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(006923SH)

MEETING NOTES
Data Quality Objectives for the Waste Management Area A-AX

MEETING NUMBER: WMA-A-AX-DQO-2017-5
MEETING DATE: May 25, 2017
LOCATION: 3110 Port of Benton Boulevard, Richland, WA
ATTENDEES:

Jim Alzheimer (Ecology)	Paul Gassman (WRPS)	Alan Olander (WRPS)
Mike Barnes (Ecology)	Bob Hiergesell (WRPS)	Dan Parker (WRPS)
Jan Bovier (DOE-ORP)	Doug Hildebrand (DOE-RL)	Julie Robertson (Freestone)
Joe Caggiano (Ecology)	Melissa Holm (WRPS)	Kristin Singleton (WRPS)
Nigel Crook (HGI)	Scott Luke (WRPS)	Harold Sydnor (WRPS)
Kathi Dunbar (WRPS)	Marc Levitt (HGI)	Cindy Tabor (WRPS)
Jim Field (WRPS)	Jeff Lyon (Ecology)	Robin Varljen (WRPS)

BACKGROUND INFORMATION: These meetings are to promote discussions among Washington State Department of Ecology (Ecology), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy Office of River Protection (DOE-ORP), and Washington River Protection Solutions (WRPS) to develop data quality objectives (DQO) for Waste Management Area (WMA) A-AX vadose zone soil. Representatives from the DOE Richland Operations Office (DOE-RL) and the Central Plateau contractor (CH2MHILL Plateau Remediation Contractor [CHPRC]), were invited to participate to promote integration. A DQO process for the same purpose was started in 2011 but was suspended prior to completion in May 2011. Agreements and progress made as part of the 2011 effort will be leveraged in support of the current DQO process.

Lists of agreements and actions (including the status of any actions) are documented in the meeting notes.

PURPOSE OF MEETING: This meeting was called to continue the WMA A-AX vadose zone characterization DQO process initiated in January 2017.

STATUS OF PRIOR MEETING NOTES: Ms. Robertson stated that meeting notes for the March 30, 2017, meeting (Meeting #3) had been entered into the Administrative Record. Meeting notes for the April 13, 2017 meeting (Meeting #4) were corrected and signed during the May 25, 2017, meeting.

POTENTIAL DIRECT PUSH LOCATIONS: Ms. Tabor provided Handout #1 to support the discussion. Ms. Tabor noted that the information covered in the handout addressed both Step 4 (boundaries of the study) and Step 7 (Plan for Obtaining Data) of the DQO process. On a wall poster of the graphic shown as the first page of Handout #1, Ms. Tabor drew a proposed horizontal boundary of the study area approximately as shown on the first page of Handout #1 attached to these meeting notes (red dashed line). The parties agreed the proposed boundary was acceptable for the A-104/105 focus area (**Agreement 5** dated 05-25-2017). Ms. Tabor identified four proposed borehole locations for data gathering and provided descriptions of the locations and reasons for sampling at each location. Basic descriptions of the planned effort at each location are provided here; details were provided in Handout #1.

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- Location #1: Angle push 60 degrees from ground surface (30 degrees from vertical); total depth goal of 260 ft vertical below ground surface (bgs) with total pipe run of ~360 ft; groundwater at approximately 290 ft bgs. Pass through or near locations of elevated soil temperature, gross gamma readings, and conductivity.
- Location #2: Vertical push to goal of 285 ft bgs; pass through or near locations of elevated soil temperature.
- Location #3: Angle push 60 degrees from ground surface (30 degrees from vertical); total depth goal of 240 ft vertical bgs with total pipe run of ~280 ft. Pass through or near locations of elevated soil temperature, gross gamma readings, and conductivity, as well as corroded dry well casing.
- Location #4: Angle push 60 degrees from ground surface (30 degrees from vertical); total depth goal of 240 ft vertical bgs with total pipe run of ~280 ft. Pass through or near locations of elevated soil temperature and gross gamma readings, as well as corroded dry well casing.

The attendees discussed options for (1) increasing the depth of the boreholes to allow for data gathering at greater depths, and (2) pushing the boreholes at something closure to a 45-degree angle to increase relatively shallow data gathering opportunities near laterals. Ms. Tabor stated that further discussion on the borehole placement/configuration should occur during Step 7 after updated ground penetrating radar information (used to locate below-ground infrastructure that must be avoided during borehole installation) becomes available (**Action 2017-05-25-01**).

SURFACE GEOPHYSICAL EXPLORATION (SGE) PRESENTATION: Mr. Levitt provided an overview of various SGE methods and the types of information that can be generated by SGE. The presentation included discussion of surface-to-surface SGE, use of deep electrodes, and the possible benefits and drawbacks of implementing different methods at A-104/105. The attendees briefly discussed the sensitivity of SGE to microgravity (**Action 2017-05-25-02**).

REVIEW OF DQO PROCESS DISCUSSIONS TO DATE: Ms. Robertson provided Handout #2, which summarizes discussions to date.

- Background Information: The attendees agreed on the DQO scope, objectives, and DQO approach as shown on pages 1 and 2 of Handout #2 (**Agreement 6** dated 05/25/2017).
- Step 1 – Define the Problem: The attendees agreed to the problem statement as shown in **Agreement 3** dated 01/26/2017. The table of DQO planning team members was identified as being satisfactory but may change over the duration of the DQO process.
- Step 2 – Identify the Goals of the Study: The attendees agreed to the goal of the study as shown on page 3 of Handout #2 (**Agreement 7** dated 05/25/2017). Table 3 of Handout #2, containing the PSQs, alternative actions, and decision/estimation statements, had been revised since the previous meeting. The latest revision of the table excludes a PSQ that had been requested by an Ecology staff member not present on May 25. Revisions to the table will be reviewed with that staff member before agreement is documented (**Action 2017-05-25-03**).
- Step 3 – Data Inputs: Although revisions were offered to Table 4 of Handout #2, Ms. Robertson stated that the table was undergoing a complete revision. The revised version will be shared in a future meeting (**Action 2017-05-25-04**). Table 5 of Handout #2, which had been shared at a prior meeting, will be reviewed by Ecology (**Action 2017-05-25-05**). Selection of methods will occur in Step 7 of the DQO process.
- Step 4 – Define the Boundaries of the Study: The attendees agreed to define the boundaries of the A-104/105 focus area as follows (**Agreement 5** dated 05/25/2017):

- Horizontal boundary as shown on the first page of Handout #1 attached to these meeting notes (red dashed line).
- Vertical boundary surface to groundwater as stated on page 9 of Handout #2. See **Actions 2017-05-25-01 and 2017-05-25-06.**
- Temporal boundary as driven by the retrieval program. Ms. Tabor stated that the retrieval construction schedule will affect the WMA A/AX tanks in the following sequence (listed first to last): AX-104, AX-102, AX-103, AX-101, A-101, A-102, A-106, A-104, A-105, A-103. Ms. Tabor also reported that ventilation work will start in the fall of 2017 in A Farm (**Action 2017-03-30-06**).

AGREEMENTS AND ACTIONS: A summary of agreements and actions are provided in the tables below. Several new actions were recorded at this meeting.

NEXT MEETING: The next meeting has been scheduled for June 15, 2017 at 10:00 am. The discussion will focus on identification of constituents and number of samples.

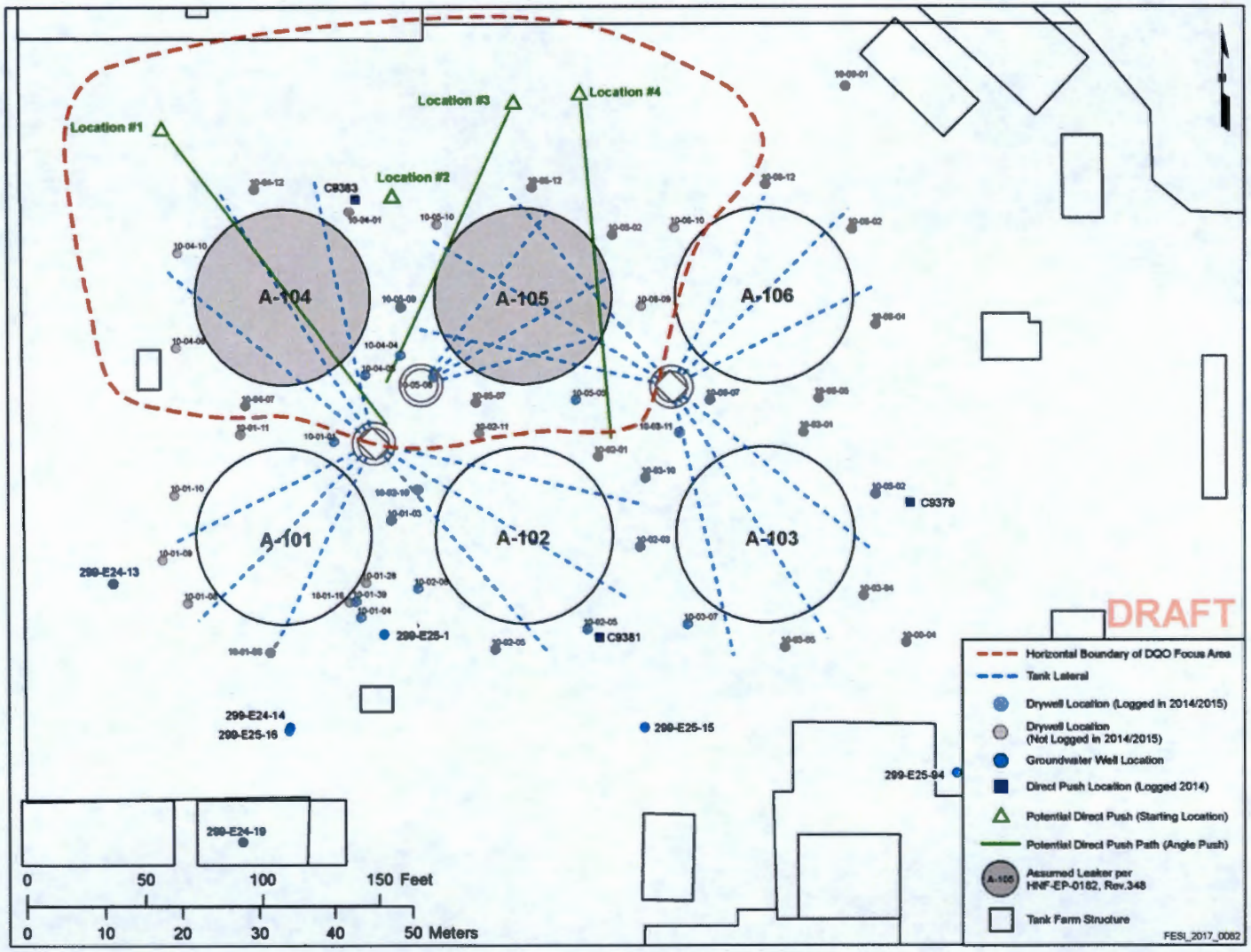
JAN B BOVIER	Jan B Bovier	7/11/2017
DOE Project Manager (print)	DOE Project Manager (signature)	Date
Jeffery J. Lyon	[signature]	7/11/2017
Ecology Project Manager (print) see Notes #4	Ecology Project Manager (signature)	Date

