TOC-Pres-16-3310 -VA
Revision 0

Vadose Zone Field Characterization WMA A-AX

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-08RV14800

washingtonriver protectionsolutions

P.O. Box 850
Richland, Washington 99352

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C. L. Tabor
Washington River Protection Solutions

A. Radloff
Washington River Protection Solutions

H. Sydnor
Washington River Protection Solutions

R. Childress
Washington River Protection Solutions

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washingtonriver protectionsolutions
P.O. Box 850
Richland, Washington 99352

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VADOSE ZONE FIELD CHARACTERIZATION WMA A-AX

2014 and 2015

VADOSE ZONE FIELD CHARACTERIZATION WMA A-AX

washington river protection solutions

PURPOSE

To Collect Data to Help Develop RCRA RFI/CMS Work Plan DQO

PERFORMED

AX-Farm:

- Drywell Logging, Direct Push Logging, and Direct Push Sampling

A-Farm:

- Drywell Logging and Direct Push Logging

Collected Temperature Data via Logging

AX-Farm Summary (Handout 1ax)

Drywell Logging

Spectral Gamma and Moisture

31 Locations

Direct Push Logging

Spectral Gamma, Moisture and Temperature

4 Locations

Direct Push Sampling

96 analytes

4 Locations, 3 sample depths @ each location

VADOSE ZONE FIELD CHARACTERIZATION WMA A-AX

AX-Farm Drywell Logging (Handout 2ax)

Total Depth ~40-125 ft

No significant changes from 1996 baseline

Cs-137

- Max. conc. Surface to ~5 ft
  - 11-01-10 and 11-02-12 have the highest concentrations (calc ~26,000* pCi/g @ 2 ft and 3,800* @ 12 ft)
- Detected in most: Surface to ~20 ft, Near tank's base (~50 ft), ~20 to 50 ft intermittently or not at all
- Detected in some: @ depths >55 ft (typically <1 pCi/g)

Co-60 and Eu-154 detected in 4 Drywells (3 same: 11-02-12, 11-04-10, 11-03-07)

Moisture: <2-43% (max. @ 11-02-22, ~5 ft), typical max. <20%, higher levels around base of tank

*calculated based on decay from 1996 reading.

VADOSE ZONE FIELD CHARACTERIZATION WMA A-AX

AX-Farm Direct Push Logging (Handout 3ax)

Deep electrodes installed

Gamma:

- Overall and Deepest Max. C9363 (~30 pCi/g @ ~surface)

Cs-137:

- Overall Max. C9363 (~54 pCi/g @ ~5 ft)
- Deepest Max. C9365 (~9 pCi/g @ ~30 ft)

Temperature:

- Range 61-86ºF, high of 86 ºF @ C9365, surface

Moisture

- Peaks near: Base of tanks (~50 ft) and @ Intermittent Depths
- Range 2-30% (max @ C9365, ~183 ft)
- Peaks selected for sample intervals

AX-Farm Direct Push Sample Results

Detected 69 of 96 analytes

- Detected Tc-99: C9360 (180-181.5 ft bgs, ~11 pCi/g) and C9362 (202-204 ft bgs 0.16 pCi/g) (Handout 3ax)
- Detected Nitrate: All samples, 5 to 56 mg/kg (Handout 3ax)
- Not Detected Cs-137, Co-60, Eu-154

Exceeded Background 16 of 49 analytes (Handouts 4ax & 5ax)

- Constituents with Most Samples Having Exceedances: Antimony, Chromium, Molybdenum, and Silicon
- Locations with Most Exceedances: C9360, 11 analytes, other 3 locations having 7 or 8 analytes
- Location with Most Rad Exceedances: C9364, 3 analytes

AX-Farm Surface Soil Removal (Handout 1ax)

Purpose:

- To Support Retrieval Infrastructure Development – Isolating Abandoned Ventilation System

Completed:

- Based on Radioactivity Survey Information
  - Removed Soil by AX-101/102 and AX-103/104
  - Excavated Depth of ~12 to 14 ft, 20 Drums
  - Survey Results Range 120K - 998K dmp/100 cm^2
    - Highest Activity AX-101/102
    - Areas Correspond to Drywells with Higher Detected Cs-137, Co-60 and Eu-154 conc. (11-02-12, 11-04-10, and 11-03-07)

A Farm Summary (Handout 1a)

Drywell Logging

Spectral Gamma and Temperature

19 Locations

Direct Push Logging

Spectral Gamma, Moisture, and Temperature

4 Locations

VADOSE ZONE FIELD CHARACTERIZATION WMA A-AX

A Farm Drywell Logging (Handout 2a)

Total Depth ~50-150 ft

No significant changes from 1996 baseline

Cs-137

- Max. conc. usually within the first 10 ft (calc ~632,000* pCi/g @ 10-01-03, 5ft, measured 501 pCi/g @ 10-02-08, 2.5 ft)
- Detected in most: Surface to ~20 ft, Near tank's base (~50 ft), ~20 to 50 ft intermittently or not at all
- Detected in some: @ depths >55 ft (typically <10 pCi/g)

Co-60 and Eu-154 detected: 4 and 6 drywells (3 same: 10-01-03, 10-01-39, and 10-02-08)

Temperature: 43-125 ºF (max. @ 10-05-09, 53 ft)

- Higher Temperatures 112-125 ºF around A-105 and between A-104/105, 64-75 ft

*calculated based on decay from 1996 reading.

VADOSE ZONE FIELD CHARACTERIZATION WMA A-AX

A-Farm Direct Push Logging (Handout 3a)

Deep electrodes installed

Gamma:

- Overall and Deepest Max. C9383 (~40 pCi/g @ ~surface [1 ft])

Cs-137:

- Overall and Deepest Max. C9383 (~67 pCi/g @ ~surface)

Temperature:

- C9369 and C39383 exhibit higher temperatures
  - 100 ºF @ C9369, 58 ft
  - 118 ºF @ C9383, 49 ft
- C9379 and C9381 exhibit similar temperatures to those in AX-Farm ~60-80 ºF

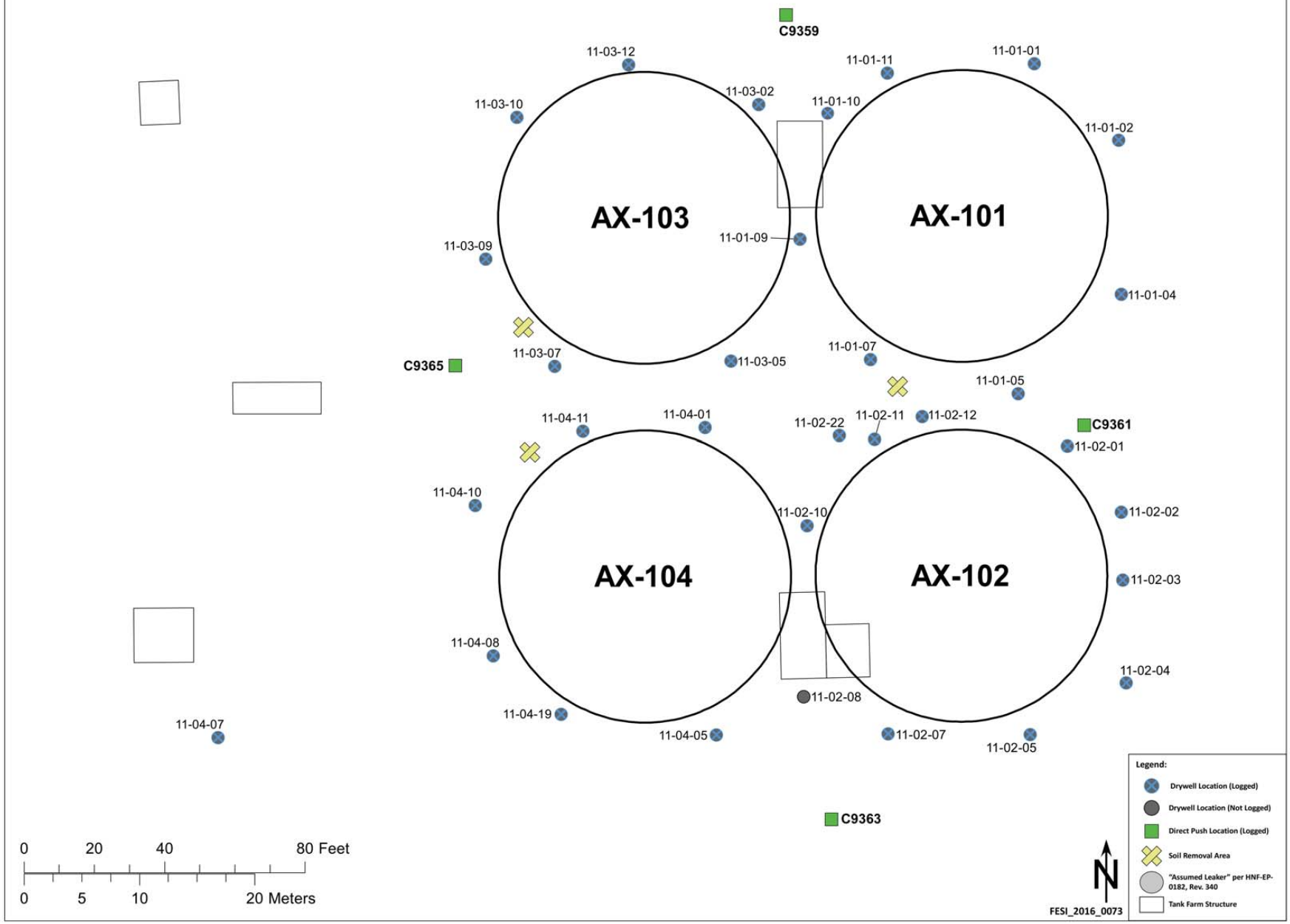
Moisture

- Peaks near: Base of tanks (~50 ft) and @ Intermittent Depths
- Range 2-30% (max @ C9379, ~127 ft)

