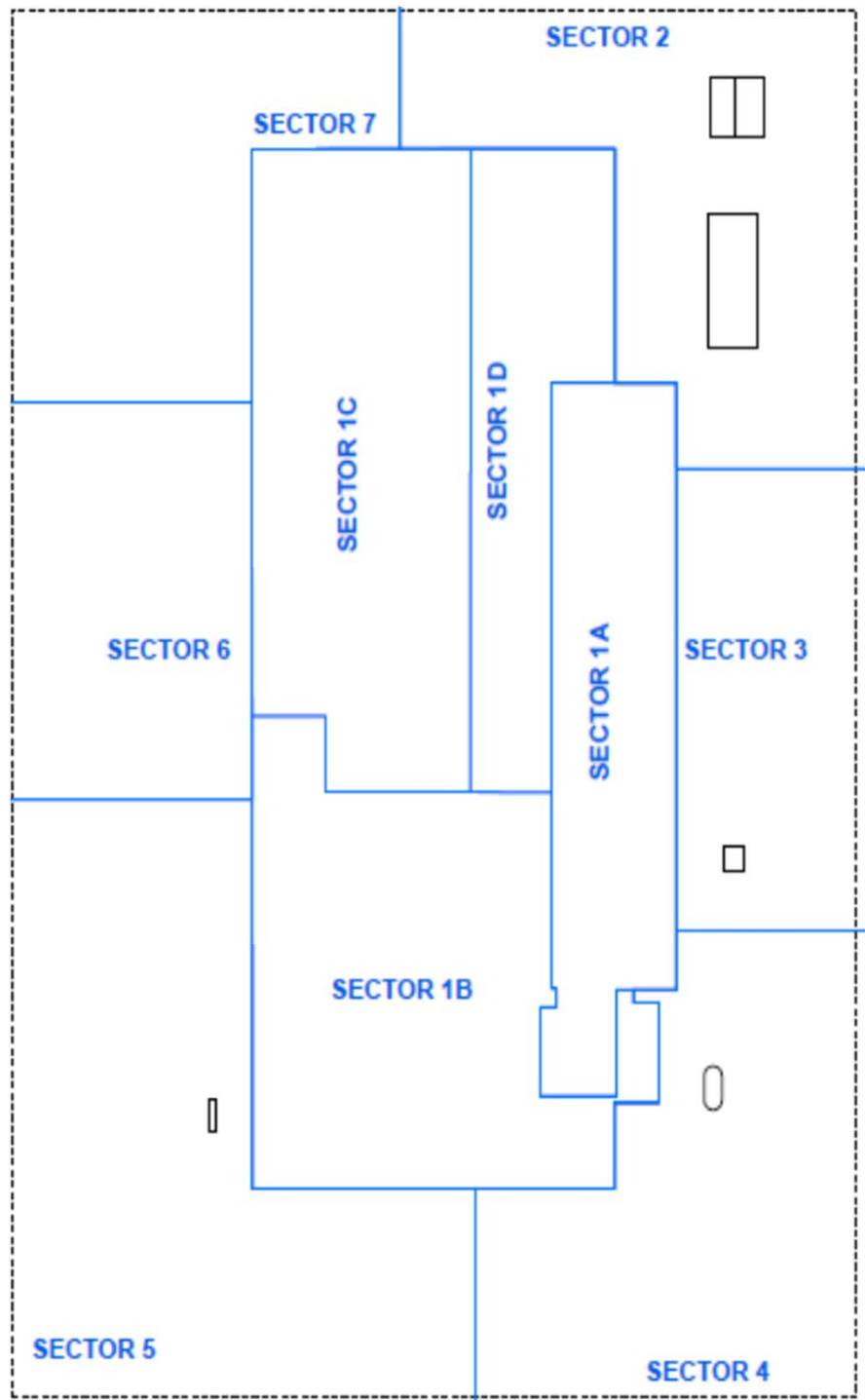




# Comprehensive RGA & McNairy Sampling for C-400 Complex OU

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# C-400 Complex OU Sectors



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# C-400 Complex OU

## RGA and McNairy Background

### Site Description

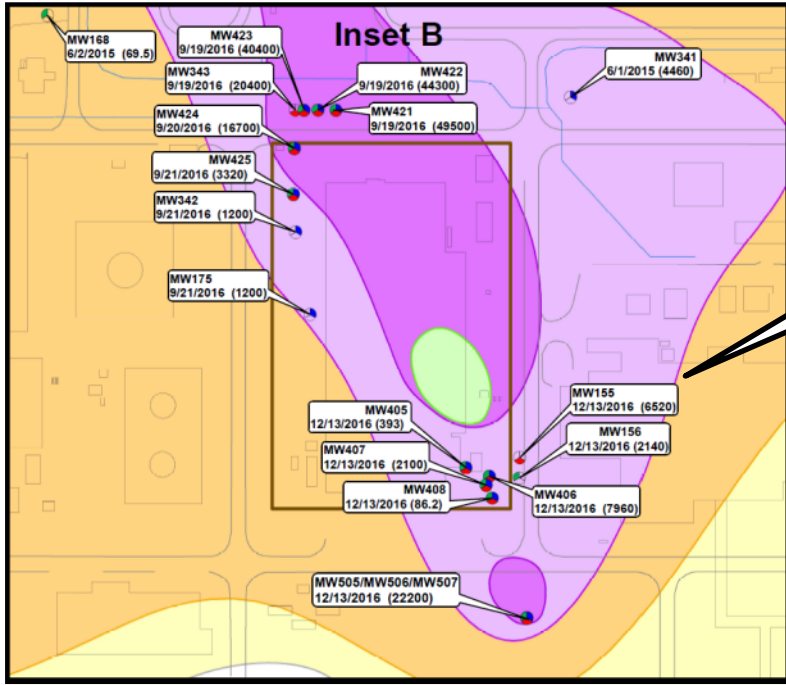
- C-400 Complex approx. ~350,000 ft<sup>2</sup> (8 acres)
- RGA HU4 horizon at approximate depth of 55 ft
- RGA HU5 horizons at approximate depth of 60 to 90 ft
- McNairy occurs below RGA

Key context based on WAG 6 RI and Process Knowledge

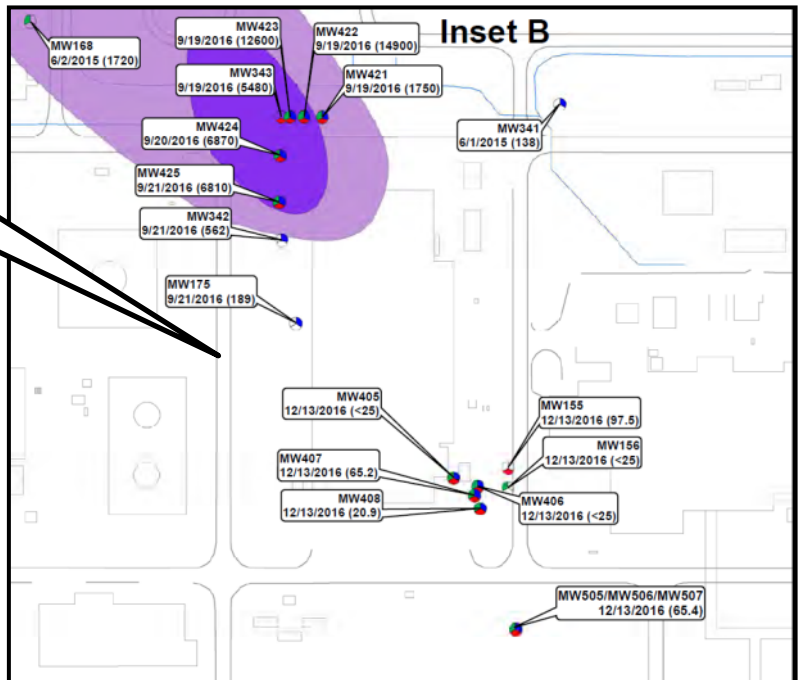




# C-400 Complex OU - Known Dissolved-Phase Plumes



CY 2016  
TCE Plume Map,  
C-400 Area



CY 2016  
Tc-99 Plume Map,  
C-400 Area

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# C-400 Complex OU - Sampling Strategy: Targeted

## Anticipated remedial action(s)

- TBD

## Primary recognized uncertainties

- Nature and extent of RGA contaminant source zones
- Nature and extent of McNairy contaminant source zones

## Sample strategy

- Sample soil in HU4 (upper RGA)
- Sample groundwater in 2 horizons within RGA (upper and lower RGA)
  - If indicated, 3<sup>rd</sup> sample will be collected
- Sample groundwater in 2 horizons within shallow McNairy Formation
  - If indicated, 3<sup>rd</sup> sample will be collected
  - Evaluating MIP and DYE-LIF as characterization tools
- Contingency of 10%: not to exceed 10% of total of soil borings and 10% of total of samples

