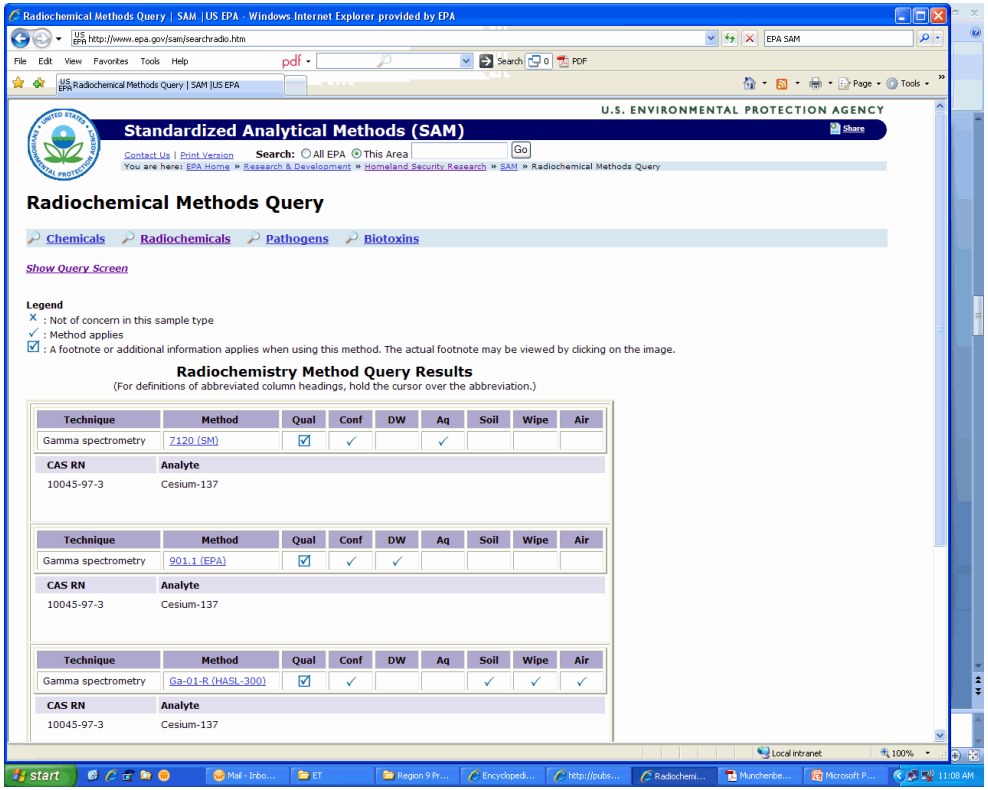
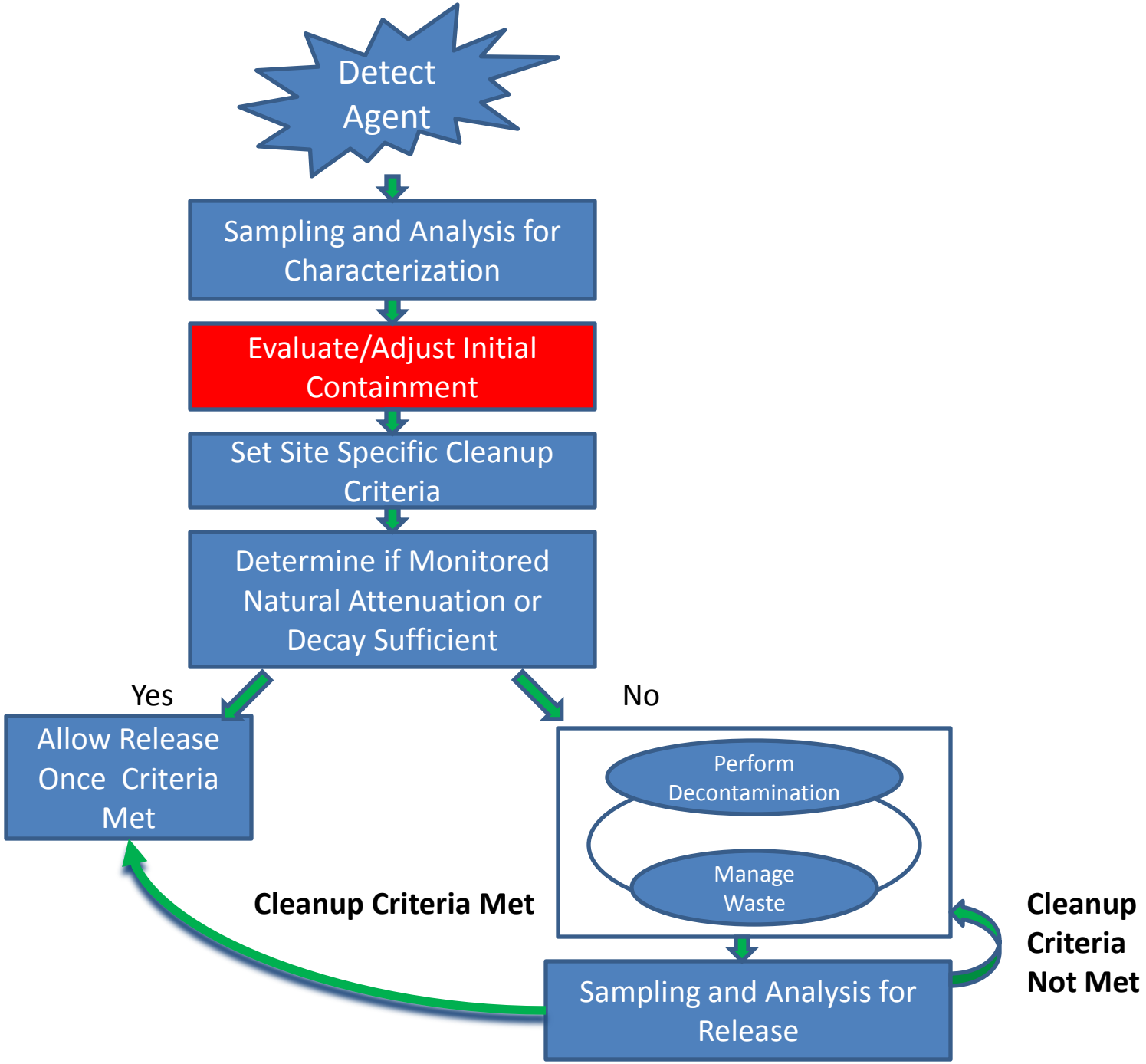
Sampling and Analysis Methods for Cesium -137