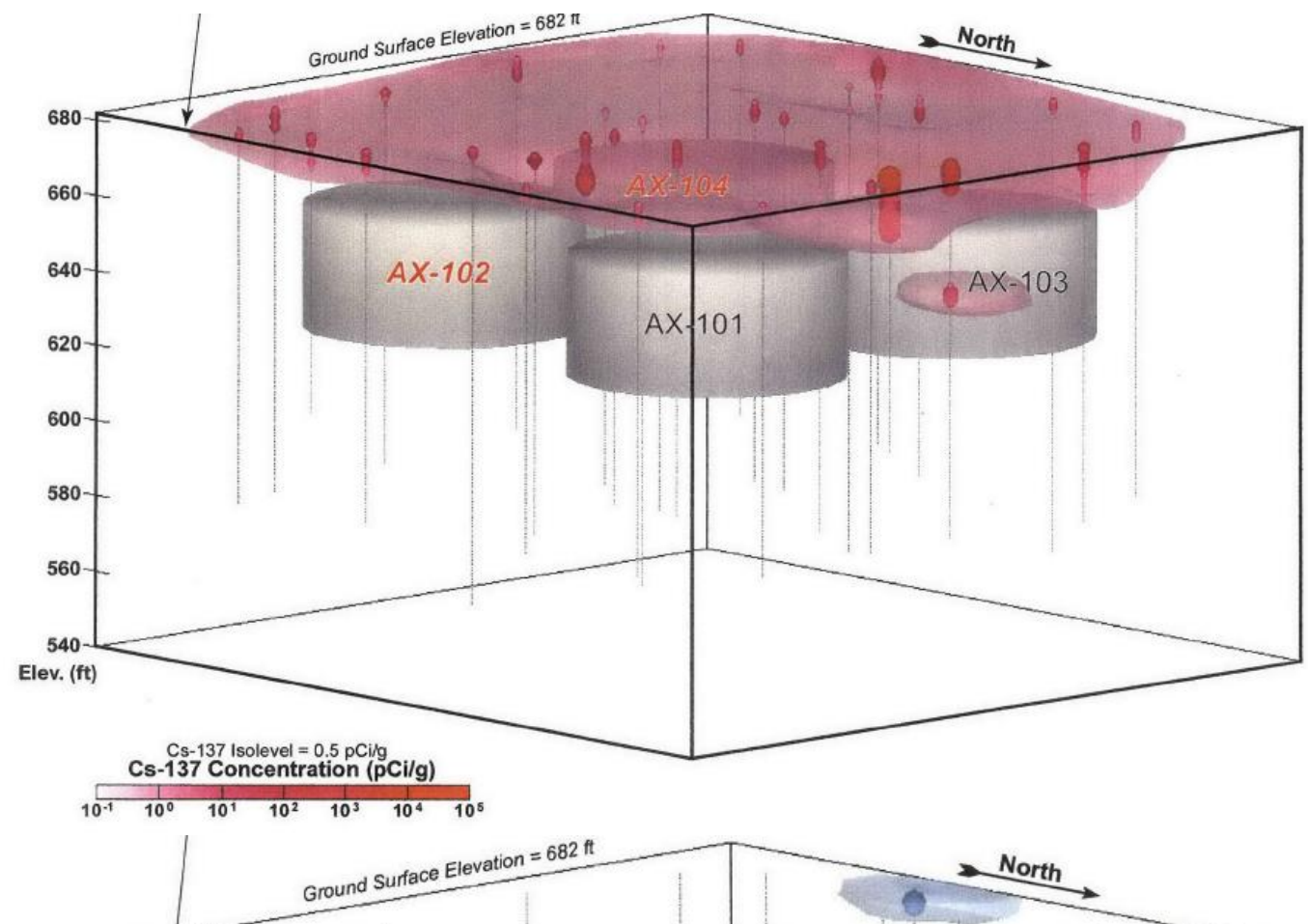
Closing Remarks

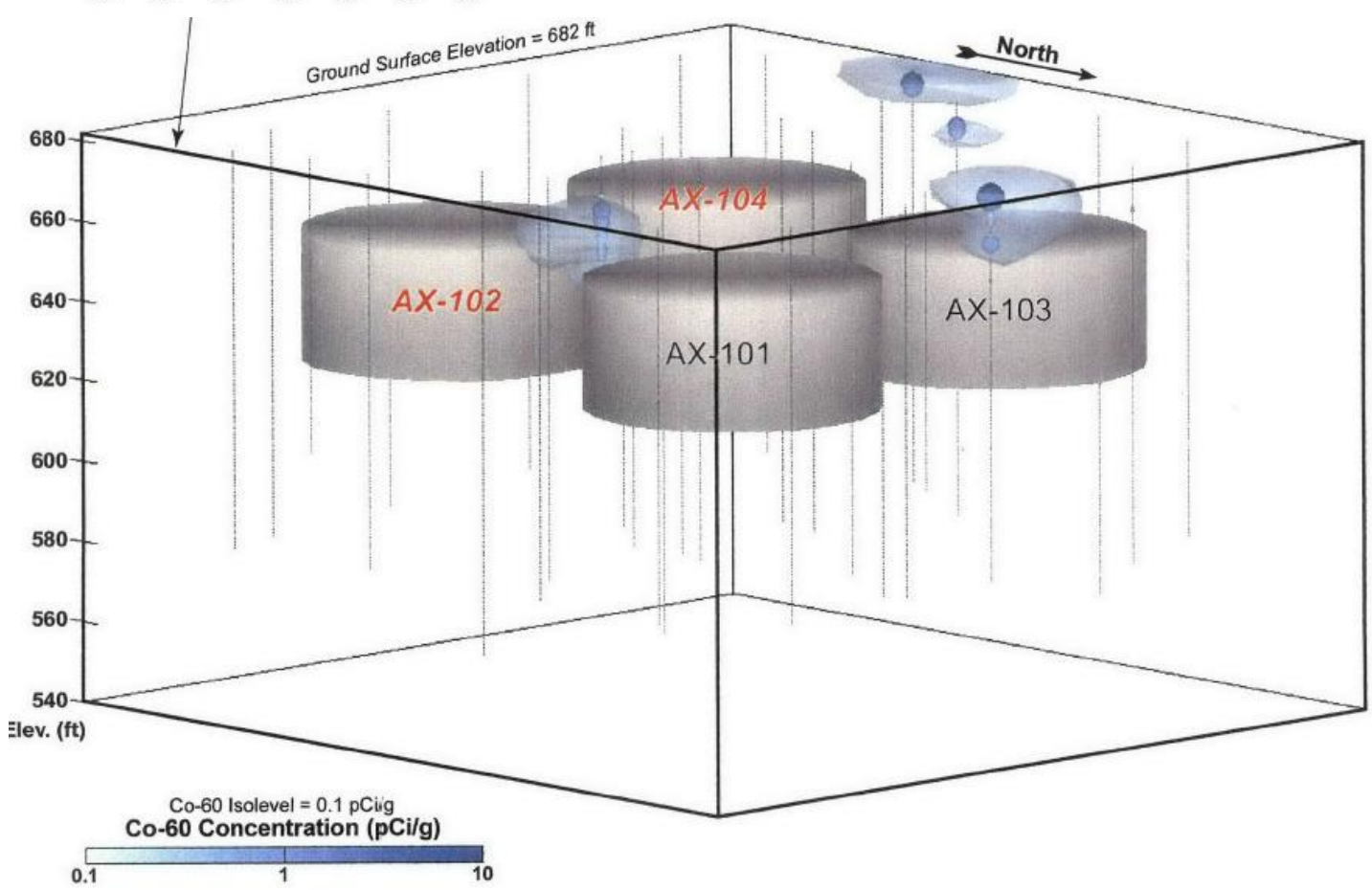
- Data will be Useful for Developing the RCRA RFI/CMS Work Plan DQO
- In General – Data Consistent with Previous Information
- Temperature Yields Useful Information

