
WELCOME
to the
ATOMIC CITY

Paducah Overview

- The 1,350-acre Paducah Gaseous Diffusion Plant (PGDP) is a uranium-enrichment facility, owned by the Department of Energy (DOE). The GDP is still in operation under a lease of the plant to the U.S. Enrichment Corporation (USEC), providing fuel rods to electricity generating reactors in the utility industry. The site is located 3 miles south of the Ohio River and 10 miles west of Paducah, Kentucky. Extensive support facilities are required to maintain the uranium enrichment process including a steam plant, four major electrical switch yards, four sets of cooling towers, a building for chemical cleaning and decontamination, a water treatment plant, and maintenance and laboratory facilities.

Paducah Overview

- Approximately 740 acres of the plant are fenced, and an uninhabited buffer zone surrounds the fence. PGDP started uranium-enrichment operations in 1952. Plant operations have generated hazardous, non-hazardous, and radioactive wastes, including polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs) technetium-99 (Tc-99), and multiple isotopes of uranium. In 1988, DOE found Tc-99 in an off-site drinking water well located north of the site. VOCs also have been detected in nearby private wells and in on-site monitoring wells. An estimated 1,400 people obtain drinking water from wells within 4 miles of PGDP.

Paducah Overview

- In addition to groundwater contamination, DOE has detected PCBs in on-site surface water and downstream of the plant in Big Bayou Creek and in Little Bayou Creek. These creeks are part of the 2,100-acre West Kentucky Wildlife Management Area, which is adjacent to the buffer area surrounding the site. In 1989, the State of Kentucky's Division of Water issued a warning against eating fish caught in the Little Bayou Creek. The Big Bayou Creek, however, currently has no fish consumption advisories. In 2006 DOE reported that PCBs had been detected in groundwater in the vicinity of the U-746 landfill and within the PGDP security boundary.

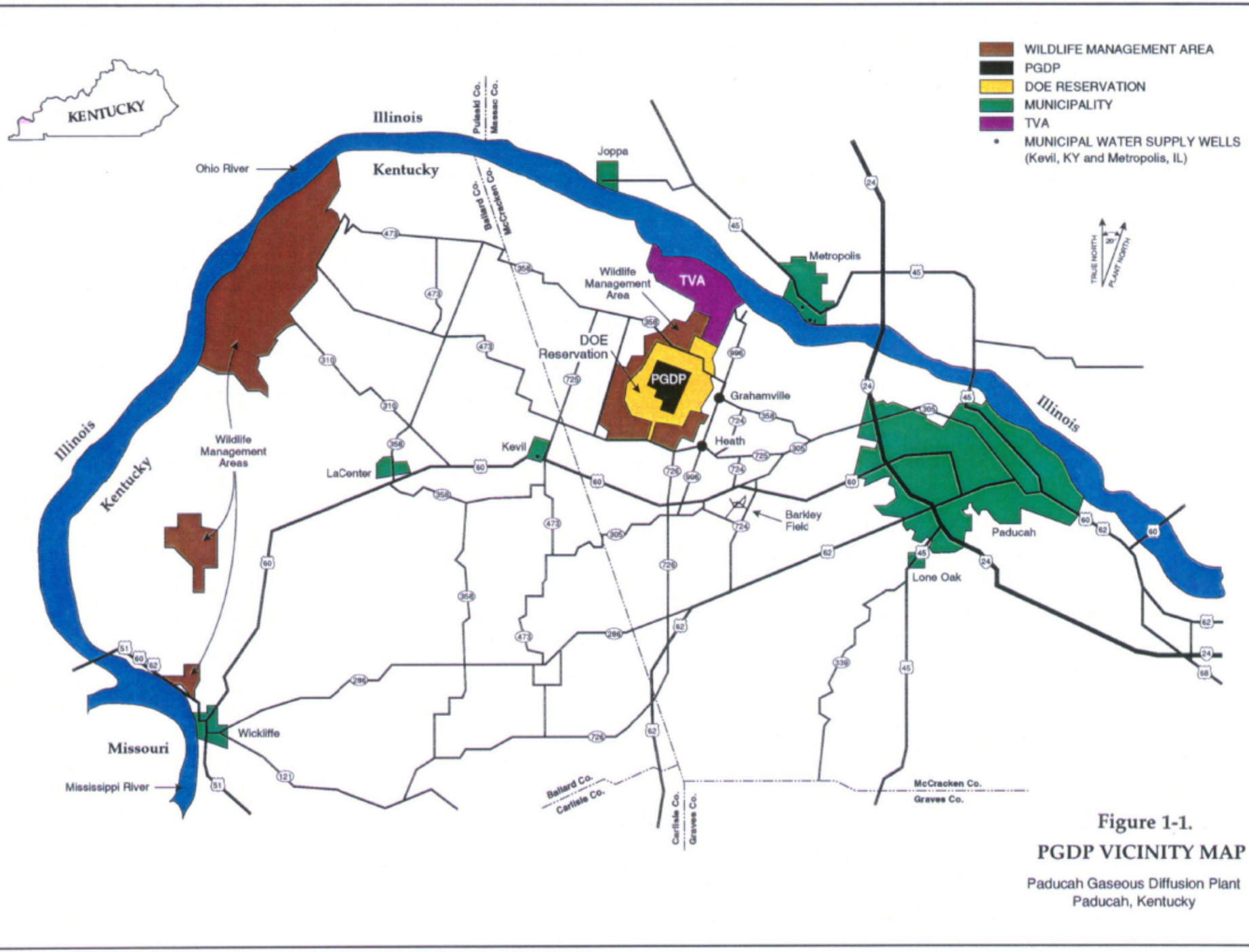
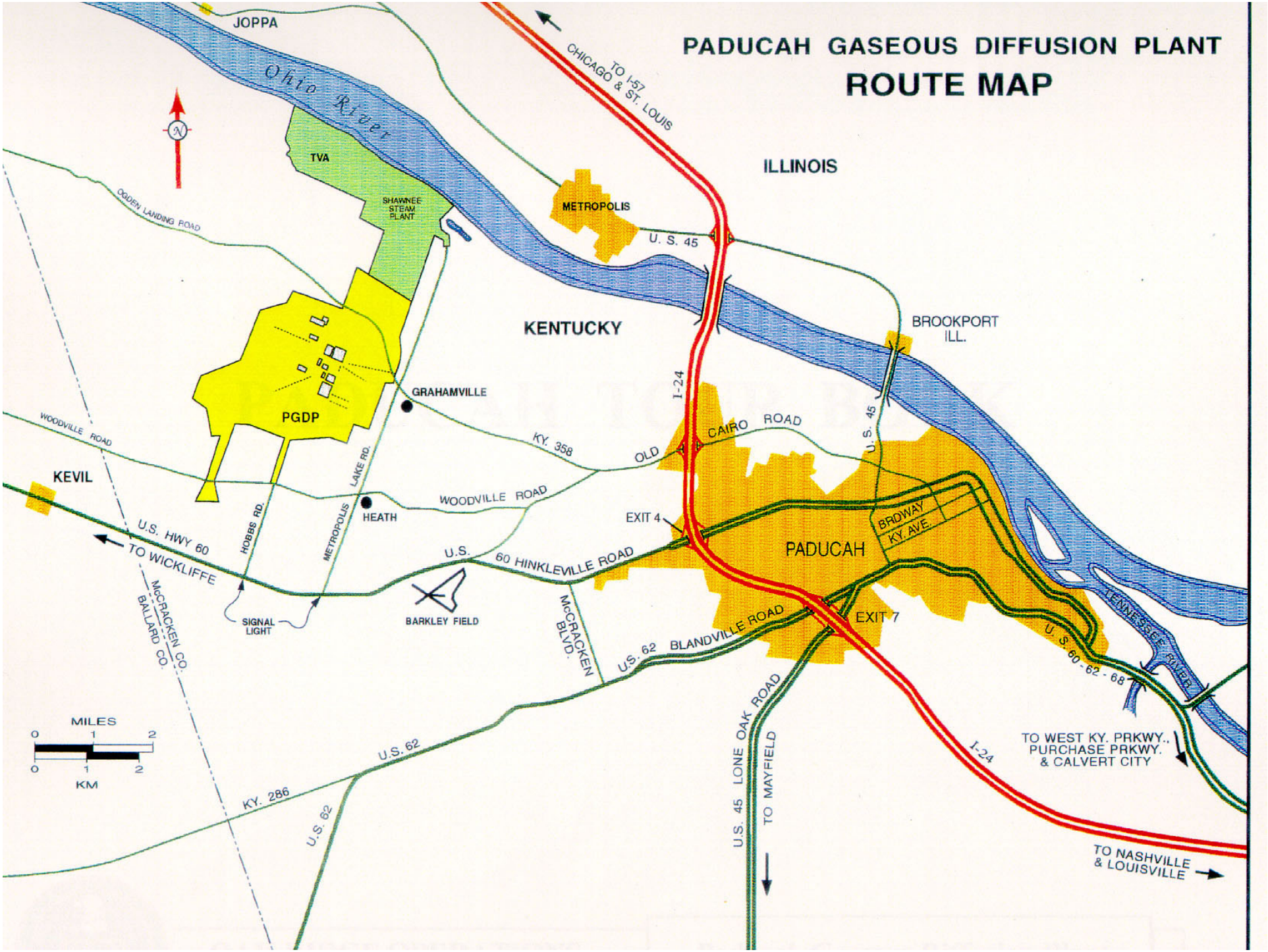