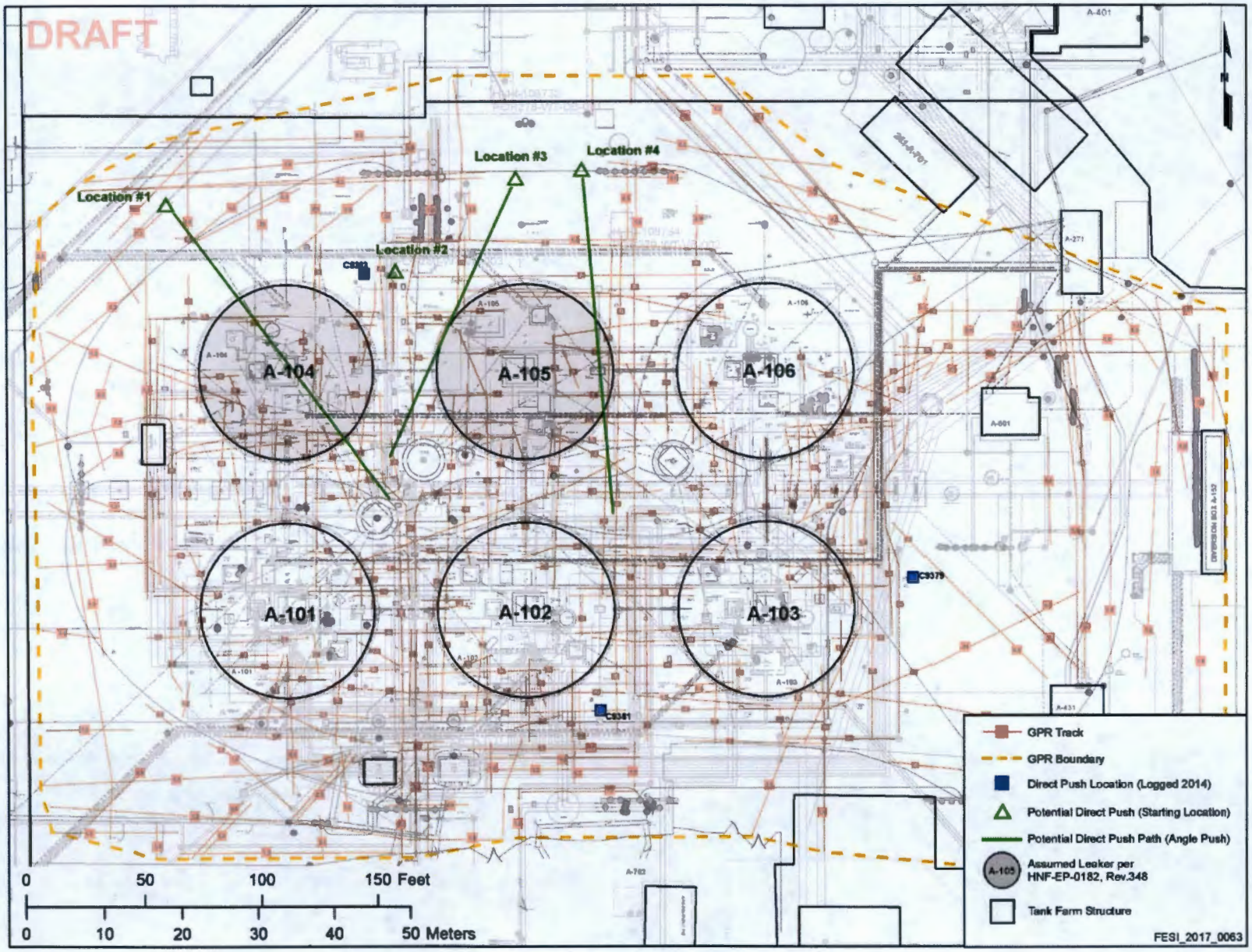
DATE	AGREEMENTS
01/26/2017	1. DOE-ORP acknowledged the need for a Phase 2 RFI at WMA A-AX.
01/26/2017	2. Available tank waste and concrete condition information will be considered for inclusion in the RFI/CMS report(s).
01/26/2017	3. **Problem Statement**: "Vadose zone contamination in and adjacent to the A-AX Tank Farms may pose a current and future risk to human health and the environment, including groundwater, that requires corrective action to support closure."
03/30/17 7/11/17 what does this mean [signature]	4. The DQO will move forward with a modified scope. The DQO will evaluate the Tank 241-A-104/105 focus area. Additional information is needed on an accelerated timeline regarding the movement of contaminants in the environment that came from releases from these tanks. Information from the resulting investigation will inform the development of the model being developed for the 241-A/AX performance assessment.
05/25/17	5. **Boundaries**: The parties agreed to a Tank A-104/105 focus area horizontal boundary as shown on the first page of Handout #1 attached to the 05/25/2017 DQO meeting notes, a vertical boundary extending from ground surface to the groundwater, and a temporal boundary driven by planned retrieval operations.
05/25/17	6. The parties agreed to the **scope, objectives, and DQO approach**: as described in Handout #2 attached to the 05/25/2017 DQO meeting notes.
05/25/17	7. The parties agreed to the **Goal of the study** as described in Handout #2 attached to the 05/25/2017 DQO meeting notes.

ACTIONS (2 pages)			
Action Number	**Actionee**	**Description**	**Status**
2017-01-26-02	Radloff	Locate the Woodward-Clyde document and verify whether it is available for public release.	Closed 5/25/17. The document is *An Estimate of Bottom Topography, Volume and Other conditions in Tank 105A, Hanford, Washington,* WCC Project 1397A – 0300, and it is cleared for public release.
2017-03-30-03	Lyon	Ecology will identify whether there are other potential 241-A/AX focus areas of interest and their level of interest in other focus areas relative to the Tanks A-104/105 focus area.	Open. Ecology identified the area near Tank A-103 as being of interest.
2017-03-30-04	Tabor	Report back about whether an engineering evaluation has been or could be developed to determine whether temperatures seen in 2014 at direct push boreholes can be explained by thermal heat propagating from Tanks A-104/105.	In progress. Tabor, Barnes, Olander to meet to discuss subsurface heat propagation.
2017-03-30-06	Tabor	Report back with information about the retrieval construction schedule for the 241-A/AX Tank Farms so that it can be factored into discussions on focus areas and timing of investigation activities.	Closed 5/25/17. Order first to last: AX-104, AX-102, AX-103, AX-101, A-101, A-102, A-106, A-104, A-105, A-103. Ventilation work to start fall 2017 in A Farm.
2017-03-30-08	Hildebrand	Provide information about releases (e.g., volumes, contaminants – including chloride from ion exchange) related to power house filter wash down effluent discharged to a trench.	Closed 5/25/17. The following documents were provided to Ecology at the 5/25/17 meeting: DOE/RL-2015-49, Rev. 0, WHC-EP-0342, SGW-54848, Rev. 0.
2017-04-13-01	Sydnor	Provide Ecology a map of proposed sample locations before the relevant DQO meeting (May).	Completed via email on 5/23/17. Closed 5/25/17.
2017-04-13-02	Bovier/Lyon	Discuss how DQO Step 4, define the boundaries of the study, will be addressed for the whole of WMA A-AX.	Open.

ACTIONS (2 pages)			
Action Number	**Actionee**	**Description**	**Status**
2017-04-13-03	Tabor	Add footnote to 4/13/17 Handout #1, Attachment 3, Table 3 listing background level reports.	Closed 5/25/17; table was revised to incorporate references to background level reports.
2017-04-13-04	Rochette	Ecology will discuss the use of "MTCA C for cleanup" and "500 mrem/yr above background via industrial land-use scenario" in Handout #1, Attachment 3, Table 3.	Closed 5/25/17; table is being completely revised.
2017-04-13-05	Tabor	Review PNNL report 15141 to determine whether wells can be included within the A-104/105 focus area boundary.	Closed 5/25/17. Agreement was reached to focus on area close to A-104/105.
2017-05-25-01	Tabor	Evaluate borehole placement/configuration after getting updated GPR results.	New.
2017-05-25-02	Levitt	Evaluate whether microgravity is applicable next to tanks and at what distance it might be applicable.	New.
2017-05-25-03	Tabor	Review Table 3 of Handout #2, containing the PSQs, alternative actions, and decision/estimation statements, with Skorska (Ecology).	New.
2017-05-25-04	Tabor	Provide revised Table 4 of Handout #2 (Data Inputs/basis for identifying acceptable levels) for Ecology review.	New.
2017-05-25-05	Barnes	Ecology review Table 5 of Handout #2 listing potentially appropriate field and analytical methods and provide feedback.	New.
2017-05-25-06	Tabor	Provide briefing on deep vadose zone project applicability to A-104/105 focus area.	New.

Handout #1


Location #1
Location #2
Location #3
Location #4
A-104
A-105
A-106
A-101
A-102
A-103
C9383
C9379
C9381
299-E24-13
299-E25-1
299-E24-14
299-E25-16
299-E25-15
299-E25-94
299-E24-19
DRAFT
0 50 100 150 Feet
0 10 20 30 40 50 Meters
Horizontal Boundary of DQO Focus Area
Tank Lateral
Drywell Location (Logged in 2014/2015)
Drywell Location (Not Logged in 2014/2015)
Groundwater Well Location
Direct Push Location (Logged 2014)
Potential Direct Push (Starting Location)
Potential Direct Push Path (Angle Push)
Assumed Leaker per HNF-EP-0182, Rev.348
Tank Farm Structure
FESI_2017_0082

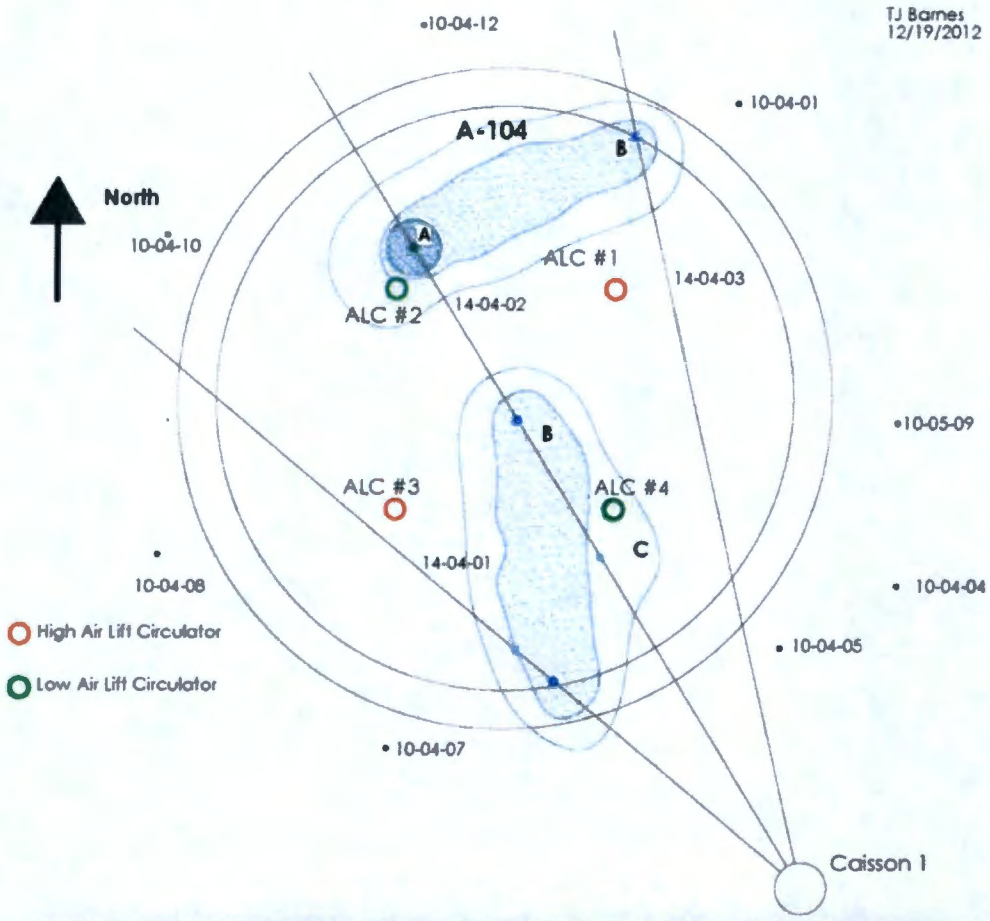

DRAFT
Location #1
Location #2
Location #3
Location #4
A-104
A-105
A-106
A-101
A-102
A-103
0
50
100
150 Feet
0
10
20
30
40
50 Meters
GPR Track
GPR Boundary
Direct Push Location (Logged 2014)
Potential Direct Push (Starting Location)
Potential Direct Push Path (Angle Push)
Assumed Leaker per HNF-EP-0182, Rev.348
Tank Farm Structure
FESI_2017_0063

Direct Push Location Strategy for Tanks 241-A-104 and 241-A-105

Location #	Approximate Location	Input Factors Associated with Location Reason for Sampling
1	Northwest of Tank 241-A-104 (Angle push going southwest and directly under the tank)	• Tank A-104 designated as a leaker (~2,000 gallons) • Possible leak location area (RPP-ENV-37956, Rev. 2, Figure 4-1) • Higher temperature and gross gamma readings in laterals (14-04-01 and 14-04-02, RPP-ENV-37956, Rev. 2 [Figures B2-11 through B2-13]) • Higher temperature and gross gamma readings in drywells (10-04-04 and 10-04-05) • Higher SGE conductivity area (RPP-ENV-37956, Rev. 2, Figure 3-9) **Assess Tank A-104 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**
2	North and between Tanks 241-A-104 and 241-A-105 (Vertical push)	• Tanks A-104 and A-105 designated as a leaker (~2,000 gallons and ~2,000 to 40,000 gallons, respectively) • Direct push log at Location C9383, temperature of ~120 °F, ~50 ft bgs • Possible location for deep push ~280 ft bgs **Assess Tanks A-104 and A-105 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**
3	North of Tank 241-A-105 (Angle push towards southwest-side of tank	• Tanks A-104 and A-105 designated as a leaker (~2,000 gallons and ~2,000 to 40,000 gallons, respectively) • Possible leak location area (RPP-ENV-37956, Rev. 2, Figure 4-2) • Higher temperature and gross gamma readings in laterals (14-05-01,14-05-02, and 14-05-03, RPP-ENV-37956, Rev. 2 [Figures B3-18 through B3-19]) • Higher temperature readings in drywells (10-05-09, 10-04-04 and 10-04-05) • Abandoned drywell 10-05-11 indicated casing corrosion (~ 64 ft bgs) • Higher SGE conductivity area ((RPP-ENV-37956, Rev. 2, Figure 3-9) **Assess Tanks A-105 and A-104 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**
4	Northeast side of Tank 241-A-104 (Angle push going south and under the east-side of tank)	• Tank A-105 designated as a leaker (~2,000 to 40,000 gallons, respectively) • Possible leak location area (RPP-ENV-37956, Rev. 2, Figure 4-2) • Higher temperature and gross gamma readings in laterals (14-05-01,14-05-02, and 14-05-03, RPP-ENV-37956, Rev. 2 [Figures B3-18 through B3-19]) • Higher temperature readings in drywell (10-05-05) • Abandoned drywell 10-05-02 indicated casing corrosion (~ 64 ft bgs) **Assess Tank A-105 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**

Location #1

Figure 4-1. Tank 241-A-104 Possible Leak Locations and Indicators



A	B	C
March 1975	**April 1975**	**May 1975**
Radioactivity first detected in lateral 14-04-02 in March 1975 in the northern portion of tank A-104 shortly after the start of sluicing the tank in September 1974. The peak radioactivity was reported at 100 cpm in lateral 14-04-02 at approximately 94-ft from the caisson. No radioactivity was detected in the other laterals or drywells during this time.	A week after initial radioactivity was detected in lateral 14-04-02, counts continued to increase in the northern portion of the tank. Thus, sluicing was halted on April 7, 1975. On April 8, 1975, radioactivity was first detected in lateral 14-04-01 and an additional peak was recorded in lateral 14-04-02, both in the southern portion of the tank. On April 21, 1975, radioactivity was first reported in lateral 14-04-03 in the northern portion of the tank. Tank A-104 was declared a confirmed leaker and supernatant was pumped out of the tank from April 9 through April 19, 1975.	In May 1975, additional peaks were detected in lateral 14-04-02 along the southern edge of the tank. Radioactivity in site B continued to slowly increase through 1975. Radioactivity in lateral 14-04-03 slowly increased in May 1975 and then slowly declined. The tank A-104 liquid level was reported at 6.5-in at the end of April 1975 and radioactivity in the laterals appeared to stabilize by the end of 1975. No radioactivity was detected in the surrounding drywells.