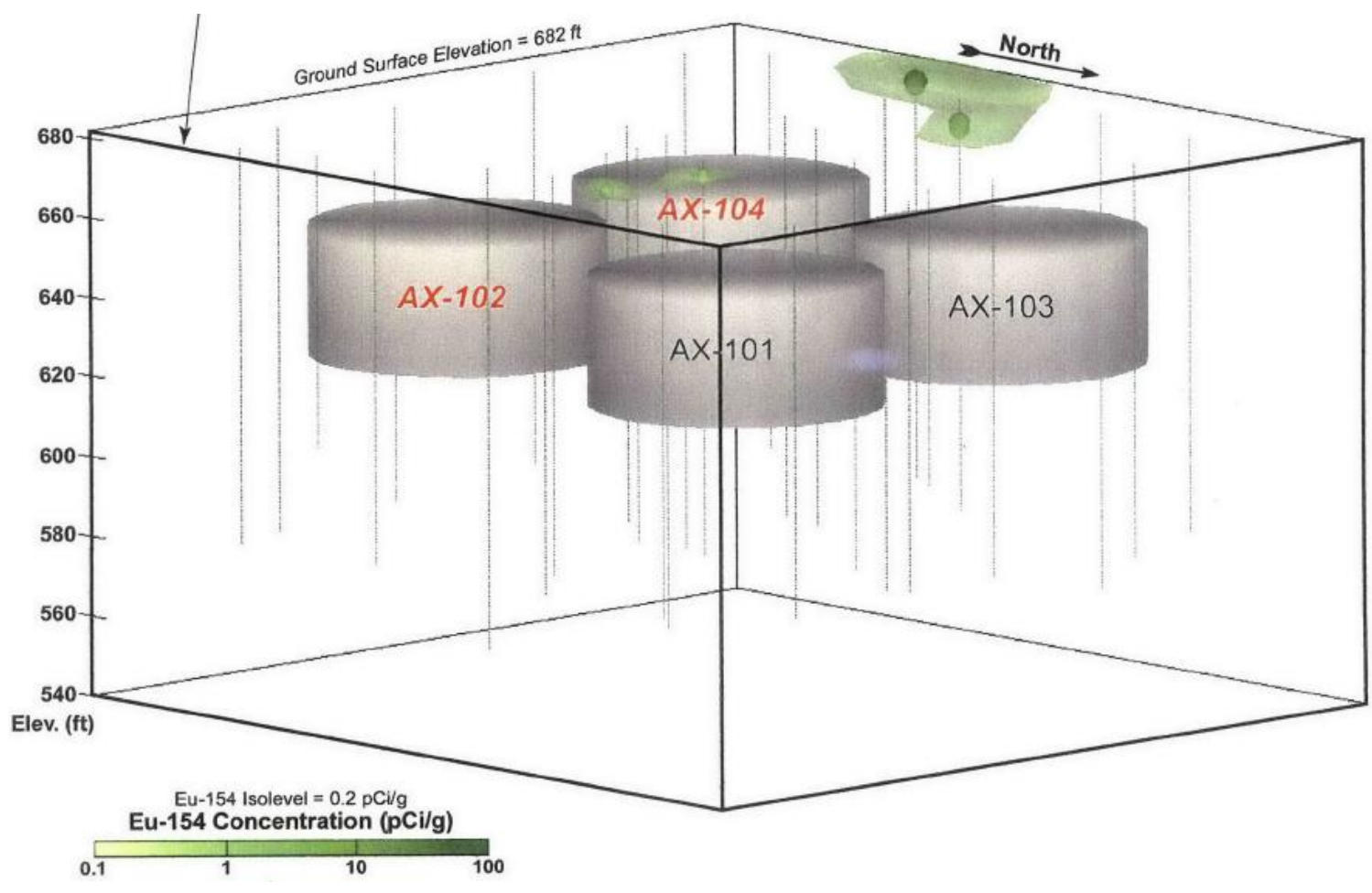
Handout 1ax : Field Characterization Locations



Handout 2ax1: 1996 Drywell Baseline 3D Visualizations for Cs-137, Co-60, and Eu-154







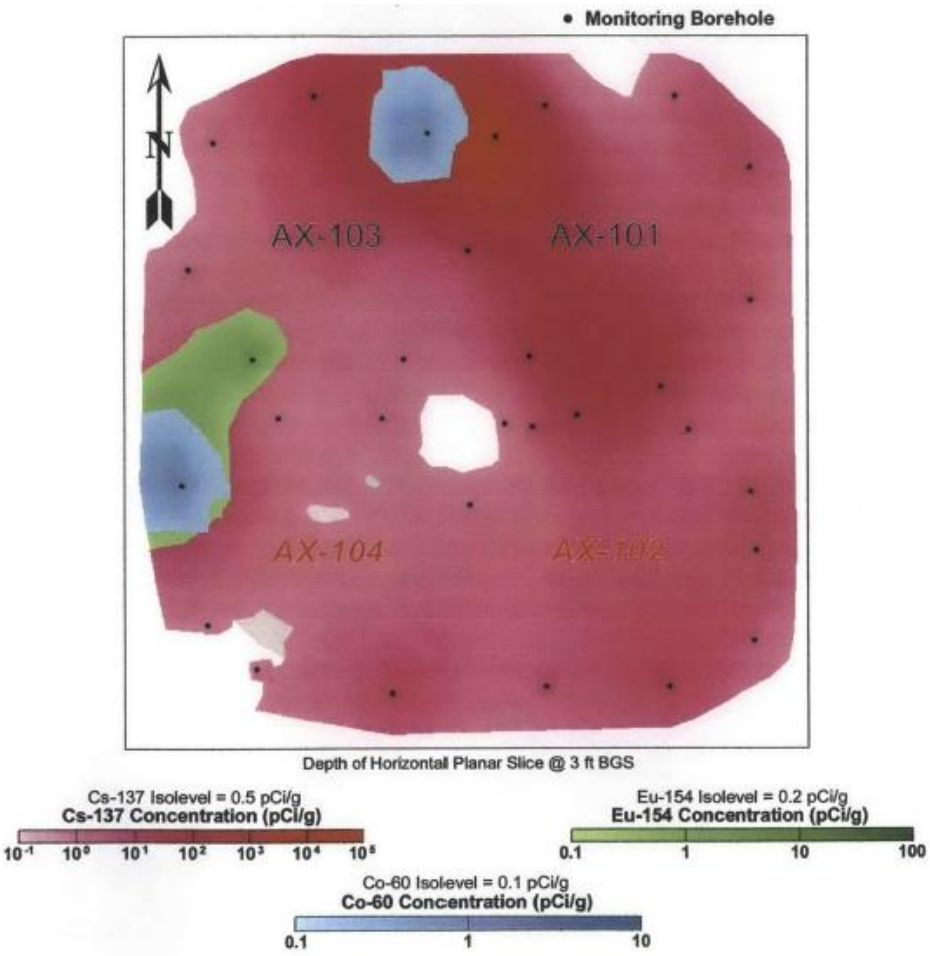
Source: Addendum to the AX Tank Farm Report GJO-97-44-TARA GJO-HAN-12, Figures D5-D12

Note: Status of assumed leakers updated to sound based on review of additional data and information (RPP-ENV-37956)

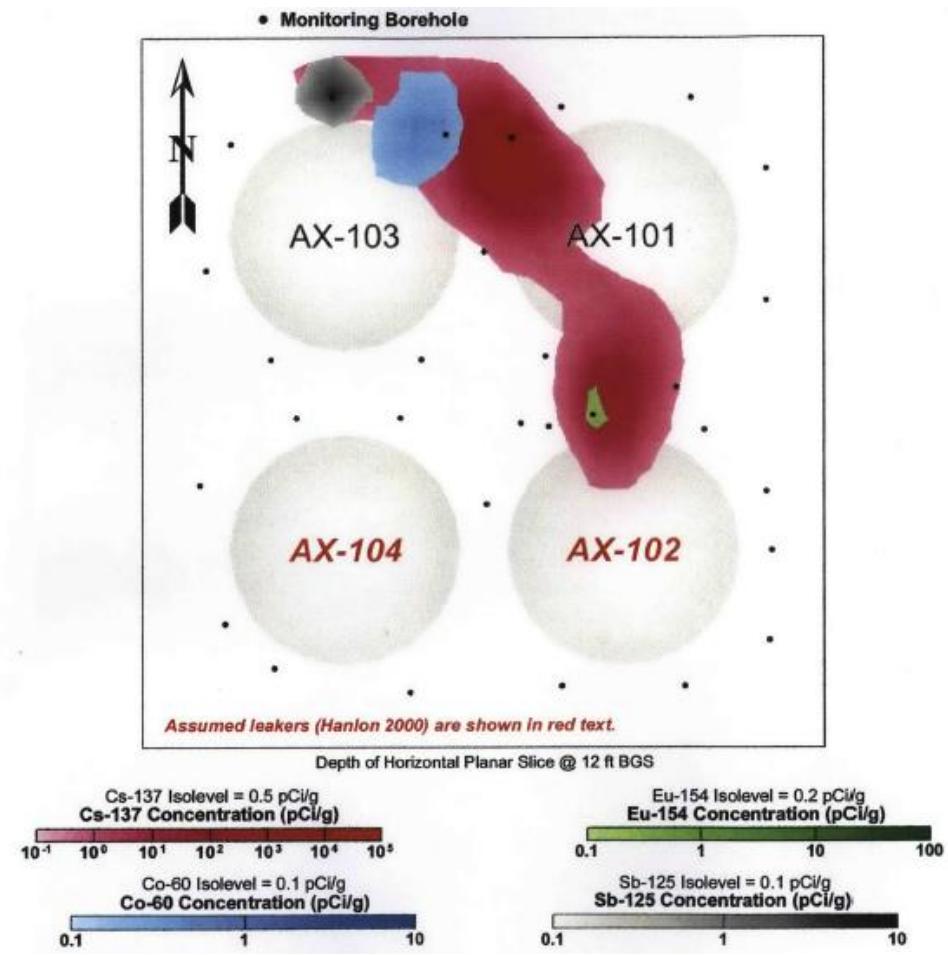
TOC-Pres-16-3310

Handout 2ax2: 1996 Drywell Baseline 2D Visualizations at various depths for Cs-137, Co-60, and Eu-154