- Need:
  - Sampling and analysis methods for environmental samples and urban material samples for Cs-137
- Response:
  - Analysis methods for this radionuclide in environmental matrices already exist but sample collection procedures are being developed
- Activities:
  - EPA/600/S-07/001 Sample Collection Procedures for Radiochemical Analytes in Environmental Matrices
  - EPA/600/R-08/128 Guide for Development of Sample Collection Plans for Radiochemical Analytes in Environmental Matrices Following Homeland Security Events
  - Sample collection of urban materials will be written when the method work is completed
- Outcomes:
  - Sampling and analysis methods are in SAM and can be used during an incident by ERLN.

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Evaluation of Containment Technologies

Need:

Coatings/fixatives that can be applied over a wide area to prevent tracking, runoff and resuspension of contamination

Response:

Develop specifications and test methods for coating/fixative technologies. Test technologies.

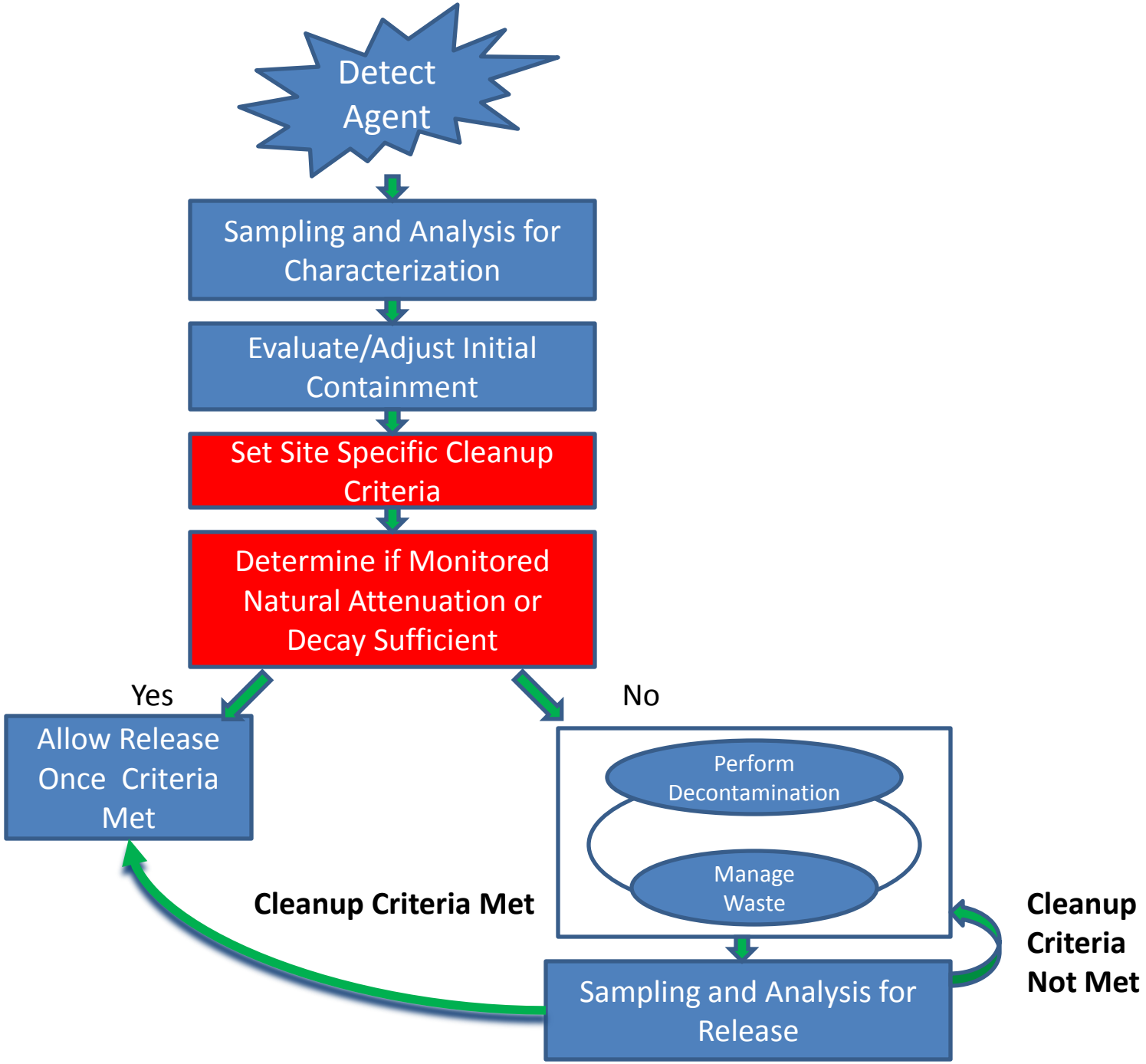
Activities:

Developing test methods for the following specifications: shelf life, weatherability, decontamination factor, ability to immobilize. Planning to test commercially available coatings/fixatives.