## Contaminant nature and extent

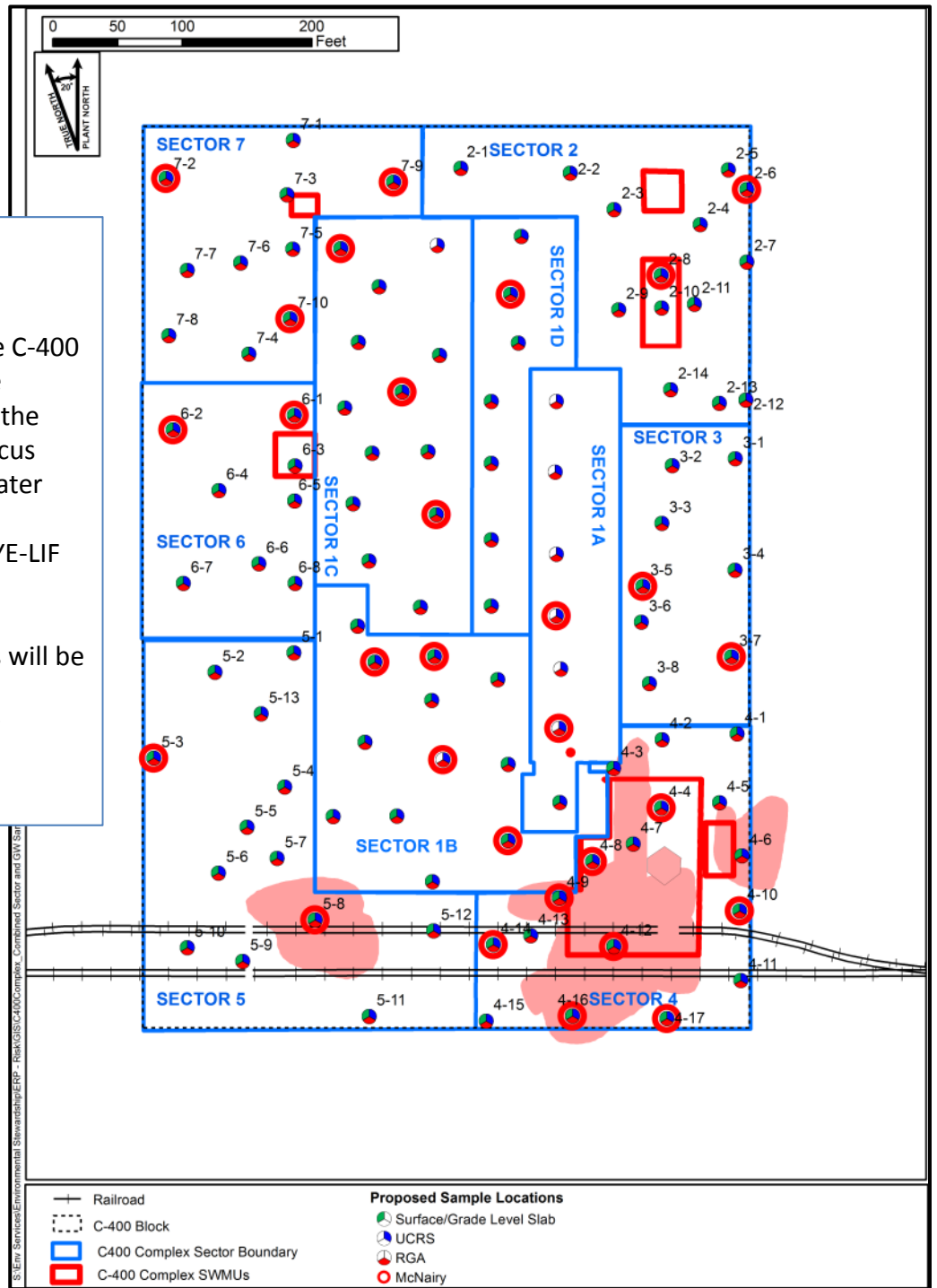
- Sampling to determine nature and extent of source zones within C-400 Complex OU
- WAG 6 RI, remedial actions, and treatability studies provide information to inform interpretation of the RI results



# Sector 1 - Targeted Sampling Approach

## HU4 Soil Sample/HU5 Groundwater Samples

- Targeted approach:
- HU4 soil sample approximates an even distribution across the C-400 Complex OU to define contaminant levels at the top of the RGA and focus contingency groundwater samples in the RGA
  - Evaluating MIP and DYE-LIF technologies as RGA characterization tools
  - Groundwater samples will be collected from 30 soil borings initially /15 or greater groundwater samples