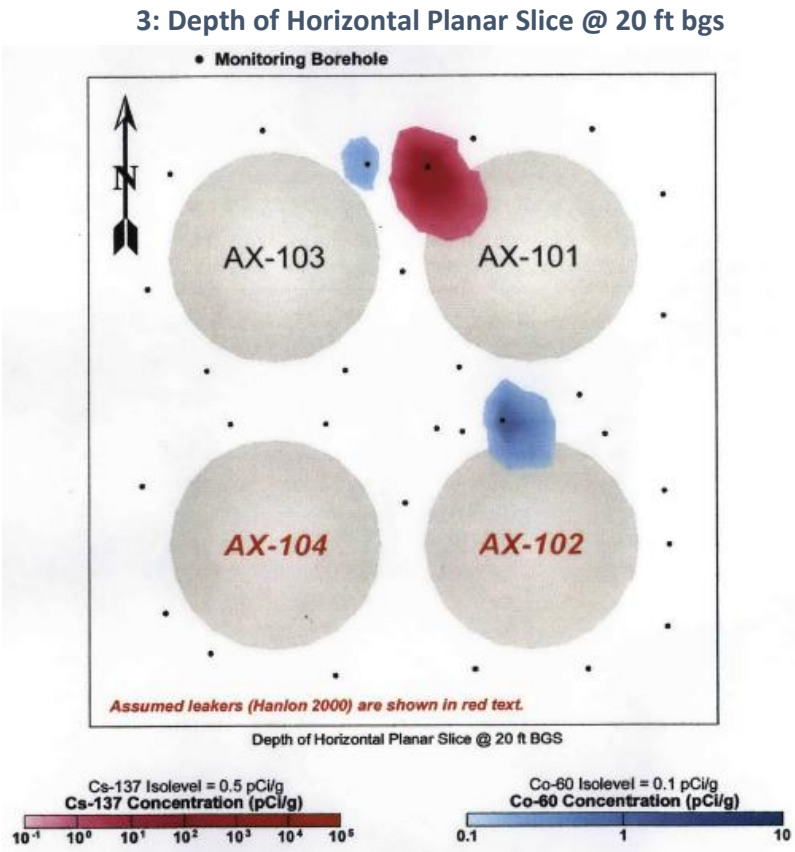
1: Depth of Horizontal Planar Slice @ 3 ft bgs



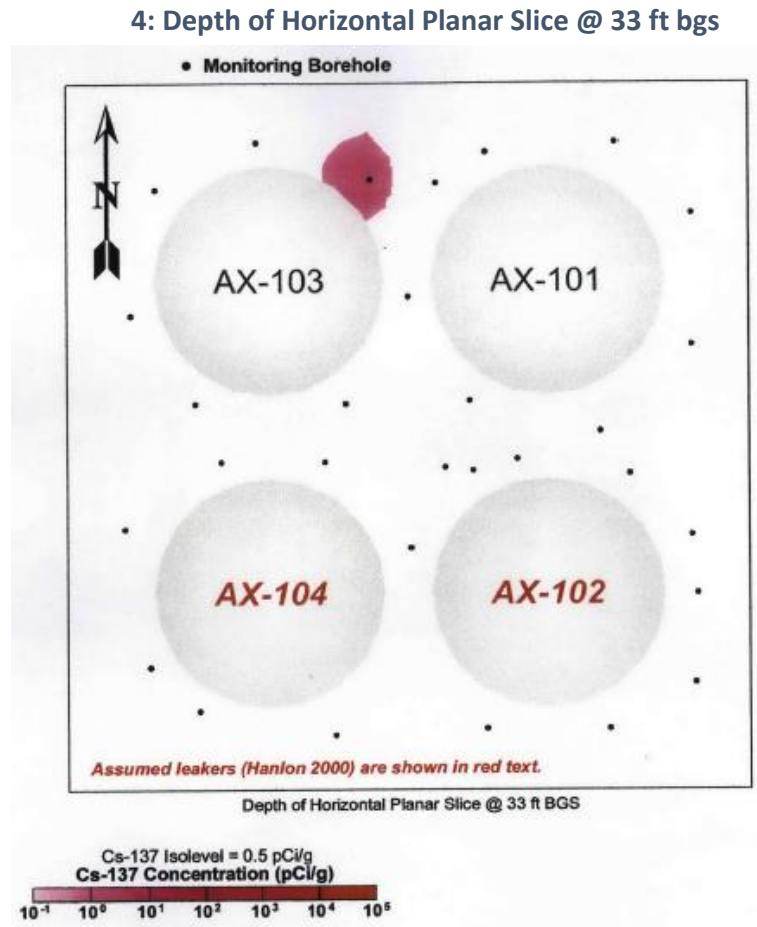
2: Depth of Horizontal Planar Slice @ 12 ft bgs



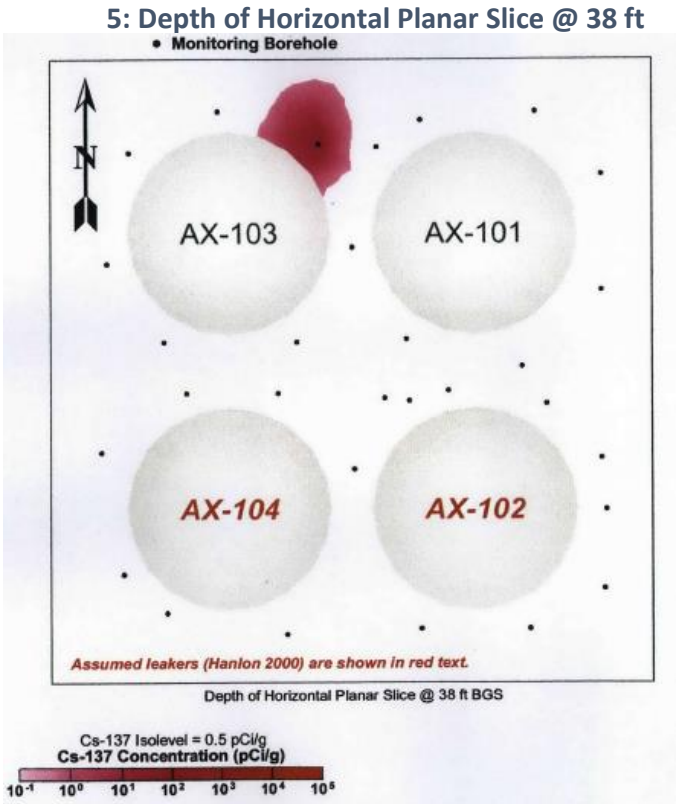
3: Depth of Horizontal Planar Slice @ 20 ft bgs



4: Depth of Horizontal Planar Slice @ 33 ft bgs



5: Depth of Horizontal Planar Slice @ 38 ft



Source: Addendum to the AX Tank Farm Report GJO-97-44-TARA GJO-HAN-12, Figures D5-D12

Note: Status of assumed leakers updated to sound based on review of additional data and information (RPP-ENV-37956)

Handout 3ax: AX-Farm Direct Push Summary Information

Location		C9359/C9360		C9361/C9362		C9363/C9364		C9365/C9366	
Date Logging Complete Total Depth ft bgs Number of Electrodes (Depth Range ft bgs)		7/2014 205.1 9 (38.25-197.25)		7/2014 205.0 9 (29.80-189.05)		7/2014 205.1 3 (15-179.8)		7/2014 205.0 9 (23.25-182.50)	
Sample Depth Meeting Date		11/25/2014		11/25/2014		11/25/2014		11/25/2014	
Sample Depth ft bgs Stratigraphic Unit		50-52 Backfill/H1		52-54 H1		45.5-47.5 Backfill (near Backfill/H1)		99.5-101.5 (H1/H2)	
Moisture Content (%)		~7.3		~7.5		~4.5		~7.4	
Nitrate* µg/g	Tc-99 pCi/g	~19	ND	~7	ND	~10	ND	~21	ND
Sample Depth ft bgs Stratigraphic Unit		115-117 Near H1/H2f		125.5-127.5 H1/H2f		121-123 H1/H2f		143-145 H2f	
Moisture Content (%)		~10.1		~5.9		~8.4		~11.6	
Nitrate* µg/g	Tc-99 pCi/g	~56	ND	~8	ND	~9	ND	~41	ND
Sample Depth ft bgs Stratigraphic Unit		180-181.5 H2c		202-204 H2c		145.5-147.5 H2f		182-184 H2c	
Moisture Content (%)		~6.5		~5.6		~7.5		~8.6	
Nitrate* µg/g	Tc-99 pCi/g	~18	~11[a,b]	~13	~0.16	~11	ND	~14	ND
Decommissioning Dates: Sample Location (Logging Location)		3/11/15 (8/11/2014)		2/24/15 (8/7/2014)		04/22/15 (7/22/2014)		4/8/15 (8/22/2014)	

Notes: ND = Not Detected (Detect limits forTc-99 ND results ranged from 0.101 to 0.114 pCi/g.), ft bgs = feet below ground surface

*Result listed is the greater of "quick turn" nitrate and nitrate by standard analysis for the sample interval. Please note, results for C9362 (125.5-127.5 ft bgs) and C9364 (all depths) are considered estimated high values based on preparation blank evaluation.

[a]Result is considered suspect and a possible false positive. The result is likely due to contamination introduced during preparation/analysis as indicated by the Tc-99 result of approximately the same level in the associated preparation blank sample.