Figure 1-1.
PGDP VICINITY MAP

Paducah Gaseous Diffusion Plant
Paducah, Kentucky

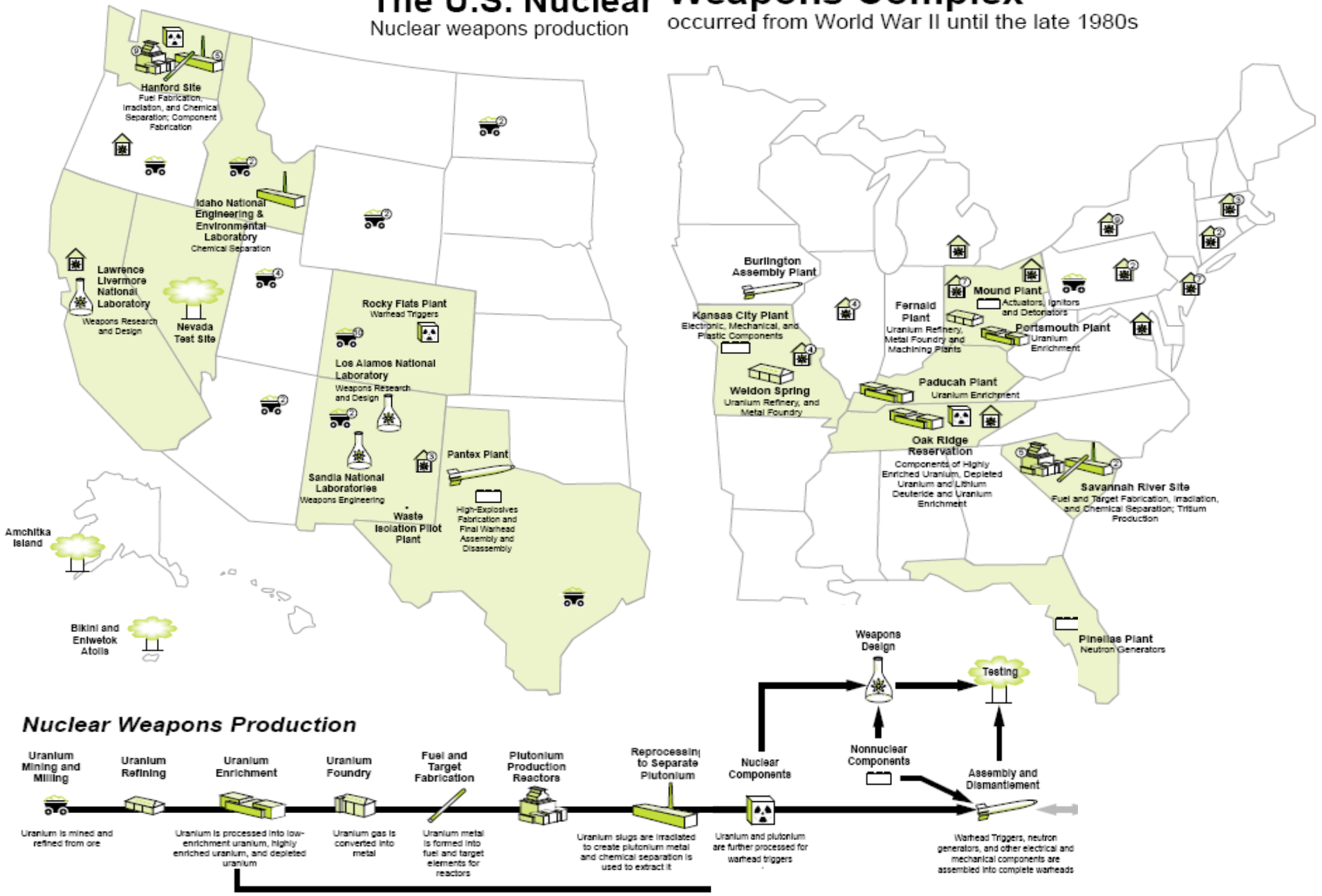

PADUCAH GASEOUS DIFFUSION PLANT
ROUTE MAP
JOPPA
Ohio River
TVA
SHAWNEE STEAM PLANT
OGDEN LANDING ROAD
TO I-57 CHICAGO & ST. LOUIS
ILLINOIS
METROPOLIS
U. S. 45
KENTUCKY
BROOKPORT ILL.
PGDP
GRAHAMVILLE
I-24
CAIRO ROAD
OLD
KY. 358
WOODVILLE ROAD
KEVIL
LAKE RD.
HOBBS RD.
METROPOLIS
HEATH
WOODVILLE ROAD
EXIT 4
BRDWAY
KY. AVE.
PADUCAH
U.S. HWY 60
TO WICKLIFFE
U.S. 60 HINKLEVILLE ROAD
McCRACKEN CO.
BALLARD CO.
SIGNAL LIGHT
BARKLEY FIELD
McCRACKEN BLVD.
EXIT 7
U.S. 62 BLANDVILLE ROAD
TENNESSEE RIVER
U.S. 60 - 62 - 68
MILES
0 1 2
0 1 2
KM
U.S. 62
KY. 286
U.S. 62
U.S. 45 LONE OAK ROAD
TO MAYFIELD
1-24
TO WEST KY. PRKWY., PURCHASE PRKWY. & CALVERT CITY
TO NASHVILLE & LOUISVILLE

PGDP Statistics

Federal Site Acreage:	3,425
Gaseous Diffusion Plant Acreage:	750
Total Number of Buildings:	161
Process Buildings:	4
Process Building Dimensions:	1,100 ft. long, 970 ft. wide, 90 ft. high
Process Building Acreage Under Roof:	74 acres
Number of Enrichment Stages:	1,760
Peak Design Power Capacity:	3,040 megawatts
Largest Process Motor:	3,300 horsepower
Water Utilization:	26 million gallons per day
Number of Control Instruments:	85,000
Miles of Process Piping:	400 (approximately)
Miles of Roadway:	19
Miles of Railroad:	9
Miles of Perimeter Fence:	5 miles

The U.S. Nuclear Weapons Complex

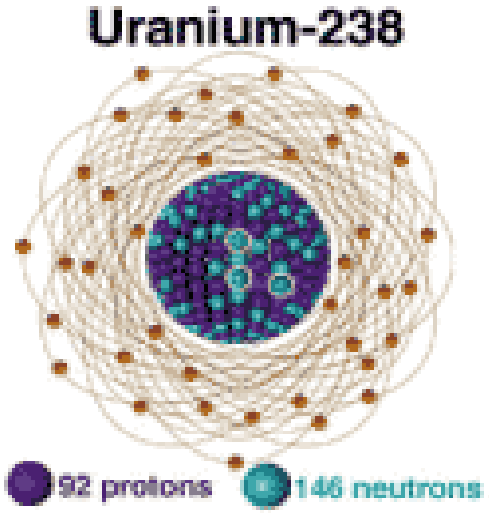
Nuclear weapons production occurred from World War II until the late 1980s



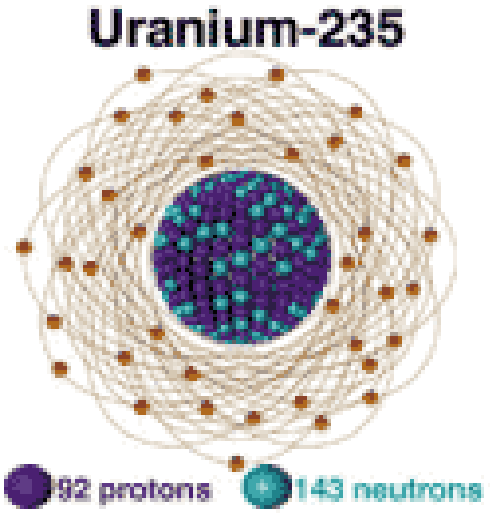
Nuclear Weapons Production

Uranium

- Uranium enrichment is the process of increasing the concentration of U^{235} isotope in natural uranium and decreasing that of U^{238} isotope
- Uranium is a naturally occurring element containing U^{235} and U^{238} isotopes. Only the U^{235} isotope is fissionable. Enrichment is a critical step in transforming natural uranium into nuclear fuel to produce electricity.



