Methodology for the Hanford Site-Wide Risk Review Project

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CRESP

Consortium For Risk Evaluation with Stakeholder Participation

September 4, 2014

Goal, Objectives and Scope

Project Goal: to identify and characterize potential risks to the public, workers, groundwater and the Columbia River, and ecological and cultural resources (collectively referred to as "receptors") at the Hanford Site.

Specific Objectives:

1. To review sources of contamination site-wide and determine the potential for contaminants and cleanup actions to cause risks to receptors;
2. To provide relative ratings of risks to receptors from sources, in order to better enable the Tri-Parties (DOE, EPA, Washington Dept. of Ecology) to make decisions on the sequencing of Hanford cleanup activities, and
3. To place the risks posed by the contamination and the cleanup at the Hanford site into context with the risks, remediation and land uses at other places and sites in the region and the significance of Hanford's unique geography.

Scope: "to go" cleanup and waste management activities as of FY 2016

What the Risk Review Project *is not*

- **The Risk Review Project is neither intended to substitute for, nor preempt any requirement imposed under applicable federal environmental laws**. And, as important, the Risk Review Project is not intended to make or replace any decision made under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) and/or 2010 Consent Order.

- **The Risk Review Project is focused on risk characterization, which is a necessary predecessor to risk management, but does not focus on risk management decisions.** Nonetheless, cleanup actions can cause risks to receptors, which are a part of risk management decisions. The Risk Review Project, however, will not analyze which cleanup option should be selected or the timing of cleanup. Instead, the Risk Review Project considers a plausible range of cleanup actions for different types of contaminant sources to better understand the range of potential risks that may be caused by future cleanup actions.

- **The Risk Review is focused only on portions of the Hanford Site where cleanup or waste management activities are ongoing or where cleanup or waste management activities will occur beginning October 1, 2015 or later.** Cleanup actions considered completed by the Tri-Parties are not part of the Risk Review Project and therefore will not be evaluated. Specific areas of the Hanford Site that are included as well those that are excluded from the Risk Review Project are described in Part 2 of this document.

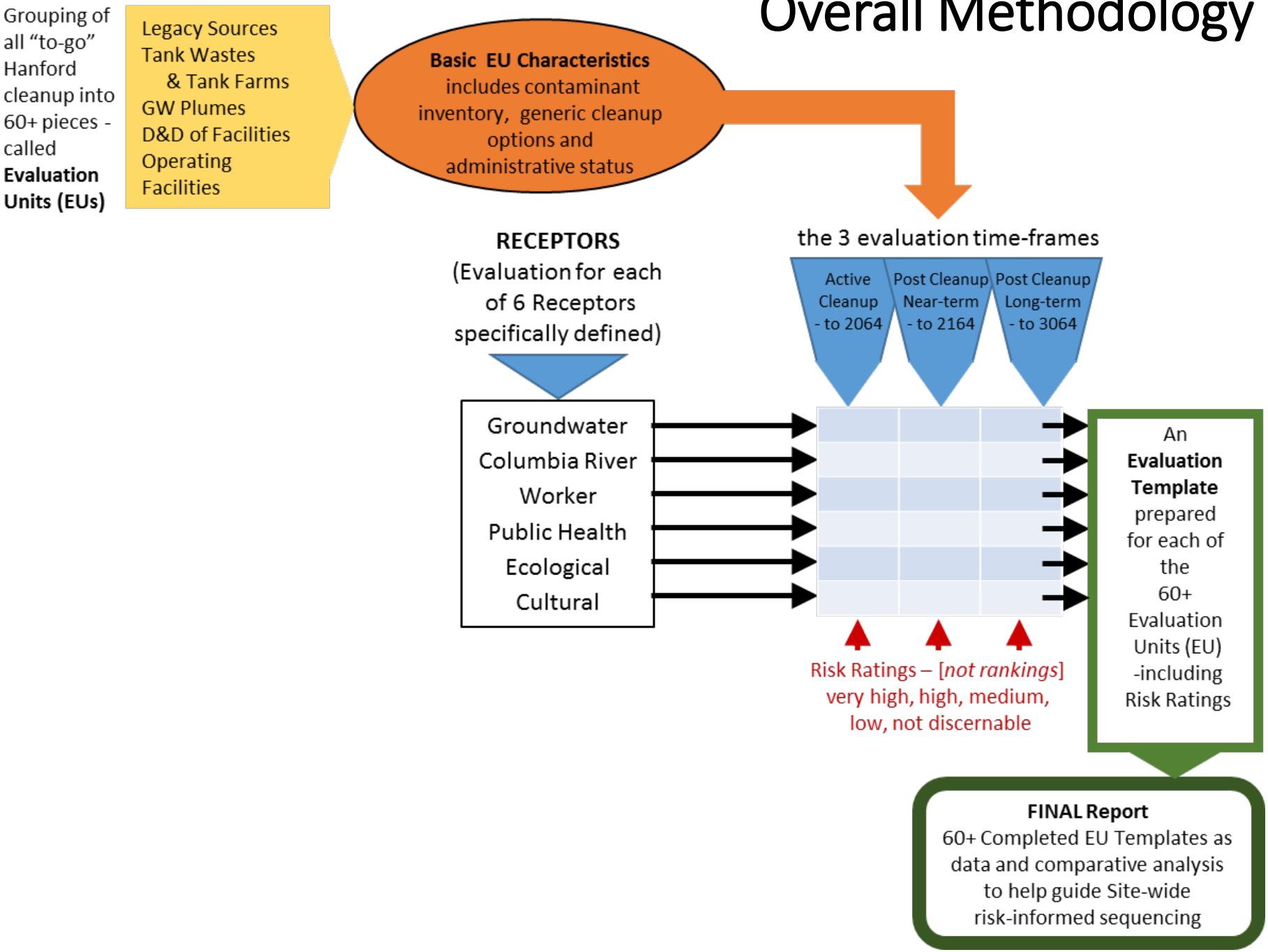
General Approach

- Divide site into Evaluation Units that are groupings of waste & contaminant sources
  - Templates used for information gathering, presentation and evaluation
  - Based on existing information
- Develop methodology for evaluating receptors (Public, Workers, Groundwater & Columbia River, Ecological Resources, Cultural Resources)
  - Pilot methodology using 6 preliminary Evaluation Units
  - Risk ratings *within* each receptor category of very high, high, medium, low, not discernable
  - Solicit broad input on Methodology
  - Refine methodology where appropriate
- Interim Report with Evaluation of xx Evaluation Units
  - Solicit broad input on Interim Report
- Final Report with complete set of evaluation units and comparative analysis
  - Solicit broad input on Draft Final Report
- Core Team provides input and guidance throughout the process
  - Washington Depts. of Ecology and Health, EPA, DOE-RL, DOE-ORP, DOE-EM, CRESP leadership, PNNL liaison
- CRESP issues Final Report

Evaluation Time Frames in the Risk Review Project

Active Cleanup To 50 years (year 2064)	**Near-Term Post-Cleanup** To 100 years past end of Active Cleanup (year 2164)	**Long-Term Post-Cleanup** From 100 to 1,000 years past end of Active Cleanup (year 3064)
A. Risks from un-remediated condition for up to 50 years. No-Action scenario. Impact of delay in completing cleanup. "Need for Action".		
B. Risks from conducting *potential range of remediation actions*. Includes increased impacts to workers, ecosystems, cultural resources, and potential for accidental releases.	**C. Risks from completion of the potential range of cleanup actions that achieve defined endpoints.** Institutional controls assumed to remain effective.	**D. Risks from completion of the potential range of cleanup actions that achieve defined endpoints.** Residual inventories and risk pathways. Institutional controls may no longer be effective.

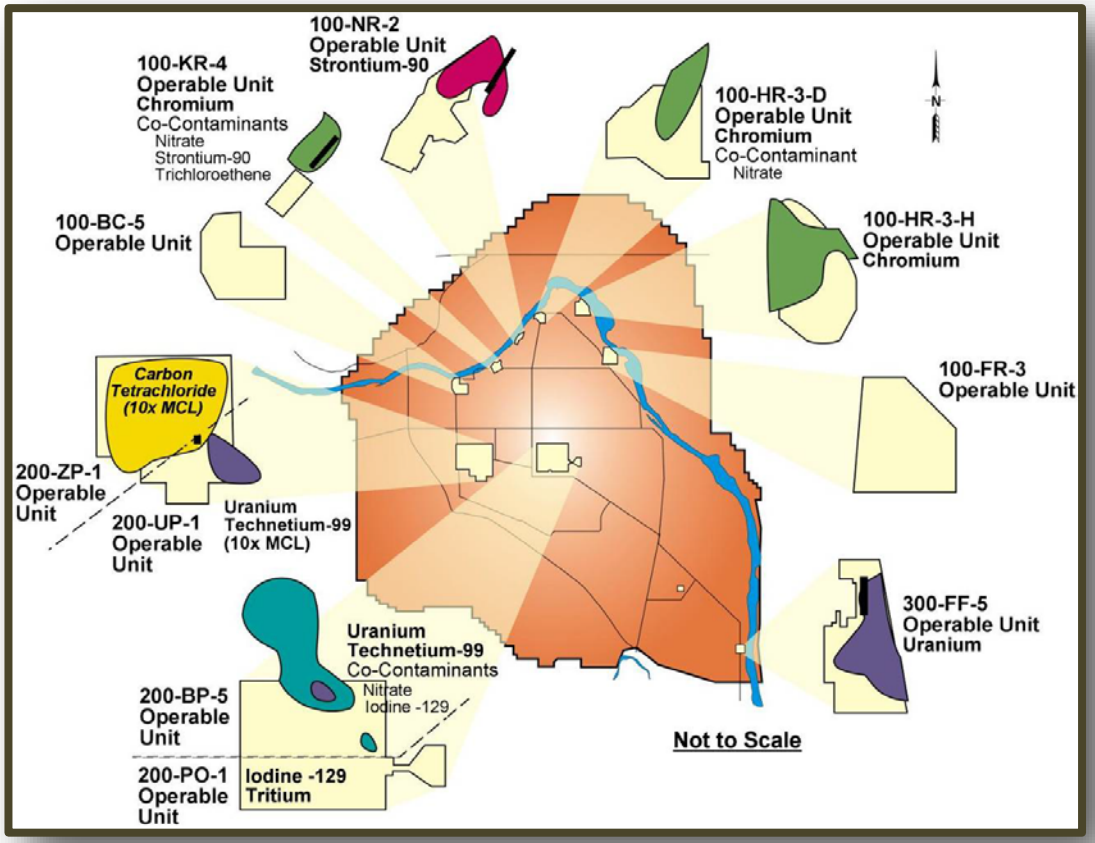
Overall Methodology



Evaluation Unit Categories

Legacy Source Sites	Tank Wastes & Tank Farms	Groundwater Plumes	D&D of Inactive Facilities	Operating Facilities
• Past practice liquid waste disposal sites • Buried solid waste sites • Unplanned releases • Underground piping and infrastructure • Near surface and vadose zone contaminated sediments	• Single-shell and double-shell high-level waste tanks • Related legacy waste sites (e.g., cribs, unplanned releases) • Near surface and vadose zone contaminated sediments	• Existing groundwater plumes (> MCLs) • Aligned with groundwater operable units • Includes pump & treat operations • Potential future contributing sources handled in other evaluation units	• Major processing complexes or key facilities with a common history of operations • Near surface and vadose zone contaminated sediments	• Solid Waste Facilities • Liquid Waste Facilities • Supporting Facilities