[b]Result is from analysis of acid extract of composite sample. All other Tc-99 results are from water extract sample analysis ("quick turn" analysis). Detection limits for analysis of water extracts ~0.1 pCi/g; whereas, detection limits for analysis of acid extracts ~10 pCi/g.

Handout 4ax: Constituents with Concentrations Above Background in 241-AX Farm

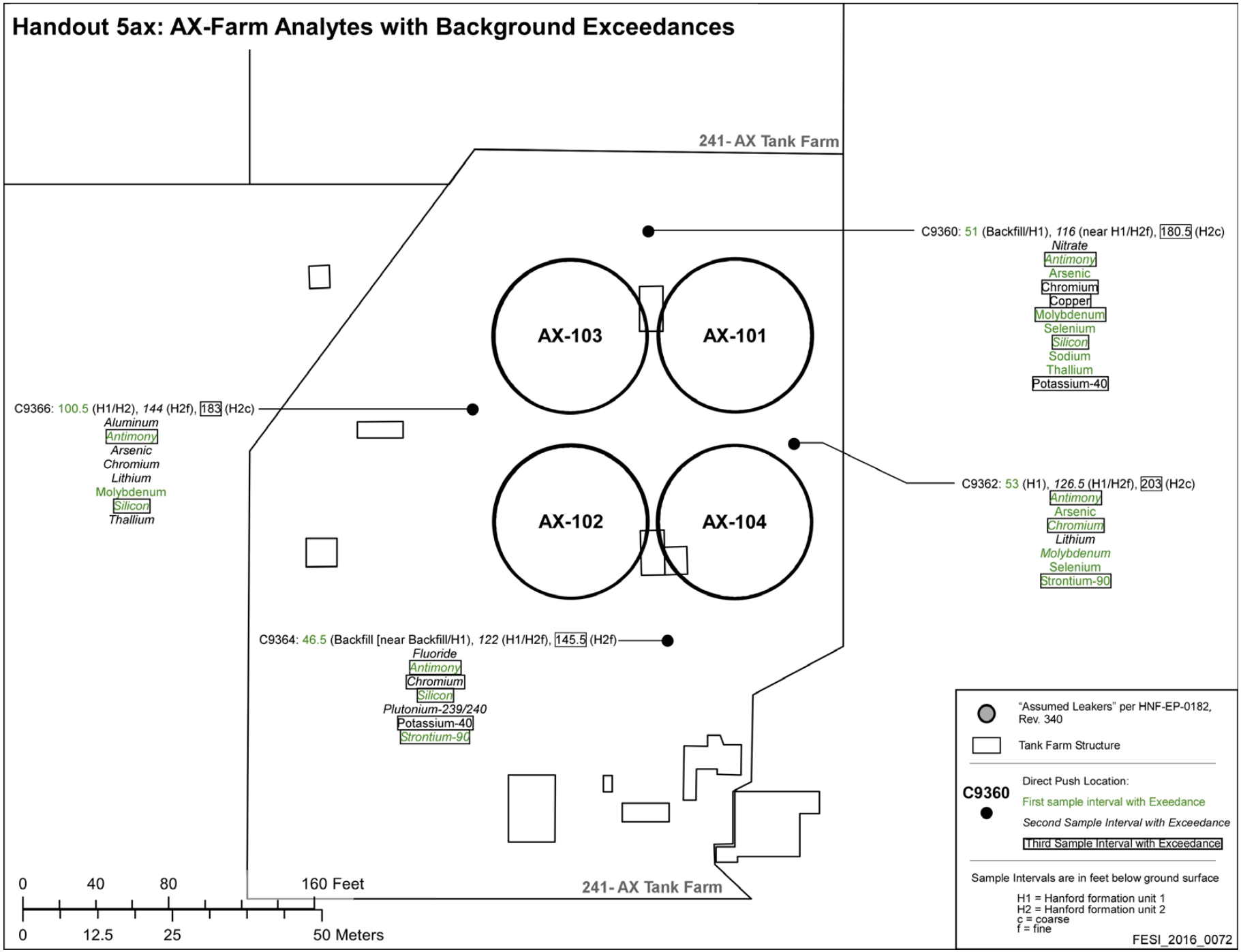
Constituent	Background Value	Minimum Concentration Above Background	Maximum Concentration Above Background	Total # of Samples with background Exceedances (out of 12)	Total # of Locations with Background Exceedances (out of 12)	Location with Maximum Concentration (Depth of Maximum Concentration in ft bgs)
µg/g						
Aluminum	11800	12600	12600	1	1	C9366 (143-145)
Antimony	0.130	0.142	0.446	12	4	C9366 (143-145)
Arsenic	6.47	6.55	6.86	3	3	C9362 (52-54)
Chromium	18.5	19	29.7	7	4	C9364 (121-123)
Copper	22	25.8	25.8	1	1	C9360 (180-181.5)
Fluoride	2.81	3.12	3.12	1	1	C9364 (121-123)
Lithium	13.3	13.4	14.8	2	2	C9366 (143-145)
Molybdenum	0.470	0.798	2.83	5	3	C9362 (52-54)
Nitrate	52	55.8	55.8	1	1	C9360 (115-117)
Selenium	0.780	0.835	0.847	2	2	C9360 (50-52)
Silicon	44	51.2	66.9	9	3	C9364 (145.5-147.5)
Sodium *Essential Nutrient*	690	840	840	1	1	C9360 (50-52)
Thallium	0.185	0.197	0.215	2	2	C9366 (143-145)
pCi/g						
Plutonium-239/240	0.0248	0.0677	0.0677	1	1	C9364 (121-123)
Potassium-40 *Naturally occurring background radiation*	16.6	17.1	17.9	2	2	C9364 (145.5-147.5)
Strontium-90	0.178	0.188	0.328	5	2	C9364 (121-123)

[a]Background concentrations are defined in DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides* and ECF-HANFORD-11-0038, *Soil Background for Interim Use at the Hanford Site*.

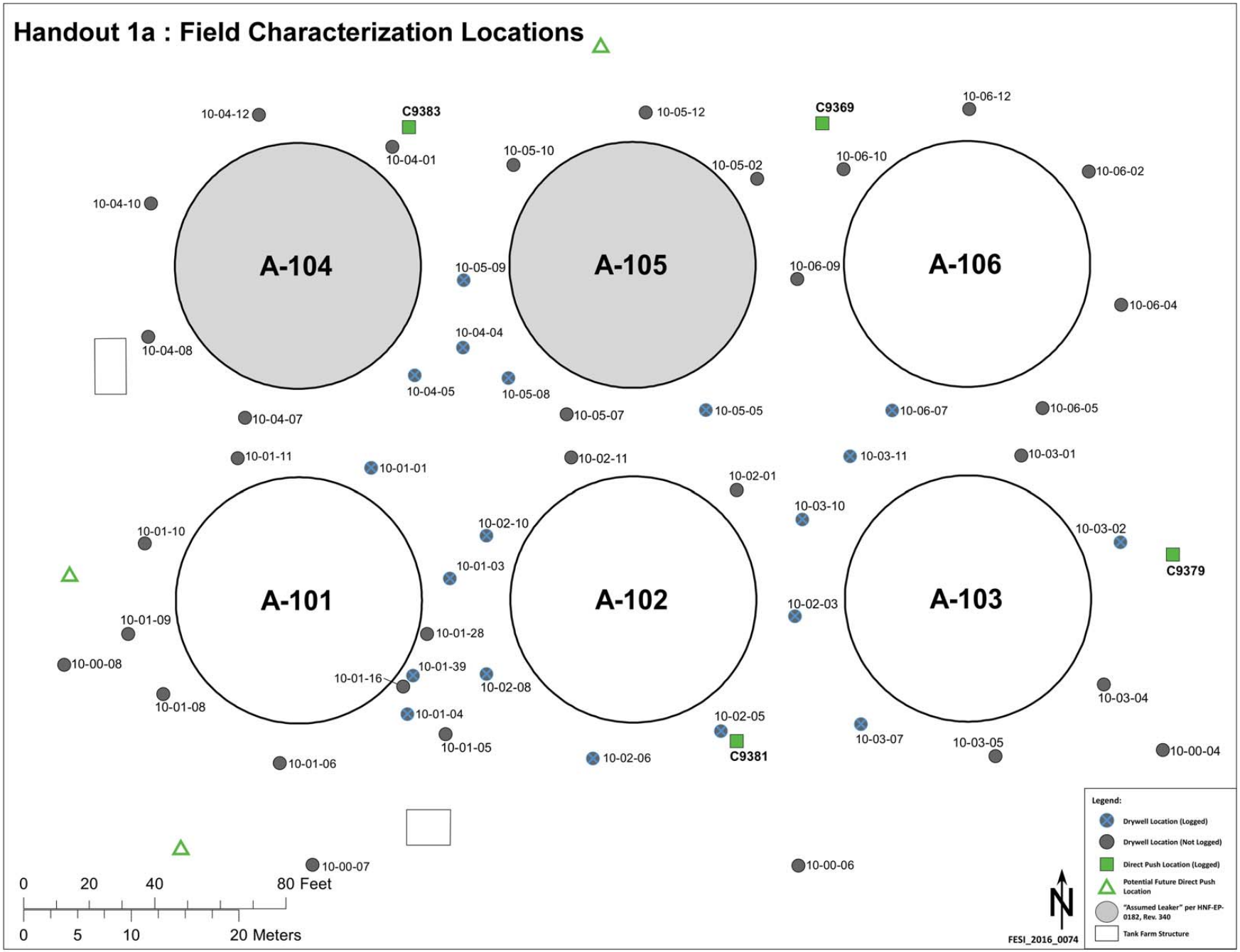
[b]Strontium-90 and Plutonium-239/240 are anthropogenic radionuclides whose background values only apply to surface soil samples.