Outcomes:

Use of these technologies to contain Cs particles during response and cleanup operations

- Shelf Life - >5 years
- Tensile Strength - 500 psi
- Adhesion - >50 psi on concrete
- Abrasion Resistance - <0.002-oz loss
- Tear Strength - 200 psi
- Flammability – not combustible
- Weatherability
- Dry/Cure Time - satisfies above mechanical criteria within 2 hrs of application
- Toxicity – nontoxic
- Decontamination Factor – optional
- Hazardous Material Category - Nonhazardous after curing and removal as waste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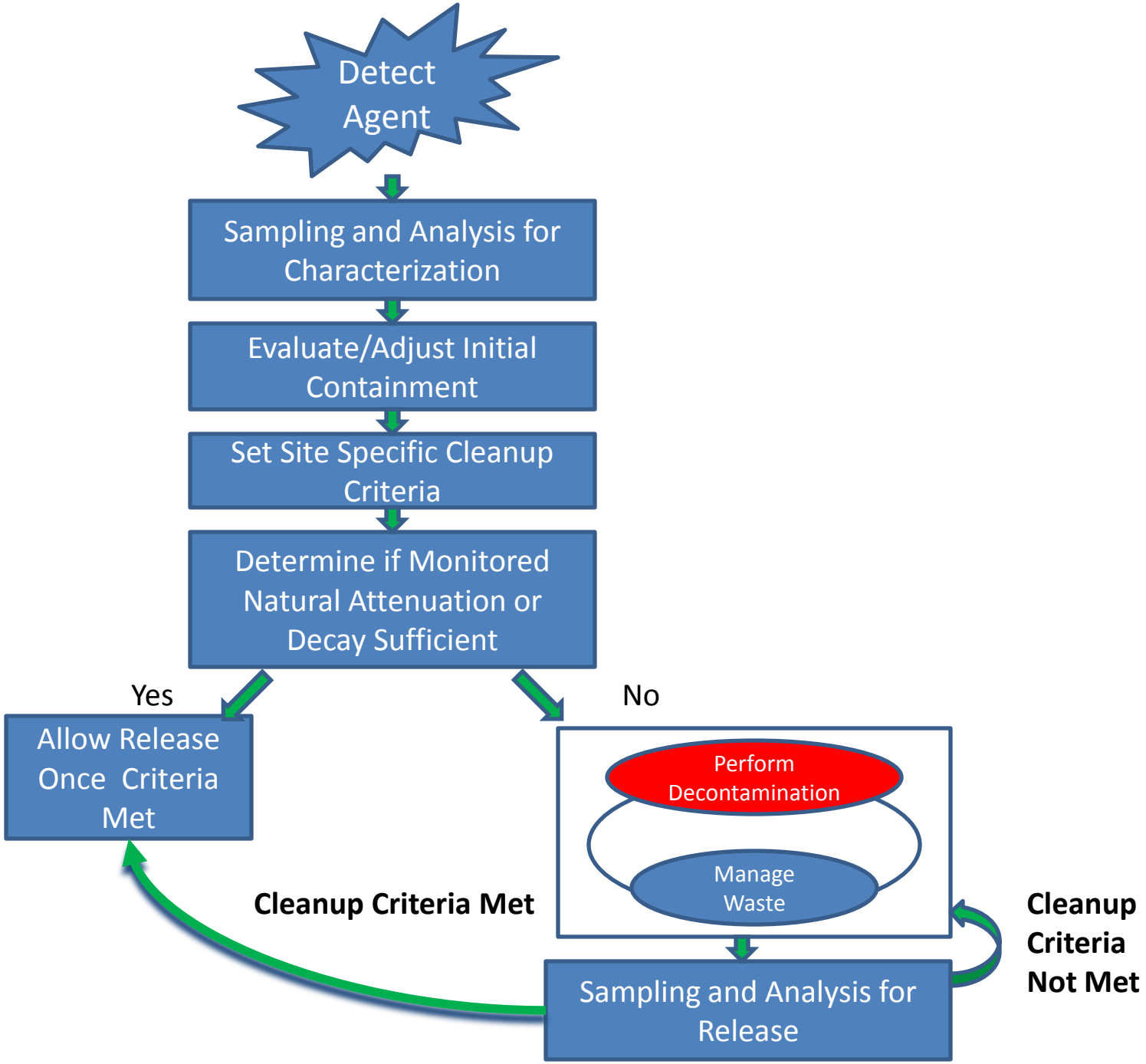
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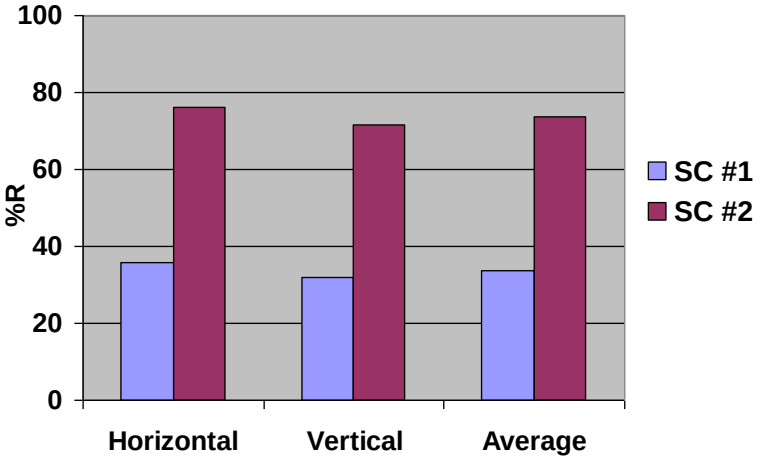
Decontamination Technology Selection – Gross Decon (Mitigation) of Cs-137