Note:  
Locations shown  
are conceptual

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# RGA & McNairy Analyses

Targeted Sampling Approach  
(based on WAG 6 RI Baseline Risk Assessment)

- Metals (chromium as total chromium)
- PCBs
- Radionuclides
- SVOCs
- VOCs (includes toluene)



# Adaptation of Table 2.1 Significant Chemicals and Radionuclides of Potential Concern at PGDP

from *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*  
DOE/LX/07-0107&D2/R8/V1

Inorganic Chemicals		Organic Compounds				Radionuclides	
Analyte	CAS Number	Analyte	CAS Number	Analyte	CAS Number	Analyte	CAS Number
Aluminum	7429-90-5	Acenaphthene	83-32-9	<del>Total Dioxins/Furans</del>	<del>1746-01-6</del>	Americium-241	14596-10-2
Antimony	7440-36-0	Acenaphthylene	208-96-8	<del>2,3,7,8-HpCDD</del>	<del>37871-00-4</del>	Cesium-137+D	10045-97-3
Arsenic	7440-38-2	Acrylonitrile	107-13-1	<del>2,3,7,8-HpCDF</del>	<del>38998-75-3</del>	Neptunium-237+D	13994-20-2
Barium	7440-39-3	Anthracene	120-12-7	<del>2,3,7,8-HxCDD</del>	<del>34465-46-8</del>	Plutonium-238	13981-16-3
Beryllium	7440-41-7	Benzene	71-43-2	<del>2,3,7,8-HxCDF</del>	<del>55684-94-1</del>	Plutonium-239	15117-48-3
Boron	7440-42-8	Bromodichloromethane	75-27-4	<del>OCDD</del>	<del>3268-87-9</del>	Plutonium-240	14119-33-6
Cadmium	7440-43-9	Carbazole	86-74-8	<del>OCDF</del>	<del>39001-02-0</del>	Technetium-99	14133-76-7
<del>Chromium III</del>	<del>16065-83-1</del>	Carbon tetrachloride	56-23-5	<del>2,3,7,8-PeCDD</del>	<del>36088-22-9</del>	Thorium-230	14269-63-7
<del>Chromium VI</del>	<del>18540-29-9</del>	Chloroform	67-66-3	<del>1,2,3,7,8-PeCDF</del>	<del>57117-41-6</del>	Uranium-234	13966-29-5
Total Chromium	7440-47-3	1,1-Dichloroethene	75-35-4	<del>2,3,4,7,8-PeCDF</del>	<del>57117-31-4</del>	Uranium-235+D	15117-96-1
Cobalt	7440-48-4	1,2-Dichloroethane	107-06-2	<del>2,3,7,8-TCDD</del>	<del>1746-01-6</del>	Uranium-238+D	7440-61-1
Copper	7440-50-8	1,2-Dichloroethane (mixed)	540-59-0	<del>2,3,7,8-TCDF</del>	<del>5127-31-9</del>		
Fluoride	16984-48-8	trans-1,2-Dichloroethene	156-60-5	Total Carcinogenic PAHs	50-32-8		
Iron	7439-89-6	cis-1,2-Dichloroethene	156-59-2	Benz(a)anthracene	56-55-3		
Lead	7439-92-1	Dieldrin	60-57-1	Benzo(a)pyrene	50-32-8		
Manganese	7439-96-5	Ethylbenzene	100-41-4	Benzo(b)fluoranthene	205-99-2		
Mercury	7439-97-6	Fluoranthene	206-44-0	Benzo(k)fluoranthene	207-08-9		
Molybdenum	7439-98-7	Fluorene	86-73-7	Chrysene	218-01-9		
Nickel	7440-02-0	Hexachlorobenzene	118-74-1	Dibenz(a,h)anthracene	53-70-3		
Selenium	7782-49-2	Naphthalene	91-20-3	Indeno(1,2,3-cd)pyrene	193-39-5		
Silver	7440-22-4	2-Nitroaniline	88-74-4	Total PCBs	1336-36-3		
Thallium	7440-28-0	N-Nitroso-di-n-propylamine	621-64-7	Aroclor 1016	12674-11-2		
Uranium	NA	<del>Pentachlorophenol</del>	<del>87-86-5</del>	Aroclor 1221	11104-28-2		
Vanadium	7440-62-2	Phenanthrene	85-01-8	Aroclor 1232	11141-16-5		
Zinc	7440-66-6	Pyrene	129-00-0	Aroclor 1242	53469-21-9		
		Tetrachloroethene	127-18-4	Aroclor 1248	12672-29-6		
		Toluene	108-88-3	Aroclor 1254	11097-69-1		
		1,1,1-Trichloroethane	71-55-6	Aroclor 1260	11096-82-5		
		1,1,2-Trichloroethane	79-00-5	Vinyl chloride	75-01-4		
		Trichloroethene	79-01-6	Xylenes (Mixture)	1330-20-7		
				p-Xylene	106-42-3		
				m-Xylene	108-38-3		
				o-Xylene	95-47-6		