Groundwater Plumes



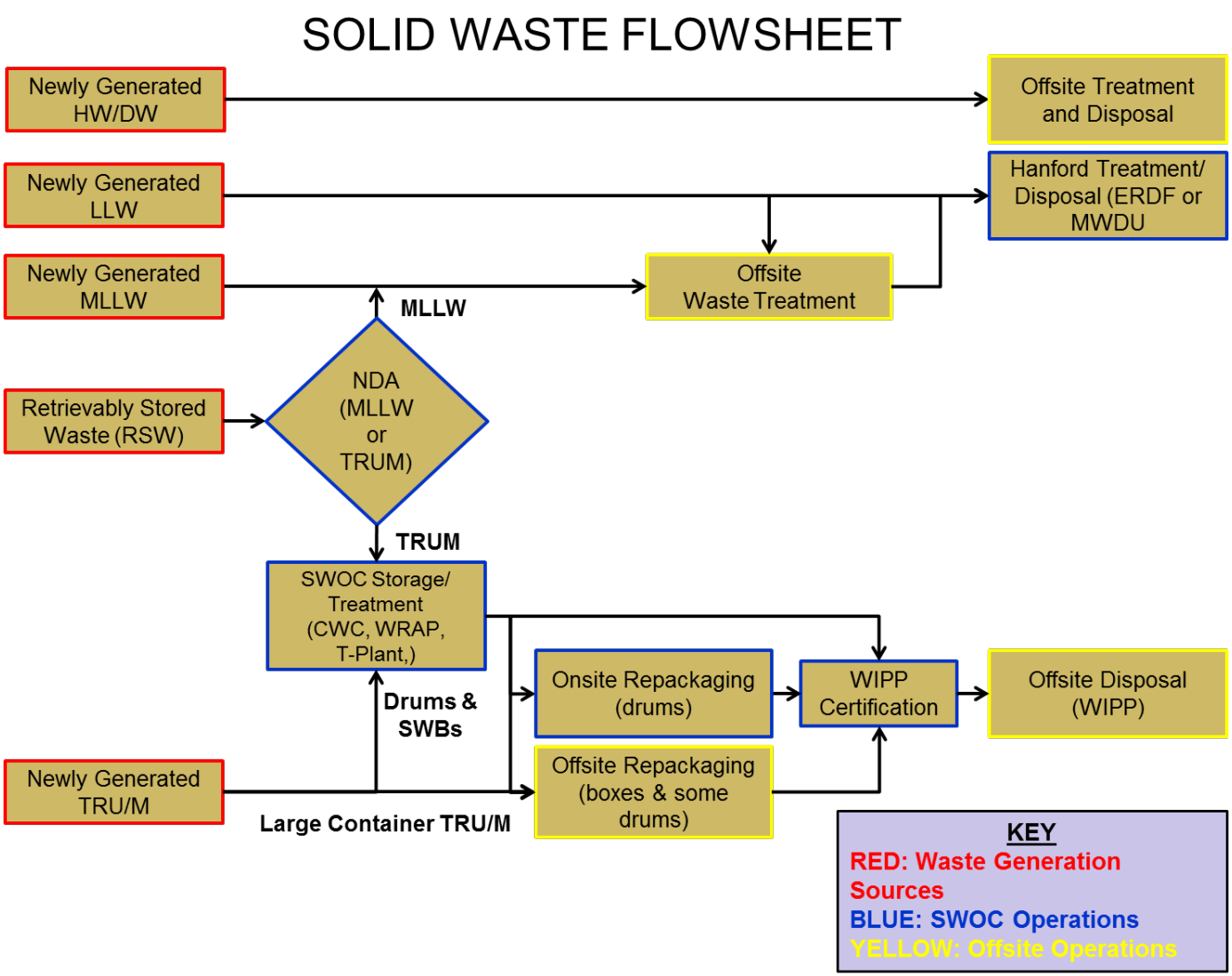
River Corridor

100-BC, 100-KR, 100-HR-3 (D&H)
primarily chromium
100-NR (strontium-90)
300-FF (uranium)

Central Plateau

200 West Groundwater
(200-ZP-1 and 200-UP-1)
200 East Groundwater
(200-BP-5 and 200-PO-1)

Operating Facilities – Solid Waste Operations



TRU, hazardous and mixed waste operations

- Buried waste retrieval operation
- WRAP
- Central Waste Complex
- T Plant (operations)

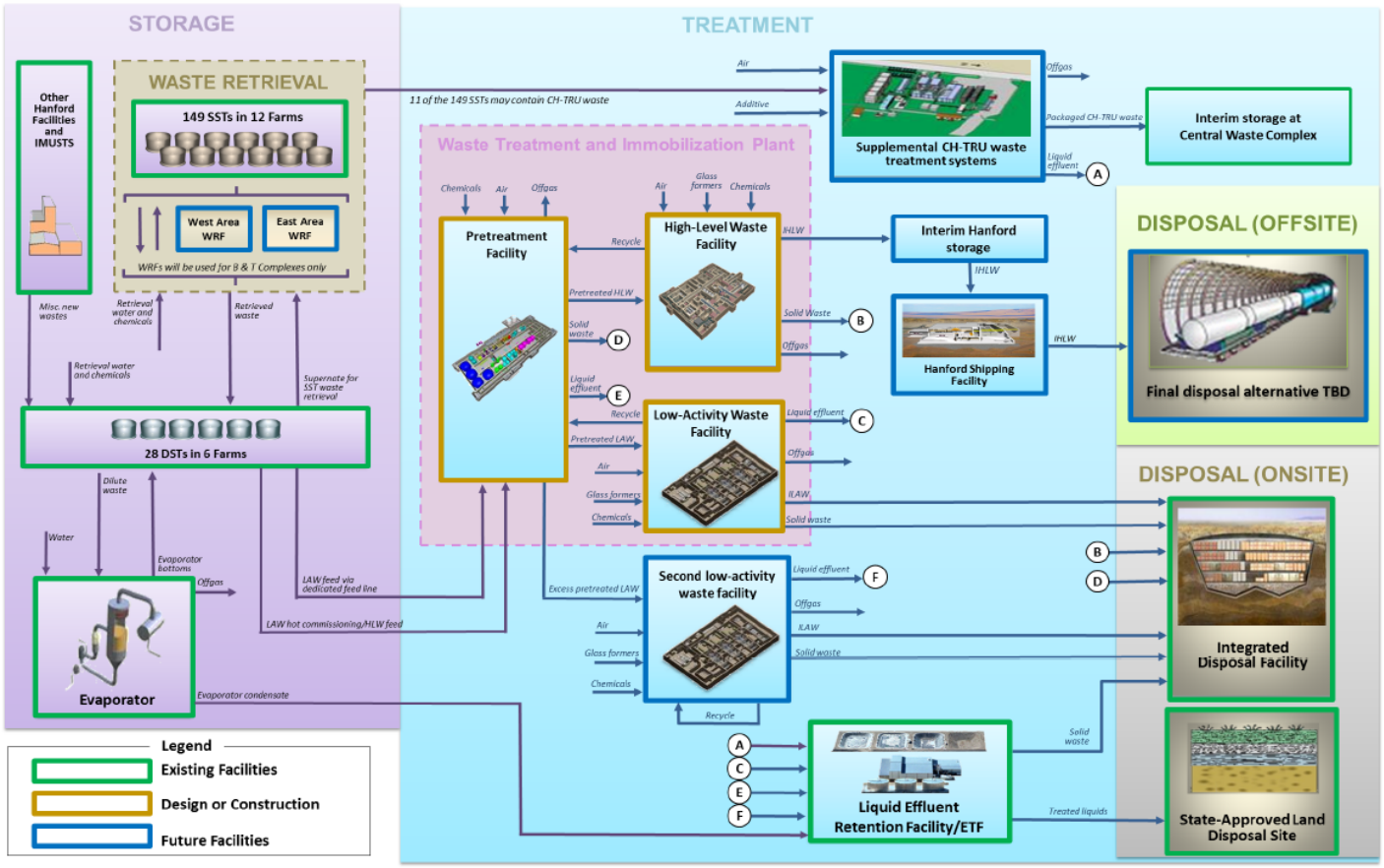
Storage of fuel and nuclear materials

- Canister Storage Building (with ISA)
- WESF and Capsules

LLW and MLLW disposal facility operations

- Mixed waste disposal trenches (31 &34)
- ERDF
- IDF (future)
- Naval Reactor Compartment Disposal Trench
- US Ecology Low-Level Waste Disposal Facility

Operating Facilities – Liquid Waste Operations



Liquid Waste Treatment and Disposal Facilities

- Evaporators
- LERF & ETF (including upgrades for WTP effluents)
- TEDF
- SALDS
- WTP (Future)

TEMPLATES FOR EVALUATION UNITS

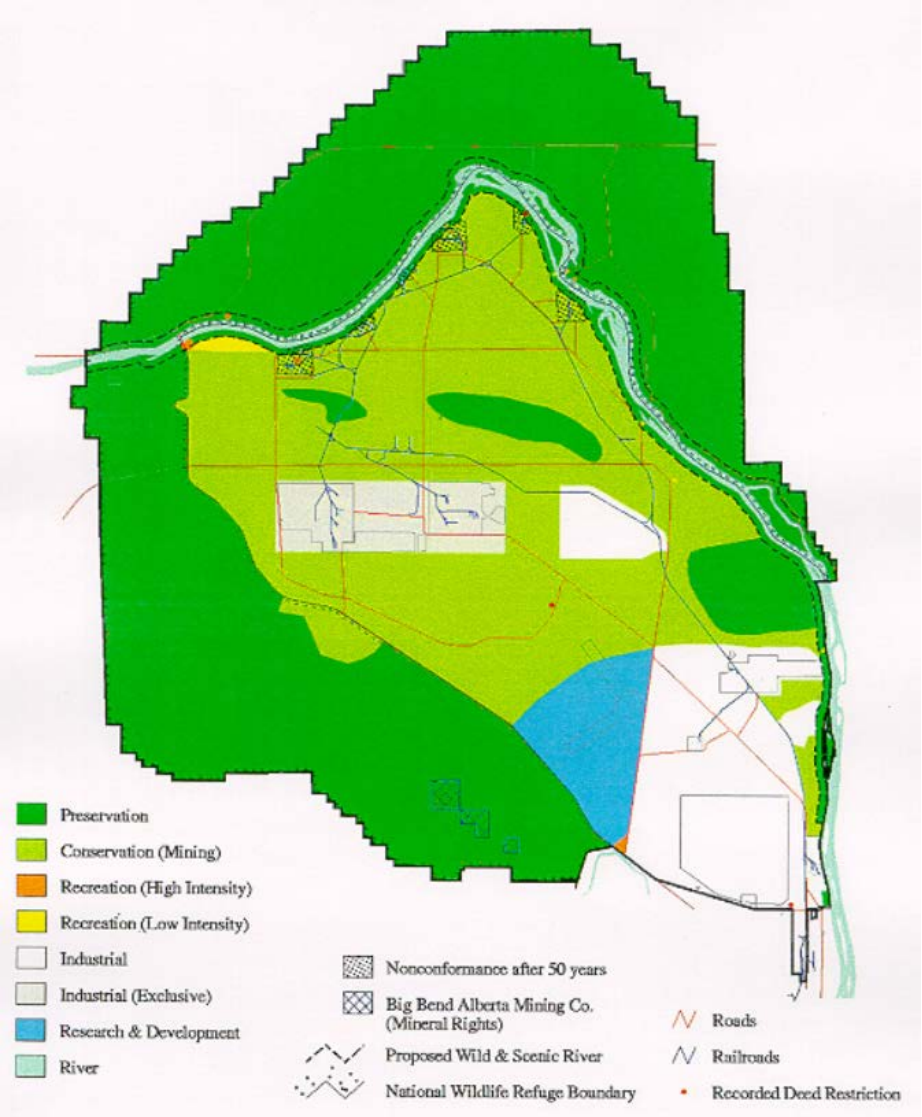
- Executive Summary
- Administrative information
- Summary description
- Unit description and history
- Waste and contamination inventory
- Potential risk/impact pathways and events
- Risk and potential impacts rating
- Supplemental information and considerations