- Need:
  - Technologies for gross decontamination of critical infrastructure
- Response:
  - Develop and test technologies for gross decontamination
- Activities:
  - Developing a water wash-aid that could be added to firehose effluent. Testing this technology as well as traditional water wash down for decon of concrete, asphalt, brick and limestone. Also testing for non-porous surfaces
- Outcomes:
  - Use of these technologies to decontaminate critical infrastructure in the early and intermediate phase of the response

Decontamination Technology Selection – Wide Area Decontamination

- Need:
  - Technologies for rapid minimally destructive decontamination of the wide area (residences, businesses, high value structures)
- Response:
  - Test technologies with a fast application rate for decontamination of Cs from concrete,
- Activities:
  - Tested mechanical technologies (EPA 600-R-11-023) and strippable coatings (EPA 600-R-08-100) for removal of Cs on concrete. Planning to test strippable coatings for removal of Cs from limestone, granite and marble
- Outcomes:
  - Use of these technologies to decontaminate the wide area restoring it for release



% R = Percent Removal

SC = strippable coating

Decontamination Technology Selection – High Value Infrastructure

- Need:
  - Technologies for non-destructive or very minimally destructive decontamination of high value infrastructure
- Response:
  - Test technologies for decontamination of Cs on concrete and Cs on urban surfaces typical to high value infrastructure (limestone, granite, marble)
- Activities:
  - Tested nine chemical decontamination technologies and two strippable coatings for removal of Cs from concrete.
- Outcomes:
  - Use of these technologies to decontaminate high value infrastructure restoring it for release

Removal of Cs from Concrete for Tested Chemical Decontamination Technologies

Decontamination Technology	%R	DF
EAI Rad-Release II	85 ± 2	7.0 ± 1.1
Argonne SuperGel	73 ± 5	3.8 ± 0.7
EAI Rad-Release I	71 ± 13	3.9 ± 1.5
Decon Gel 1108	67 ± 9	3.2 ± 0.9
QDS Liquid	53 ± 7	2.1 ± 0.3
INTEK ND-600	52 ± 12	2.1 ± 0.4
QDS Foam	51 ± 8	2.1 ± 0.4
Decon Gel 1101	49 ± 7	1.9 ± 0.2
INTEK ND-75	47 ± 6	1.9 ± 0.2

DF = Decon Factor

Decontamination Technology Selection – Self Help Methods

- Need:
  - Technologies that the general public outside of the exclusion zone can employ to reduce their risk of exposure
- Response:
  - Testing methods available to the general public (off the shelf cleaners and laundering) for removal of Cs.
- Activities:
  - Tested Simple Green for removal of Cs from kitchen and bathroom surfaces (EPA/600/R-10/094). Testing machine washing for removal of Cs from soft porous surfaces (clothes, linens etc.)
- Outcomes:
  - Use of these technologies by the general public to minimize their risk of exposure

Removal of Cs from Kitchen and Bathroom Surfaces by Simple Green and Water

Material	%R (Simple Green)	%R (water)
Plastic laminate	97.6%	93.4%
Vinyl flooring	96.7%	96.0%
Granite	31.4%	7.7%
Poly coated wood	67.2%	68.1%
Painted wallboard	9.5%	7.3%
Stainless steel	97.5%	94.8%

Decontamination of Drinking Water Infrastructure

Need:

Methods that can be used to restore drinking water infrastructure after water source was contaminated.

Response:

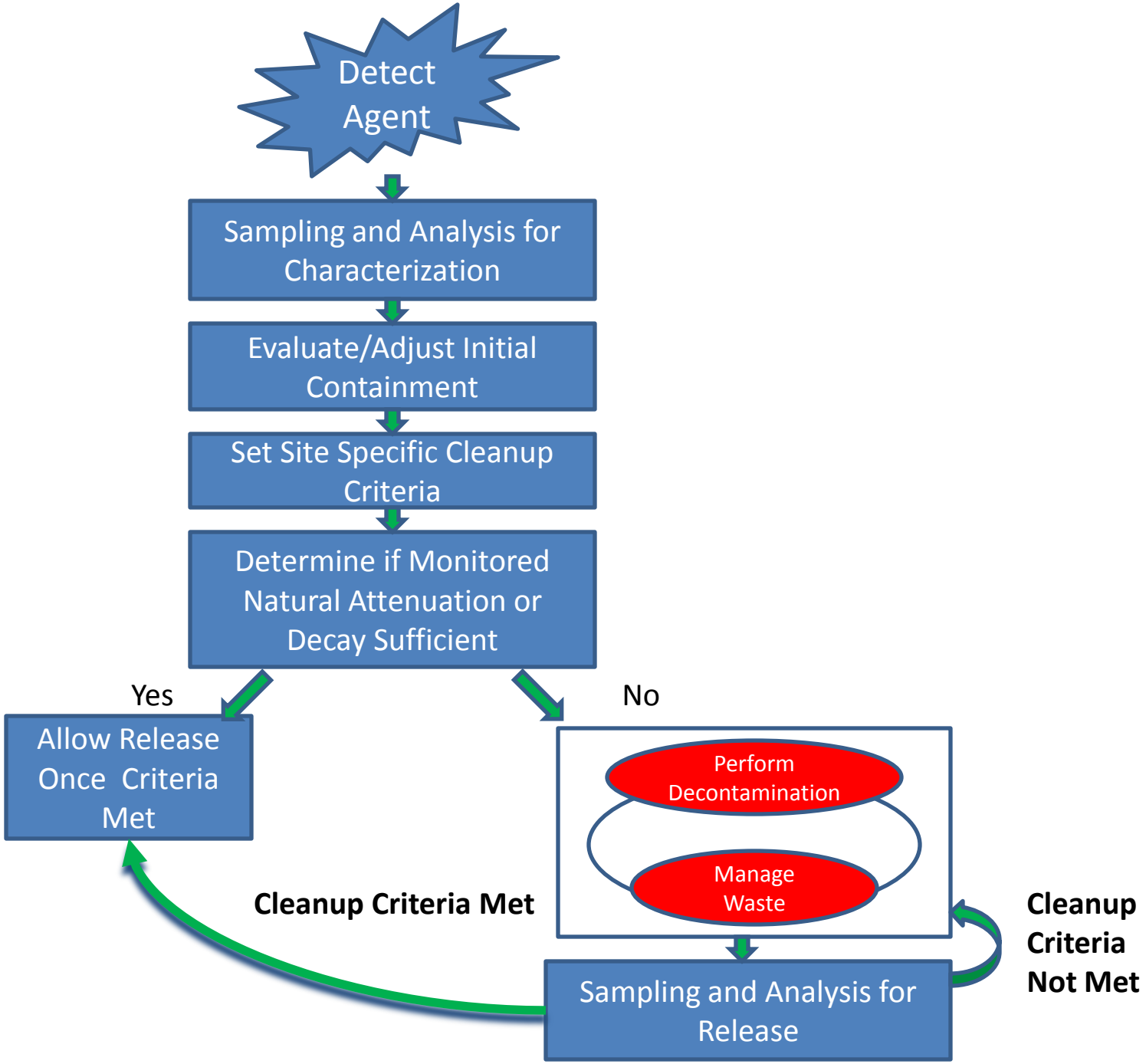
Determine the persistence of Cs on drinking water infrastructure. Test decon methods if Cs is persistent.