Reference: RPP-RPT-54912, *Hanford Single-Shell Tank Leak Causes and Locations - 241-A Farm.*

Figure B2-11. Historical Radioactivity for Tank 241-A-104 Laterals

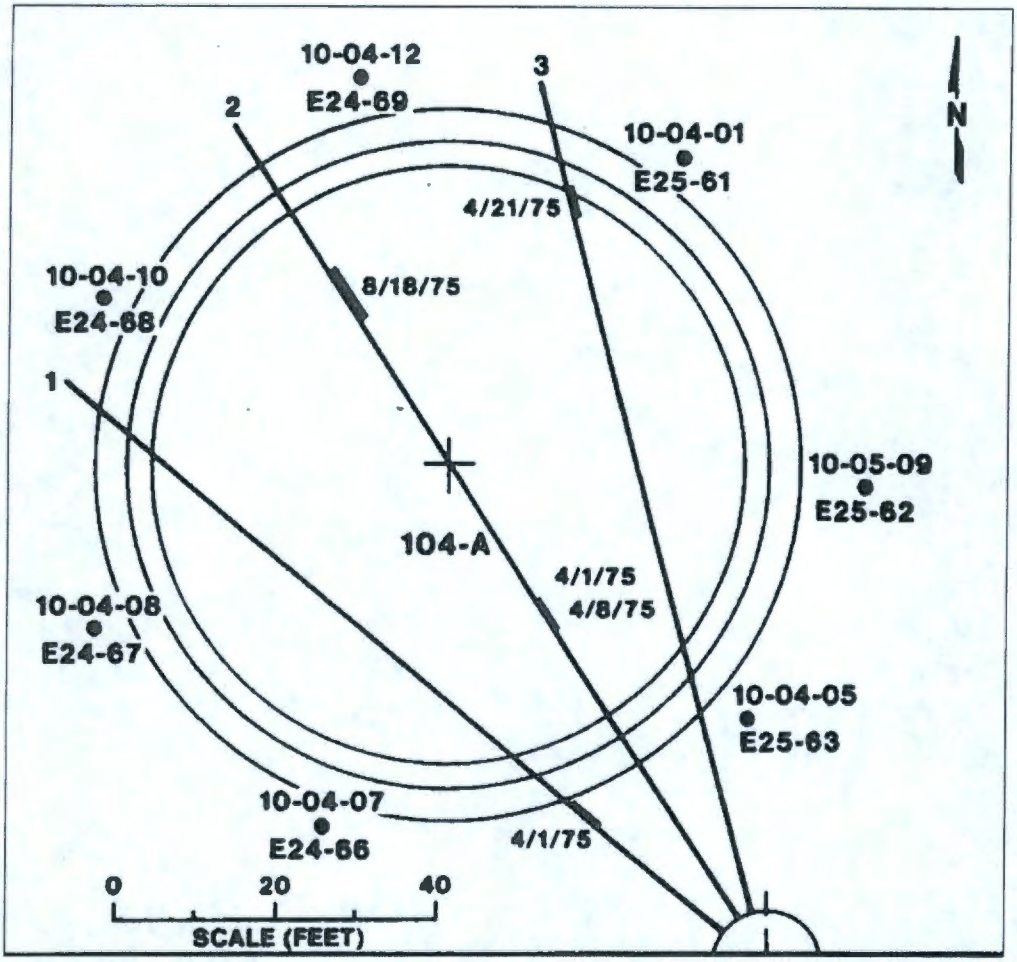


Figure B2-12. Summary Gamma Survey for Lateral 14-04-01, April 2005

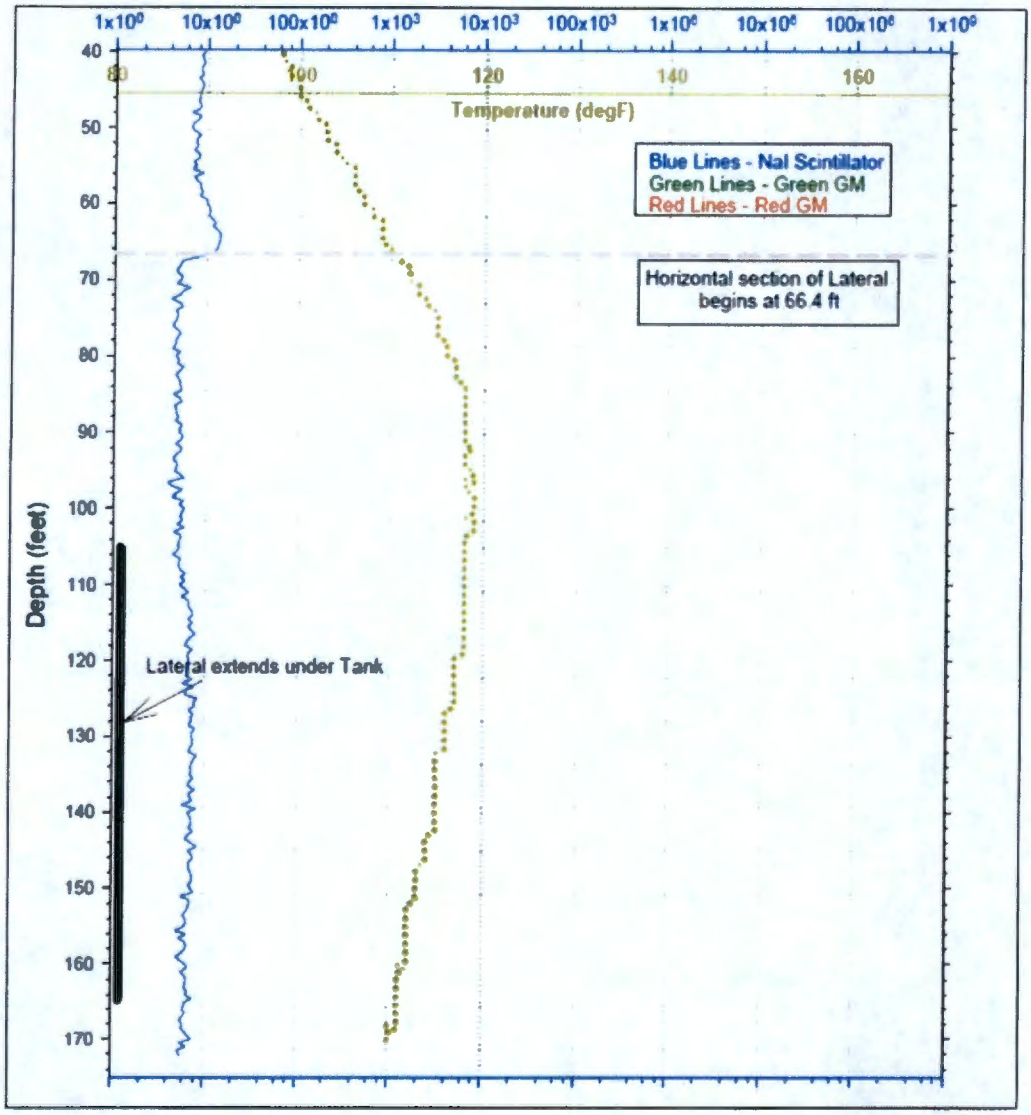
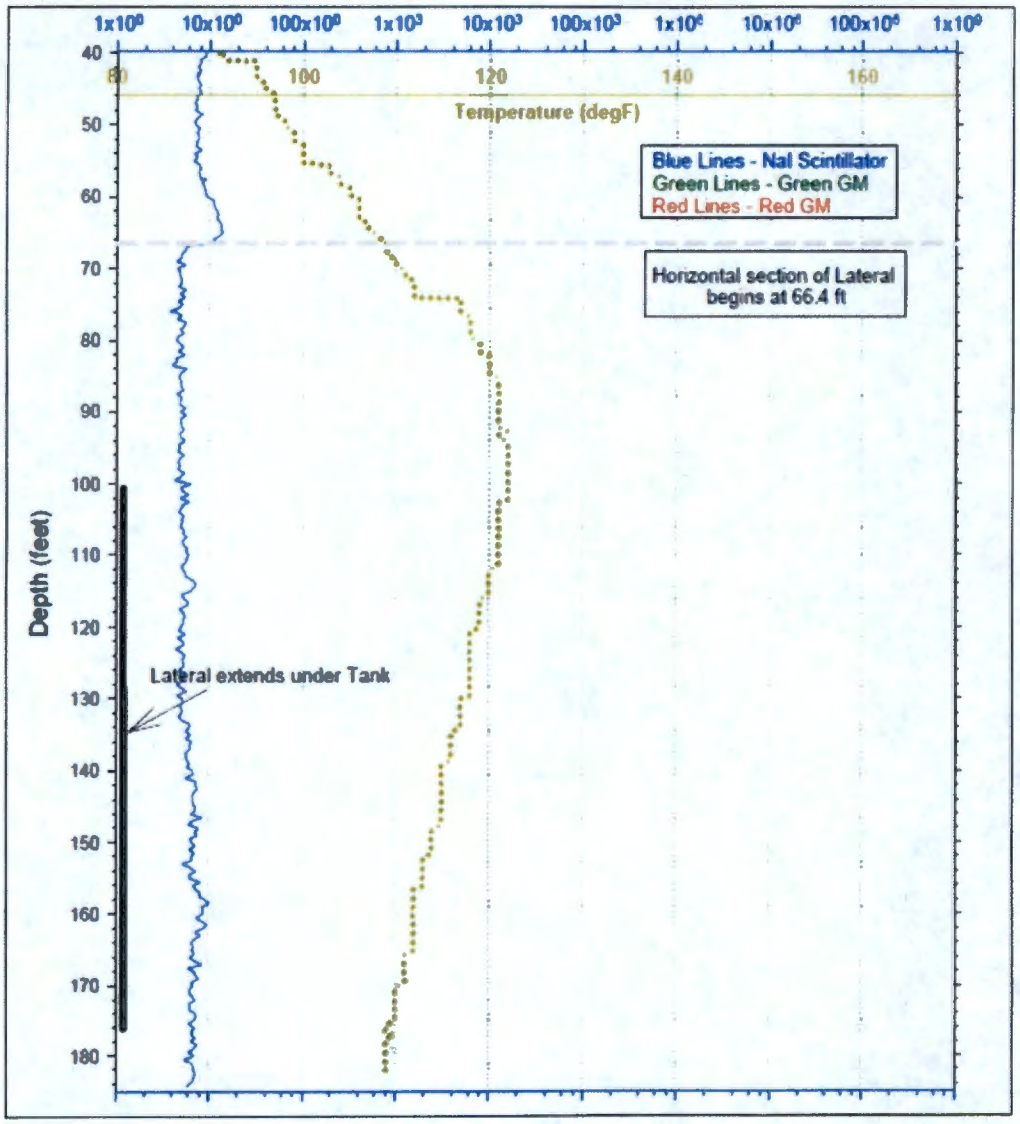