324 building

Public Health

- Groundwater evaluated separately from land use
  - Groundwater considered protected resource by State of WA
  - Land use and institutional controls restrict water usage
  - Alternate water supply is possible such that groundwater does not constrain land use
- Current status & during cleanup
  - Controlled access limits potential public health risks to workers not affiliated with DOE mission and “stealth intruder”
  - Precluded or impaired land use should not be confused with health risk
- Post-Cleanup status
  - Comprehensive Land Use EIS and ROD (CLUP) to serve as basis for future use exposure scenarios
  - Lack of exposure scenario definitions tied to CLUP land use designation largely renders CLUP mute with respect to remediation standards and leads to confusion; WA recognizes only Industrial and unrestricted use exposure scenarios
  - Stealth intruder & stealth farmer (failure of institutional controls)

FUTURE LAND USE DESIGNATIONS FROM THE CLUP
(DOE/EIS-0222-F, Figure 3.3)



Worker Risk

- Categories of worker risk
  1. Worker exposure to site-specific radiologic or chemical hazards – Acute
  2. Worker exposure to site-specific radiologic or chemical hazards – Sub-acute
  3. Accidents and injury unrelated to site-specific contamination (identified here as “industrial accidents”)
- DOE and its contractors have accident rates approximately 1/3 of that from comparable non-DOE work
- Worker risk increases with respect nature of hazards, complexity and duration of project
- Delaying cleanup of a specific EU **may reduce** worker risk (radioactive decay) **or may increase worker risk** (facility deterioration, trained workforce availability)

Worker Risk

- Risk rating structure based on *Safety Analysis and Risk Assessment Handbook* (DOE 2012)
- Evaluations consider current status, during cleanup activities, post-cleanup (i.e., surveillance and maintenance)
- Primary risks during cleanup activities or operations
  - Hazard Assessments and Documented Safety Analyses for the EU or analogous units/experience
  - First of a kind activities considered higher risk

Groundwater

- Evaluation metrics for current groundwater plumes as a protected resource
  - Impact considered based on MCL (State of WA resource designation)
  - Amount (area) of currently impacted groundwater (>1 km^2, 0.1-1 km^2, <0.1 km^2)
  - Rate of change (increase or decrease) of impacted area
  - Considers contaminant characteristics
- Evaluation metrics for potential future sources of contamination (i.e., vadose zone, tanks)
  - Time until groundwater is impacted
  - Amount (area) of additionally impacted groundwater
  - Considers contaminant characteristics

Primary Contaminant Groups

Persistence	Mobility: Low	Mobility: Medium	Mobility: High
Low			$^{3}H_2O$, NO_3
Medium		Cs-137, Sr-90, TCE	Cyanide
High	Pu	U, Cr	Tc-99, I-129, Carbon Tetrachloride

- Group A Primary Contaminants
- Group B Primary Contaminants
- Group C Primary Contaminants
- Group D Primary Contaminants

Example Groundwater Evaluation Tables

Group A, Evaluation of Tc-99, I-129, carbon tetrachloride

	Estimated spatial extent of impact to						
	Case I. previously unimpacted groundwater (fresh plume)			**Case II.** existing plume of Group A (impact area within existing plume)		**Case III.** existing less recalcitrant plume (Group B or C; impact area within existing plume)	
Evaluation Period	>1 km^2	0.1 – 1 km^2	<0.1 km^2	0.1 – 1 km^2	<0.1 km^2	0.1 – 1 km^2	<0.1 km^2
Existing Plume	VH	VH	H	H	M	VH	H
<50 y	VH	H	M	M	L	H	M
50 – 150 y	H	M	L	L	L	M	L

VH = Very High, H = High, M = Medium, L = Low, NA = Not Applicable

Group B, Evaluation of Cr, Cs-137, Sr-90, U, TCE

	Estimated spatial extent of impact to						
	Case I. previously unimpacted groundwater (fresh plume)			**Case II.** existing same or more recalcitrant plume (Group A or B; impact area within existing plume)		**Case III.** existing less recalcitrant plume (Group C; impact area within existing plume)	
Evaluation Period	>1 km^2	0.1 – 1 km^2	<0.1 km^2	0.1 – 1 km^2	<0.1 km^2	0.1 – 1 km^2	<0.1 km^2
Existing Plume	H	H	M	M	L	H	M
<50 y	H	M	L	L	L	M	L
50 – 150 y	M	M	L	L	L	M	L

VH = Very High, H = High, M = Medium, L = Low, NA = Not Applicable

Columbia River

- Limited current direct discharges; primary potential impacts from groundwater discharge of contaminants (e.g., Sr-90, Tc-99, I-129, Cr, U, nitrate)
- Evaluation metrics for groundwater plumes
  - Time to reach/discharge to Columbia River
  - Area (river reach) impacted (> 100 m or < 100 m)
  - Contaminant characteristics
  - Fraction of contaminant load to Columbia River (< 1% or > 1%) if other than Hanford sources exist
- Consideration of thresholds
  - Free stream ecology
  - Benthic ecology

Approach for Ecological Risk Evaluation

Compare Hanford Habitat To Columbia Basin Ecoregion

IDENTIFY Ecological Resources On Evaluation Site Using Resource Level Maps

Evaluate Ecological Resources Using Modifiers

Invasive Species
Patch Size and Shape
Connectivity

Field Ground-truthing

Describe Ecological Resources

During Cleanup Ecological Risk Matrix

+

100 years Post-cleanup Risk Matrix

Consider Potential Initiating Events

Consider Functional Remediation

Evaluate Future Land Use Effects on Ecological Resources

Chinook Salmon

Changes in habitat types from historical records to 2001 for the Hanford Site and the Columbia Basin ecoregion

Cover Type	Historic Ecoregion Area (ha)	Current Ecoregion Area (ha)	Historic Hanford Site Area (ha)	Current Hanford Area (ha)	% Change in Ecoregion	% Change in Hanford Site
Bluebunch wheatgrass steppe	1,028,900	431,400	612	1602	-58.1%	161.8%
Idaho fescue steppe	436,700	122,200	0	0	-72.0%	No change
Bitterbrush steppe	118,600	78,100	915	904	-34.1%	-1.2%
Big sagebrush steppe	4,096,900	1,662,400	148,902	137,834	-59.4%	-7.4%
Juniper/sagebrush	110,300	109,100	508	508	-1.1%	No change
Threetip sagebrush	746,000	0	16	0*	-100%	-100%
Black greasewood	134,900	0	503	0*	-100%	-100%
Conifers/Idaho fescue	225,000	0	0	0	-100%	-100%
Ponderosa pine	302,900	335,100	102	102	10.6	10.6%
Water	71,100	71,100	25	25	No change	No change
Other	205,500	4,667,400	0	10,612	2,171%	
Total	7,476,800	7,476,800	151,583	151,587		

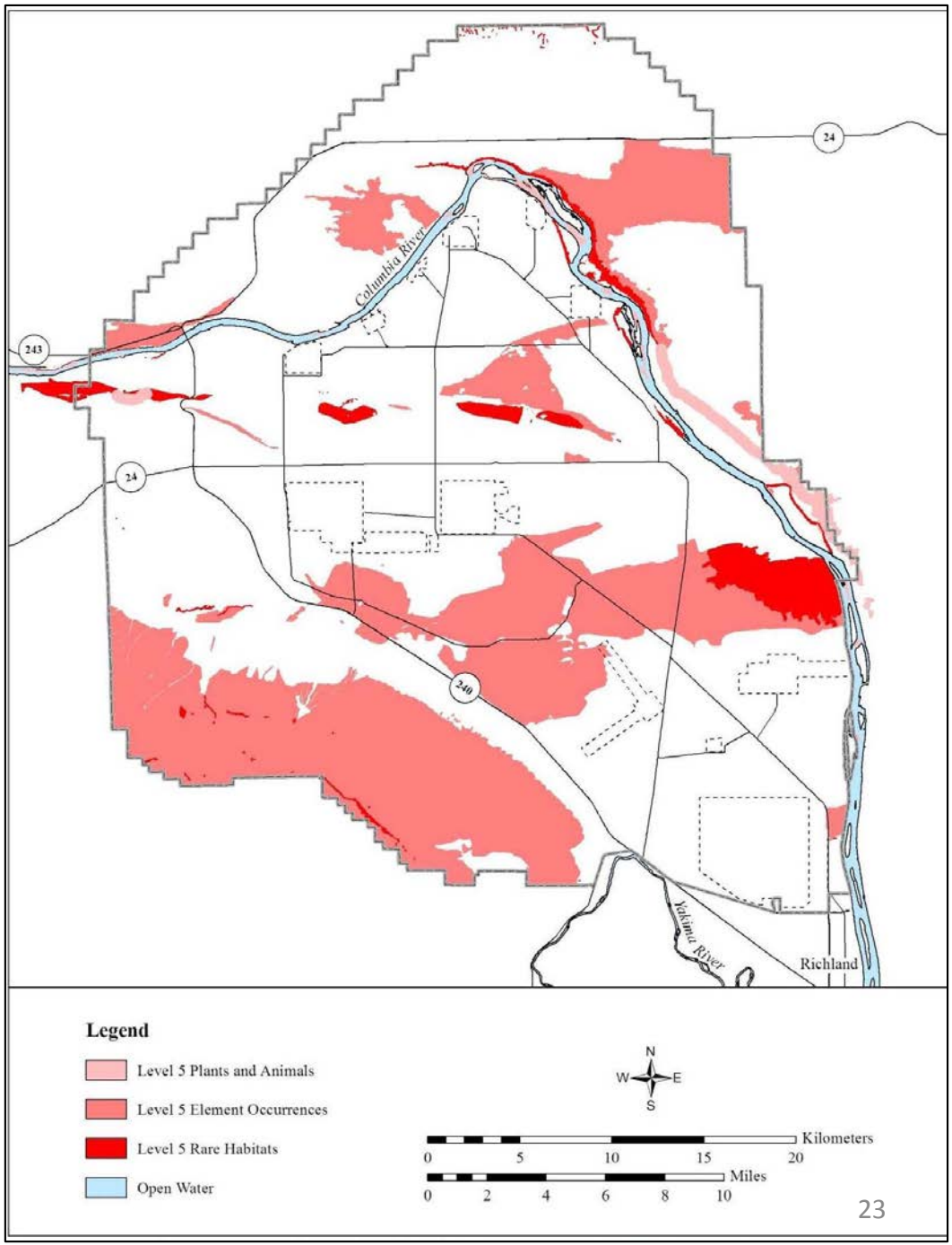
*This disappearance is likely due to not being documented in later years.
100 % decrease means it went from some amount to none (or it was not measured).