Activities:

Determined that Cs was not persistent (at detectable levels) on biofilm lined iron pipe material - decontamination methods were not assessed for this material. Determining if Cs adsorbs to cement-mortar material

Outcomes:

Use of these methods to restore drinking water infrastructure.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Wide Area RDD Decon/Disposal Systems Approach

Need:

A systems approach covering response/remediation, including characterization sampling, decontamination technology application, confirmation sampling, waste management.

Response:

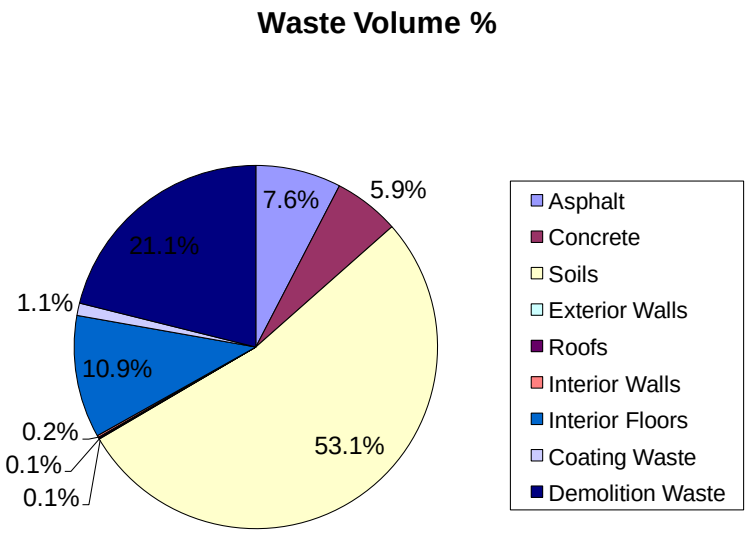
Design a user friendly tool that integrates decontamination and waste management decisions.

Activities:

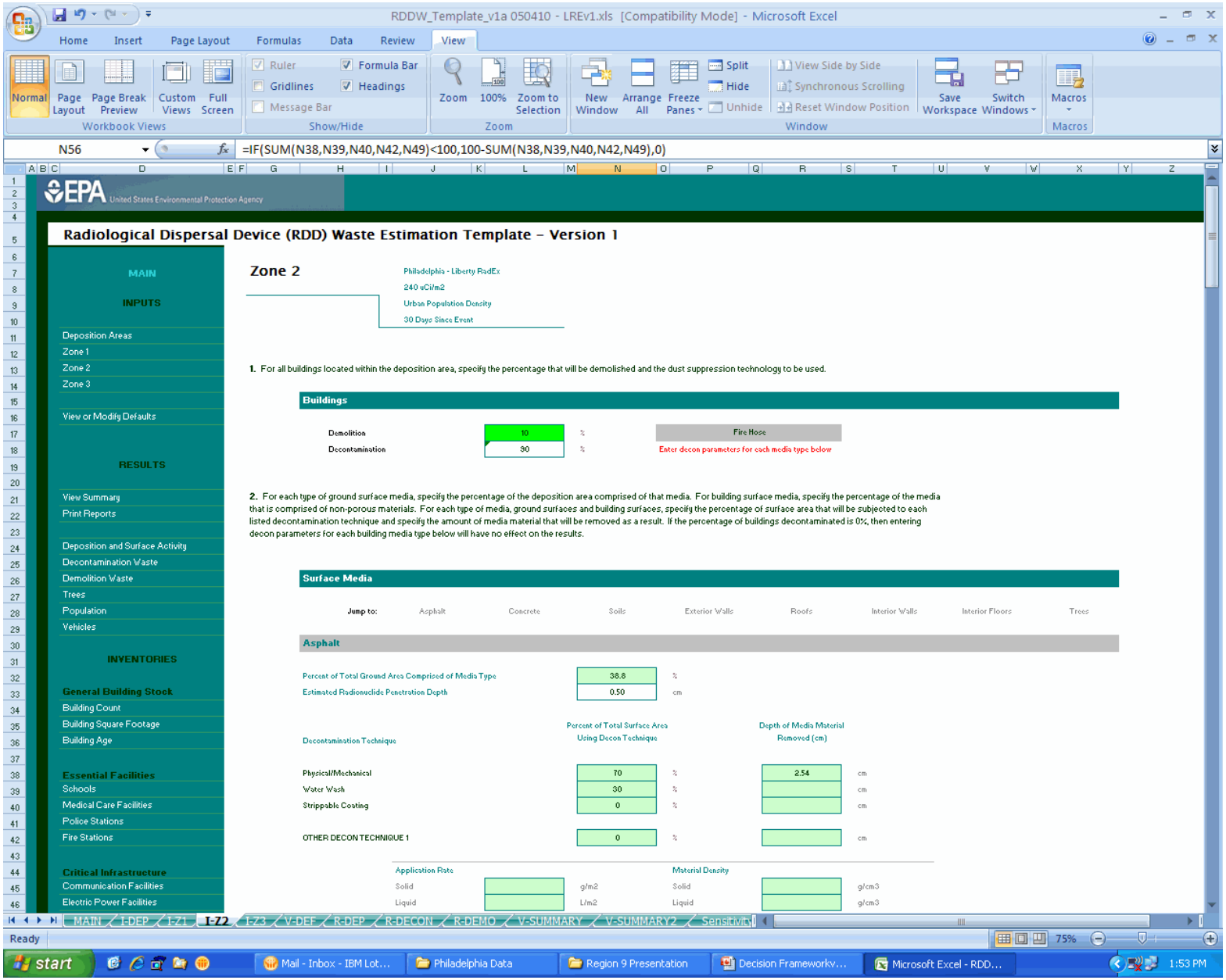
Developing a waste estimation tool for wide area RDD.