Note: ft bgs = feet below ground surface

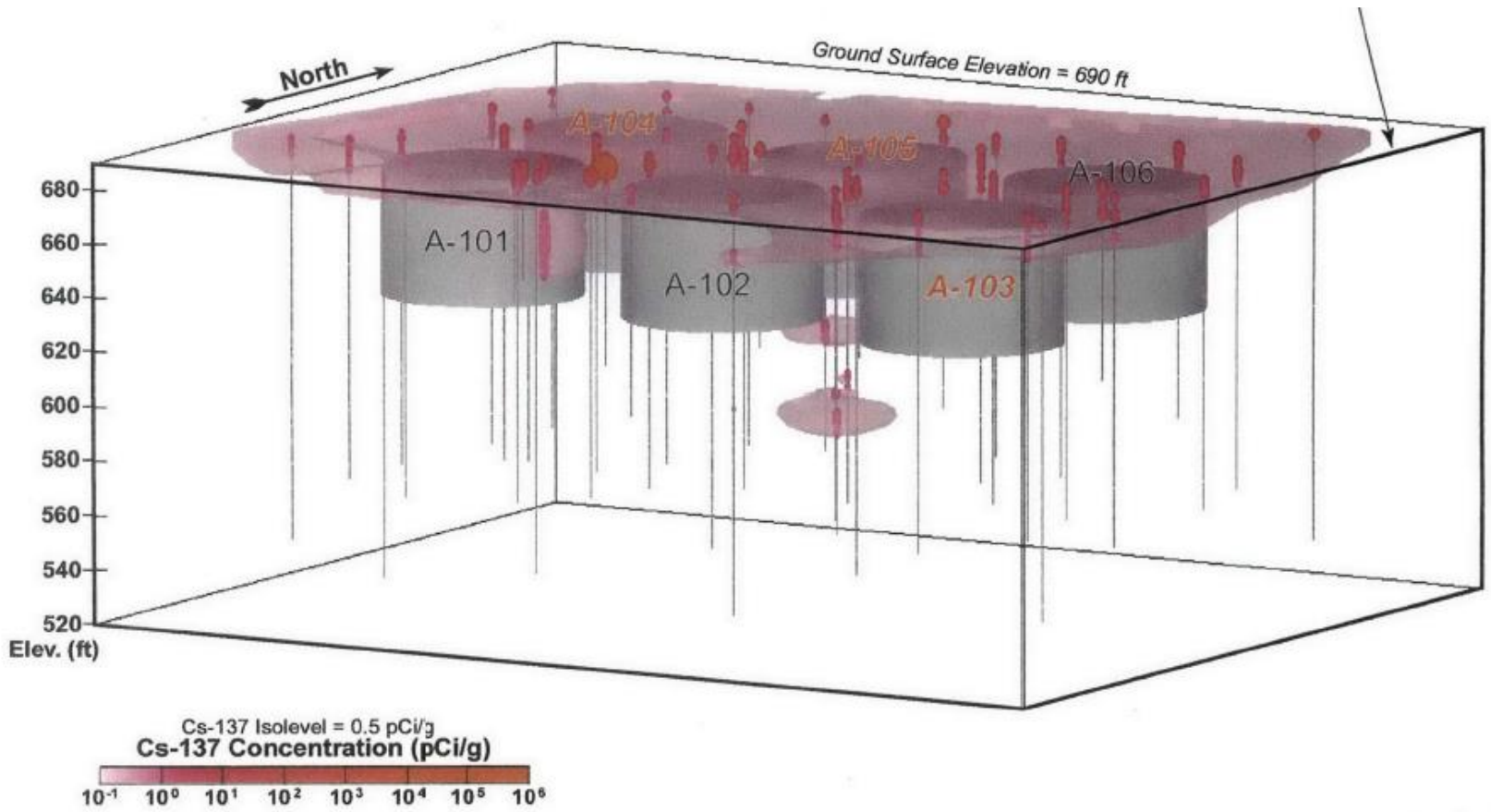
Handout 5ax: AX-Farm Analytes with Background Exceedances