LEVELS OF ECOLOGICAL RESOURCES
(DOE/RL-96-32, 2013)

Level 5 = irreplaceable habitat or federal threatened and endangered species (including proposed species and species new to science or unique to WA).
Level 4 = Essential habitat for important species
Level 3 = Important habitat
Level 2 = Habitat with high potential for restoration
Level 1 = Industrial or developed
Level 0 = Non-native plants and animals

Level 5 Species / Habitat

Sage Grouse



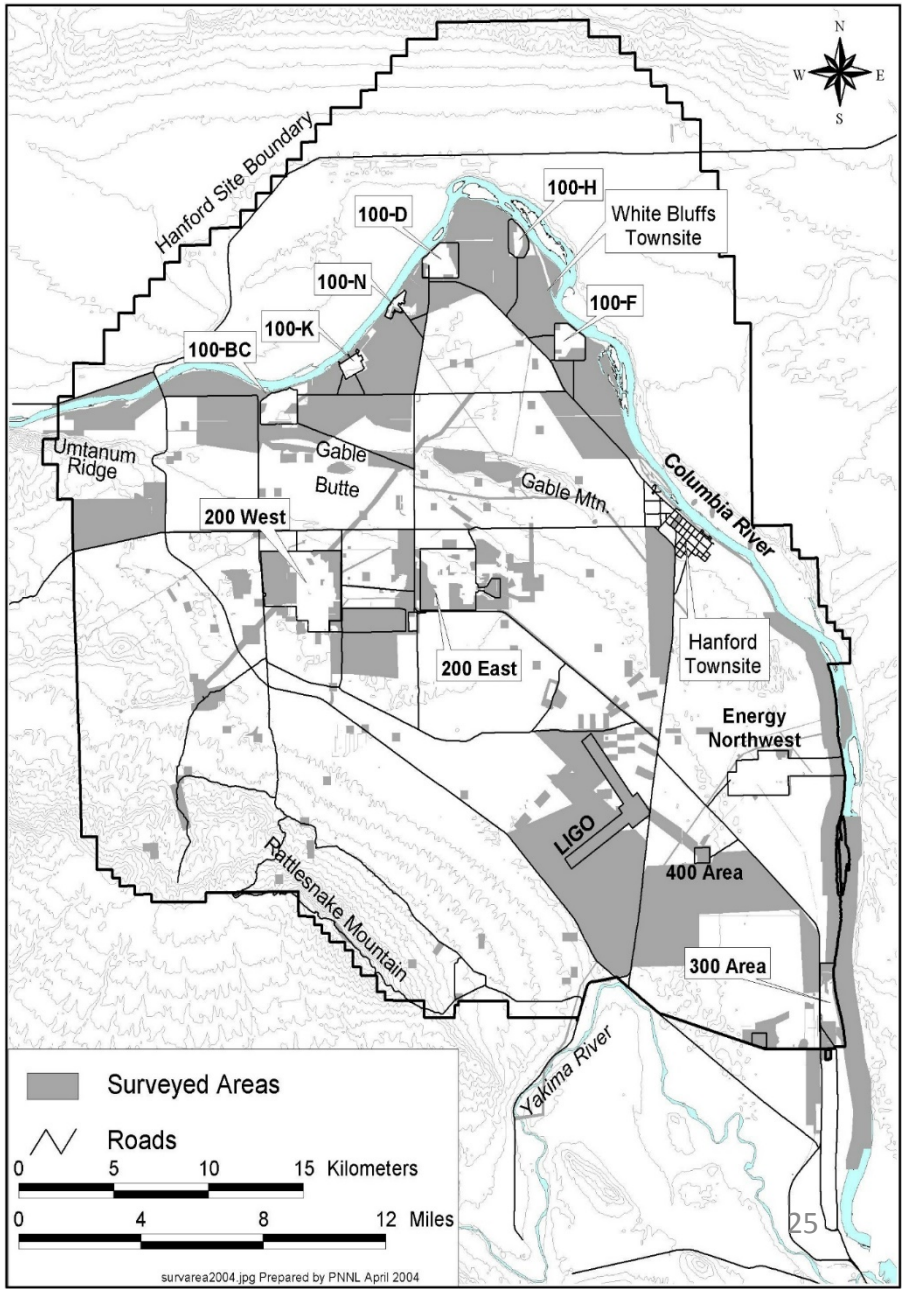
RISK RATING FOR ECOLOGICAL RESOURCES DURING REMEDIATION

	Level 1	Level 2	Level 3	Level 4	Level 5
Natural Attenuation	ND	ND	Low	Low	Medium
In-Situ Containment(Capping)	ND	ND	Low	Medium	High
Pump and Treat	ND	Low	Low	Medium	High
In-Situ Treatment (grouting, permeable barriers)	Low	Low	Medium	High	High
D & D (Take down building)	Low	Medium	High	High	Very High
Excavation	Low-Medium	High	Very High	Very High	Very High

NOTE: The ecological impact to resources at the borrow pits is not included in these evaluations. Restoration of the evaluation unit is assumed to be part of the remediation action.

CULTURAL RESOURCES

- **Native American:** Pre-contact - 10,000 years to Present
- **Historic Pre-Hanford:** 1805 to 1943
- **Manhattan Project and Cold War Era:** 1943 to 1990



Manhattan Project National Historical Park

– Six Resources Explicitly Mentioned in Legislation

CULTURAL RESOURCE LEVELS

The Key to levels of Cultural Resources (listed from highest to lowest):

- **Level 4 =** (A) Contains a Native American burial site or burial Item and/or (B) Contains property listed or eligible for listing in the National Register of Historic Places (except as described in Level 1 B)
- **Level 3 =** Is a location that has been specifically identified as having tribal historic, religious and cultural importance
- **Level 2 =** (A) Contains a place for usual and customary subsistence or consumptive practices or exercising other tribal rights by Native Americans; and/or (B) Is a place for recreation and/or is considered a view shed of a scenic place or is scenic place
- **Level 1 =** (A) Uncertain, But Presence Is Possible or Likely and/or (B) Contains Manhattan Project and Cold War Era building or structure (within the Historic District and eligible for listing in the National Register, but a determination has been made that the building or structure does not qualify for adaptive reuse)

CULTURAL RESOURCES RISK MATRIX
ACTIVE CLEANUP (50 Years or to 2064)

(from Not Discernible to Very High Risk)

CLEANUP OPTIONS	Level 1 (Uncertain Presence, but Possible, Likely)	Level 2 (Consumptive; Scenic; Recreation)	Level 3 (Important to Tribes)	Level 4 (Burial Site; Listed in National Register)
Natural Attenuation	Not Discernible	Low	Low	Low
In-Situ Containment	Low	Medium	High	High
Pump and Treat	Low	Medium	High	High
In-Situ Treatment	Low	Low to Medium	Medium to High	High
D & D	Medium	High	High	Very High
Excavation	Medium	High to Very High	High to Very High	Very High

Overall Evaluation

Summary Table of Risks and Potential Impacts to Receptors:

EU: CP-TF-1 - Risk or Impact Rating				
		Evaluation Time Periods		
		Active Cleanup (to 2064)		Near-Term Post Cleanup (to 2164)
Population or Resource		Current Condition/ Operations	From Cleanup Actions	
Human	Worker (remediation & facility worker)			
	Worker (co-located)			
	Public			
Environmental	Groundwater			
	Surface water			
	Ecological Resources			
Social	Cultural Resources			
	Economic Resources			

TO BE COMPLETED IN FINAL TEMPLATE

Pilot Evaluation Units

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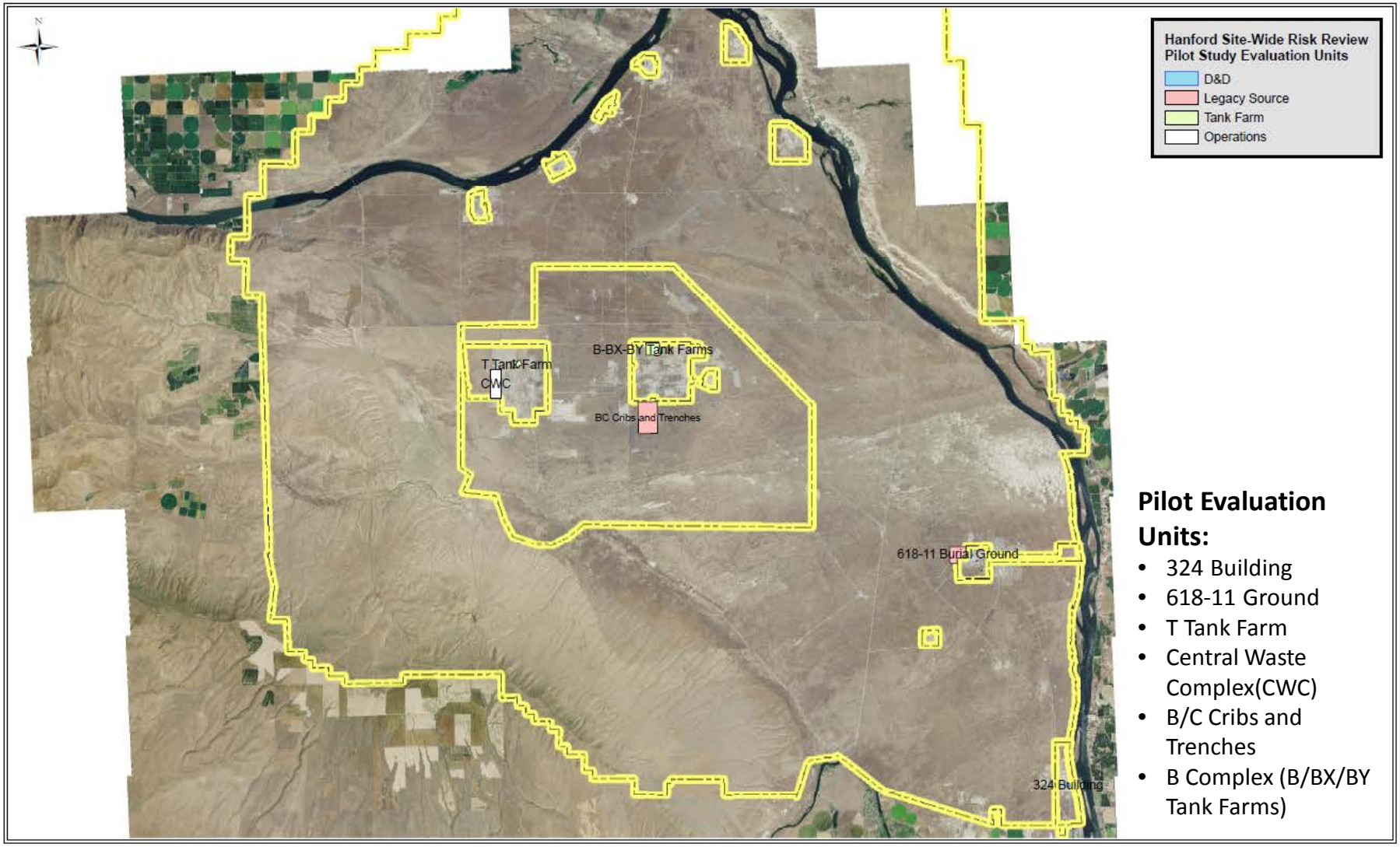
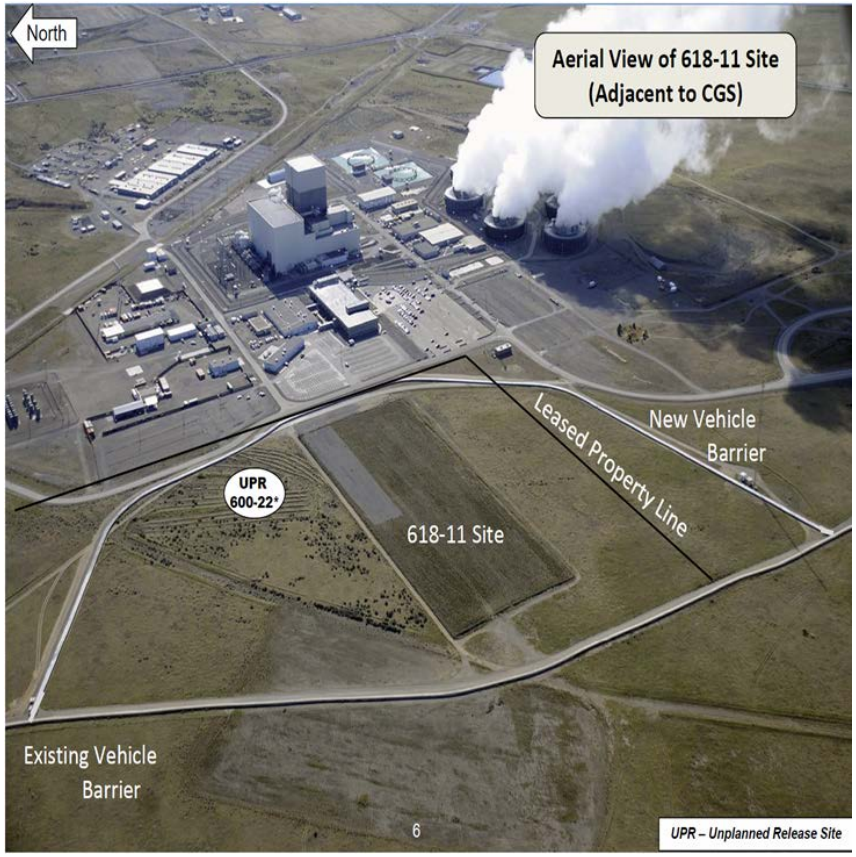


Pilot Evaluation Units:

- 324 Building
- 618-11 Ground
- T Tank Farm
- Central Waste Complex(CWC)
- B/C Cribs and Trenches
- B Complex (B/BX/BY Tank Farms)

1 inch = 15,000 feet

618-11 Near Surface Burial Site



- Adjacent to Energy Northwest nuclear power generating station
- Estimated Inventory:
  4,200 Ci Sr-90 5,300 Ci Cs-137
  226 Ci Am-241 132 Ci Pu-239
  639 Ci Pu-241 330 kg Beryllium
- 3 Trenches, 50 vertical pipe units, 4-6 caissons
- Poorly characterized fissile & pyrophoric materials, tritium targets, high dose rate wastes
- Tritium & nitrate plume estimated to attenuate to below drinking water standard prior to reaching Columbia River
- Greatest risks during cleanup actions

Figure 2-5. A 618-11 Site Caisson.