Outcomes:

Use of this tool by emergency planners/decision makers (including states and locals) to design area specific recovery plans.



RDD Waste Estimation Tool- Input



Output Waste Volume – Zone 2
90 % Decon and 10 % Demo

Demolition and Decontamination Waste Summary

Philadelphia – Liberty

RadEx

	Zone 1	Zone 2	Zone 3	Total	
Solid Waste					
Demolition	66,883	82,548	142,110	291,540	MT
Decontamination	22,060	311,435	615,156	948,651	MT
Total	88,943	393,983	757,266	1,240,191	MT
Liquid Waste *					
Demolition	–	–	–	–	L
Decontamination	–	14,480,199,150	27,591,713,972	42,071,913,122	L
Total	–	14,480,199,150	27,591,713,972	42,071,913,122	L

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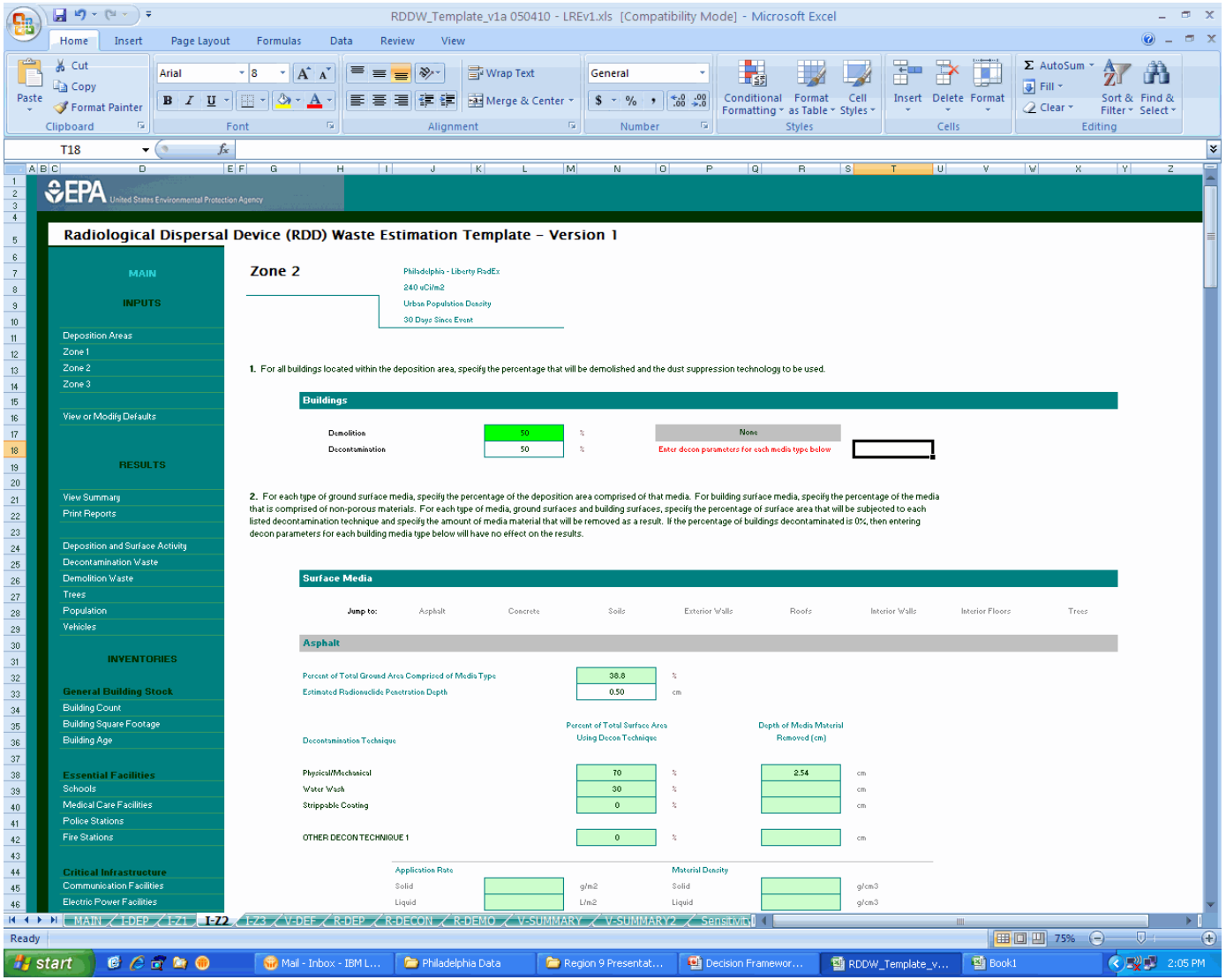