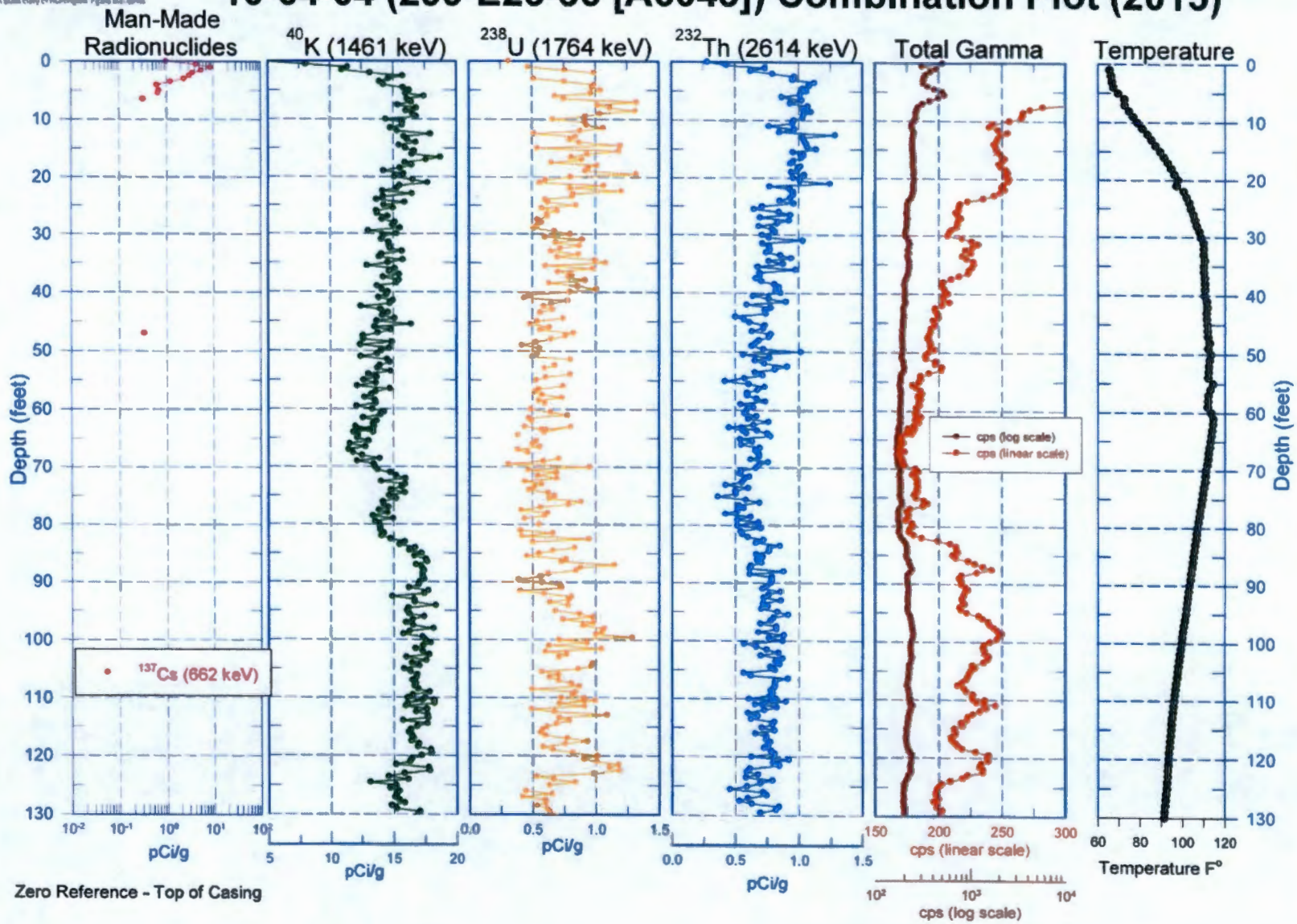
Figure B2-13. Summary Gamma Survey for Lateral 14-04-02, April 2005



Stoller Newport News Nuclear

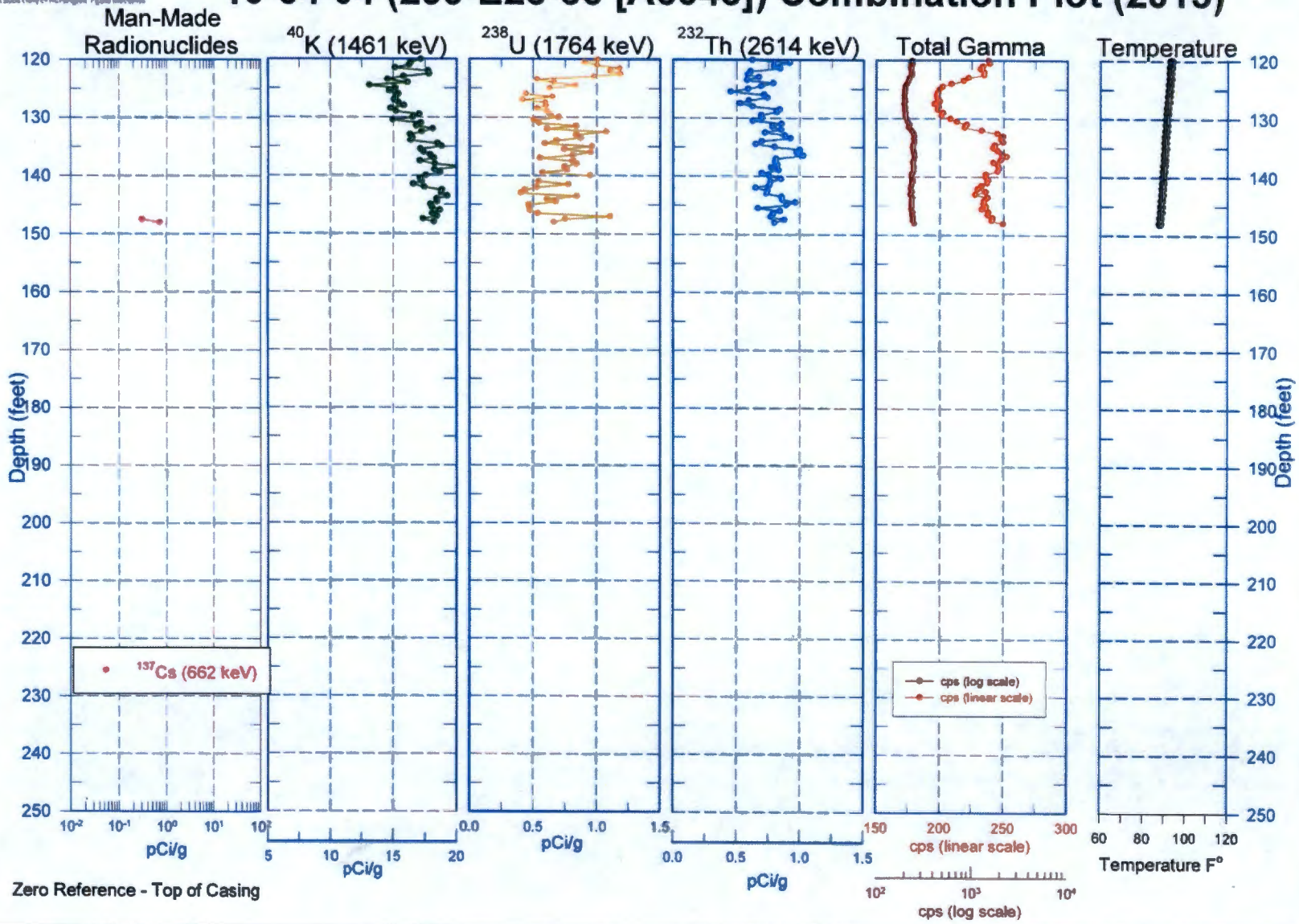
HGLP-LDR-881, Rev. 0
Page 5 of 10

10-04-04 (299-E25-56 [A6045]) Combination Plot (2015)



Stoller Newport News Nuclear

10-04-04 (299-E25-56 [A6045]) Combination Plot (2015)



Zero Reference - Top of Casing

Stoller Newport News Nuclear

10-04-05 (299-E25-63 [A6502]) Combination Plot (2015)

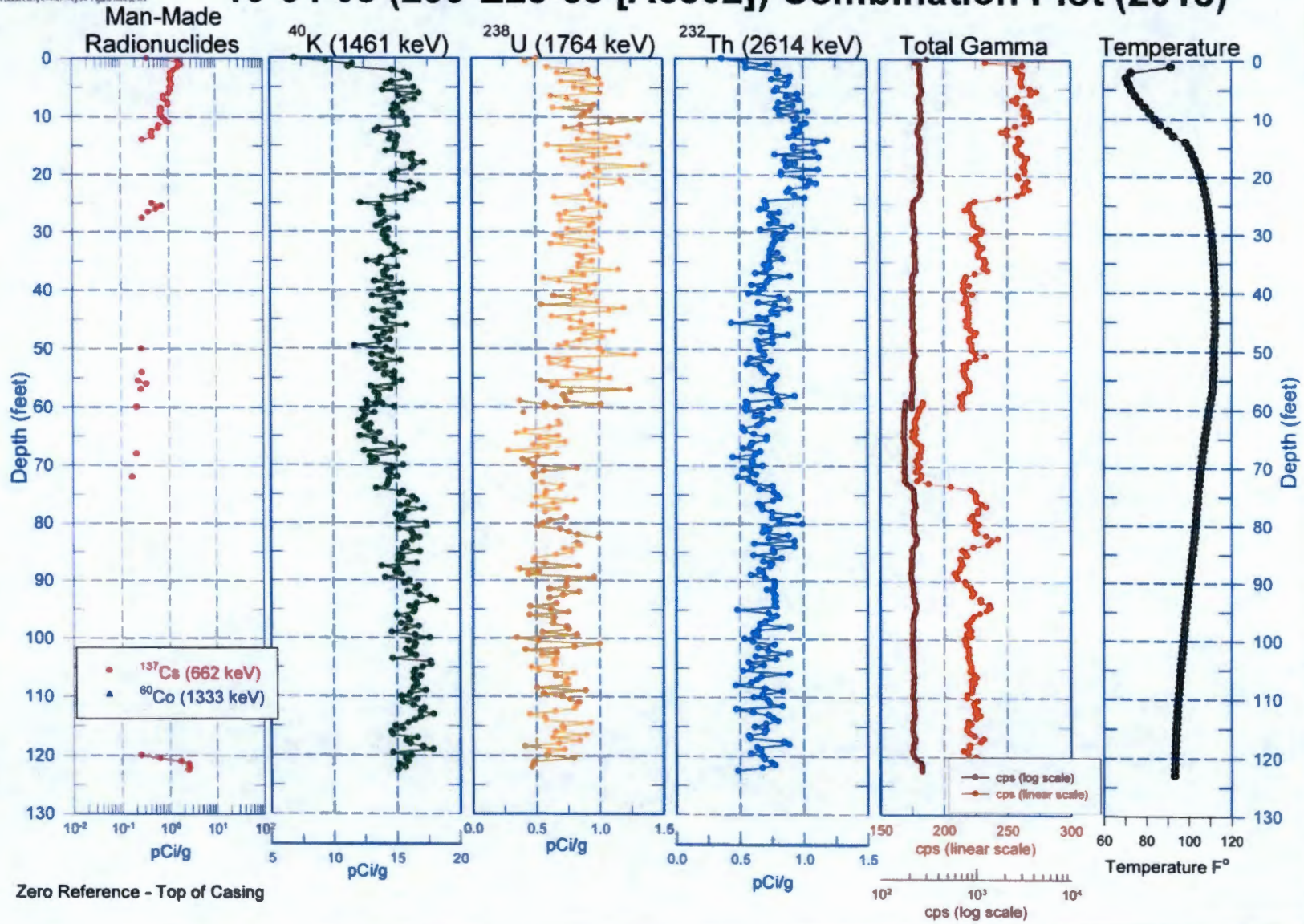
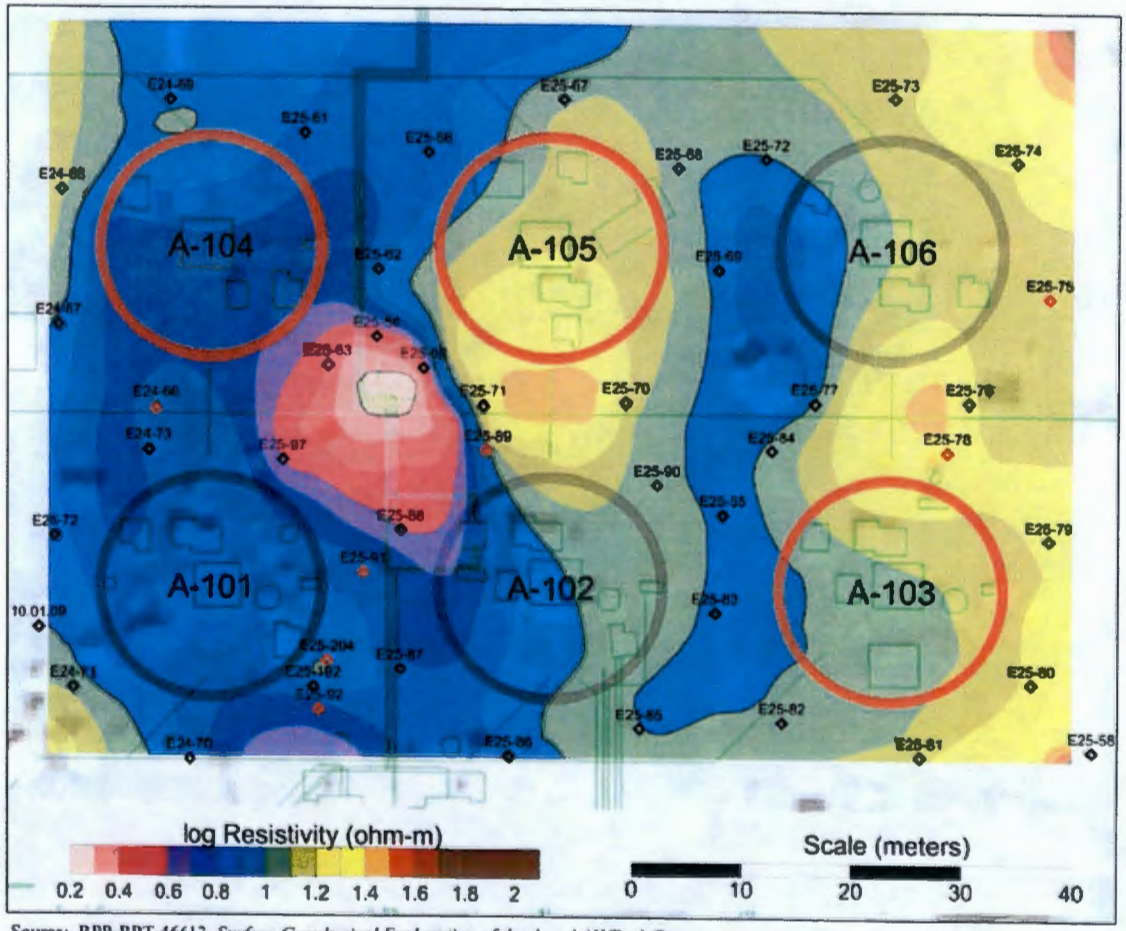
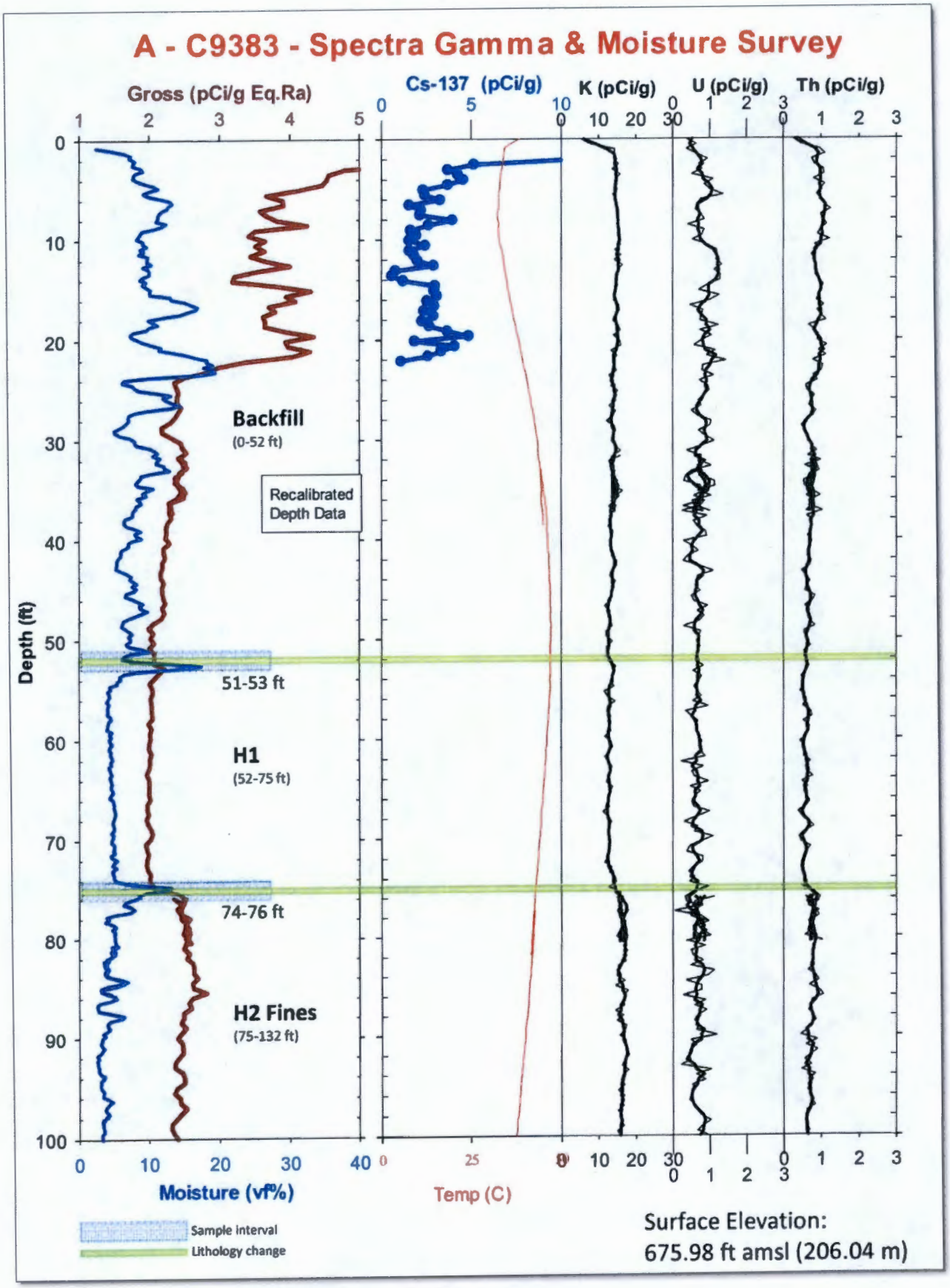