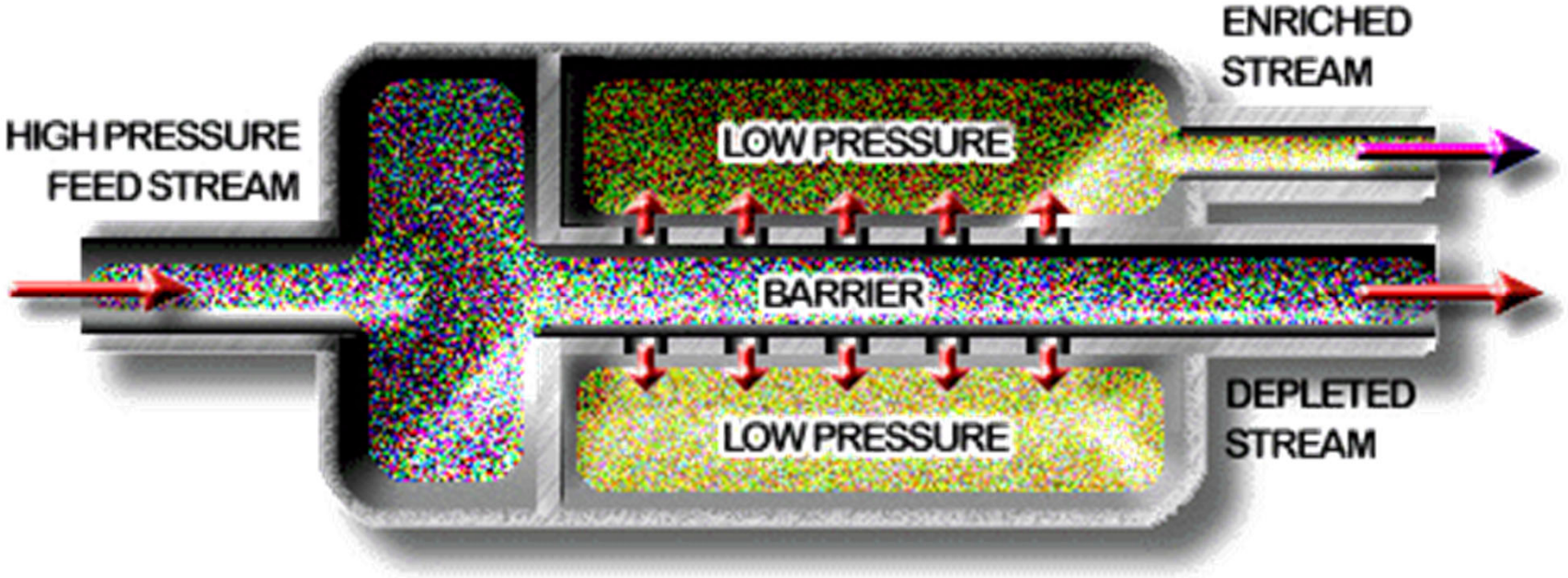
extra neutrons - heavier

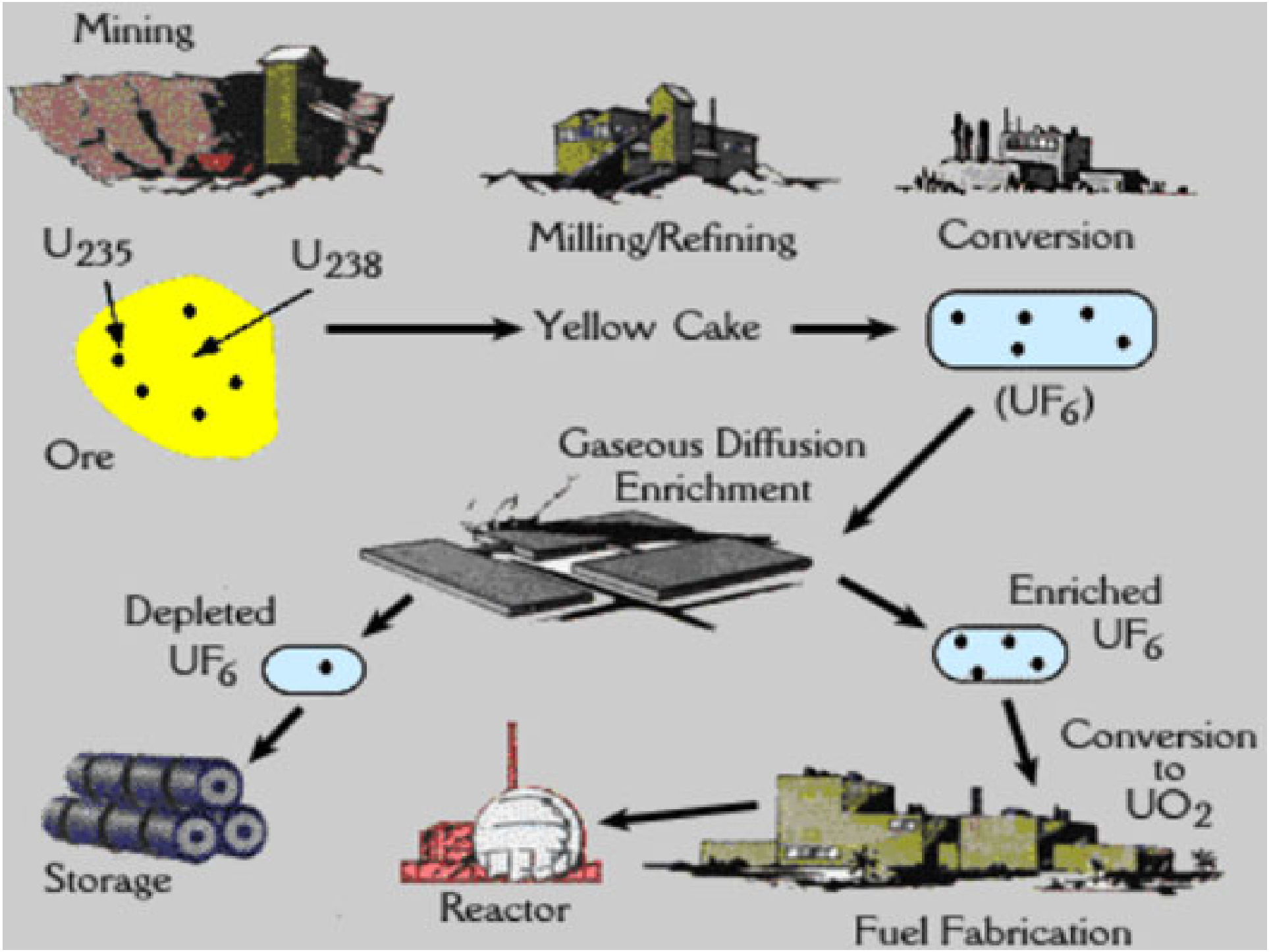


lighter and more active

Uranium

- Natural uranium contains about 0.7% U^{235}. But the fuel assemblies that power a commercial nuclear reactor at an electric utility generally need uranium with a 4% - 5% concentration of U^{235}. To produce this fuel, USEC increases, or enriches, the concentration of U^{235} in natural uranium hexafluoride (UF6) to the appropriate level and sells the fuel to its utility customers.




Mining
Milling/Refining
Conversion
U235
U238
Ore
Yellow Cake
(UF6)
Gaseous Diffusion
Enrichment
Depleted
UF6
Enriched
UF6
Conversion
to
UO2
Storage
Reactor
Fuel Fabrication


WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
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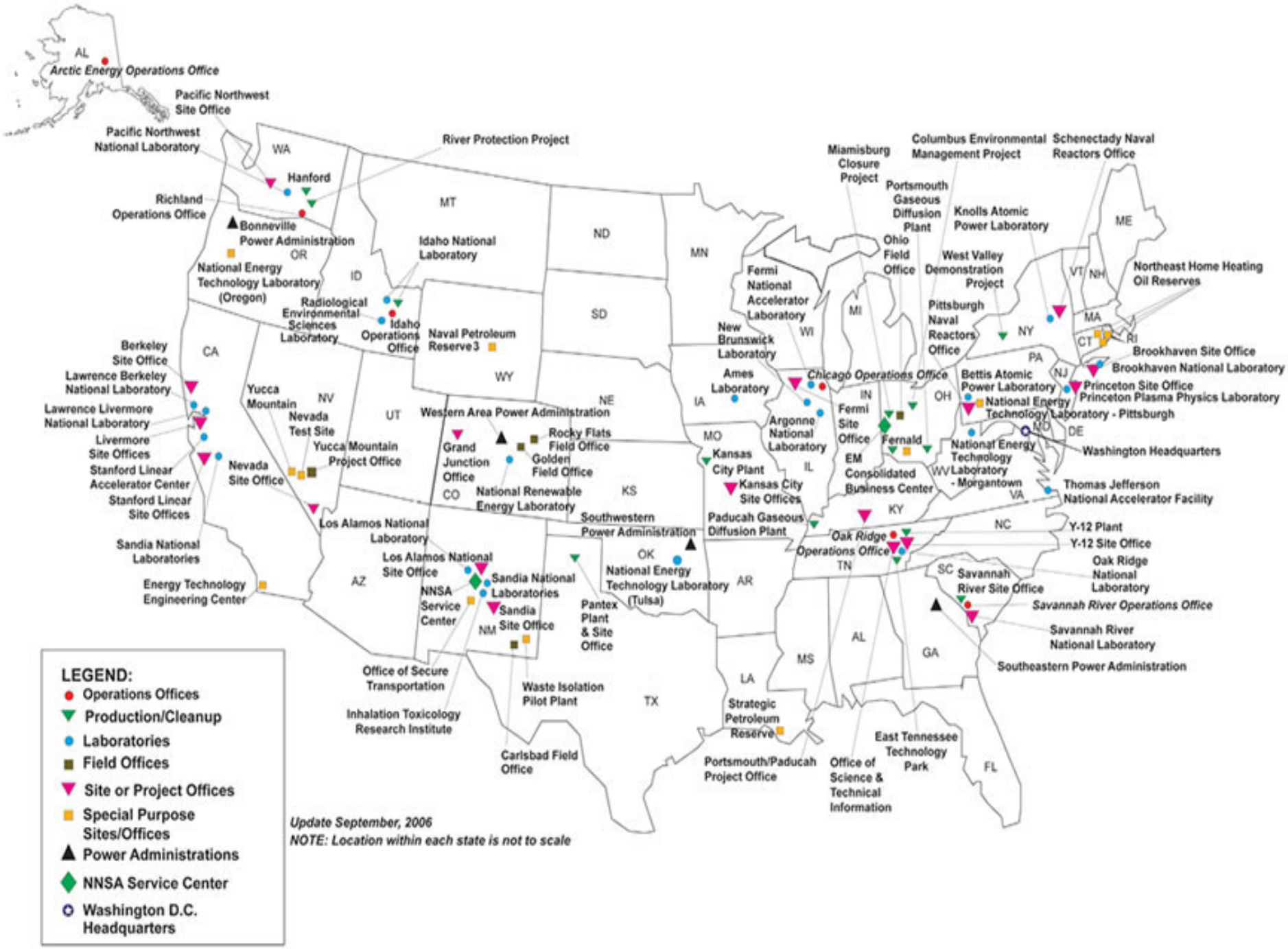
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
MD
DE
NJ
CT
RI
MA
VT
NH
ME
Columbia
Monticello
Prairie Island 1,2
Kewaunee
Point Beach 1,2
Palisades
Fermi 2
Cook 1, 2
Davis-Besse 1
Perry 1
Byron 1,2
Dresden 2,3
Quad Cities 1,2
LaSalle 1,2
Braidwood 1,2
Clinton 1
Duanne Arnold
Fort Calhoun
Cooper
Wolf Creek
Callaway
Arkansas Nuclear One 1,2
Diablo Canyon 1,2
San Onofre 2,3
Palo Verde 1,2,3
Comanche Peak 1,2
South Texas Project 1,2
Grand Gulf 1
River Bend
Waterford 3
Watts Bar 1
Sequoyah 1,2
Browns Ferry 2 ,3
Farley 1,2
Vogtle 1,2
Hatch 1,2
Crystal River 3
St. Lucie 1,2
Turkey Point 3,4
Catawba 1,2
Oconee 1,2,3
McGuire 1,2
Harris 1
Robinson 2
Summer 1
Brunswick 1,2
North Anna 1,2
Surry 1,2
Calvert Cliffs 1,2
Beaver Valley 1,2
Peach Bottom 2,3
Three Mile Island 1
Susquehanna 1,2
Limerick 1,2
Salem 1,2
Hope Creek 1
Oyster Creek
Indian Point 2,3
Millstone 2,3
Nine Mile Point 1,2
FitzPatrick
Ginna
Vermont Yankee
Seabrook
Pilgrim 1


AL
Arctic Energy Operations Office
Pacific Northwest Site Office
Pacific Northwest National Laboratory
WA
River Protection Project
Hanford
Richland Operations Office
Bonneville Power Administration
OR
National Energy Technology Laboratory (Oregon)
ID
Idaho National Laboratory
Radiological Environmental Sciences Laboratory
Idaho Operations Office
MT
ND
MN
SD
Naval Petroleum Reserve 3
WY
Berkeley Site Office
Lawrence Berkeley National Laboratory
CA
Lawrence Livermore National Laboratory
Livermore Site Offices
Stanford Linear Accelerator Center
Stanford Linear Site Offices
Sandia National Laboratories
Yucca Mountain
NV
Nevada Test Site
Nevada Site Office
Yucca Mountain Project Office
UT
Western Area Power Administration
Grand Junction Office
Rocky Flats Field Office
Golden Field Office
CO
National Renewable Energy Laboratory
NE
KS
Los Alamos National Laboratory
Los Alamos National Site Office
Sandia National Laboratories
NNSA Service Center
Sandia Site Office
NM
AZ
Energy Technology Engineering Center
Southwestern Power Administration
OK
National Energy Technology Laboratory (Tulsa)
Pantex Plant & Site Office
AR
TX
Office of Secure Transportation
Waste Isolation Pilot Plant
Inhalation Toxicology Research Institute
Carlsbad Field Office
LA
Strategic Petroleum Reserve
Portsmouth/Paducah Project Office
MS
AL
GA
FL
Office of Science & Technical Information
East Tennessee Technology Park
Miamisburg Closure Project
Columbus Environmental Management Project
Schenectady Naval Reactors Office
Portsmouth Gaseous Diffusion Plant
Knolls Atomic Power Laboratory
Ohio Field Office
West Valley Demonstration Project
Northeast Home Heating Oil Reserves
ME
VT
NH
MA
CT
RI
NY
Pittsburgh Naval Reactors Office
Fermi National Accelerator Laboratory
MI
WI
New Brunswick Laboratory
Ames Laboratory
IA
Chicago Operations Office
Argonne National Laboratory
IL
IN
Fermi Site Office
Fernald
OH
PA
NJ
Bettis Atomic Power Laboratory
National Energy Technology Laboratory - Pittsburgh
Brookhaven Site Office
Brookhaven National Laboratory
Princeton Site Office
Princeton Plasma Physics Laboratory
MD
DE
Washington Headquarters
National Energy Technology Laboratory - Morgantown
WV
VA
Thomas Jefferson National Accelerator Facility
Kansas City Plant
Kansas City Site Offices
MO
EM Consolidated Business Center
Paducah Gaseous Diffusion Plant
KY
Oak Ridge Operations Office
TN
NC
SC
Y-12 Plant
Y-12 Site Office
Oak Ridge National Laboratory
Savannah River Site Office
Savannah River Operations Office
Savannah River National Laboratory
Southeastern Power Administration
LEGEND:
Operations Offices
Production/Cleanup
Laboratories
Field Offices
Site or Project Offices
Special Purpose Sites/Offices
Power Administrations
NNSA Service Center
Washington D.C. Headquarters
Update September, 2006
NOTE: Location within each state is not to scale

Site name	Location	Function	Status
Los Alamos National Laboratory	Los Alamos, New Mexico	Research, Design, Pit Production	Active
Lawrence Livermore National Laboratory	Livermore, California	Research and design	Active
Sandia National Laboratories	Livermore, California; Albuquerque, New Mexico	Research and design	Active
Hanford Site	Richland, Washington	Material production (Plutonium)	Not active, remediation
Oak Ridge National Laboratory	Oak Ridge, Tennessee	Material production (Uranium-235, fusion fuel), research	Active to some extent
Y-12 National Security Complex	Oak Ridge, Tennessee	Component fabrication, stockpile stewardship, uranium storage	Active
Nevada Test Site	Near Las Vegas, Nevada	Nuclear testing and nuclear waste disposal	No nuclear tests since 1992, engaged in waste disposal
Yucca Mountain	Nevada Test Site	Waste disposal (primarily power reactor)	Pending
Waste Isolation Pilot Plant	East of Carlsbad, New Mexico	Radioactive waste from nuclear weapons production	Active
Pacific Proving Grounds	Marshall Islands	Nuclear testing	Not active, last test in 1962
Rocky Flats Plant	Near Denver, Colorado	Components fabrication	Not active, remediation
Pantex	Amarillo, Texas	Weapons assembly, disassembly, pit storage	Active, esp. disassembly
Paducah Plant	Paducah, Kentucky	Material production (Uranium-235)	Active (commercial use)
Fernald Site	Near Cincinnati, Ohio	Material fabrication (Uranium-235)	Not active, remediation
Kansas City Plant	Kansas City, Missouri	Component production	Active
Mound Plant	Miamisburg, Ohio	Research, component production, Tritium purification	Not active, remediation
Portsmouth Gaseous Diffusion Plant	Near Portsmouth, Ohio	Material fabrication (Uranium-235)	Active, but not for weapons production
Pinellas Plant	Largo, Florida	Manufacture of electrical components	Active, but not for weapons production
Savannah River Site	Near Aiken, South Carolina	Material production (Plutonium, Tritium)	Active (limited operation), remediation