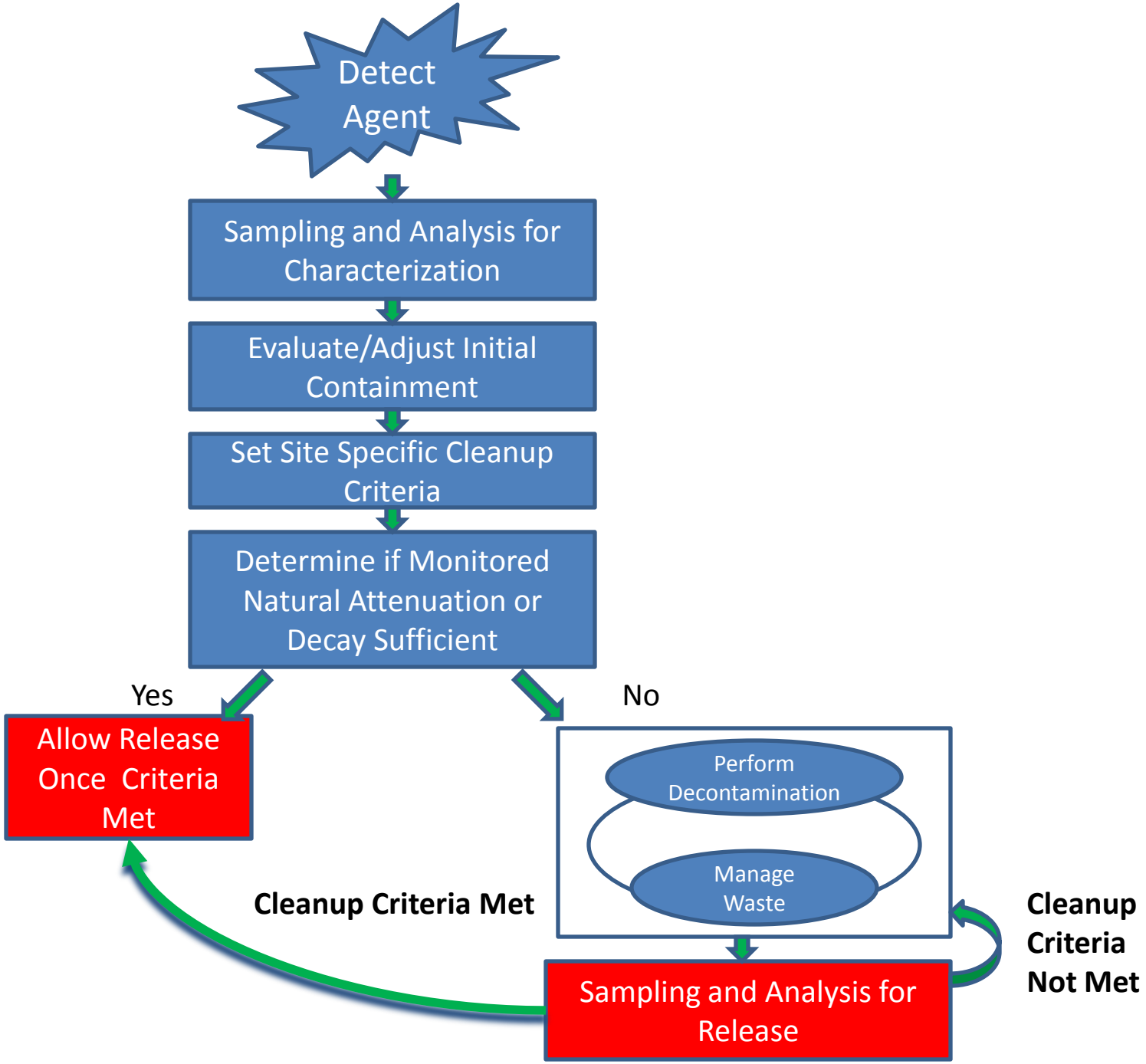
Output Waste Volume – Zone 2 50% Decon and 50% Demo

Demolition and Decontamination Waste Summary

Philadelphia – Liberty RadEx

	Zone 1	Zone 2	Zone 3	Total	
Solid Waste					
Demolition	66,883	412,739	142,110	621,732	MT
Decontamination	22,060	273,440	615,156	910,656	MT
Total	88,943	686,179	757,266	1,532,388	MT
Liquid Waste *					
Demolition	–	–	–	–	L
Decontamination	–	9,265,235,873	27,591,713,972	36,856,949,845	L
Total	–	9,265,235,873	27,591,713,972	36,856,949,845	L