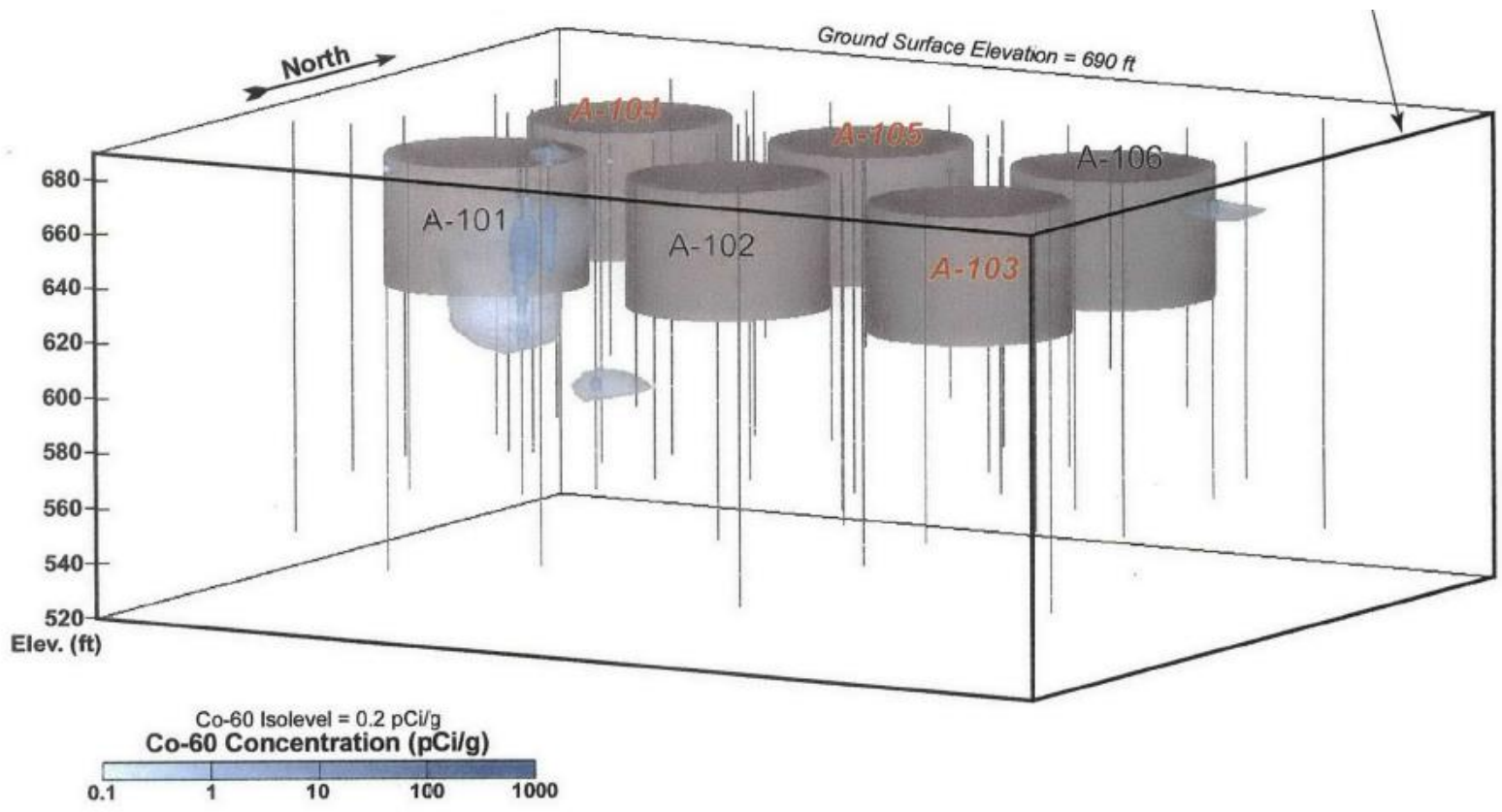


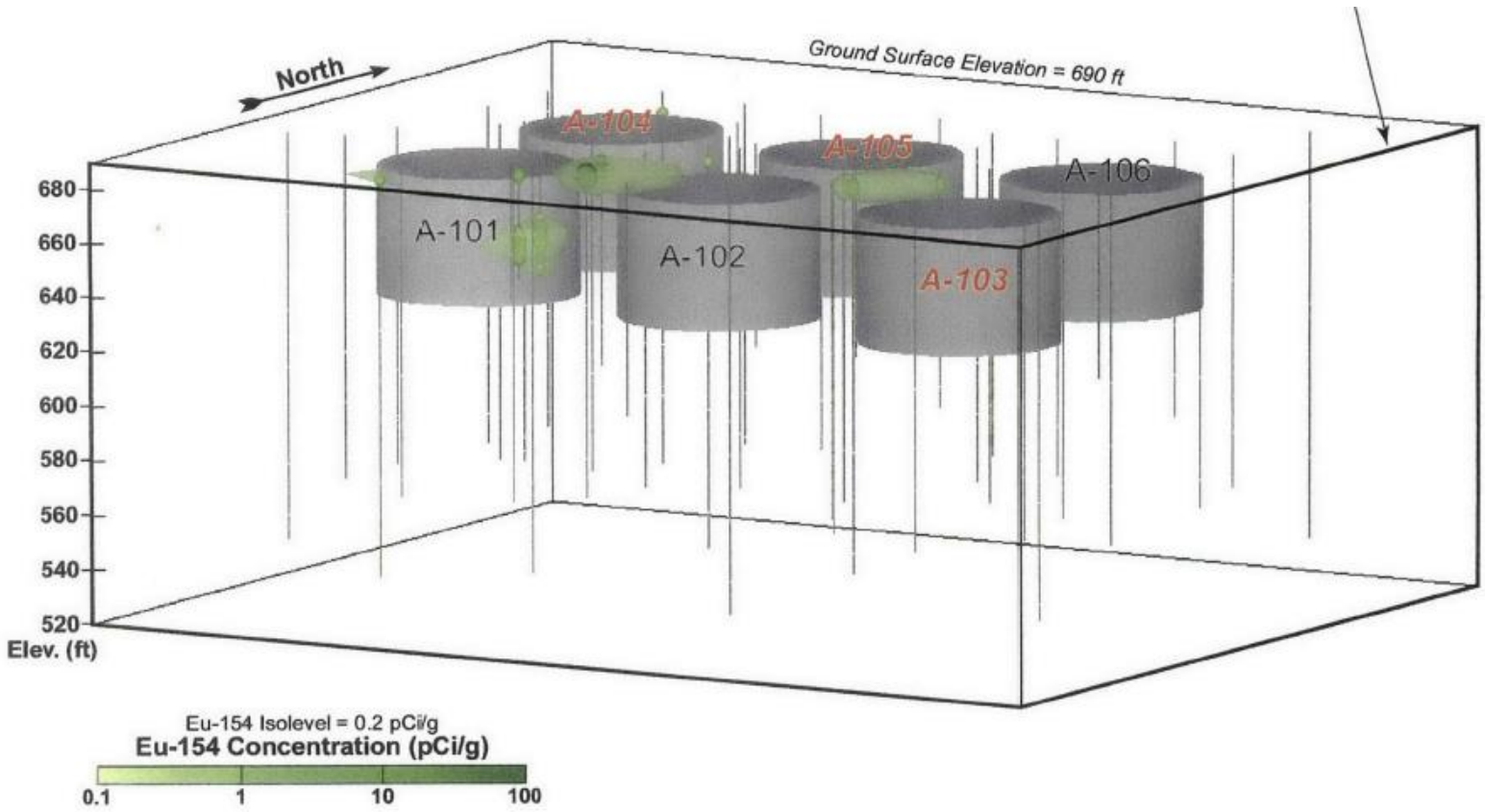
Handout 1a : Field Characterization Locations



Handout 2a1: 1996 Drywell Baseline 3D Visualizations for Cs-137, Co-60, and Eu-154



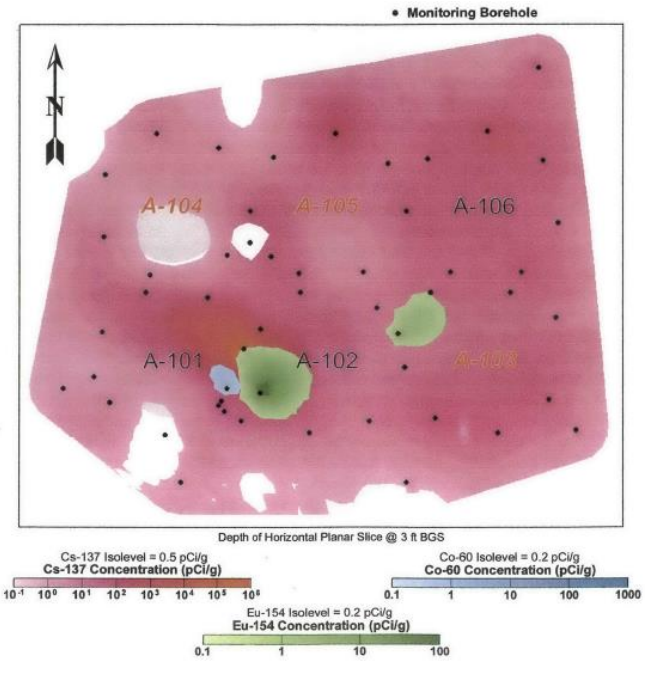




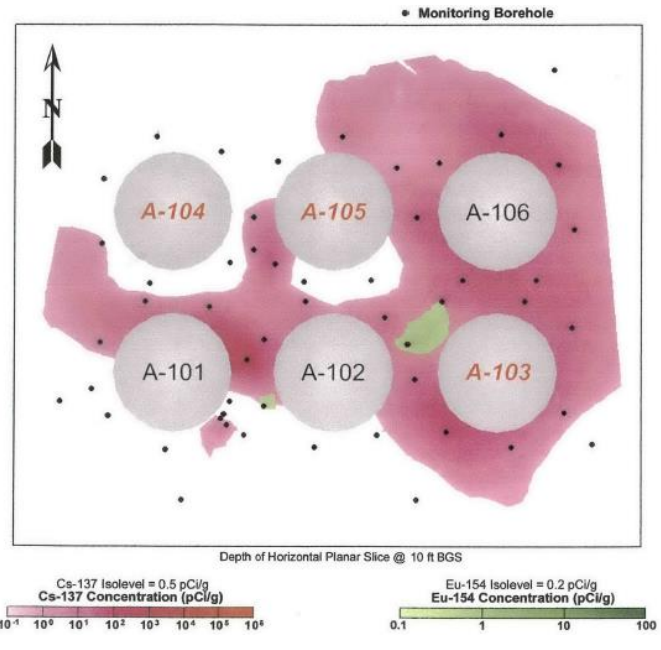
Source: GJO-98-64-TARA GJO-HAN-23, Addendum to the A Tank Farm Report, Figures D4-D16
NOTE: Status of A-103 updated to "sound" based on review of additional data and information (RPP-ENV-37956)

Handout 2a2: 1996 Drywell Baseline 2D Visualizations at various depths for Cs-137, Co-60, and Eu-154

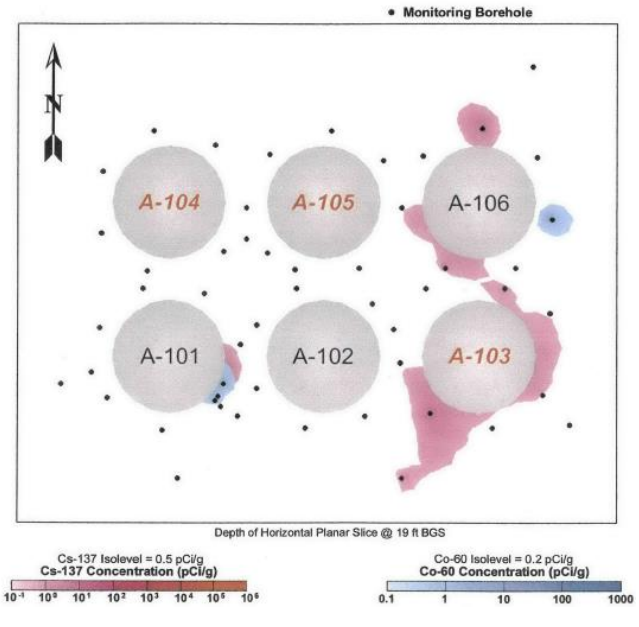
1: Depth of Horizontal Planar Slice @ 3 ft bgs



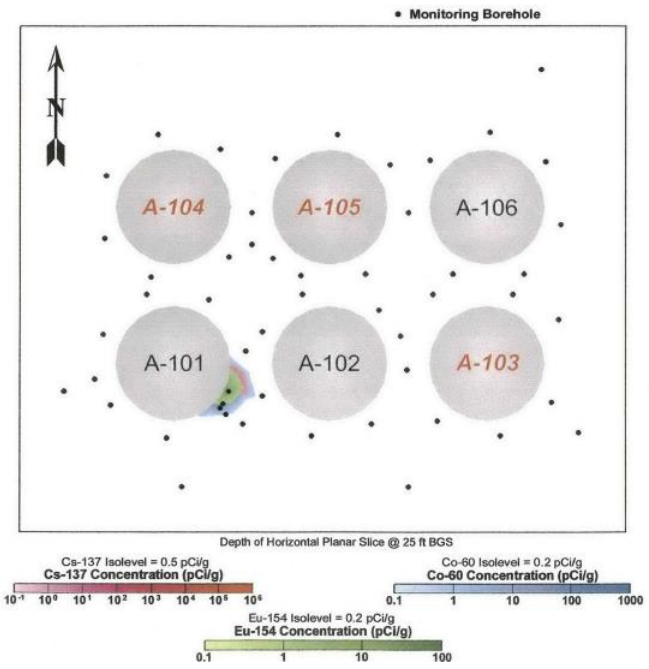
3: Depth of Horizontal Planar Slice @ 10 ft bgs