<sup>1</sup> This list of chemicals, compounds, and radionuclides was compiled from COPCs retained as COCs in baseline risk assessments performed at PGDP between 1990 and 2013 (i.e., DOE 1996a; DOE 1996b; DOE 1999a; DOE 1999b; DOE 2000a; DOE 2001; DOE 2005; DOE 2008; DOE 2010; DOE 2013).

<sup>2</sup> List may be added to during project scoping based on additional information.

Yellow cells with strikethrough text indicate COPCs that will not be analyzed for C-400 RI/FS.

Green cells indicate additional analytes, not identified as COPCs, that will be analyzed for C-400 RI/FS.

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# RGA & McNairy – Possible Response Actions

## *In Situ* Treatment

- Biological Treatment
- Physical/Chemical Treatment

## Ex Situ Treatment

- Biological Treatment
- Physical/Chemical Treatment (Assuming Pumping)

## Containment

## Air Emissions/Off-Gas Treatment



## C-400 Complex OU – Possible Response Actions to Infrastructure

All surface and subsurface infrastructure (including utilities, auxiliary systems, site infrastructure such as railroads, etc.) inside the C-400 Complex remaining following demolition will be evaluated on a case by case basis to determine an appropriate response action, if required. The evaluation may consider if an action level [i.e., the lesser of the hazard-based value calculated using target hazard index of 3 and the cancer-based value calculated using target excess lifetime cancer risk of 1E-04 when both are calculated (DOE 2018)] is exceeded in any sample based on a realistic exposure scenario. In addition to the risk-based values above, the evaluation would consider a combination of additional factors including, but not limited to, response to an immediate site threat to human health and the environment, rapidly achieving risk reduction, extent of contamination, accessibility, efficiency, cost effectiveness, building/site specific conditions at the end of demolition and beyond, and forecasted timeline for final remedy decision and implementation. Surface and subsurface infrastructure traveling through the complex (i.e., supplying multiple facilities or not associated with the C-400 Building at all) may remain in place or be rerouted, as appropriate. Surface and subsurface infrastructure designated to be left in place will be characterized based on sample analyses, evaluation of existing data, and/or process knowledge to ensure risks are properly mitigated. Surface and subsurface infrastructure supplying only the C-400 building and/or support structures inside the C-400 Complex may undergo one or more of the following actions:

- air-gapped
- sealed (e.g., grouted)
- excavated
- addressed by other appropriate means

The purpose of these actions would be to mitigate potential impacts to the RI/FS, remedial action, etc. One example of a potential impact would be void spaces beneath grade. The RI/FS Work Plan will include a listing of these surface and subsurface infrastructure components and include additional details to support further evaluation.

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# C-400 Complex OU – Geotechnical Samples

Geotechnical samples (in general):

- Engineering properties, transport properties, and risk assessment
- Geotechnical properties likely consistent across C-400 Complex OU
  - 1 boring<sup>3</sup> [8 samples: HU1, HU2, HU3, (3) RGA, and (2) McNairy] per sector to define characteristic value and variability for C-400 Complex OU
  - Samples from minimally affected soil
- Examples of data needs for potential remedial actions
  - Geochemical and biological parameters that could affect chemical degradation and transformation
  - Modeling<sup>4</sup> parameters including chemical parameters, mineralogy, reduction-oxidation potential, porosity, permeability, and stratigraphy
  - Potentiometric surfaces (groundwater flow direction—from regional MWs, not from these soil borings)
  - Physical parameters including compaction, grain size, cation exchange, chemical oxygen demand, pH, permeability, genetic profiling, microbial community, NOD, moisture content of soils, and  $K_d$  (for selected chemicals)

<sup>3</sup>Boring to be collected from location with most natural setting.