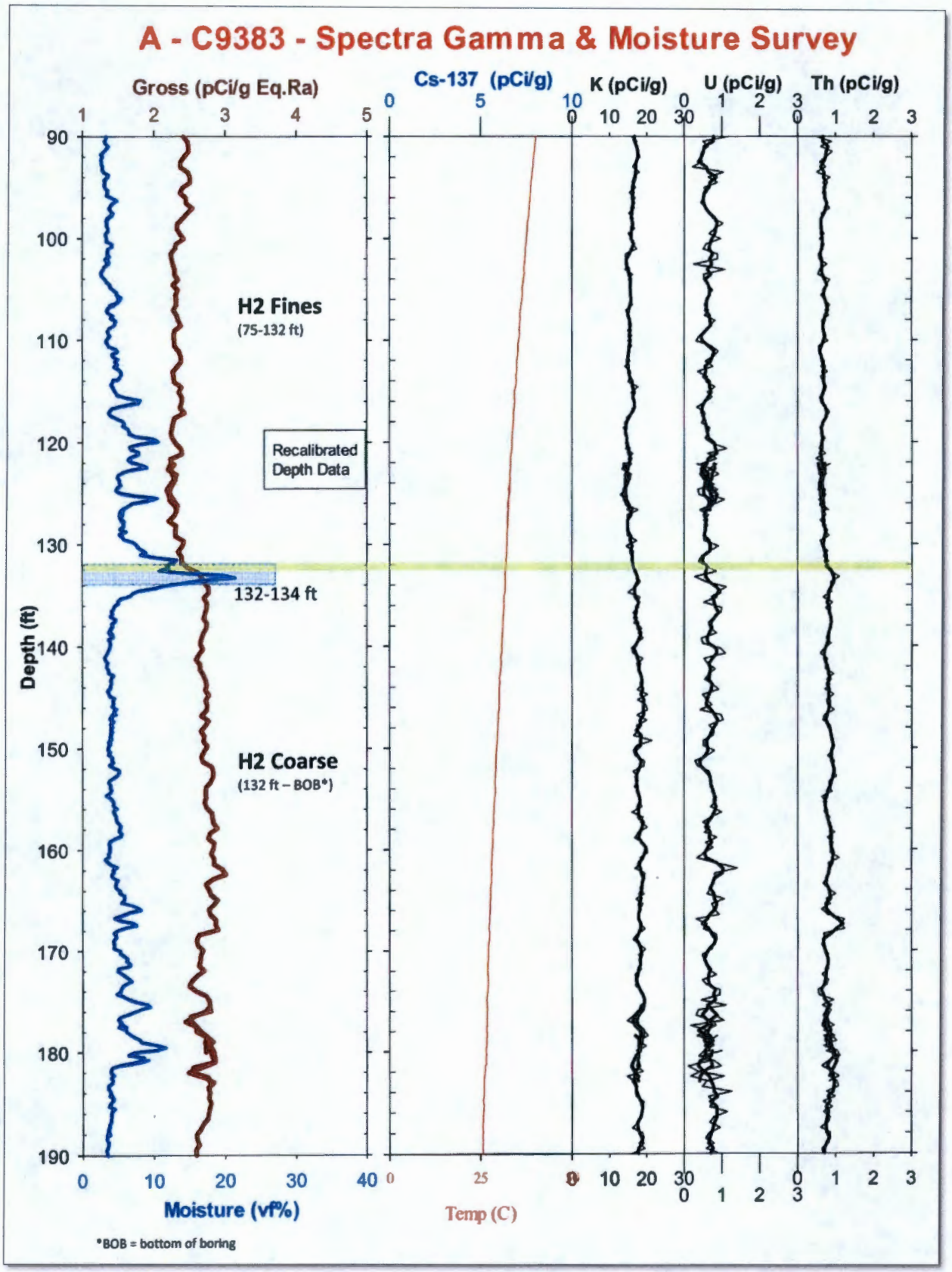
Figure 3-9. 241-A Tank Farm Well-to-Well Surface Geophysics Exploration Results

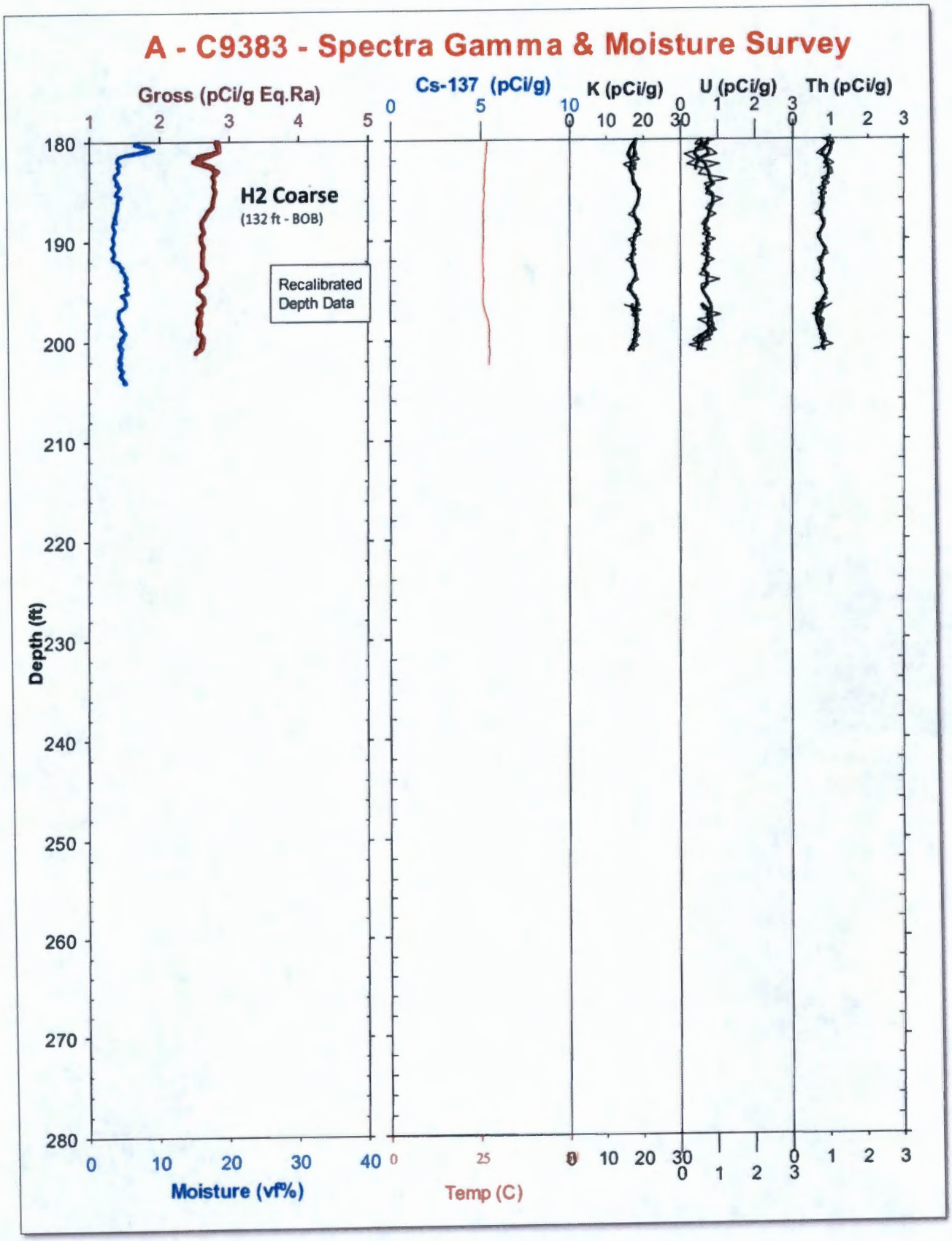


Source: RPP-RPT-46613, *Surface Geophysical Exploration of the A and AX Tank Farms.*