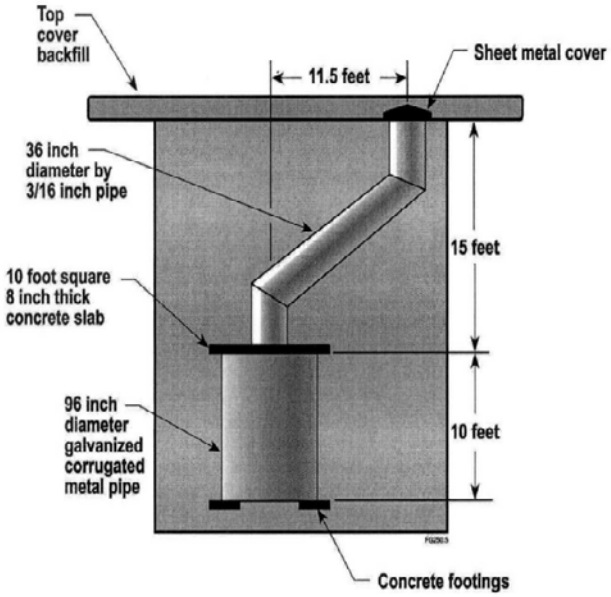


Figure 2-3. A 618-10 and 618-11 Site Vertical Pipe Unit.

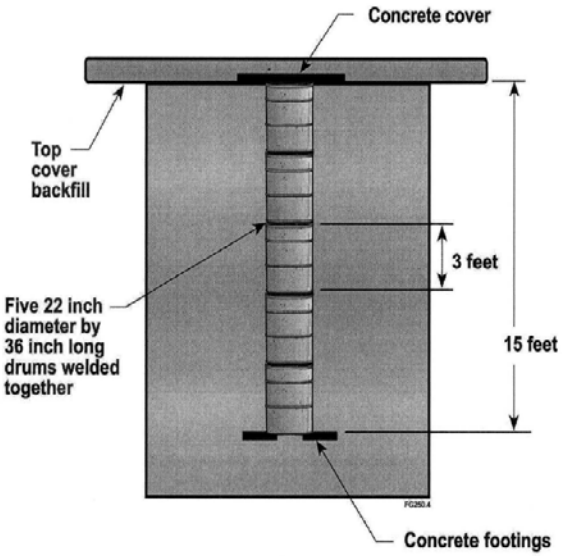
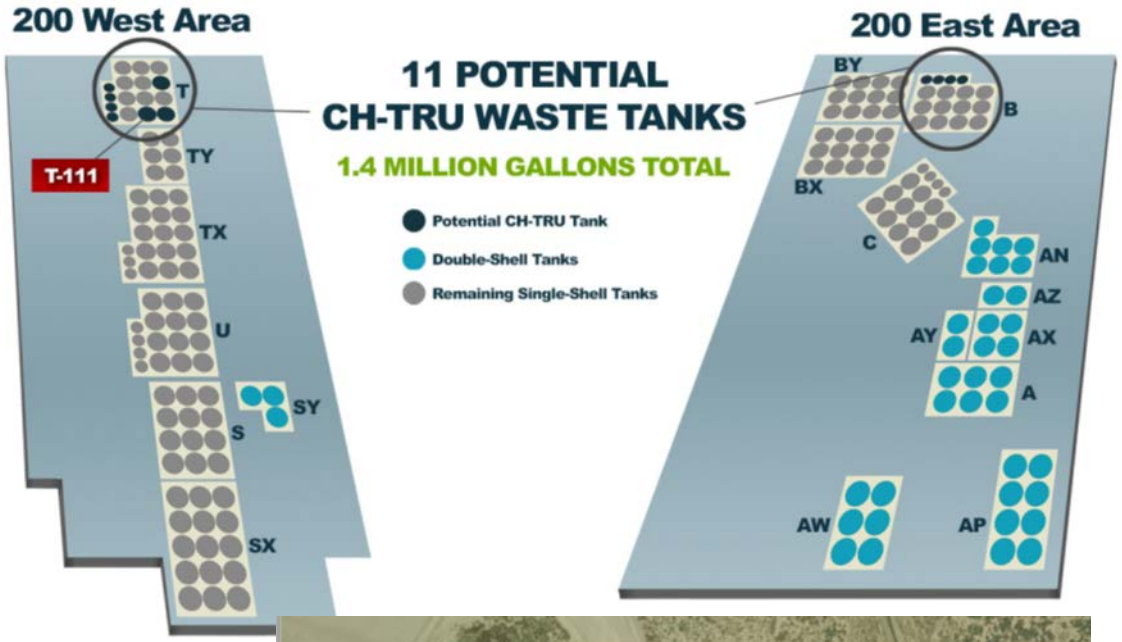


Figure 2-19: Covering and Solving Over Filled Trench

- Vertical pipe units - five 55 gallon drums welded together
- Caissons 8 ft diameter pipe with chute offset to limit radiation shine
- Trenches received varied waste packages

T Tank Farm Evaluation Unit

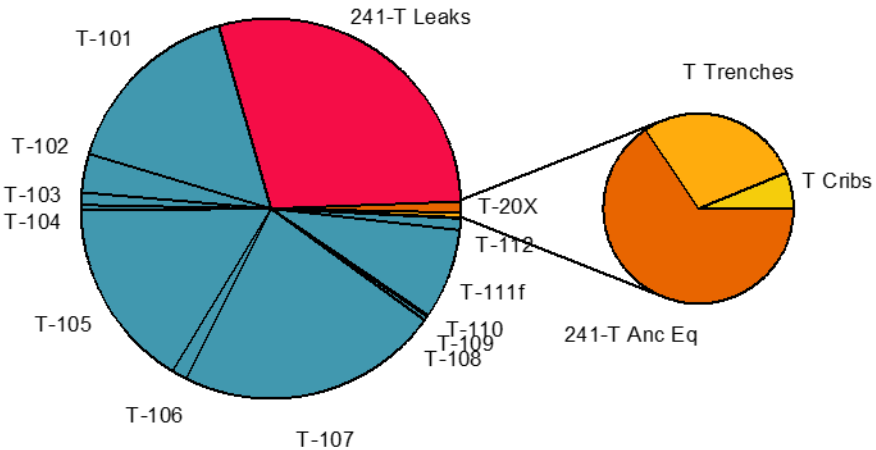


- 16 high-level waste (HLW) tanks, ancillary structures, associated liquid waste sites, and soils contamination (cribs, trenches, graves, unplanned releases)
- Cr, I-129, Tc-99, nitrate vadose zone contamination and groundwater plumes

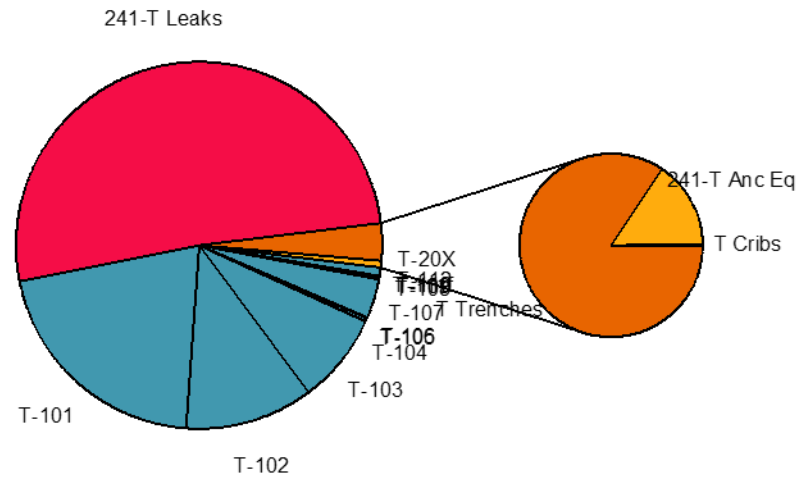
Relative Contributions of T Tank Farm Evaluation Unit Sources to Corresponding Inventory over All Hanford Single-Shell Tank Farm Sources (TC&WM EIS, Appendix D)
(T Tank Farm EU contributions exceeding equal distribution, 8.3%, are shown in red.)

	Analyte	Current Plume[c]	HLW Tanks[d]	Ancillary Equipment[e]	Soil (Leaks)[f]	Unplanned Releases[g]	Cribs[h]	Trenches[i]
Radionuclides	Hydrogen-3 (tritium)	√	0.38%	0.91%	17.53%	--	0.002%	93.64%
	Carbon-14		0.57%	1.38%	27.59%	--	2.62%	3.91%
	Strontium-90[a]		1.08%	1.51%	19.13%	--	4.14%	3.56%
	Technetium-99	√	1.05%	2.33%	26.12%	--	0.14%	0.66%
	Iodine-129	√	0.38%	0.88%	26.92%	--	0.01%	3.51%
	Cesium-137[a]		1.02%	2.04%	6.38%	--	3.09%	12.21%
	Uranium isotopes (U-233, -234, -235, -238)		2.96%	3.47%	2.37%	--	3.95%	2.17%
	Neptunium-237		0.47%	0.99%	23.92%	--	7.69%	1.82%
	Plutonium isotopes (Pu-239, -240)		2.14%	3.25%	19.57%	--	47.31%	2.47%
Chemicals	Chromium	√	2.44%	5.24%	11.65%	--	36.22%	3.23%
	Mercury		1.18%	1.48%	10.68%	--	--	18.41%
	Nitrate	√	1.44%	3.21%	11.87%	--	27.16%	3.25%
	Lead		6.06%	7.90%	11.69%	--	--	19.78%
	Uranium (total)		6.86%	9.63%	2.12%	--	9.31%	5.13%
	Butanol (n-butyl alcohol)		--	--	33.45%	--	--	--
	Polychlorinated biphenyls (PCBs)		5.77%	10.73%	--	--	--	--

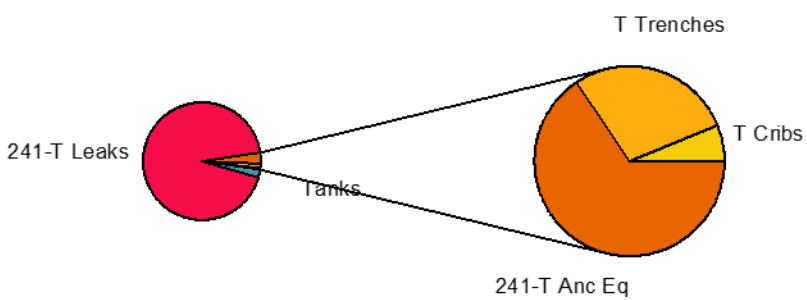
T Tank Farm – Tc-99 & I-129 Before and After Retrieval



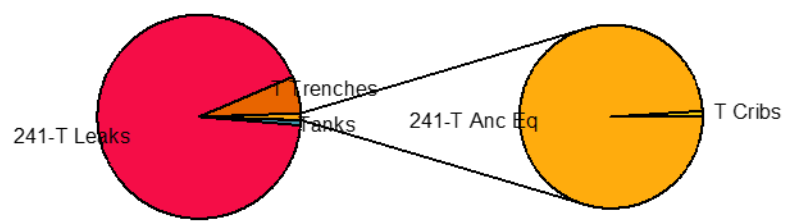
Before Retrieval Tc-99 (Total Inventory = 230 [Ci])