<sup>4</sup>Modeling from the Risk Methods Document, Table 3.2. “Modeling Matrix for Groundwater, Surface Water, and Biota”



Sector	Sample Point Location	Concrete Samples	Surface Soil Samples	UCRS Samples (Soil)			RGA Sample (Soil)	RGA Samples (Water)			McNairy Samples (Water)			Soil Samples Collected from Specific Location	Water Samples Collected from Specific Location	Rationale for focused sampling
				HU1 (~10 ft bgs)	HU2 (~20 ft bgs)	HU3 (~35 ft bgs)	HU4/HU5 Interface	HU5 (1)	HU5 (2)	HU5 (3)	Interface	+.10 ft	+.20 ft			
1A	3				X	X	X	X	X	X	X	X	3	6	TCE transect, near degreaser, etc.	
1A	4				X	X	X	X					3	0	TCE transect, near degreaser, etc.	
1A	5				X	X	X	X	X	X	X	X	3	6	dip tanks	
1A	6				X	X	X	X					3	0	dip tanks	
1A	7				X	X	X	X					3	0	dip tanks	
1A	8				X	X	X	X					3	0	dip tanks	
1A	23	2		X	X	X	X						4	0	TCE transect, near degreaser, etc.	
1B	2			X	X	X	X	X	X	X	X	X	4	6	Cylinder disassembly area & TCE transect	
1B	21	2		X	X	X	X						4	0	TCE transect, near degreaser, etc.	
1B	22	2		X	X	X	X						4	0	TCE transect, near degreaser, etc.	
1B	24	2		X	X	X	X	X	X	X	X	X	4	6	TCE transect, near degreaser, acid waste lines, etc.	
1B	25	2		X	X	X	X						4	0	TCE transect	
1B	26	2		X	X	X	X						4	0	TCE transect & Acid Discard lines	
1B	27	2		X	X	X	X						4	0	Acid Discard Line	
1B	28	2		X	X	X	X	X	X	X	X	X	4	6	Spray booth	
1B	41	2		X	X	X	X						4	0	Hand table and acid discard line (Disassembly and DECON Area)	
1B	42	2		X	X	X	X	X	X	X	X	X	4	6	Blakeslee Degreaser and acid discard line (Disassembly and DECON Area)	
1B	43	2		X	X	X	X						4	0	Blakeslee Degreaser, Seal disassembly (Disassembly and DECON Area)	
1B	44	2		X	X	X	X						4	0	Seal Disassembly, Receiving Booth (Disassembly and DECON Area), and acid discard line	
1C	1				X	X	X	X	X	X	X	X	3	6	Tc-99 transect	
1C	29	2		X	X	X	X						4	0	#5 disolver storage tanks and acid discard line	
1C	30	2		X	X	X	X						4	0	U solution storage tanks, acidifying tanks, and acid drain and <b>GEOTECHNICAL</b>	
1C	31	2		X	X	X	X						4	0	Test Loop acid discard lines	
1C	32	2		X	X	X	X	X	X	X	X	X	4	6	Calciner, (area covered in concrete due to severley eroded floor and contamination)	
1C	33	2		X	X	X	X						4	0	Test loop and acid waste line	
1C	34	2		X	X	X	X	X	X	X	X	X	4	6	Tc-99 transect, Cubicles, acid discard line	
1C	35	2		X	X	X	X						4	0	Tc-99 transect	
1C	36	2		X	X	X	X						4	0	Tc-99 transect and acid discard line	
1C	37	2		X	X	X	X						4	0	tc-99 transect, acid discard line, #4 dissolver, gold dissolver, gold furnace	
1C	38	2		X	X	X	X						4	0	Uranium recovery and acid discard line,	
1C	39	2		X	X	X	X						4	0	uranium recovery, acid discard line	
1C	40	2		X	X	X	X						4	0	Uranium Recovery, #5 disolver, acid discard line	
1D	14	2		X	X	X	X						4	0	acid waste drain and UF6 pulverizer	
1D	15	2		X	X	X	X	X	X	X	X	X	4	6	acid waste drain and UF6 pulverizer	
1D	16	2		X	X	X	X						4	0	Acid waste line and bound dip tank area	
1D	17	2		X	X	X	X						4	0	acid waste line and bound dip tank area	
1D	18	2		X	X	X	X						4	0	acid waste line and bound dip tank area	
1D	19	2		X	X	X	X						4	0	acid waste line and bound dip tank area	
1D	20	2		X	X	X	X						4	0	acid waste line and bound dip tank area	