Location #2

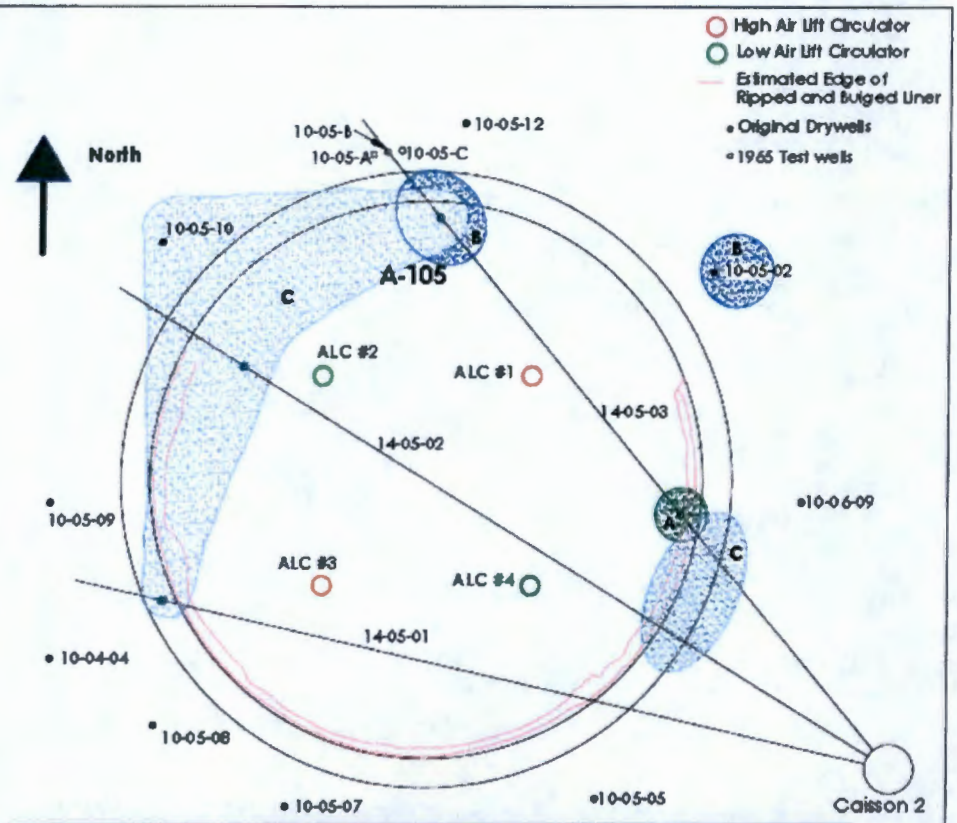

A - C9383 - Spectra Gamma & Moisture Survey
Gross (pCi/g Eq.Ra)
Cs-137 (pCi/g)
K (pCi/g)
U (pCi/g)
Th (pCi/g)
Depth (ft)
Backfill
(0-52 ft)
Recalibrated Depth Data
51-53 ft
H1
(52-75 ft)
74-76 ft
H2 Fines
(75-132 ft)
Moisture (vf%)
Temp (C)
Sample interval
Lithology change
Surface Elevation:
675.98 ft amsl (206.04 m)


A - C9383 - Spectra Gamma & Moisture Survey
Gross (pCi/g Eq.Ra)
Cs-137 (pCi/g)
K (pCi/g)
U (pCi/g)
Th (pCi/g)
Depth (ft)
H2 Fines
(75-132 ft)
Recalibrated Depth Data
132-134 ft
H2 Coarse
(132 ft – BOB*)
Moisture (vf%)
Temp (C)
*BOB = bottom of boring


A - C9383 - Spectra Gamma & Moisture Survey
Gross (pCi/g Eq.Ra)
Cs-137 (pCi/g)
K (pCi/g)
U (pCi/g)
Th (pCi/g)
H2 Coarse
(132 ft - BOB)
Recalibrated Depth Data
Depth (ft)
Moisture (vf%)
Temp (C)

Location #3

Figure 4-2. Tank 241-A-105 Possible Leak Locations and Indicators

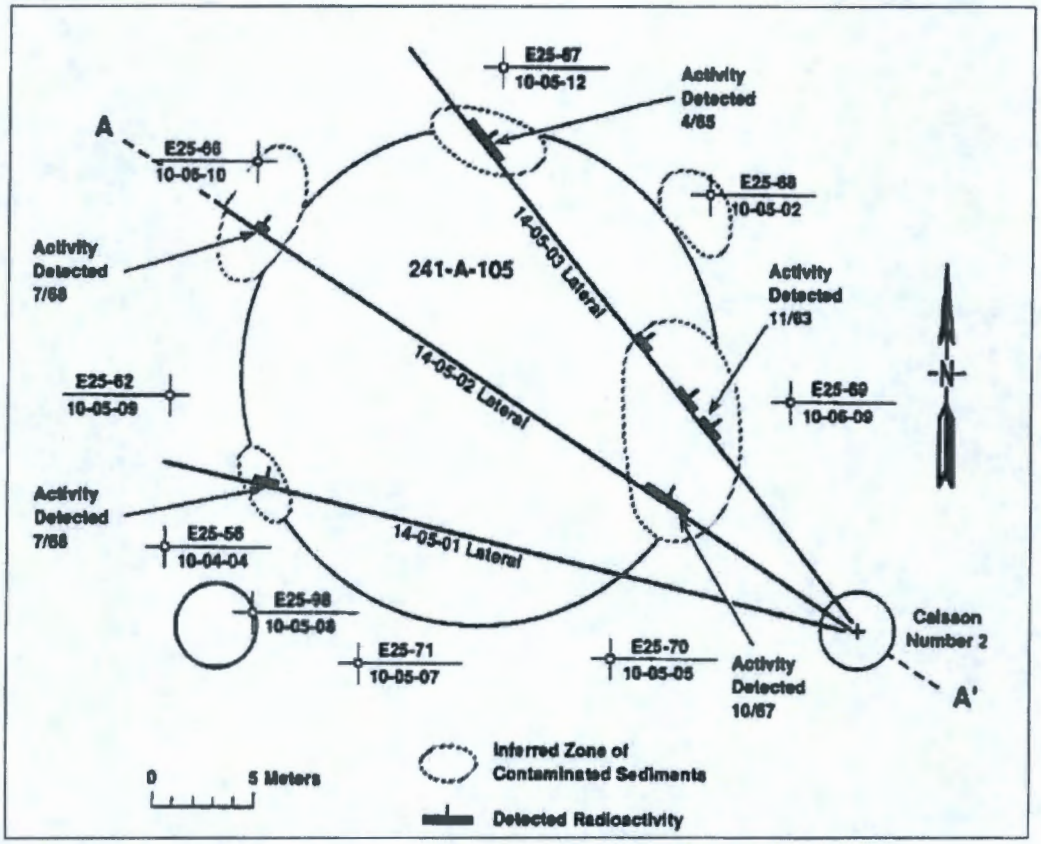


A	B	C
Nov-63	**Feb-65**	**Aug-68**
Radioactivity first detected in lateral 14-05-03 in November 1963 in the southeast portion of tank A-105. Readings remained relatively stable through March 1965. A sidewall leak was postulated during this time; however, it was not confirmed. No radioactivity was detected in the other laterals or drywells, and tank A-105 remained in service.	A steam eruption occurred in tank A-105 on January 28, 1965 causing the bottom liner to tear. One month later, radioactivity was reported in lateral 14-05-03 in the north portion of the tank. Three test wells were drilled near this lateral, however, no radioactivity or moisture was detected in these test wells. Radioactivity was detected January 1965 in drywell 10-05-02 at 74-ft BGS. The source of radioactivity may have been migration of mobile Ru-106 from a tank A-105 leak, possibly related to the November 1963 event.	In March 1968, tank A-105 was declared a confirmed leaker. Tank A-105 sluicing campaigns were conducted in 1968 and 1970. Laterals 14-05-01 and 14-05-02 began to increase in radioactivity during the first sluicing campaign August 1968 to November 1968. Sluicing became ineffective and was shut down. A second, more aggressive, sluicing campaign began August 1970 and was halted November 1970 after significant increases were detected in all the laterals underneath tank A-105. Radioactivity in drywell 10-05-10 increased between 1965 and 1972 which appears to be associated with radioactivity detected in lateral 14-05-02.

TJ Barnes
12/3/2012

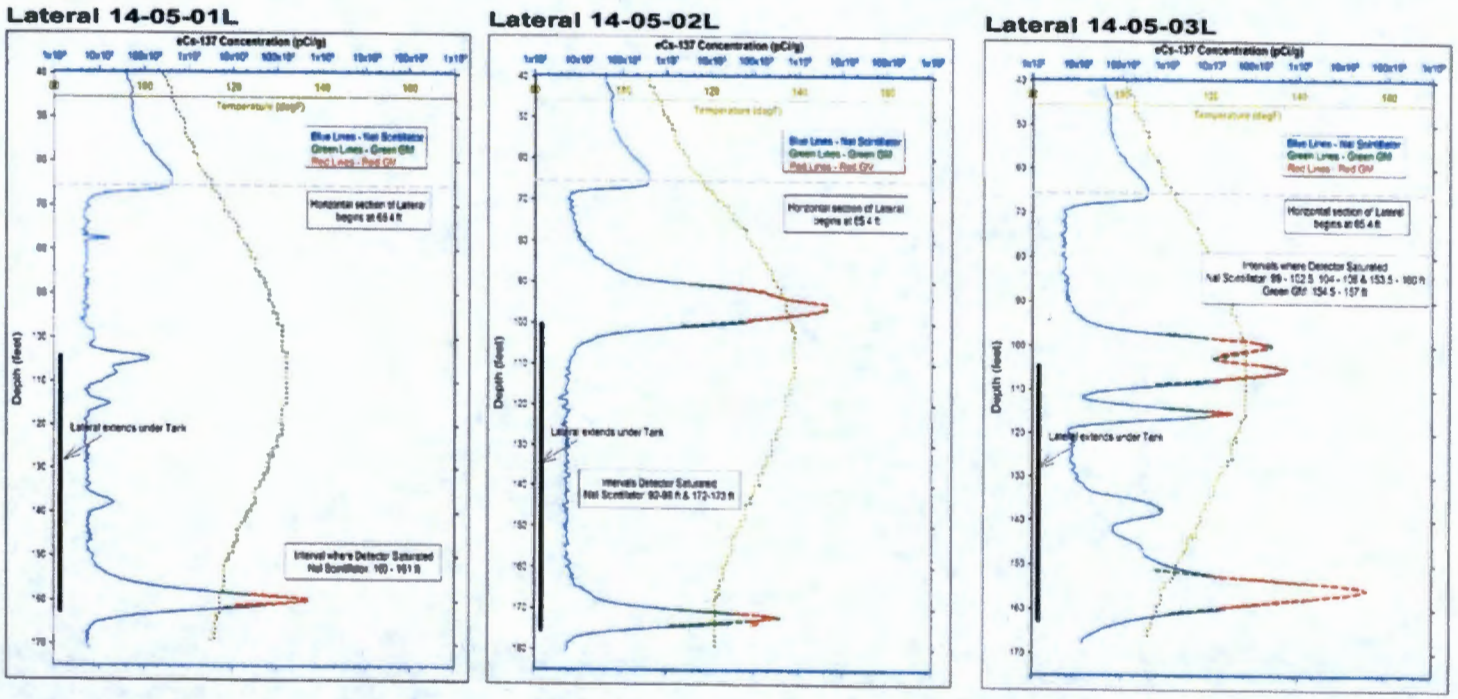
Reference: RPP-RPT-54912, *Hanford Single-Shell Tank Leak Causes and Locations - 241-A Farm.*

Figure B3-18. Location of Laterals and Gamma Activity for Tank 241-A-105



Note: The dates of lateral radioactivity increases and stabilization during August 1968 conflict between document WHC-MR-0264, *Tank 241-A-105 Leak Assessment* and WHC-EP-0412, *Fate and Transport of Constituents Leaked from Tank 241-A-105* and Interoffice Memorandum 7G420-06-004, "Estimation of Tank 241-A-105 Supernatant Cesium-137 Concentration During Sluicing in August 1968."