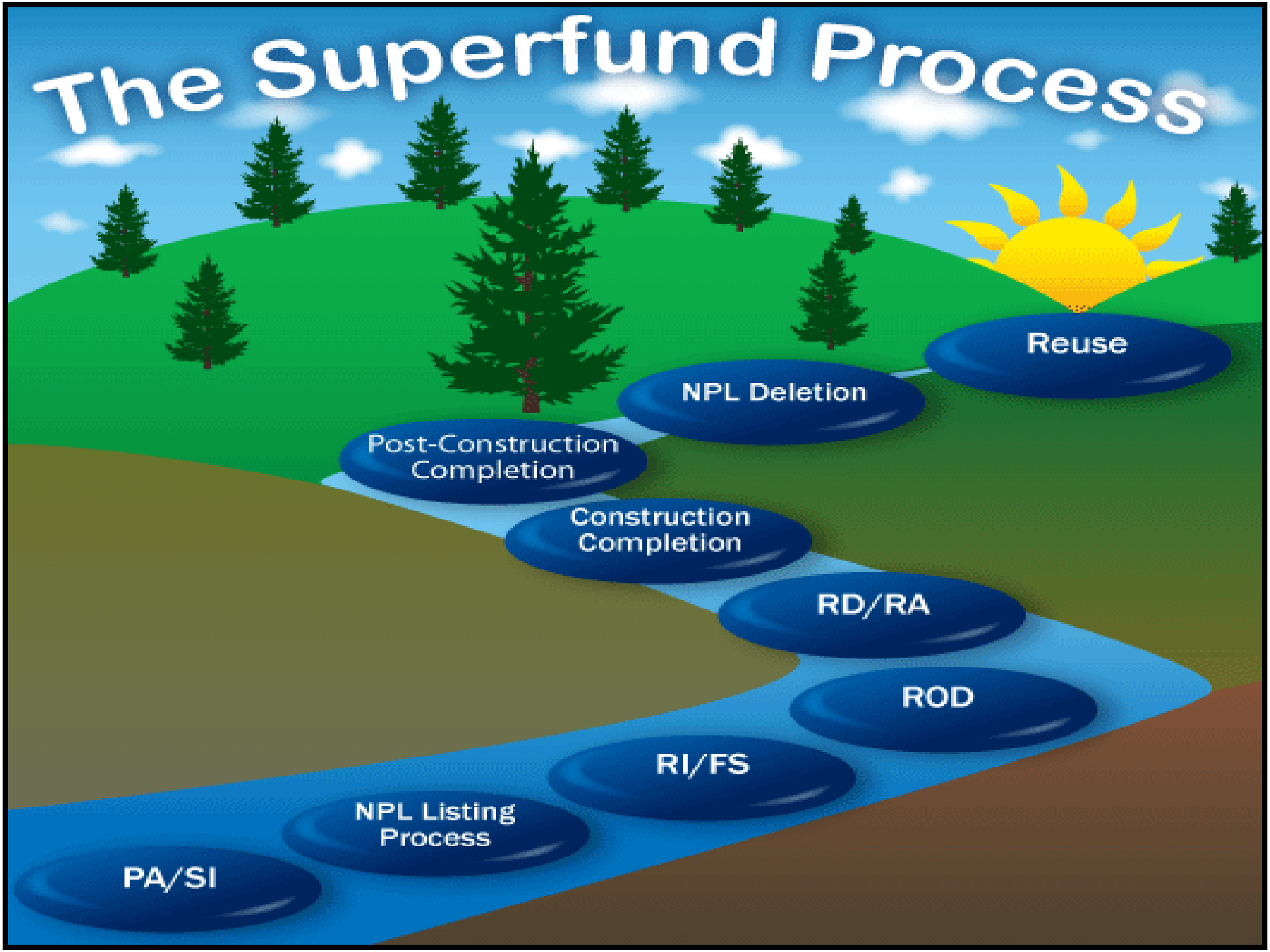
U.S. Environmental History

- 1965 Solid Waste Disposal Act (WSDA)
- 1976 Resource Conservation and Recovery Act (RCRA)
  - Identification of wastes (characteristics and/or publication)
    - Ignitability
    - Reactivity
    - Corrosivity
    - Toxicity
  - Tracking of wastes
    - Generation
    - Labeling
    - Transportation
    - Storage
    - Disposal
  - Hazardous waste management plans
    - Permits
- 1984 Amendments
  - Incinerators
  - Small quantify generators
  - Substandard landfills
- 1986 Amendments
  - Underground storage tanks

Valley of the Drums – Bullitt County KY

U.S. Environmental History

- 1976 Toxic Substances Control Act (TSCA)
  - Regulates the introduction of new or existing chemicals
  - (1976) Subchapter I: Regulates the disposal of PCBs
  - (1986) Subchapter II: Asbestos Hazard Emergency Response
  - (1988) Subchapter III: Indoor Radon Abatement
  - (1992) Subchapter IV: Lead Exposure Reduction
- 1980 Comprehensive Environmental Response, Compensation, Liability Act (CERCLA)
  - Hazardous Substance Superfund
- 1986 Superfund Amendments and Reauthorization Act (SARA)
  - Toxics Reporting
    - Material safety data sheets
    - Emergency inventory forms
    - Toxic release reporting
  - Superfund Basic Research Program
    - University of Kentucky


The Superfund Process
Reuse
NPL Deletion
Post-Construction Completion
Construction Completion
RD/RA
ROD
RI/FS
NPL Listing Process
PA/SI

CERCLA Process

PA/SI	Preliminary Assessment/Site Inspection Investigations of site conditions. If the release of hazardous substances requires immediate or short-term response actions, these are addressed under the Emergency Response program of Superfund.
NPL Listing	National Priorities List (NPL) Site Listing Process A list of the most serious sites identified for possible long-term cleanup.
RI/FS	Remedial Investigation/Feasibility Study Determines the nature and extent of contamination. Assesses the treatability of site contamination and evaluates the potential performance and cost of treatment technologies.
ROD	Records of Decision Explains which cleanup alternatives will be used at NPL sites. When remedies exceed 25 million, they are reviewed by the National Remedy Review Board.
RD/RA	Remedial Design/Remedial Action Preparation and implementation of plans and specifications for applying site remedies. The bulk of the cleanup usually occurs during this phase. All new fund-financed remedies are reviewed by the National Priorities Panel.
Construction Completion	Construction Completion Identifies completion of physical cleanup construction, although this does not necessarily indicate whether final cleanup levels have been achieved.
Post Construction Completion	Post Construction Completion Ensures that Superfund response actions provide for the long-term protection of human health and the environment. Included here are Long-Term Response Actions (LTRA), Operation and Maintenance, Institutional Controls, Five-Year Reviews, Remedy Optimization.
NPL Delete	National Priorities List Deletion Removes a site from the NPL once all response actions are complete and all cleanup goals have been achieved.
Reuse	Site Reuse/Redevelopment Information on how the Superfund program is working with communities and other partners to return hazardous waste sites to safe and productive use without adversely affecting the remedy.