Sector	Sample Point Location	Concrete Samples	Surface Soil Samples	UCRS Samples (Soil)			RGA Sample (Soil)	RGA Samples (Water)			McNairy Samples (Water)			Soil Samples Collected from Specific Location	Water Samples Collected from Specific Location	Rationale for focused sampling
				HU1 (~10 ft bgs)	HU2 (~20 ft bgs)	HU3 (~35 ft bgs)	Hu4/Hu5 interface	HU5 (1)	HU5 (2)	HU5 (3)	Interface	+.10 ft	+.20 ft			
2	2-1		X	X	X	X	X							5	0	Confirm Wag 6 data
2	2-2		X	X	X	X	X							5	0	Bound Acid Waste line to C-403 & Confirm Wag 6 data
2	2-3		X	X	X	X	X							5	0	Bound Acid Waste line to C-403, C-403 surrounding soils, and confirm Wag 6 data
2	2-4		X	X	X	X	X							5	0	C-403 & C-402 surrounding soil and near storm drain line
2	2-5		X	X	X	X	X							5	0	HF transfer line to C-410
2	2-6		X	X	X	X	X	X	X	X	X	X	X	5	6	HF transfer line to C-410 & <b>GEOTECHNICAL</b>
2	2-7		X	X	X	X	X							5	0	HF transfer line to C-410 and storm drain
2	2-8		X	X	X	X	X	X	X	X	X	X	X	5	6	C-402 underlying soils
2	2-9		X	X	X	X	X							5	0	Acid waste line to C-403 and confirm WAG 6 data (PAH near surface)
2	2-10		X	X	X	X	X							5	0	C-402 underlying soils
2	2-11		X	X	X	X	X							5	0	C-402 surrounding soil and storm drains
2	2-12		X	X	X	X	X							5	0	HF transfer line to C-410
2	2-13		X	X	X	X	X							5	0	Storm drain
2	2-14		X	X	X	X	X	X	X	X	X	X	X	5	6	Confirm Wag 6 data
3	3-1		X	X	X	X	X							5	0	Storm drain (depression) and HF line to C-410
3	3-2		X	X	X	X	X							5	0	Storm drain and confirm WAG 6 data
3	3-3		X	X	X	X	X							5	0	Storm drain and confirm WAG 6 data
3	3-4		X	X	X	X	X							5	0	Storm Drain and confirm WAG 6 data
3	3-5		X	X	X	X	X	X	X	X	X	X	X	5	6	Acid Waste line to C-403 and bound WAG 6 data (C-400-011)
3	3-6		X	X	X	X	X							5	0	Acid Waste line to C-403 and bound WAG 6 data (C-400-011)
3	3-7		X	X	X	X	X	X	X	X	X	X	X	5	6	Confirm WAG 6 data (PCB near surface) and <b>GEOTECHNICAL</b>
3	3-8		X	X	X	X	X							5	0	Confirm WAG 6 data
4	4-1		X	X	X	X	X							5	0	Storm drain and confirm WAG 6 data
4	4-2		X	X	X	X	X							5	0	Confirm WAG 6 data
4	4-3		X	X	X	X	X							5	0	Bound contamination from potential building source(s)
4	4-4		X	X	X	X	X	X	X	X	X	X	X	5	6	1st line of transects for Phase IIb (TCE) area
4	4-5		X	X	X	X	X							5	0	Storm Drain and confirm WAG 6 data
4	4-6		X	X	X	X	X							5	0	Bound contamination inside Complex OU
4	4-7		X	X	X	X	X							5	0	Confirm WAG 6 and IRA data
4	4-8		X	X	X	X	X	X	X	X	X	X	X	5	6	1st line of transects for Phase IIb (TCE) area
4	4-9		X	X	X	X	X	X	X	X	X	X	X	5	6	1st line of transects for Phase IIb (TCE) area
4	4-10		X	X	X	X	X	X	X	X	X	X	X	5	6	Ensure Phase Iib (DNAPL) is inside block
4	4-11		X	X	X	X	X							5	0	Bound contamination inside Complex OU
4	4-12		X	X	X	X	X	X	X	X	X	X	X	5	6	Previously determined phase Iib DNAPL area - (Potential TEST Location for high resolution characteriz
4	4-13		X	X	X	X	X							5	0	Storm drain & confirm WAG 6/IRA data
4	4-14		X	X	X	X	X	X	X	X	X	X	X	5	6	1st line of transects for Phase IIb (TCE) area
4	4-15		X	X	X	X	X							5	0	Bound contamination inside Complex OU
4	4-16		X	X	X	X	X	X	X	X	X	X	X	5	6	Ensure Phase Iib (DNAPL) is inside block
4	4-17		X	X	X	X	X	X	X	X	X	X	X	5	6	Ensure Phase Iib (DNAPL) is inside block and <b>GEOTECHNICAL</b>