Figure B3-19. Summary Gamma Survey for the Laterals under Tank 241-A-105



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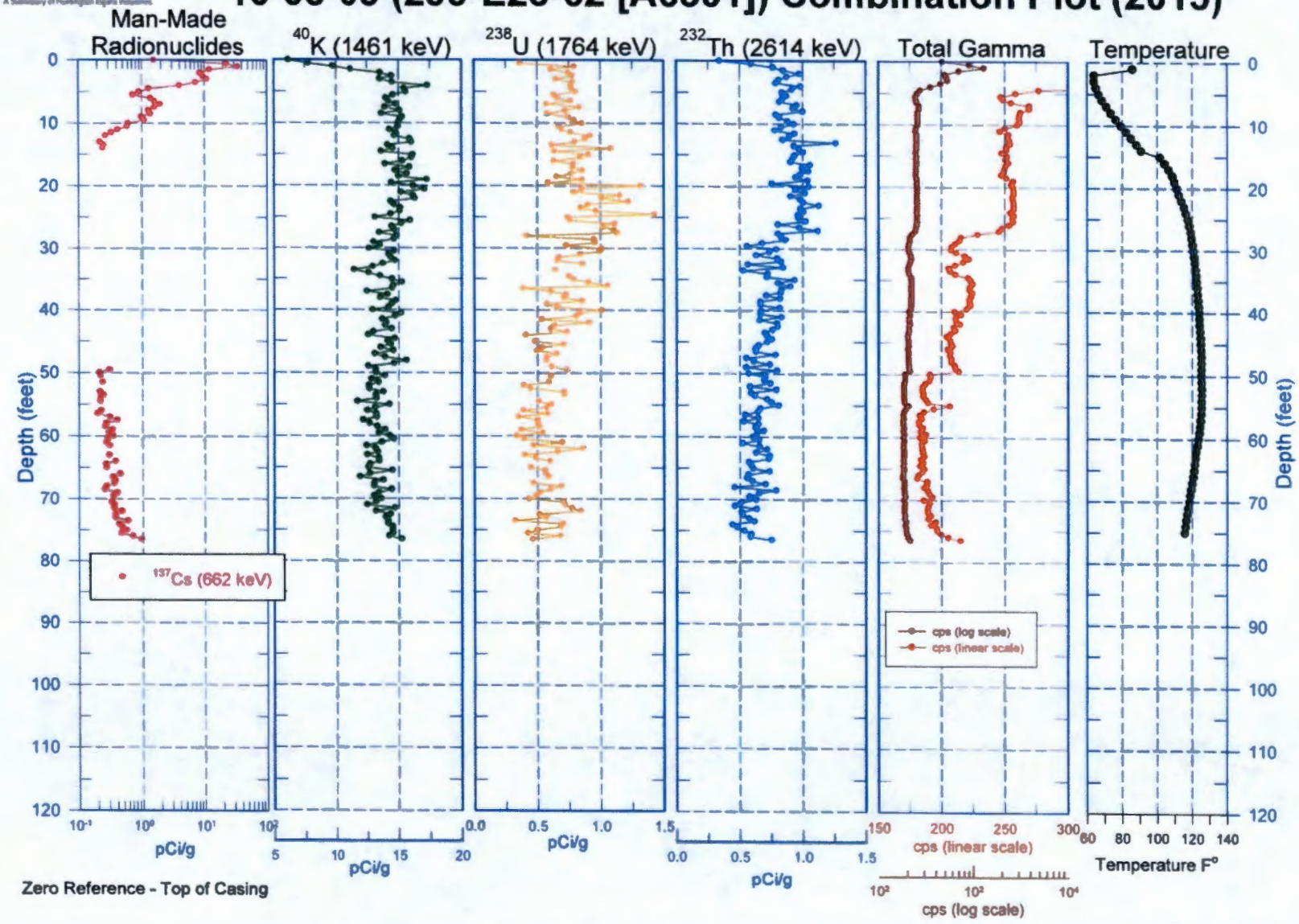
10-05-09 (299-E25-62 [A6501]) Combination Plot (2015)



Location #4

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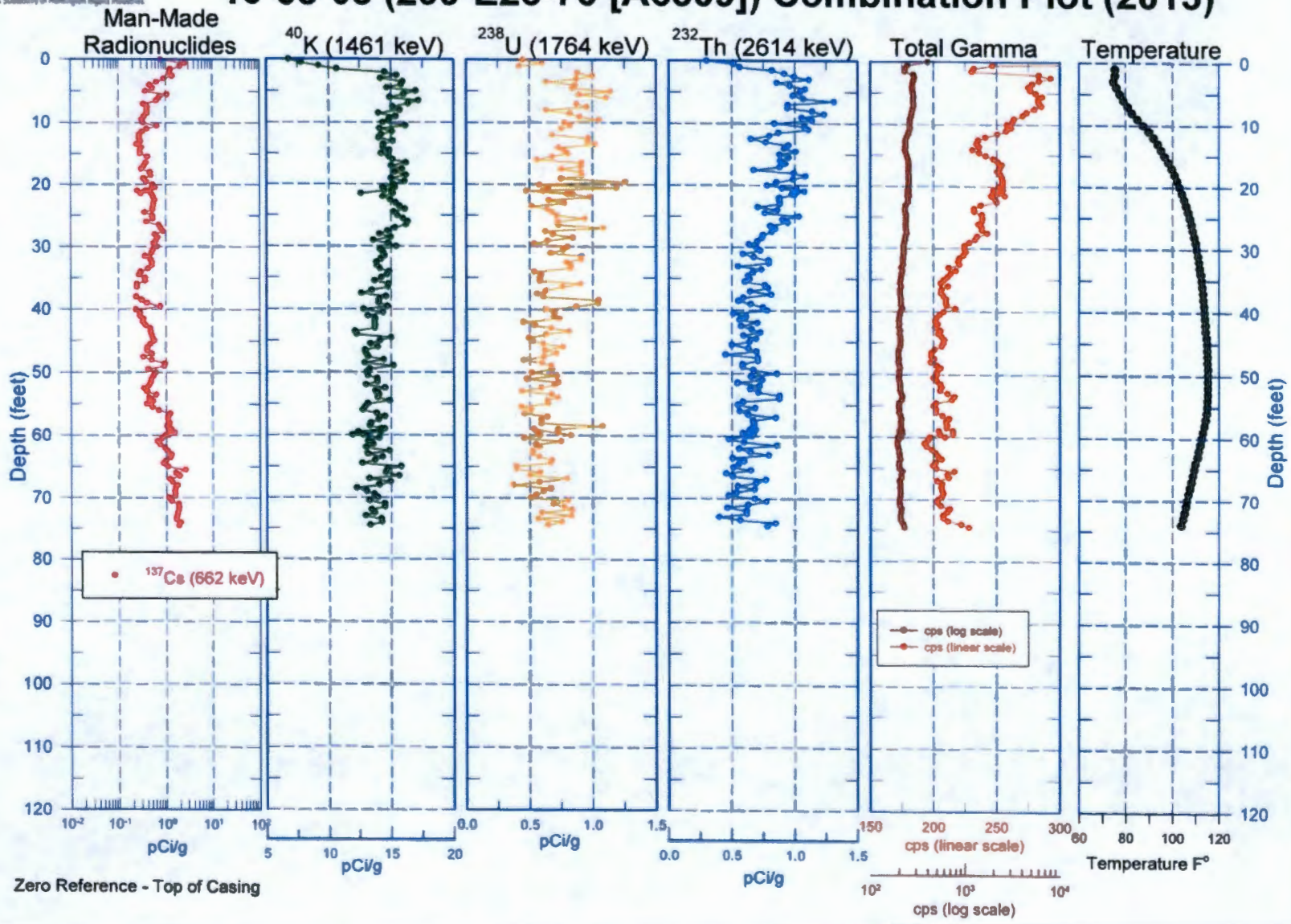
10-05-05 (299-E25-70 [A6509]) Combination Plot (2015)



Handout #2

WMA A-AX DATA QUALITY OBJECTIVES (DQO) PROCESS SUMMARY
Hand Out for May 25, 2017

BACKGROUND INFORMATION

DQO Scope and objectives

The DQO scope was outlined as follows (**WMA-A/AX-DQO-2017-1**):

- The DQO process will address vadose zone contamination in and around A-AX tank farms.
- Data will be used to develop an assessment of risk to human health and the environment including the future risk to groundwater.
- Data will be used to evaluate alternatives in a CMS and in the selection of a proposed remedy.
- The corrective action decisions supported by the data collected under this DQO will be consistent with and support final closure of A-AX tank farms.
- This DQO will not address data requirements of SST residual waste sampling and analysis or other data required to address closure associated with ancillary equipment in the tank farm. These data requirements will be addressed in a separate DQO for the closure of the SST system.

DQO objectives (**WMA-A-AX-DQO-2017-3** for bullets 2 and 3, and **WMA-A/AX-DQO-2017-4** for bullet 1):

- Define the WMA A-AX vadose zone characterization data necessary to guide planning to make vadose zone soil remedial decisions, support an evaluation of risks by direct contact and to ecological receptors, and support integration of vadose zone and groundwater decisions.
- Optimize a data collection program that will be used to support the Phase 2 RFI/CMS characterization of WMA A-AX and to support risk-informed retrieval efforts.
- Support refining the preliminary conceptual site model (CSM).

DQO Process

The DQO development is a seven step process. The DQO process for WMA A-AX will be iterative, with revisions being prepared to address focus areas, as needed. It will be setup to ensure that the data needs to support the performance assessment (PA) and risk-informed retrieval process and ultimately the Phase 2 RFI/CMS efforts are achieved. The steps and the manner in which they will be applied at WMA A-AX is identified in Table 1 below (**WMA-A/AX-DQO-2017-4**).

Table 1. WMA A-AX DQO Approach		
Step	**Purpose of Step**	**WMA A-AX DQO Document Information**
1	**State the Problem** *Define the problem that necessitates the study, identify the planning team, examine budget, and schedule.*	**The problem statement will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
2	**Identify the Goal of the Study** *State how environmental data will be used in meeting objectives and solving the problem, identify study questions, define alternative outcomes.*	**The goal of the study will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
3	**Identify Information Inputs** *Identify data and information needed to answer study questions.*	**The information inputs will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
4	**Define the Boundaries of the Study** *Specify the torget population and characteristics of interest, define spatial and temporal limits, scale of inference.*	**Each revision will be specific to a focus area.**
5	**Develop the Analytical Approach** *Define the parameter of interest, specify the type of inference, and develop the logic for drawing conclusions and findings.*	**The analytical approach will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
6	**Specify Performance or Acceptance Criteria** *Specify probability limits for false acceptance decision errors.*	**Performance/Acceptance Criteria will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
7	**Develop the Plan for Obtaining Data** *Select the resource-effective sampling and analysis plan that meets the performance criteria*	**Each revision will be specific to a focus area.**

Note: Steps that reflect the "overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS" will be reviewed to determine if any specifics are needed for Focus Area Evaluation.

STEP 1 – DEFINE THE PROBLEM

Step 1 of the seven-step DQO process is to clearly define the problem (the reason analytical data are needed) so that the focus of the project is clear.

DQO problem statement

Considering the DQO scope, and after review of available information, the concise statement of the problem was identified as follows (**WMA-A-AX-2017-1**):

> ***Vadose zone contamination in and adjacent to the A-AX tank farm may pose a current and future risk to human health and the environment, including groundwater, which requires corrective action to support closure.***

The DQO project team is identified as follows (**WMA-A-AX-2017-1**; modifications proposed **WMA-A-AX-2017-5**):

Table 2. DQO planning team members

Organization	Name	Function/Decision Authority
U.S. Department of Energy – Office of River Protection (ORP)	Jan Bovier	ORP Project Lead
U.S. Department of Energy – Operations Office (RL)	Doug Hildebrand	RL Lead - Integration with 200-EA-1 and Groundwater OUs
Washington State Department of Ecology (Ecology)	Mike Barnes Jeff Lyon Joe Caggiano Elizabeth Rochette Marysia Skorska Jim Alzheimer	Lead WMA A-AX DQO Tank Farms Project Manager Technical Support Technical Support Technical Support Technical Support
Washington River Protection Solutions	Scott Luke Paul Rutland Cindy Tabor/Ryan Childress Julie Robertson Jim Field Robin Varljen Kristin Singleton/Marcel Bergeron Harold Sydnor Kathi Dunbar Steve McKinney/Paul Gassman Bob Hiergesell Duc Nguyen	DQO Facilitator Vadose Zone Project Director Project Lead Regulatory Support Leak Assessments and Process Knowledge Regulatory Compliance Risk Assessment Field Characterization/Sampling and Analysis QA Laboratory Interface WMA A-AX PA Integration DQO Oversight
CHPRC	Bert Day Lee Brouilland/Jeremy Lynn Greg Thomas Curt Wittreich	200-EA-1, 200-DV-1, and 200-IS-1 200-PO-1 200-BP-5 Groundwater OU Integration

STEP 2 – IDENTIFY THE GOALS OF THE STUDY

Step 2 identifies the decisions information that requires new environmental data to address the problem and identifies decision statements for Estimation problems identifies what needs to be estimated to solve the "problems" stated in Step 1 and associated key assumptions.

Goal of the study (WMA-A-AX-2017-1):

> ***The goal is to ensure the appropriate vadose zone soil characterization data needs are identified to support corrective measure decisions for WMA A-AX, recognizing the need to integrate characterization and closure actions with ongoing and nearby operations and waste site/groundwater remedial actions.***

The Principal Study Questions, Alternative Actions, and Decision/Estimation Statements are described in Table 3 (**WMA-A-AX-2017-4**; modifications proposed **WMA-A-AX-2017-5**).