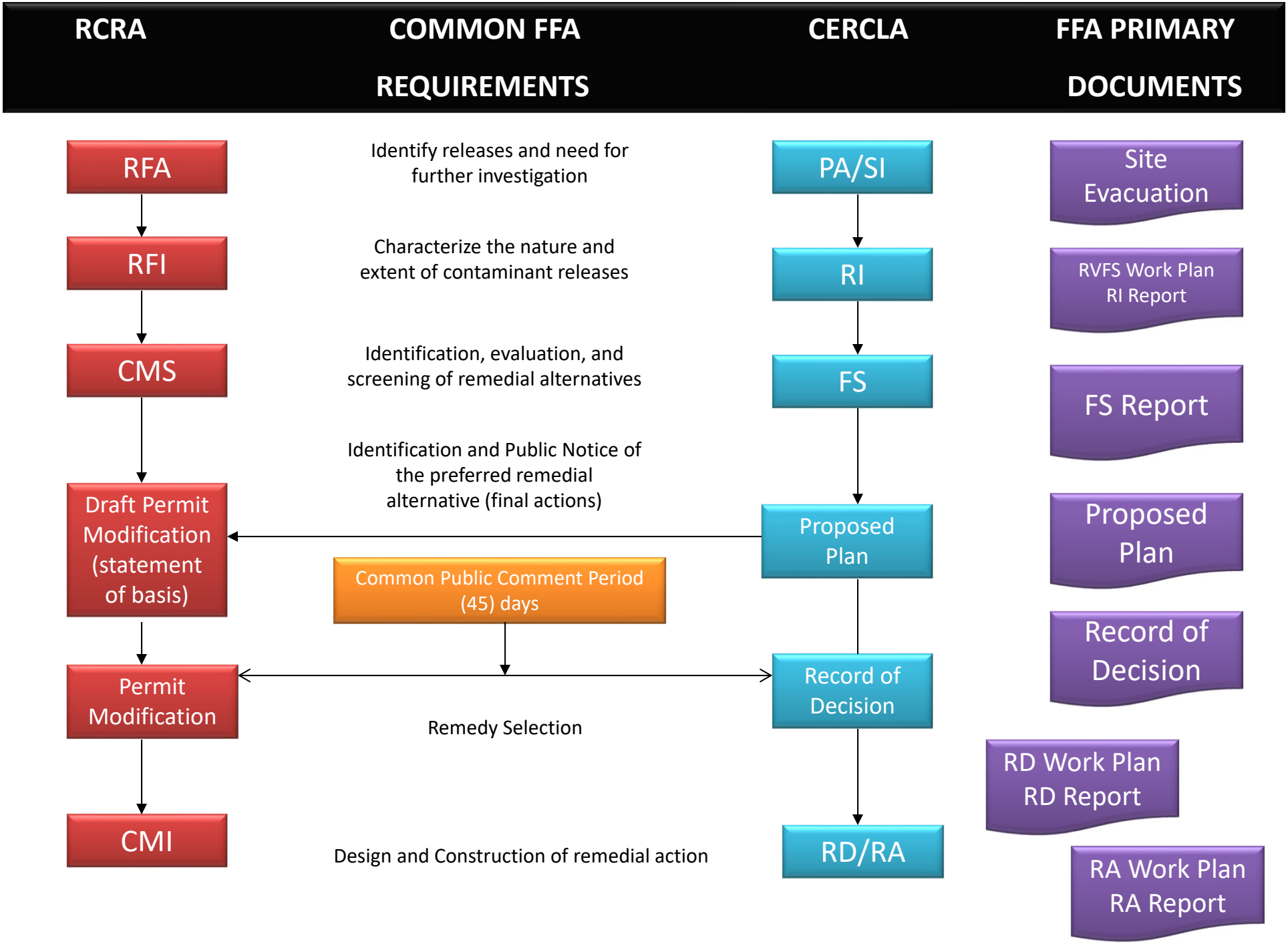
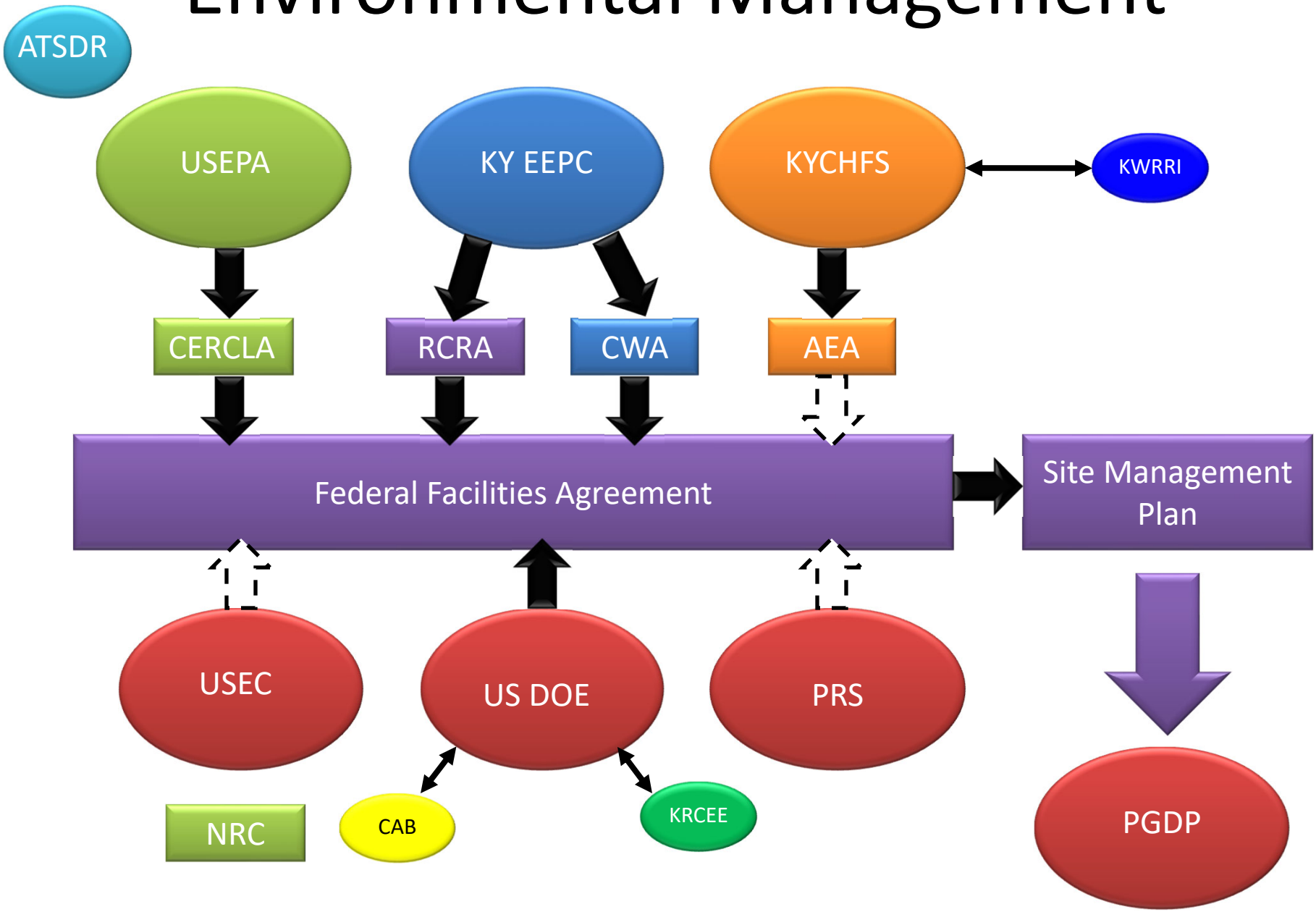

RCRA
COMMON FFA REQUIREMENTS
CERCLA
FFA PRIMARY DOCUMENTS
RFA
Identify releases and need for further investigation
PA/SI
Site Evacuation
RFI
Characterize the nature and extent of contaminant releases
RI
RVFS Work Plan
RI Report
CMS
Identification, evaluation, and screening of remedial alternatives
FS
FS Report
Identification and Public Notice of the preferred remedial alternative (final actions)
Draft Permit Modification (statement of basis)
Proposed Plan
Proposed Plan
Common Public Comment Period (45) days
Record of Decision
Permit Modification
Record of Decision
Remedy Selection
RD Work Plan
RD Report
CMI
RD/RA
Design and Construction of remedial action
RA Work Plan
RA Report

Table 1.1. Significant contaminants of potential concern at PGDP[a]

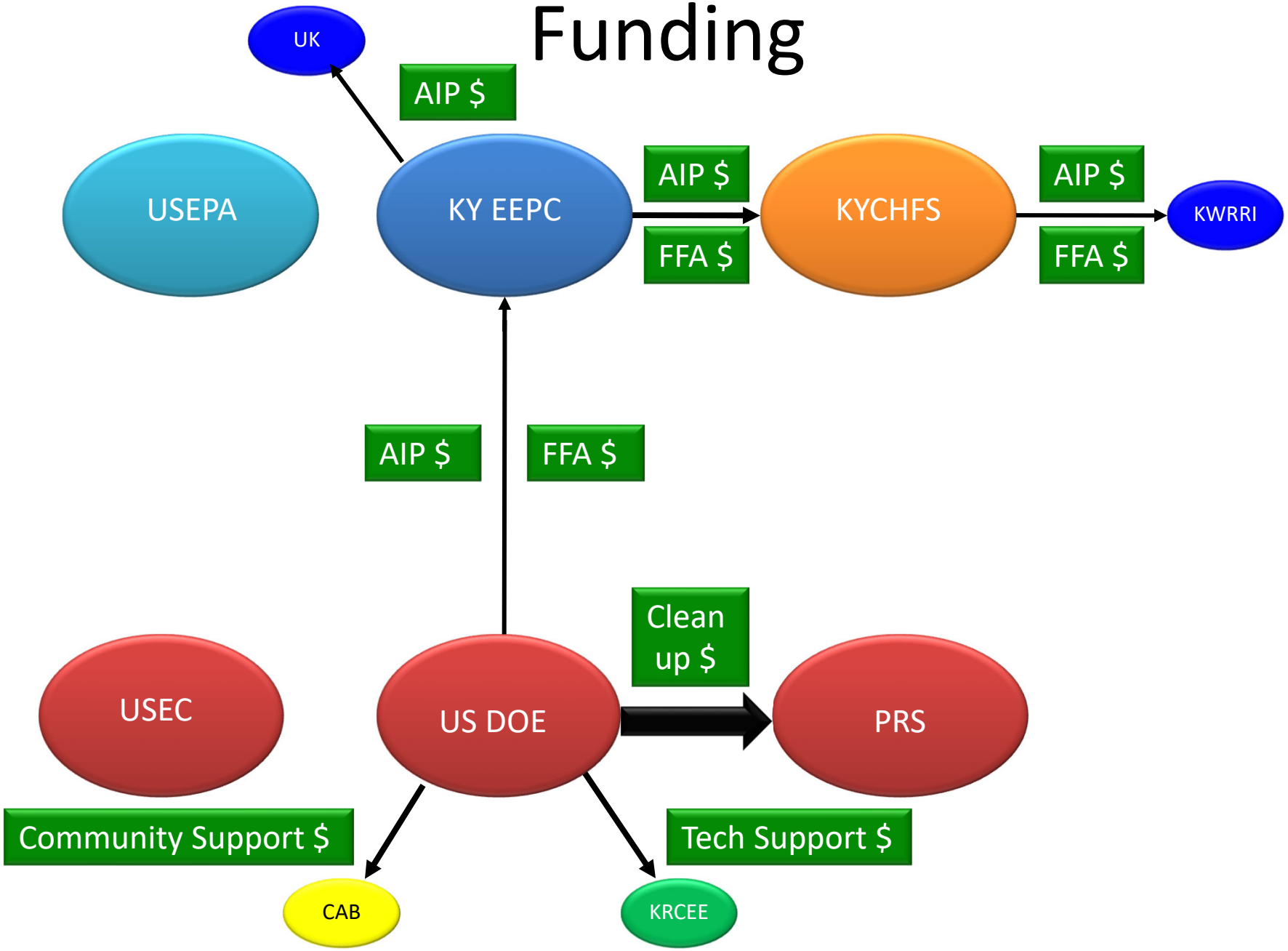
Metals/Inorganic Chemicals	Organic Compounds	Radionuclides
Antimony	Acrylonitrile	Americium-241
Arsenic	Benzene	Cesium-137
Beryllium	***Carbon tetrachloride***	Cobalt-60
Cadmium	***Chloroform***	Neptunium-237
Chromium III	***1,1-Dichloroethene***	Plutonium-238
Chromium VI	***1,2-Dichloroethene (mixed)***	Plutonium-239
Copper	***trans-1,2-Dichloroethene***	Plutonium-240
Iron	***cis-1,2-Dichloroethene***	Radium-226
Lead	Ethylbenzene	Radon-222
Manganese	Pyrene	Strontium-90
Mercury	Tetrachloroethene	***Technetium-99***
Molybdenum	***Trichloroethene***	Thorium-228
Nickel	Dioxins/Furans	Thorium-230
Selenium	***Polynuclear aromatic hydrocarbons***	Thorium-232
Silver	***Polychlorinated biphenyls***	***Uranium-234***
Thallium	***Vinyl chloride***	***Uranium-235***
Uranium	Xylenes	***Uranium-238***
Vanadium		
Zinc		

Primary contaminants associated with site challenges are highlighted in bold, italic font.