Before Retrieval I-129 (Total Inventory = 0.25 [Ci])



Post Retrieval Tc-99 (Total Inventory = 72 [Ci])



Post Retrieval I-129 (Total Inventory = 0.14 [Ci])

T Cribs
T Trenches
241-T Anc Eq
241-T Leaks
Tanks

T Cribs
241-T Anc Eq
T Trenches
241-T Leaks
Tanks

Interim Report Evaluation Units
200-E Area

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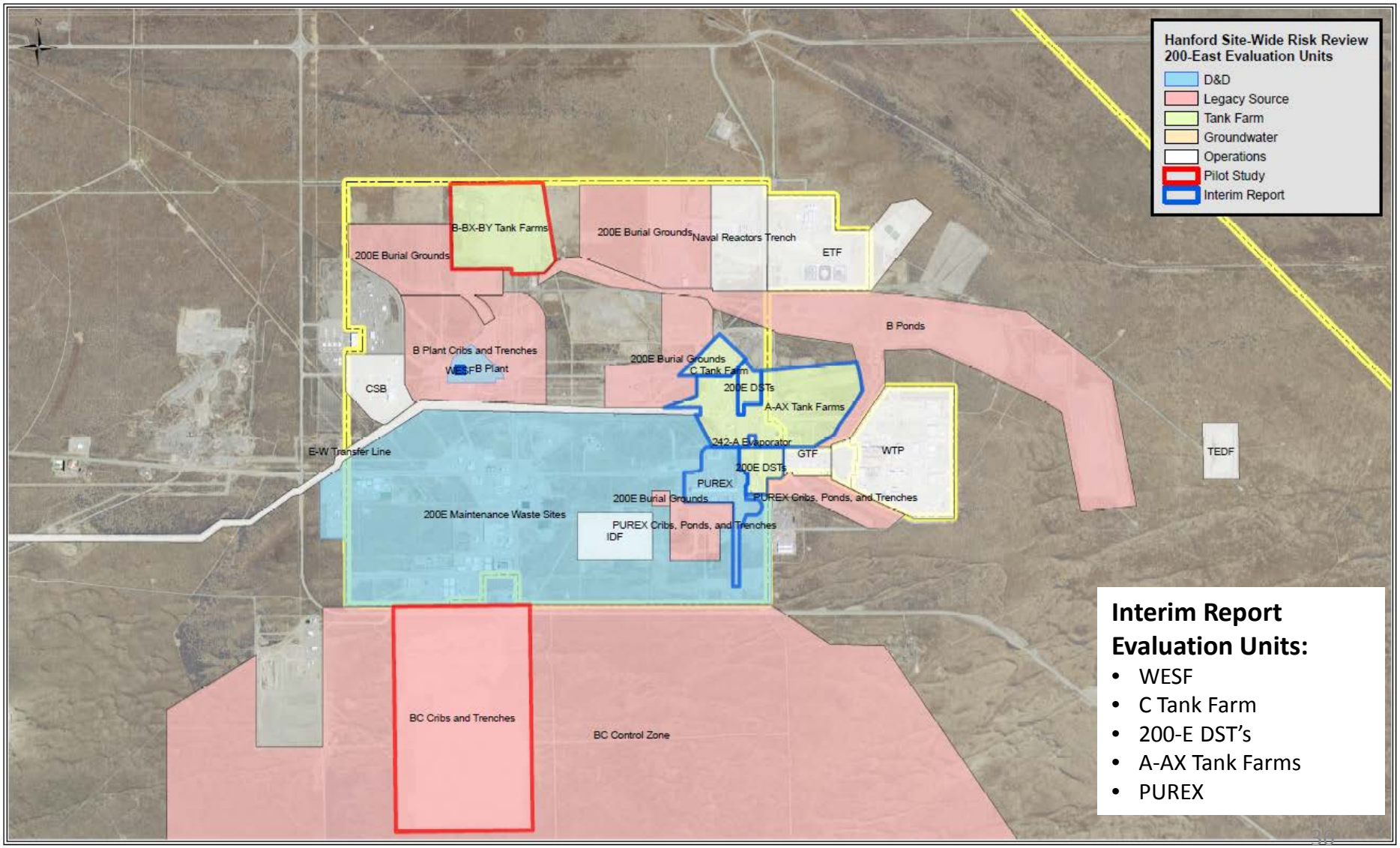


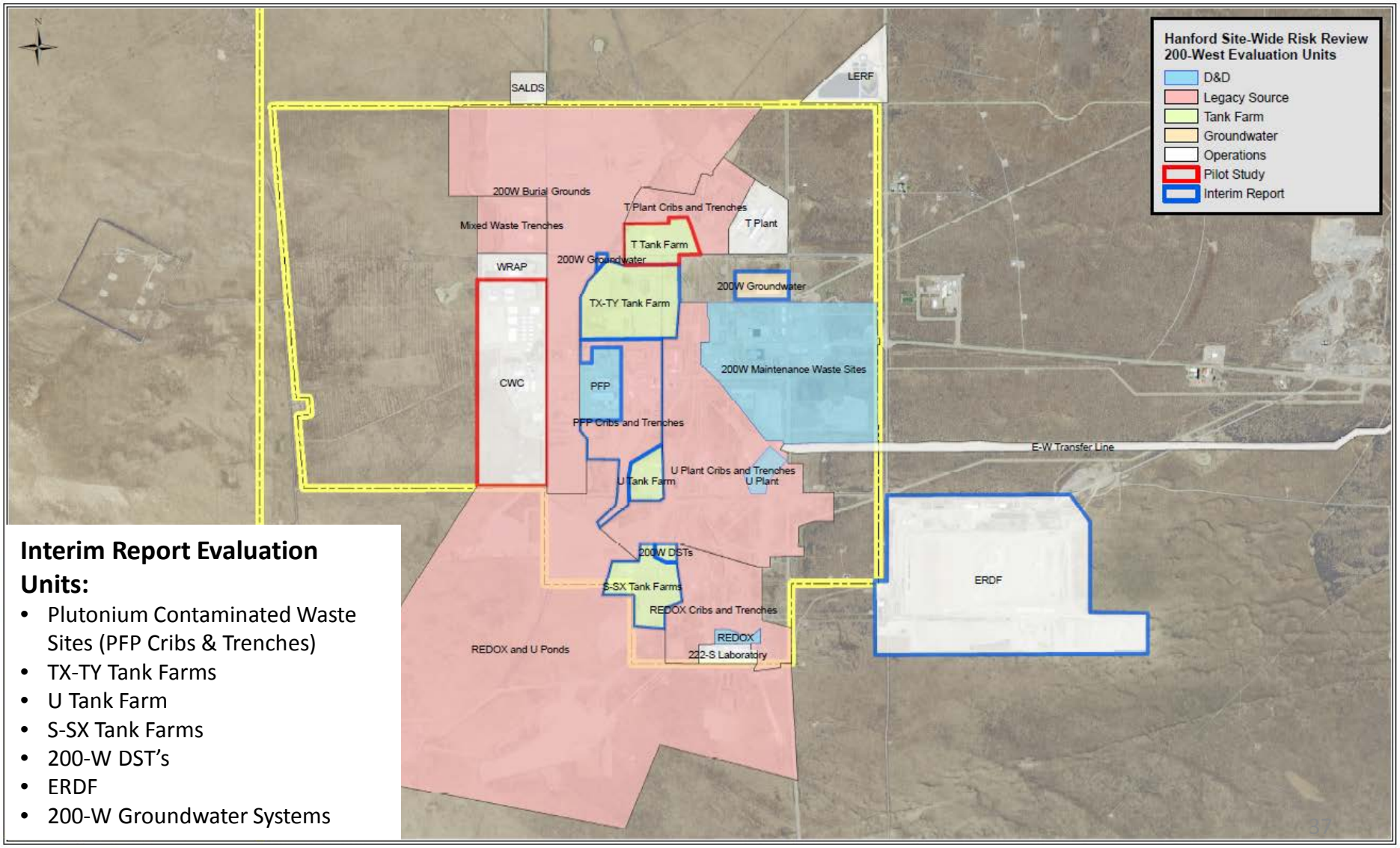
Interim Report Evaluation Units:

- WESF
- C Tank Farm
- 200-E DST's
- A-AX Tank Farms
- PUREX

1 inch = 2,100 feet

Interim Report Evaluation Units
200-W Area

DRAFT



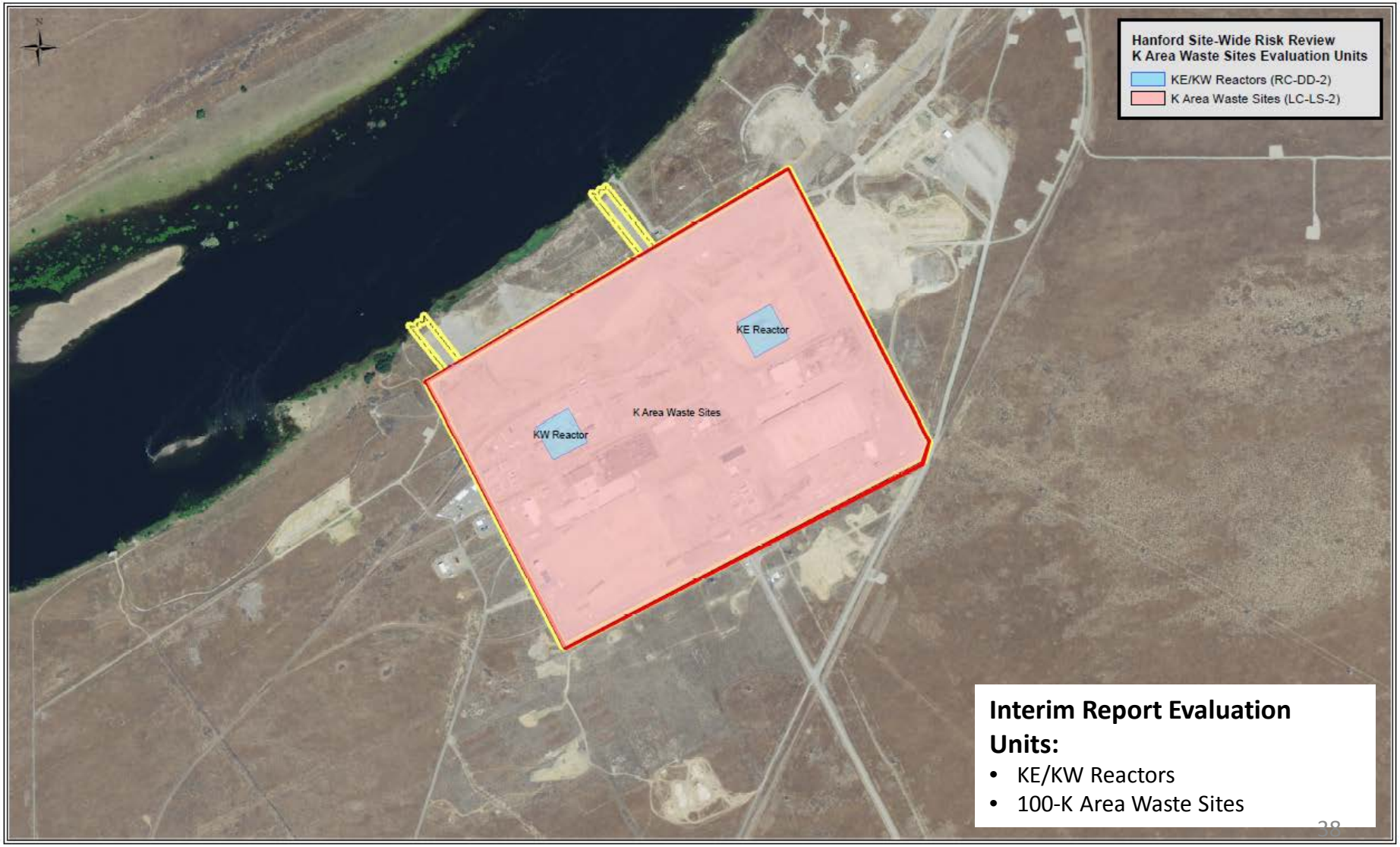
Interim Report Evaluation Units:

- Plutonium Contaminated Waste Sites (PFP Cribs & Trenches)
- TX-TY Tank Farms
- U Tank Farm
- S-SX Tank Farms
- 200-W DST's
- ERDF
- 200-W Groundwater Systems

1 inch = 2,100 feet

Interim Report Evaluation Units
100 Areas

DRAFT



Interim Report Evaluation Units:

- KE/KW Reactors
- 100-K Area Waste Sites

1 inch = 800 feet

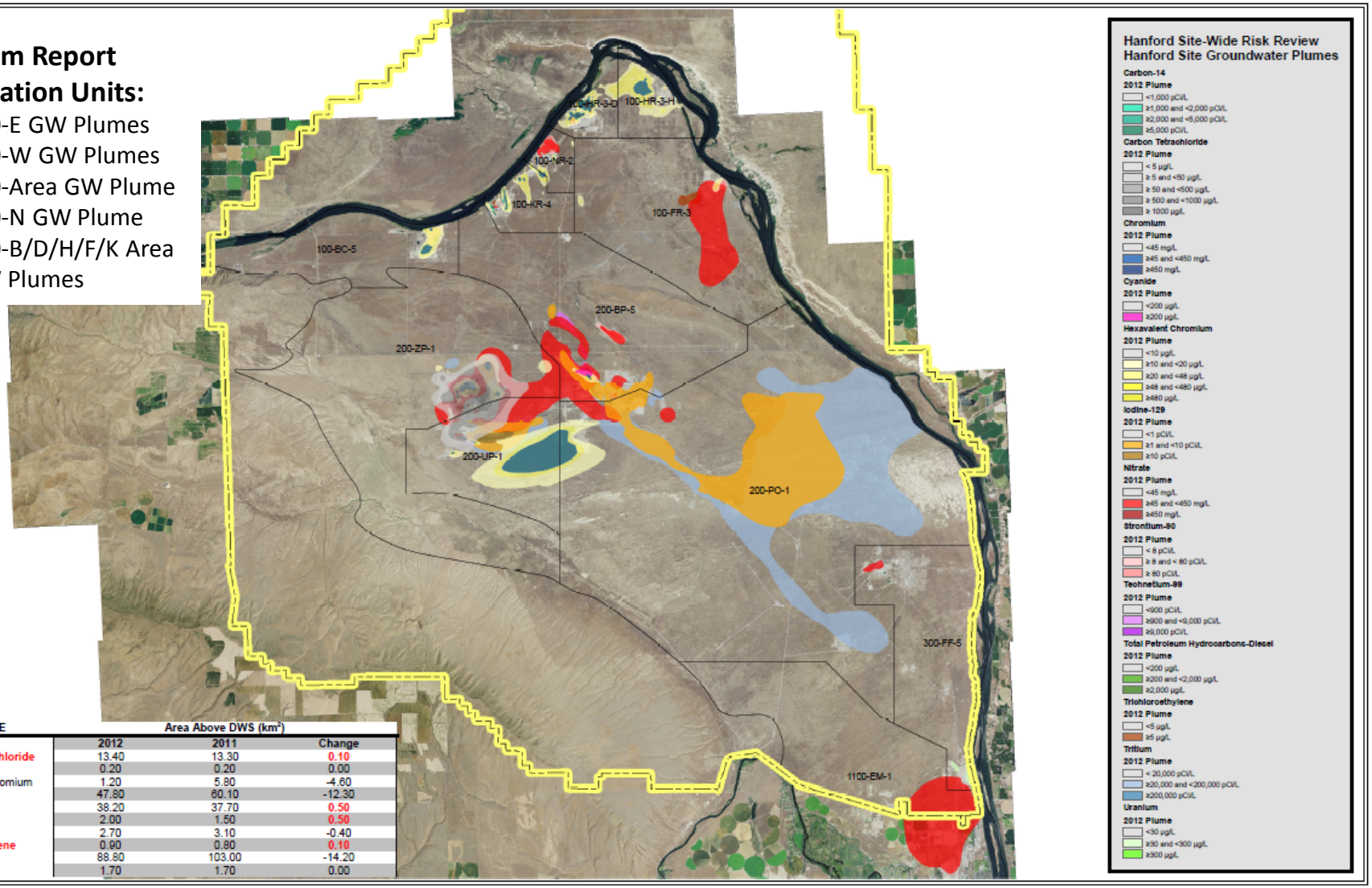
Interim Report Evaluation Units
Groundwater Units

DRAFT

N

Interim Report Evaluation Units:

- 200-E GW Plumes
- 200-W GW Plumes
- 300-Area GW Plume
- 100-N GW Plume
- 100-B/D/H/F/K Area GW Plumes



HANFORD SITE	Area Above DWS (km²)		
COPC	2012	2011	Change
Carbon Tetrachloride	13.40	13.30	0.10
Cyanide	0.20	0.20	0.00
Hexavalent Chromium	1.20	5.80	-4.60
Iodine-129	47.80	60.10	-12.30
Nitrate	38.20	37.70	0.50
Strontium-90	2.00	1.50	0.50
Technetium-99	2.70	3.10	-0.40
Trichloroethylene	0.90	0.80	0.10
Tritium	88.80	103.00	-14.20
Uranium	1.70	1.70	0.00

1 inch = 17,000 feet

Note: All groundwater plumes were generated by CH2MHILL Plateau Remediation Company for the 2012 Hanford Site Groundwater Monitoring Report (DOE/RL-2013-22).

OUTREACH ON METHODOLOGY

- Solicit Input
  - Government agencies
    (Washington Ecology & Health, EPA, DNFSB, Oregon)
  - Hanford Communities & Elected Officials
  - Tribes
  - Hanford Advisory Board (HAB)
- Multiple approaches
  - Briefings
  - Comments through CRESP web-site submission

OUTREACH ON METHODOLOGY

BRIEFINGS

- ✓ Governmental Agencies
  (DOE, EPA, DNFSB, Washington Ecology/Health, Oregon)
- ✓ Tribes (on Ecological and Cultural Resources Chapters)
- ✓ Hanford Advisory Board
- ✓ Hanford Communities & Elected Officials

HOW TO COMMENT

- Period for providing written comments begins Thursday, September 4, 2014
- Copies of entire methodology may be obtained at: www.cresp.org/hanford
- We encourage you to distribute methodology within organization or tribe for review and comment
- Deadline for providing comments is Friday, October 3, 2014
- Comments should be submitted online
- All written comments received will be acknowledged, considered and form the basis for improving the methodology used to execute the entire Risk Review Project

NEXT STEPS

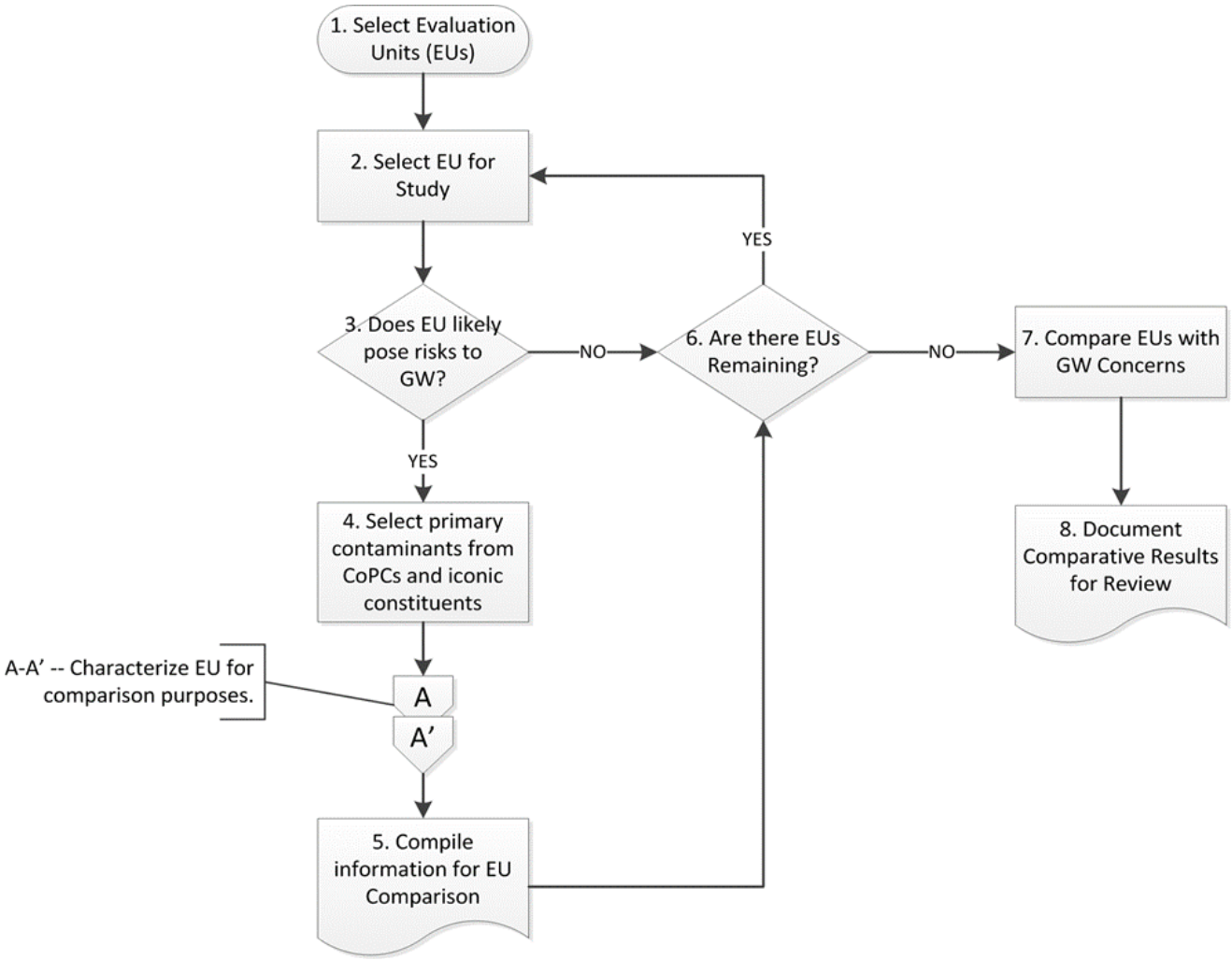
- Collect information on next set of evaluation units (approximately 26, includes pilot cases)
- Complete evaluations using Methodology (improved from comments)
- Interim Progress Report –submitted by February 2, 2015 (written comments solicited on Report)
- Draft Final Report – submitted December 2015 (written comments solicited on draft)