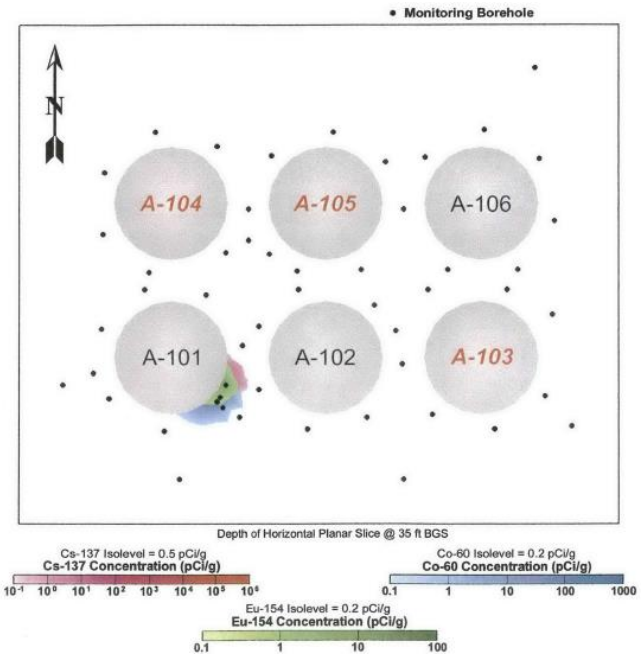
2: Depth of Horizontal Planar Slice @ 19 ft bgs



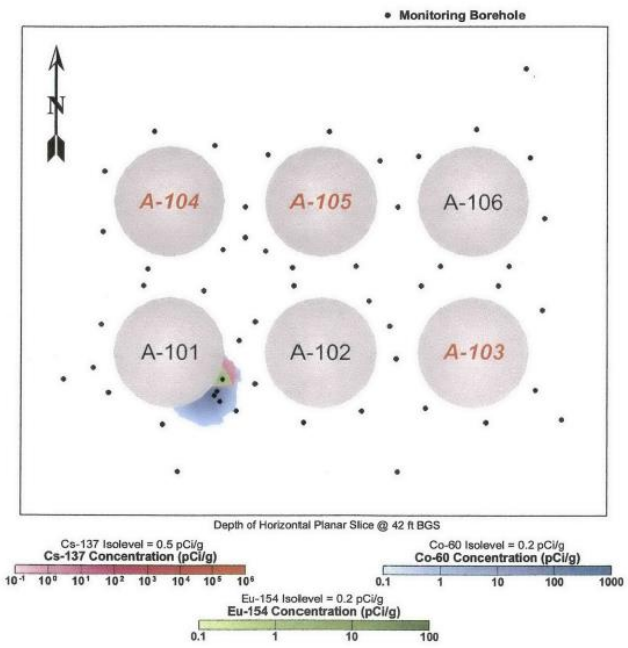
4: Depth of Horizontal Planar Slice @ 25 ft bgs



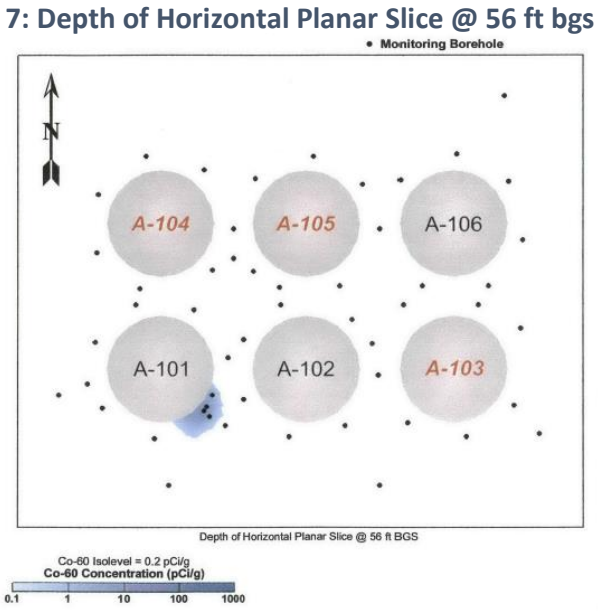
5: Depth of Horizontal Planar Slice @ 35 ft bgs



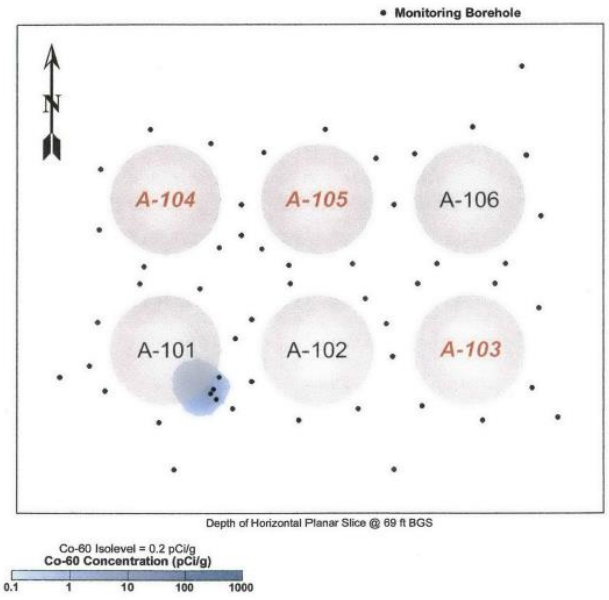
6: Depth of Horizontal Planar Slice @ 42 ft bgs



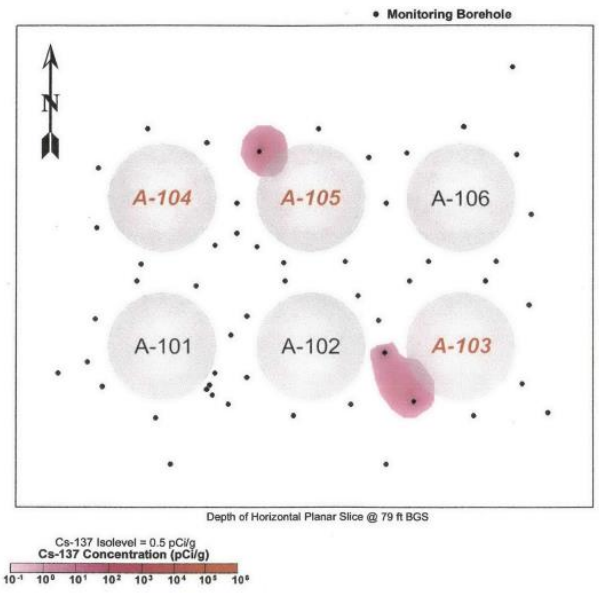
7: Depth of Horizontal Planar Slice @ 56 ft bgs



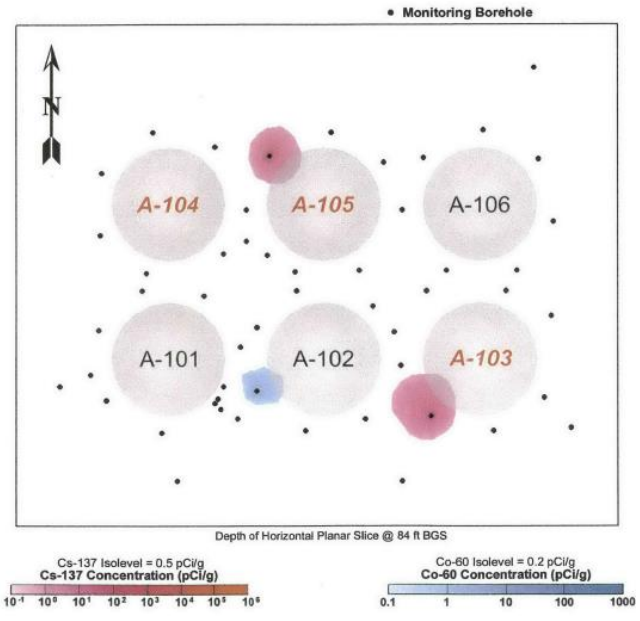
8: Depth of Horizontal Planar Slice @ 69 ft bgs



9: Depth of Horizontal Planar Slice @ 79 ft bgs



10: Depth of Horizontal Planar Slice @ 84 ft bgs



Source: GJO-98-64-TARA GJO-HAN-23, Addendum to the A Tank Farm Report, Figures D4-D16
NOTE: Status of A-103 updated to "sound" based on review of additional data and information (RPP-ENV-37956)

Handout 3a: A-Farm Direct Push Summary Information

Location	C9369/C9370	C9379/C9378	C9381/C9382	C9383/C9384
Date Logging Complete Total Depth ft bgs Number of Electrodes (Depth Range ft bgs)	8/2014 205.1 9 (20-179.25)	8/2014 205.1 9 (30-189.25)	8/2014 205.1 9 (20-179.25)	8/2014 205.0 9 (33-192.25)
Sample Depth Meeting Date	11/25/2014	11/25/2014	11/25/2014	11/25/2014
Sample Depth ft bgs Stratigraphic Unit	52-54 Backfill/H1	53-55 Backfill/H1	54-56 Backfill/H1	51-53 Backfill/H1
Sample Depth ft bgs Stratigraphic Unit	139-141 H2f	124-126 H1/H2f	99-101 H1/H2f	74-76 H1/H2f
Selected Sample Depth ft bgs Stratigraphic Unit	173-175 H2c	126-128 H2f	140-142 H2c	132-134 H2f/Hc
Decommissioning Date: (Logging Location)	(9/11/2014)	(8/29/2014)	(9/5/2014)	(8/28/2014)

Notes: ft bgs = feet below ground surface, ft amsl = feet above mean sea level