Compare to 393,983 MT for 90% Decon and 10% Demo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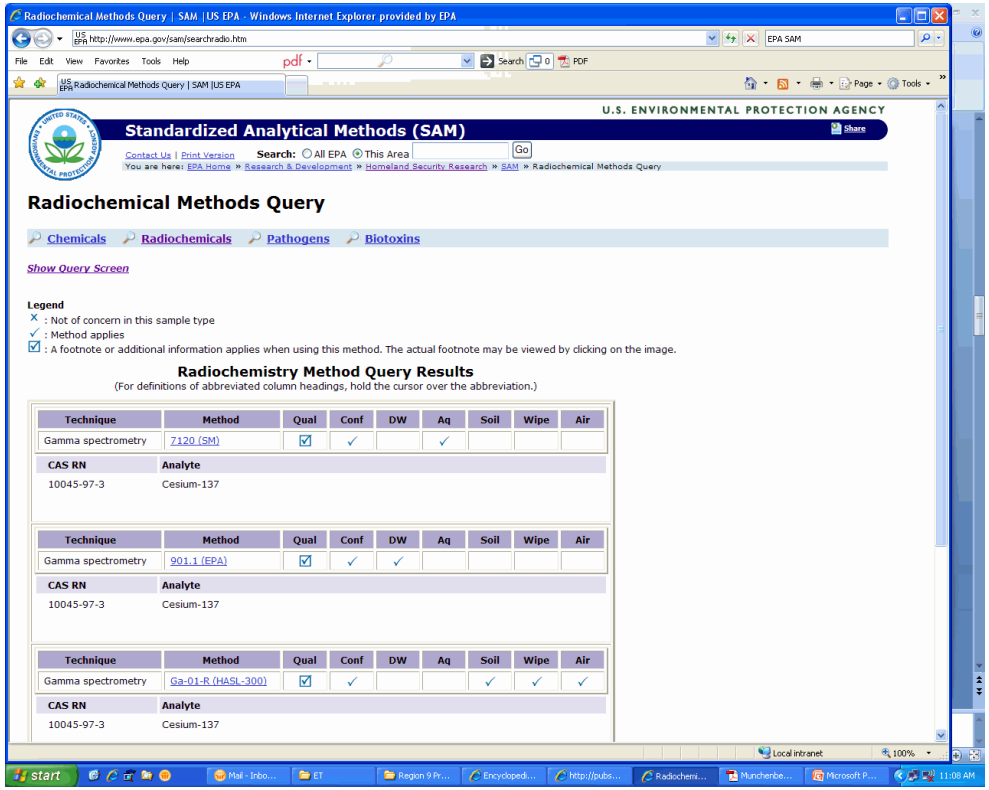

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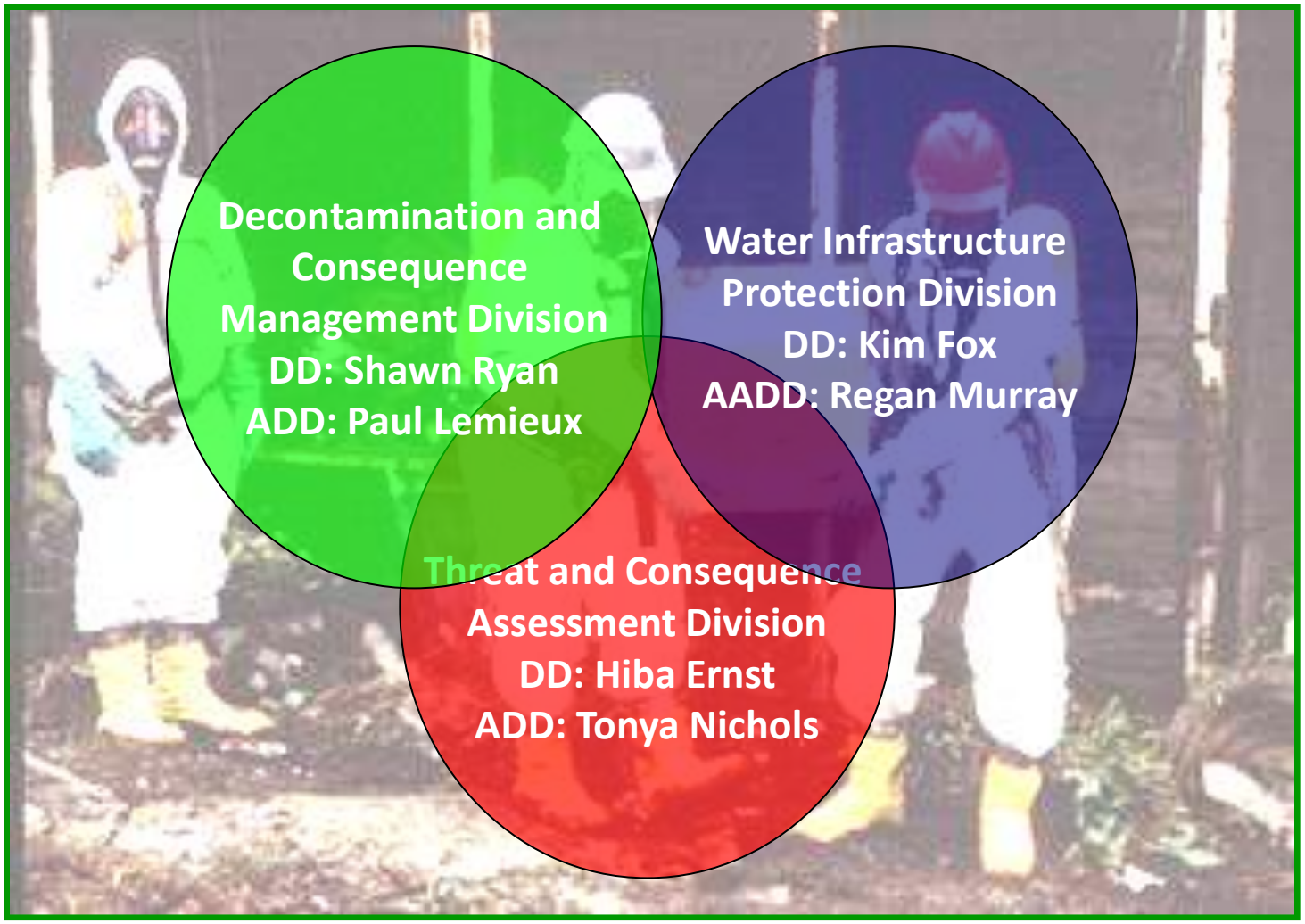
Decontamination and Consequence Management Division
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ADD: Paul Lemieux
Water Infrastructure Protection Division
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