Supporting Information

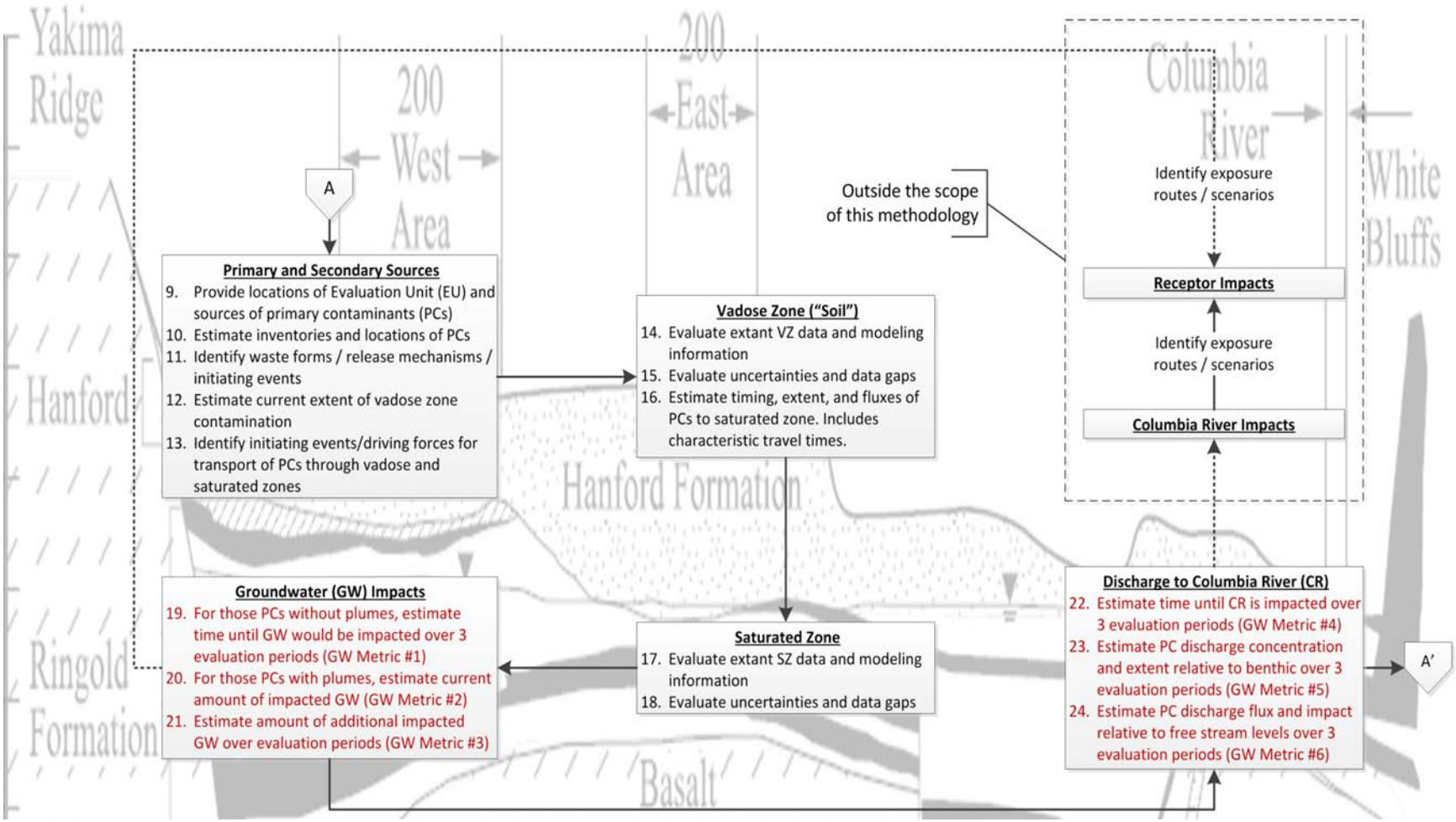
DEFINITIONS OF LAND USE DESIGNATIONS IN THE CLUP
(DOE/EIS-0222-F)

Industrial Exclusive	An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes. Includes related activities consistent with Industrial-Exclusive uses.
Industrial	An area suitable and desirable for activities, such as reactor operations, rail, barge transport facilities, mining, manufacturing, food processing, assembly, warehouse, and distribution operations. Includes related activities consistent with Industrial uses.
Research and Development	An area designated for conducting basic or applied research that requires the use of a large-scale or isolated facility, or smaller scale time-limited research conducted in the field or within facilities that consume limited resources. Includes scientific, engineering, technology development, technology transfer, and technology deployment activities to meet regional and national needs. Includes related activities consistent with Research and Development.
High-Intensity Recreation	An area allocated for high-intensity, visitor-serving activities and facilities (commercial and governmental), such as golf courses, recreational vehicle parks, boat launching facilities, Tribal fishing facilities, destination resorts, cultural centers, and museums. Includes related activities consistent with High-Intensity Recreation.
Low-Intensity Recreation	An area allocated for low-intensity, visitor-serving activities and facilities, such as improved recreational trails, primitive boat launching facilities, and permitted campgrounds. Includes related activities consistent with Low-Intensity Recreation.
Conservation (Mining)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes) could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining), consistent with the protection of archeological, cultural, ecological, and natural resources.
Preservation	An area managed for the preservation of archeological, cultural, ecological, and natural resources. No new consumptive uses (i.e., mining or extraction of non-renewable resources) would be allowed within this area. Limited public access would be consistent with resource preservation. Includes activities related to Preservation uses.

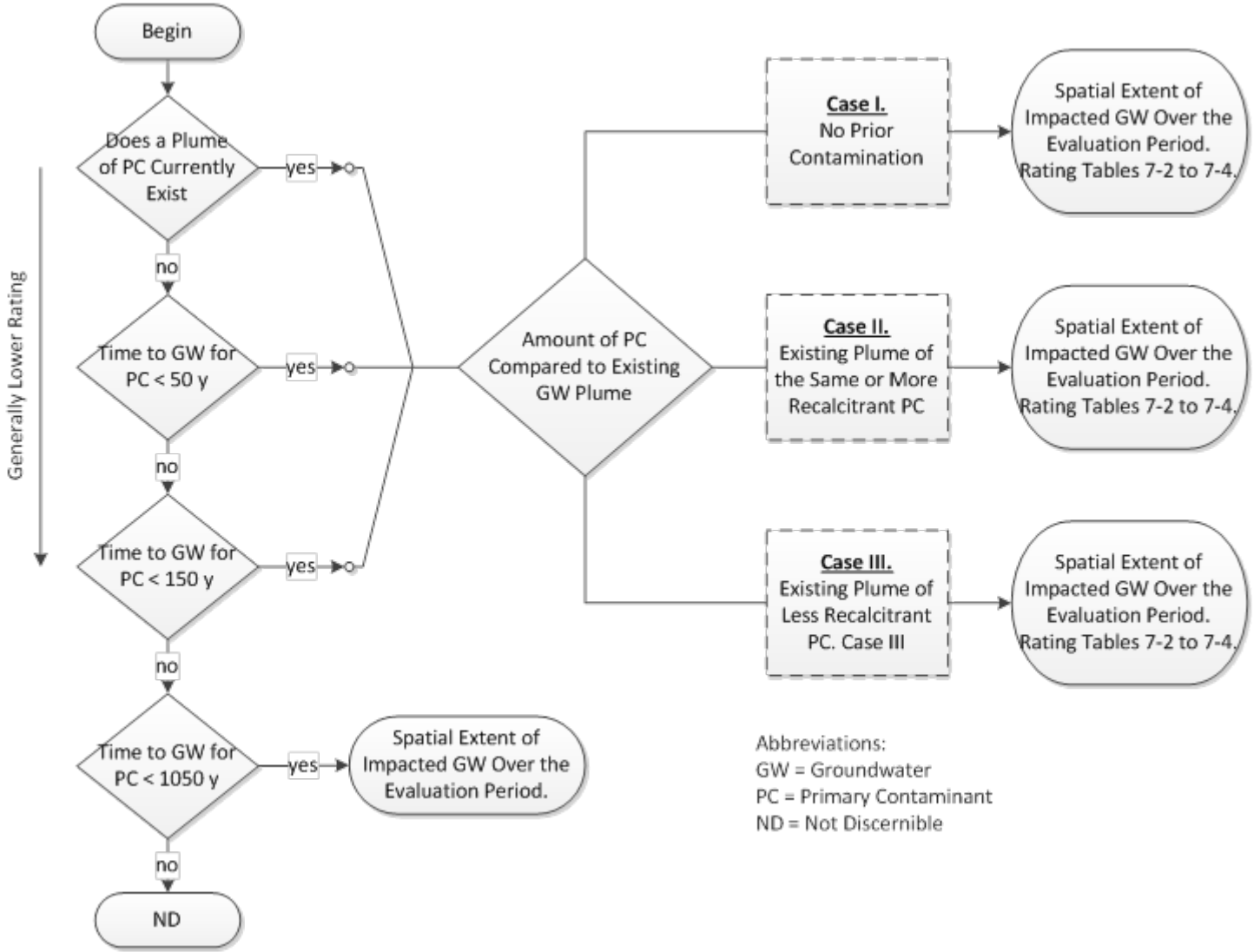
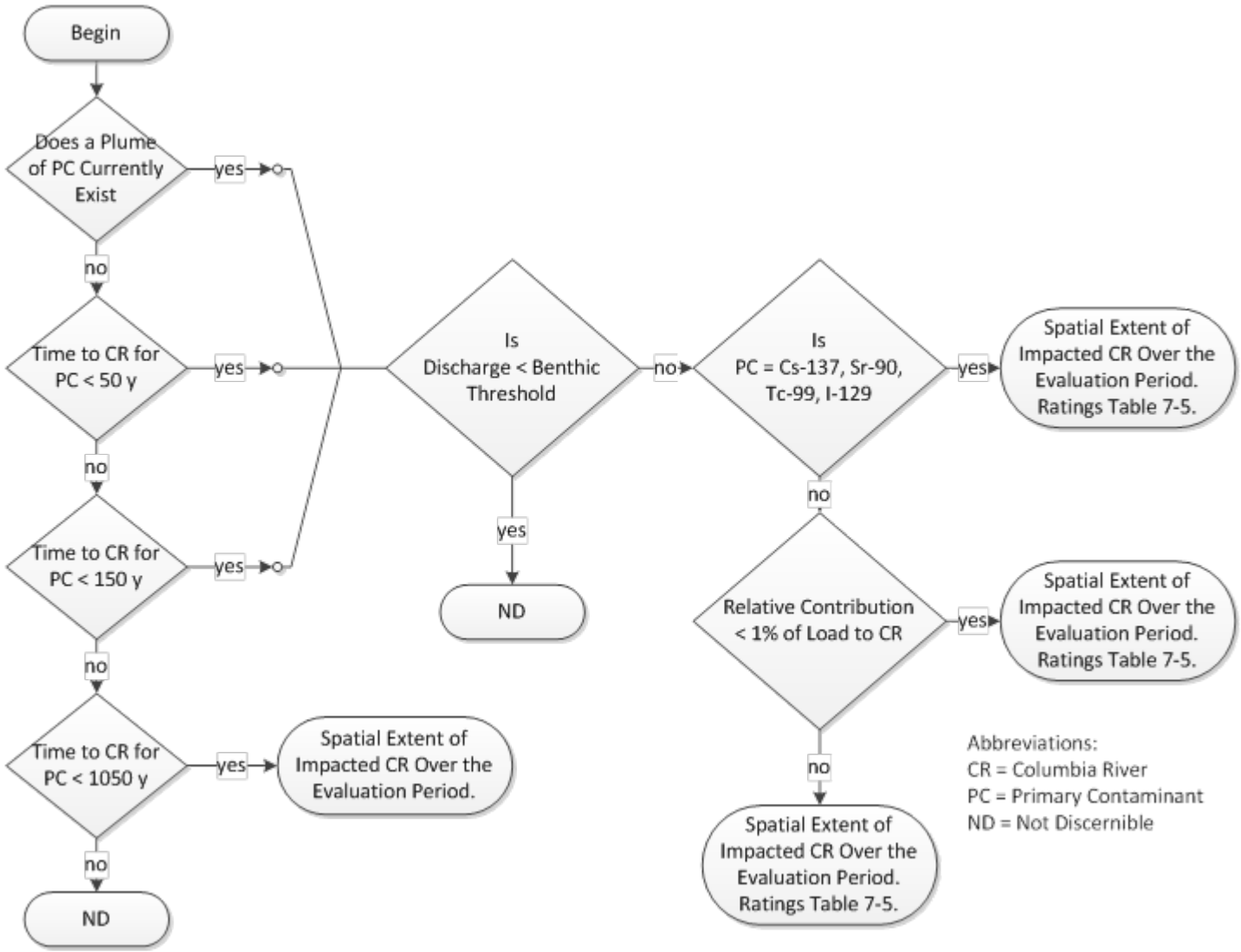
Flow Diagram for Evaluating Risks to Groundwater and Columbia River – Part 1



Flow Diagram for Evaluating Risks to Groundwater and Columbia River – Part 2



Risk rating basis for impact of a primary contaminant from surface and vadose zone sources to groundwater



Risk rating basis for impact of primary contaminant to the Columbia River