Table 3. Principal Study Questions, Alternative Actions, and Decision/Estimation Statements		
Principal Study Question (PSQ)	**Proposed Alternative Actions (AA)**	**Decision/Estimation Statement (DS/ES)**
#1— Is there sufficient chemical/radiological concentration and distribution data to perform risk assessment for WMA A-AX vadose zone soil (exceedances of applicable levels to define magnitude and extent of risk issues). **Proposed PSQ:** *Does contamination in the WMA A-AX vadose zone soil exceed acceptable levels?*	If yes, use existing data to develop risk assessment in support of the RCRA facility investigation report and performance assessment. If not, collect data or determine if other information can be used. **Proposed AA:** *If contamination exceeds acceptable levels, evaluate the need for corrective measures; otherwise, document that corrective action is not required.*	**#1** — Determine whether or not the chemical/radiological concentration and distribution data are sufficient to perform risk assessment for WMA A-AX vadose zone soil. **Proposed DS:** *Determine whether contamination exceeds acceptable levels and, therefore, whether there is a need to evaluate corrective measures.*
#2— Is there sufficient chemical/radiological concentration and distribution data to define the WMA A-AX vadose zone soil nature and extent of contamination (exceedances of applicable levels to define magnitude and extent of contamination). **Proposed PSQ:** *Incorporate purpose into first PSQ/DS and delete this one.*	If yes, use existing data to refine the conceptual/numerical site models and develop the RCRA facility investigation report. If not, collect data or determine if other information can be used. **Proposed AA:** *Delete.*	**#2** — Determine whether or not the chemical/radiological concentration and distribution data are sufficient to define WMA A-AX vadose zone soil nature and extent of contamination. **Proposed DS:** *Incorporate purpose into first PSQ/DS and delete this one.*
#3 – Is there sufficient information about vadose zone soil chemical/physical properties to determine how contaminants move through vadose zone soil in and near WMA A-AX? **Proposed PSQ:** *Is information available to define the chemical/physical properties of WMA A-AX vadose zone soil that can impact contaminant movement through the WMA A-AX vadose zone soil?*	If yes, use existing vadose zone soil chemical/physical property data to refine the conceptual/numerical site models. If not, collect data or determine if other information could be used. **Proposed AA:** *If information is available to define the vadose zone soil properties, then incorporate those properties into the contaminant modeling; otherwise evaluate the need to collect additional information to model contaminant movement.*	**#3** – Determine whether or not there is sufficient information about vadose zone soil chemical/physical properties that could affect contaminant movement through vadose zone soil in and near WMA A-AX. **Proposed Estimation Statement:** *Identify whether information to define the chemical and physical properties of WMA A-X vadase zone soil, which can impact contaminant movement through the WMA A-AX vadose zone soil, is available, and evaluate whether to use the existing information for modeling or to collect additional information to model contaminant movement.*

Table 3. Principal Study Questions, Alternative Actions, and Decision/Estimation Statements		
Principal Study Question (PSQ)	**Proposed Alternative Actions (AA)**	**Decision/Estimation Statement (DS/ES)**
#4 – Is there sufficient information about tank waste chemical/physical properties that could affect contaminant movement through the WMA A-AX vadose zone soil? **Proposed PSQ:** *Is information available to define the chemical/physical properties of tank waste that can impact contaminant movement through the WMA A-AX vadose zone soil?*	**If yes, use existing tank waste chemical/physical property data to refine the conceptual/numerical site models.** **If not, identify tank waste chemical/physical property data needs to be considered as a part of a future tank DQO.** **Proposed AA:** *If information is available to define the tank waste properties, then incorporate those properties into the contaminant modeling; otherwise evaluate the need to collect additional information to model contaminant movement.*	**#4 – Determine whether or not there is sufficient information about tank waste chemical/physical properties that could affect contaminant movement through the WMA A-AX vadose zone soil.** **Proposed Estimation Statement:** *Identify whether information to define the chemical and physical properties of tank waste, which can impact contaminant movement in the WMA A-AX vadose zone soil, is available, and evaluate whether to use the existing information for modeling or to collect additional information to model contaminant movement.*
#5 – Does the available contaminant concentration data provide sufficient information to determine whether, and if so, where waste passed through the WMA A-AX vadose zone soil? **Proposed PSQ:** *Is information available to define whether, and where, tank waste passed through WMA A-AX vadose zone soil and, therefore, could exist elsewhere in the environment?*	**If yes, use existing contaminant concentration data to evaluate the leak loss interpretation.** **If not, collect data or determine if other information could be used.** **Proposed AA:** *If information is available to define whether, and where, tank waste passed through WMA A-AX vadose zone soil, then incorporate that information into the contaminant modeling; otherwise, evaluate the need to collect additional information to model contaminant movement.*	**#5 – Determine whether or not there is sufficient contaminant concentration data to determine whether waste passed through the WMA A-AX VZ soil.** **Estimation statement:** *Identify whether information to define whether, and where, tank waste passed through WMA A-AX vadose zone soil is available, and evaluate whether to use the existing information for modeling or to collect additional information to model contaminant movement.*
Note: Estimation Statements for Focus Area Tanks A-104/105: ~~Use data to~~ support the continued development of the conceptual site model, support risk informed retrieval, and evaluate leak assessment interpretation.		

STEP 3 - DATA INPUTS

This step identifies the specific data required to answer the study questions, also identified as DQO data inputs.

Per EPA QA/G4 the major outputs of Step 3 are:

- *Identification of the **types** (e.g., chemical/physical properties), **as well as sources** of information needed to resolve the decision or estimates*
- *Identification of the **basis** of information (e.g., regulations, guidance, and permits) that will guide or support choices to be made in later steps of the DQO process; information on the number of variables (analytes) that will need to be collected; and types of information (e.g., action limits, uncertainty requirements) needed to meet performance or acceptance criteria*

- *Selection of, and information on the performance of, appropriate **sampling and analysis methods** for generating the information.*

Table 4 identifies bases for acceptable levels for Decision Statement #1. The contents of Table 4 were presented for discussion during DQO Meeting **WMA-A-AX-DQO-2017-4**. In consideration of concerns raised about the contents of Table 4, the table will be reconfigured to address all the QA/G4 information requirements. A table listing specific analytes is in development.

Proposal: *Update Table 4 to focus more directly on the EPA QA/G4 Step 3 activities and outputs.*

Table 4. Bases for Identification and Setting of Acceptable Levels for Decision and Estimation Statements

PSQ/ DS	Constituents of Concern (COC)		Basis [source] for Protection Threshold	Acceptable Levels	Basis for Setting Acceptable Levels
1	Radionuclides	Shallow zone (<4.6m [<15 ft.] bgs)	500 mrem/yr above background via industrial land-use scenario, no additional groundwater degradation, ecological protection.	Contaminant specific; fate and transport modeling	• Radiological lookup values for shallow zone soils based on fate and transport analyses for the applicable scenarios • Deep zone values will be determined using STOMP or another model
		Deep zone (>4.6m [>15 ft] bgs)	No additional groundwater degradation	MCLs, state and Federal ambient water quality control criteria; alternatively, site-specific modeling	
1	Chemicals	Shallow zone (<4.6m [<15 ft] bgs)	• MTCA Method B for need for action • ~~MTCA Method C for cleanup~~ • Ecological protection	Chemical-specific	~~MTCA Method C cleanup levels~~ and ecological protection values with contaminant-specific variations.
		Deep zone (>4.6m [<15 ft] bgs)	MTCA Three Phase Model	Alternatively, site-specific modeling	
3, 4	Chemical/physical properties		NA	NA	• Acceptable levels do not apply for preliminary conceptual contaminant distribution model evaluation. • This is a judgmental assessment.
2, 5	Radiological and chemical		NA	Contaminant specific; Hanford site soil background levels and fate and transport modeling	• Soil background levels[1] and fate and transport analyses of past leaks

[1] Relevant background level information is contained in the following documents:
- 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*
- ECF-HANFORD-11-0038, *Soil Background for Interim Use at the Hanford Site.*

Table 5 identifies a range of field and analytical methods (e.g., ground penetrating radar, geophysical logging, and direct push) that could be used for vadose zone soil characterization. The contents of Table 5 were presented for discussion during DQO Meeting **WMA-A-AX-DQO-2017-4**.

Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization

Potentially Appropriate Field Method/Analytical Method	Parameter	Possible Limitations
Ground Penetrating Radar (GPR): Radar-reflection surface geophysical survey technique that detects contrasts in di-electric constants in the below-grade environments from the surface.	Underground structures or interferences	Requires subjective interpretation of the reflected signals. Lack of reflective below-grade surfaces or the presence of interfering matrices can complicate or invalidate the findings. The presence of nearby buildings and utilities can interfere with reflected signals. Fines (e.g., clay and heavy fly ash) can act as a reflector to the radar signal.
Electromagnetic Induction (EMI): Surface geophysical survey technique that measures electrical conductivity in below-grade soils based on detected changes in electrical fields. Generally used to support the interpretation of GPR surveys.		The presence of nearby buildings and utilities can interfere with reflected signals.
Surface Geophysical Exploration: Electrical Resistivity Imaging can be acquired to develop shallow and deep, 2-dimensional and 3-dimensional images.	Resistivity (conductivity)	Results are impacted by interference from infrastructure such as pipelines, tanks, buildings, and other large features.
Large Diameter Hole (LDH) Conventional Drilling (e.g., cable tool):	Geophysical Logging and Laboratory Analysis	Most drilling methods have difficulty in cobbles and boulders. Waste/tailings are brought to the surface and need to be properly contained and disposed, increasing cost and risk of exposure to workers. Not viable for new exploration in the tank farms due to waste generation and logistics (e.g., dome loading and access).
LDH Geophysical Logging	Gross and isotopic gamma emissions	Larger size instrument has lower detection limits (more sensitive) but does not fit into a small diameter hole (SDH) (<3-inch); therefore, is not a compatible technology for use with direct push methods. The count rate can effect accuracy and precision of measurements.
	Gamma emissions from fission products, Am-241, Pu-239, and Np-237 It is considered by some to be more accurate than sampling and laboratory assay because the assay is performed in situ with less disturbance of the sample, there is higher vertical spatial resolution, and the sample size is much larger. This	This method does not assess radionuclides or daughter products that do not emit gamma rays. The gamma energies from these isotopes are at the low end of the spectrum, which results in high numerical minimum detectable activities and possible matrix effects from other isotopes. This technique requires the use of a single casing

Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization

Potentially Appropriate Field Method/Analytical Method	Parameter	Possible Limitations
	method may also be more economical than traditional sampling and analysis.	(installed by drilling or driving) in contact with the soil formation. The detector is too large to fit in a SDH (<3-inch); therefore, is not a compatible technology for use with direct push methods.
	Neutron emissions from plutonium	Because of the very low incidence of spontaneous plutonium fission and alpha-N reactions, the passive neutron profile is orders of magnitude lower than the gamma emission. The detector is too large to fit in a SDH (<3-inch); therefore, is not a compatible technology for use with direct push methods.
	Active neutron emissions from transuranics	Although neutron activation methods have been developed, they are not expected to be useful for this initial characterization effort. At present, these techniques are too expensive and time consuming, and logistical problems are associated with the handling of intense sources or generators. The detector is too large to fit in a SDH (<3-inch); therefore, is not a compatible technology for use with direct push methods.
LDH Geophysical Logging (continued)	Beta emissions	Not a fully developed technology.
	Neutron moisture	Moisture zones can be very thin and can be missed based on data collection intervals (distance and time).
	Temperature	Difficult differentiating/determining source and extent of high temperatures (e.g., soil versus infrastructure).
Laboratory Analysis for LDH	Chemical and radiological constituents and physical properties Constituent list will be discussed in future meetings	Highly contaminated samples may require use of on-site laboratories, with associated impacts (e.g., high cost, reduced analyte lists, matrix effects, degraded detection limits, and long turnaround times). Lower contamination levels may allow use of offsite laboratories, avoiding these limitations.
Small Diameter Hole (SDH) Direct Push	Geophysical Logging and Laboratory Analysis	Direct-push methods may be ineffective in cobbly or rocky soils.
SDH Geophysical Logging	Gross and isotopic gamma emissions	The smaller diameter detectors are not as sensitive as those used in LDH (Detection limits are not as low from instruments used in LDH.)
	Beta emissions	Not a fully developed technology.
	Neutron moisture	Moisture zones can be very thin and can be missed based on data collection intervals (distance and time).

Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization		
Potentially Appropriate Field Method/Analytical Method	**Parameter**	**Possible Limitations**
	Temperature	Difficult differentiating/determining source and extent of high temperatures (e.g., soil versus infrastructure).
Laboratory Analysis for SDH	Chemical and radiological constituents and physical properties Constituent list will be discussed in future meetings	Small sample size leads to difficulty to with large analysis list and low detection limits.
Note: Reinterpreting available data (e.g., surface geophysical exploration data) and/or determine if analysis on existing cores could be performed.		

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

Identify the target population of interest and specify the spatial and temporal features pertinent for decision making or estimation.

Per EPA QA/G-4, the major outputs of this step are as follows:

- *Definition of the target populotion with detailed descriptions of geographic limits (spatial boundaries)*
- *Detailed descriptions of what constitutes a sampling unit*
- *Time frame appropriate for collecting data and making the decision or estimate, together with those practical constraints that may interfere with data collection*
- *The appropriate scale for decision making or estimation.*

Focus Area:

Around Tanks A-104 and A-105, Surface to Groundwater (Vadose Zone Soil)

Time component:

Collect information prior to retrieval of Tanks A-104 and A-105

Note that it was agreed in 2011 that the vertical spatial area of interest was to be soil depths from the following:

- 0 to 11 inches for soil contamination to support ecological and direct contact assessment. This depth supports not needing an excavation permit.
- <15 ft to support direct contact assessment and groundwater assessment
- >15 ft to support groundwater assessment