Environmental Management



Funding


UK
AIP $
USEPA
KY EEPC
AIP $
FFA $
KYCHFS
AIP $
FFA $
KWRRI
AIP $
FFA $
USEC
US DOE
Clean up $
PRS
Community Support $
Tech Support $
CAB
KRCEE

Management Units

- Federal Facilities Agreement
- Site Management Plan
- Operable Units (OU)
- Waste Area Groups (WAGs)
- Solid Waste Management Unit (SWMU)

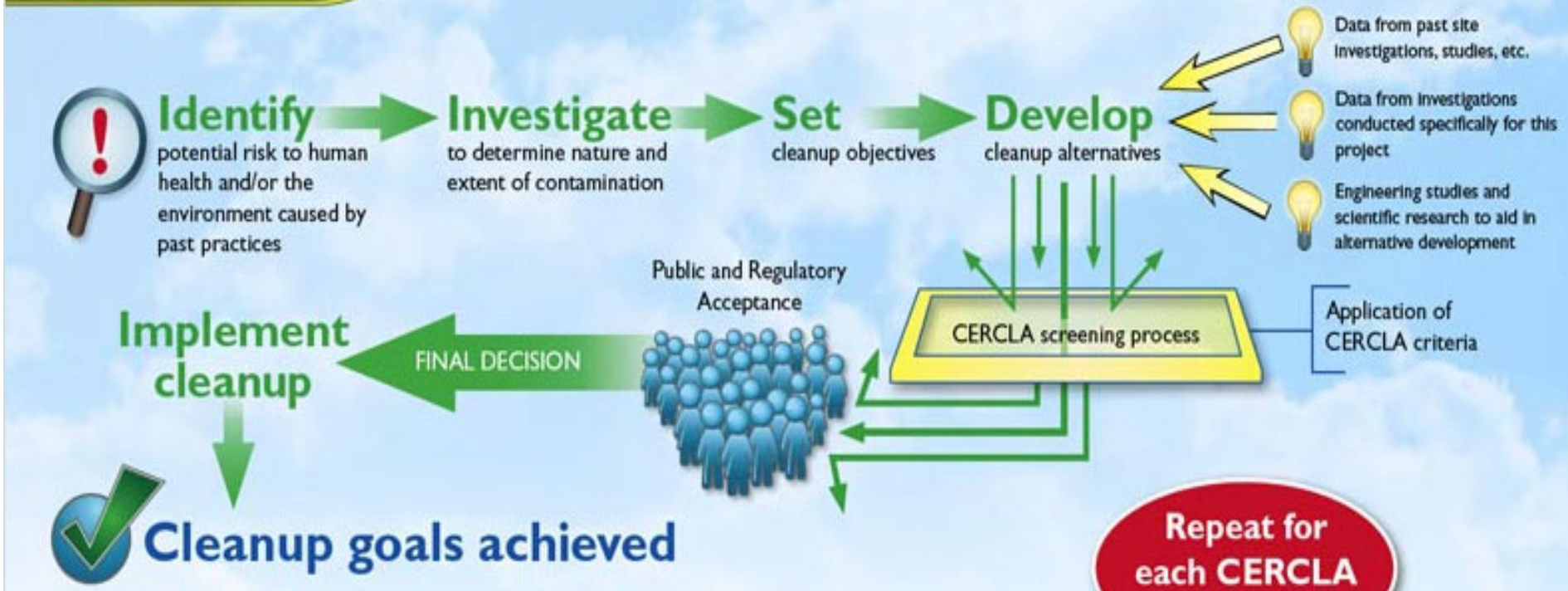
Operable Units

OU ID	Name	Types of Contaminants found at this OU	Cleanup Technologies Used	Cleanup Status at this OU
23	COMPREHENSIVE SITE-WIDE OU	No Contaminants	No Cleanup Technologies	Study Not Begun
22	BURIAL GROUNDS OPERABLE UNIT	No Contaminants	No Cleanup Technologies	Study and Remedy Selection Underway
21	SOILS OPERABLE UNIT	No Contaminants	No Cleanup Technologies	Study Not Begun
20	D & D OPERABLE UNIT	No Contaminants	No Cleanup Technologies	Remedy Design Complete
19	GROUNDWATER OPERABLE UNIT	VOC	Air Monitoring; Building; demolition; or excavation regulation; Covenant; Deed Notices; Physical/Chemical Treatment; (In-Situ.); Thermal Treatment; Not Specified	Remedy Construction Underway
18	SURFACE WATER OPERABLE UNIT	Inorganics; Metals; PAH; PCBs; Radioactive	Building; demolition; or excavation regulation; Cap; Covenant; Disposal	Remedy Construction Complete
16	WAG 28	No Contaminants	No Cleanup Technologies	Study and Remedy Selection Complete
15	WAG 27	VOC	Bioremediation (In-Situ); Monitoring; Treatment; Not Specified	Study and Remedy Selection Complete
13	WAG 6	No Contaminants	No Cleanup Technologies	Study and Remedy Selection Complete
12	WAG 17	No Contaminants	No Cleanup Technologies	Study and Remedy Selection Complete
11	GW INTEGRATOR	No Contaminants	No Cleanup Technologies	Study and Remedy Selection Underway
10	SURF WATER INTEGRATER	No Contaminants	No Cleanup Technologies	Study and Remedy Selection Underway

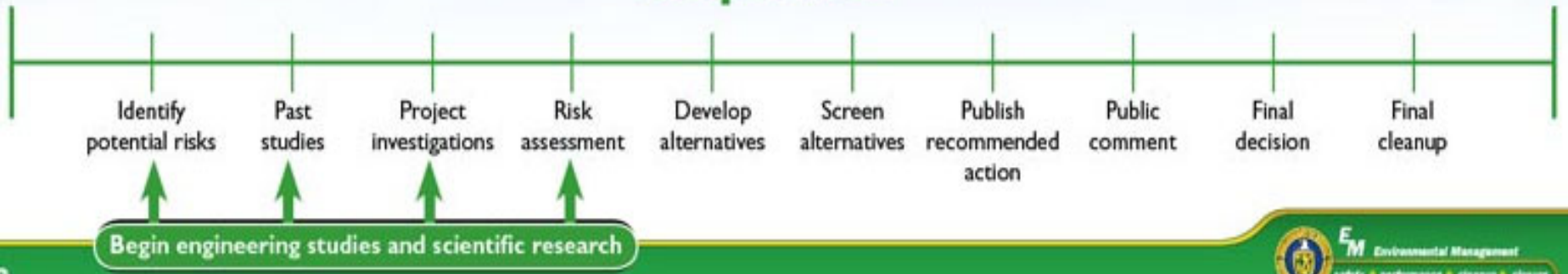
Operable Units

10	SURF WATER INTEGRATER	No Contaminants	No Cleanup Technologies	 Study and Remedy Selection Underway
09	WAG 23 PCB SPILL	No Contaminants	No Cleanup Technologies	 Study and Remedy Selection Complete
08	WAG 22 BURIAL GROUNDS	Metals; Radioactive; VOC	Cap; Deed Restriction; Monitoring	 Study and Remedy Selection Underway
07	WAG 13	No Contaminants	No Cleanup Technologies	 Study and Remedy Selection Complete
06	NS DIV DITCH	Inorganics; Metals; PCBs; Radioactive	Discharge; Engineering Control; Not Specified; Institutional Controls; Not Specified; Ion Exchange; Physical/Chemical Treatment; Not Specified; Precipitation; Surface Water Control	 Remedy Construction Complete
05	WAG 1 & 7	Metals	Deed Restriction; Engineering Control; Not Specified; Institutional Controls; Not Specified; Leachate Control; Monitoring; No Further Action	 Remedy Construction Complete
04	NW PLUME CONTAINMENT 2	No Contaminants	No Cleanup Technologies	 Study and Remedy Selection Underway
03	NE PLUME CONTAINMENT 1	VOC	Discharge; Filtration; Hydraulic Control; Monitoring; Pump And Treat	 Remedy Construction Complete
02	NW PLUME CONTAINMENT 1	Radioactive; VOC	Air Stripping; Discharge; Hydraulic Control; Ion Exchange; Liquid Phase Carbon Adsorption; Physical/Chemical Treatment; Not Specified; Pump And Treat	 Remedy Construction Complete
01	106 ADM ORDER / CONSENT	No Contaminants	No Cleanup Technologies	 Study and Remedy Selection Underway
00	SITEWIDE	No Contaminants	No Cleanup Technologies	 Remedy Selected