Sector	Sample Point Location	Concrete Samples	Surface Soil Samples	UCRS Samples (Soil)			RGA Sample (Soil)	RGA Samples (Water)			McNairy Samples (Water)			Soil Samples Collected from Specific Location	Water Samples Collected from Specific Location	Rationale for focused sampling
				HU1 (~10 ft bgs)	HU2 (~20 ft bgs)	HU3 (~35 ft bgs)	Hu4/Hu5 interface	HU5 (1)	HU5 (2)	HU5 (3)	Interface	+.10 ft	+.20 ft			
5	5-1		X	X	X	X	X							5	0	Acid discard line
5	5-2		X	X	X	X	X							5	0	Utilities and confirm WAG 6 data
5	5-3		X	X	X	X	X	X	X	X	X	X	X	5	6	Utilities, confirm WAG 6 data, and <b>GEOTECHNICAL</b>
5	5-4		X	X	X	X	X							5	0	Acid Discard line & confirms WAG 6 data
5	5-5		X	X	X	X	X							5	0	Confirm previously RCRA sampling event
5	5-6		X	X	X	X	X							5	0	Utilities and WAG 6 data
5	5-7		X	X	X	X	X							5	0	bound Phase I SW Area
5	5-8		X	X	X	X	X	X	X	X	X	X	X	5	6	Utilities, confirm WAG 6, and Phase I SW area (Cylinder Freeze area N/A)
5	5-9		X	X	X	X	X							5	0	Utilities, confirm WAG 6 data, and bound Phase I SW Area
5	5-10		X	X	X	X	X							5	0	Utilities and confirm WAG 6 data
5	5-11		X	X	X	X	X							5	0	Storm drain, confirm WAG 6 area, and bound Phase I SW area
5	5-12		X	X	X	X	X							5	0	Confirms WAG 6 data
5	5-13		X	X	X	X	X							5	0	Targets area of unknown contamination & confirms WAG 6 data
6	6-1		X	X	X	X	X	X	X	X	X	X	X	5	6	SWMU 47 underlying soils, Tc-99 transect, acid discard line
6	6-2		X	X	X	X	X	X	X	X	X	X	X	5	6	Utilities and <b>GEOTECHNICAL</b>
6	6-3		X	X	X	X	X							5	0	SWMU 47 underlying soils acid discard line
6	6-4		X	X	X	X	X							5	0	Utilities and confirm WAG 6 data
6	6-5		X	X	X	X	X							5	0	SWMU 47 underlying soils acid discard line
6	6-6		X	X	X	X	X							5	0	Utilities and confirm WAG 6 data
6	6-7		X	X	X	X	X							5	0	No other information in this area (requested by regulators)
6	6-8		X	X	X	X	X							5	0	Acid discard line
7	7-1		X	X	X	X	X							5	0	Previous waste discard line from SWMU 203 and confirm WAG 6 data
7	7-2		X	X	X	X	X	X	X	X	X	X	X	5	6	Storm drain and other utilities & <b>GEOTECHNICAL</b>
7	7-3		X	X	X	X	X							5	0	SWMU 203 underlying soils
7	7-4		X	X	X	X	X							5	0	Confirm WAG 6 data
7	7-5		X	X	X	X	X							5	0	Acid discard line and SWMU 203 soils
7	7-6		X	X	X	X	X							5	0	Utilities and confirm WAG 6 data
7	7-7		X	X	X	X	X							5	6	Utilities and confirm WAG 6 data
7	7-8		X	X	X	X	X							5	0	Utilities and confirm WAG 6 data
7	7-9		X	X	X	X	X	X	X	X	X	X	X	5	6	Storm drain and confirm WAG 6 data
7	7-10		X	X	X	X	X	X	X	X	X	X	X	5	1	Tc-99 transect & acid discard line
<b>Totals</b>	<b>109</b>	<b>62</b>	<b>70</b>	<b>102</b>	<b>109</b>	<b>109</b>	<b>109</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>499</b>	<b>181</b>	