Reaching a Final Cleanup Decision



Sequence

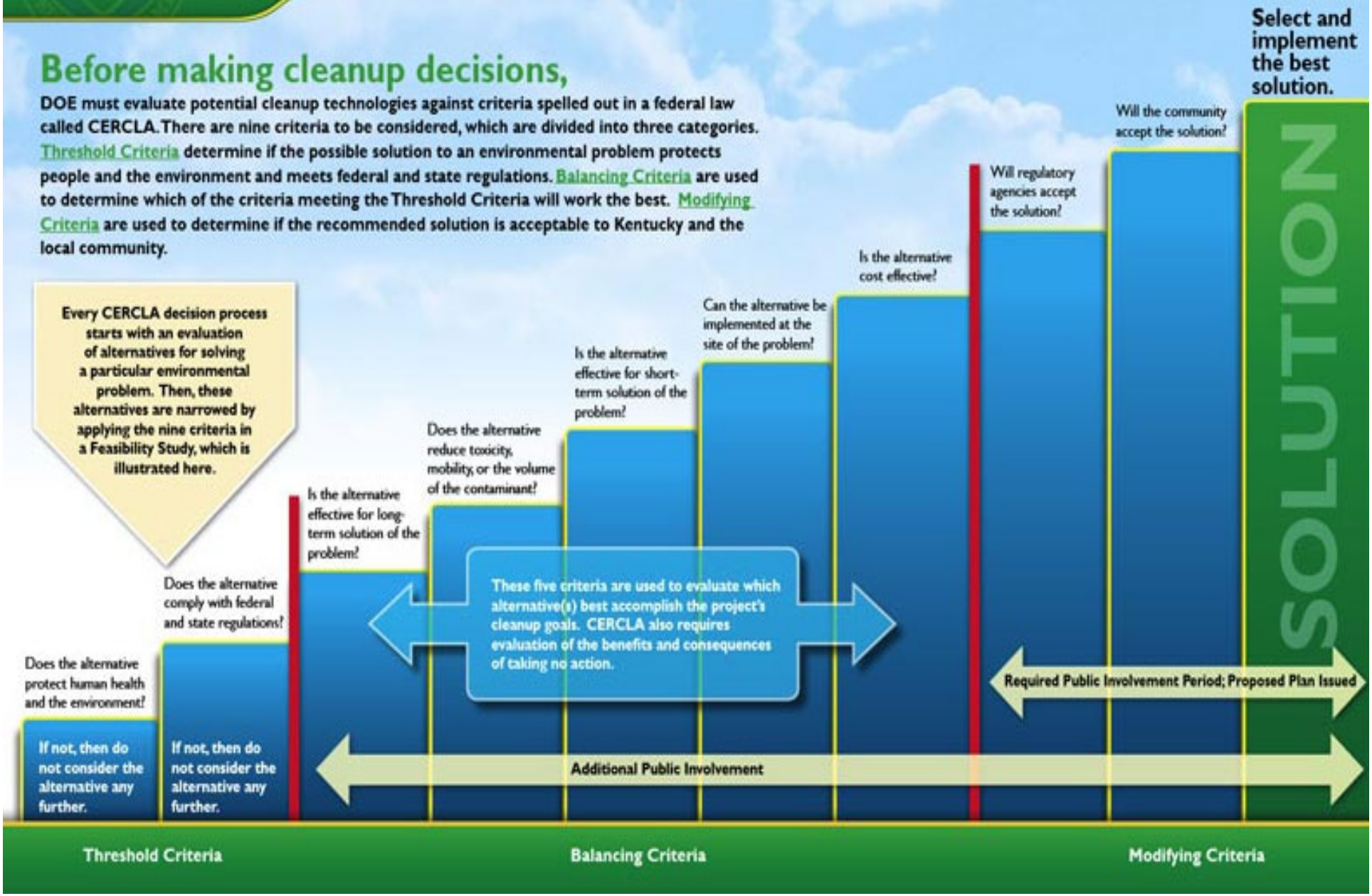


EM Environmental Management
safety • performance • cleanup • closure

What the Law Requires in Making Cleanup Decisions

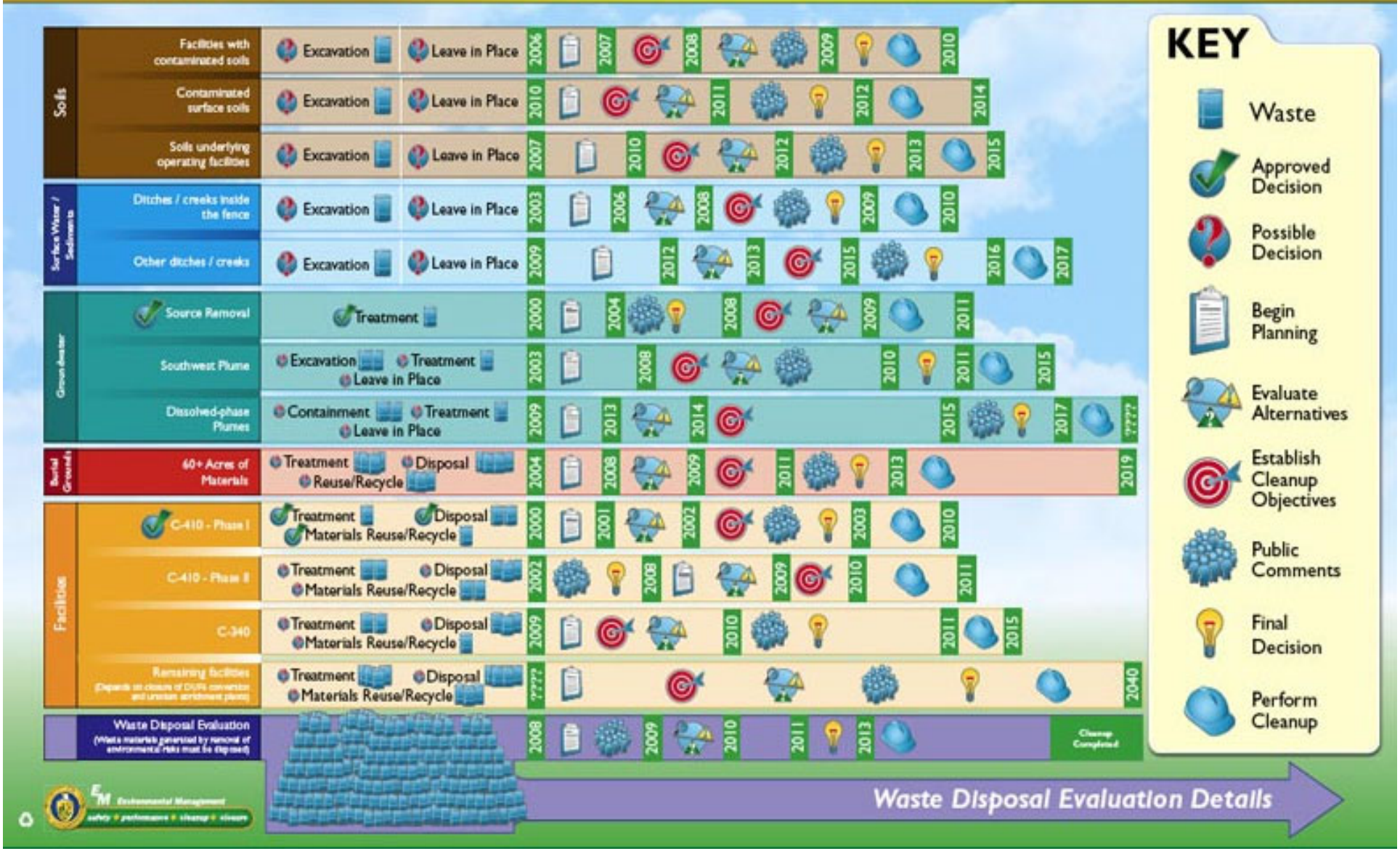
Before making cleanup decisions,

DOE must evaluate potential cleanup technologies against criteria spelled out in a federal law called CERCLA. There are nine criteria to be considered, which are divided into three categories. Threshold Criteria determine if the possible solution to an environmental problem protects people and the environment and meets federal and state regulations. Balancing Criteria are used to determine which of the criteria meeting the Threshold Criteria will work the best. Modifying Criteria are used to determine if the recommended solution is acceptable to Kentucky and the local community.



Environmental Cleanup Project Alternatives

Some projects may have only one reasonable solution, others may have myriad alternatives. In each project, the amount of waste material generated by the cleanup may vary depending on the alternative selected. (NOTE: The barrels are to illustrate the differing amounts of waste generated by each alternative and do not equate to a specific volume.



Future Decisions

- Contaminated creeks and ditches, 2009
- Three facilities with contaminated soils, 2009
- Certain contaminated soils, 2009
- Contaminated soil/rubble piles, 2009
- Waste Disposal Evaluation, 2009
- Removal of unusable facilities, 2010
- Southwest Groundwater Plume, 2010
- Waste burial grounds, 2010
- Remaining contaminated soils, 2011
- Off-site groundwater plumes, 2015