SMUD®

DPG 17-085

April 20, 2017

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Docket No. 50-312
Rancho Seco Nuclear Generating Station
License No.: DPR-54

Final Status Survey Report Submittal – Clarifying Information

Attention: Zahira Cruz

The purpose of this letter is to submit clarifying information to the Final Status Survey Summary Report submitted previously for NRC review (SMUD letter DPG 17- 038, dated February 28, 2017).

In response to comments arising from our April 6, 2017 conference call, SMUD has provided additional descriptive text regarding the application of the ALARA evaluations performed in accordance with Section 4 of the NRC approved Rancho Seco License Termination Plan as well as detailed context associated with survey units that contain additional survey units within their boundaries. SMUD is confident this additional information will clearly demonstrate the relationships between the Class 1, Class 2, and Class 3 survey units evaluated during Final Site Status Survey performance and provide assurance the ALARA requirements of 10CFR20.1402 have been met.

Attachment 1; FSS Final Report Rev. 1, provides a summary of the assessment performed for the remainder of the Part 50 site. SMUD has reviewed the survey area results to ensure that the proposed action will have no adverse impact on the ability of the site, in aggregate, to meet 10 CFR Part 20, Subpart E "Radiological Criteria for License Termination."

Attachment 2; contains the remove and replace page instructions for Final Status Survey Reports not reissued in their entirety.

Attachment 3; contains replacement instructions for Final Status Survey Reports reissued in their entirety.

Following NRC approval of the FSS Final Report and several programmatic and licensing transitions currently being processed under separate docketing, SMUD will

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submit a License Amendment request that the Nuclear Regulatory Commission (NRC) terminate the Rancho Seco 10 CFR Part 50 License, Number DPR-54. The spent nuclear fuel and the Greater than Class C (GTCC) waste remain stored at the Rancho Seco Independent Spent Fuel Storage Installation (ISFSI), licensed under 10 CFR Part 72.

Members of your staff with questions requiring additional information or clarification may contact me at (916) 732-4893.

Sincerely,

Dan Tallman
Manager, Rancho Seco Assets

BG/DT

Attachments (3)

Cc: Jack Parrott (w/o attachment)
NRC, Region IV (w/o attachment)
RIC: 1F.099 (w/o attachment)

ATTACHMENT 1

RANCHO SECO
FSS FINAL REPORT

Final Status Survey Report
Phase II- IOSB

April 13, 2017 rev 1

1.0 Overview

As discussed in Section 1.4 of the Rancho Seco License Termination Plan (LTP), SMUD intends to release the Rancho Seco site for unrestricted use in two phases, with the license being terminated after completion of the second phase. The first phase included the release of the majority of the site, including impacted and non-impacted areas, except for the Interim Onsite Storage Building (IOSB) and the area immediately surrounding it.

SMUD shipped all Class B & C radioactive waste once stored in the IOSB to a licensed disposal facility in 2014. In accordance with the LTP, after disposing of the Class B & C radioactive waste, SMUD completed the final status survey for the IOSB and the area immediately surrounding the IOSB and will submit a license amendment request to terminate the 10 CFR Part 50 license and release the remainder of the site for unrestricted use. The spent nuclear fuel and the Greater than Class C (GTCC) waste are stored at the Rancho Seco Independent Spent Fuel Storage Installation (ISFSI), which is licensed under 10 CFR Part 72, independent of the 10 CFR Part 50 licensed site.

Section 1.4 of the LTP discusses the information to be provided to support release of land from the Rancho Seco 10 CFR Part 50 license. The information provided in this report includes a discussion of final status survey results for each survey unit completed.

The information contained in this submittal, will be sufficient for the NRC to conclude that, for the land and structures associated with the release, the terminal radiation survey and associated documentation demonstrates that the facility and site are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, Subpart E by meeting a site release criterion of 25 millirem TEDE per year over background.

Once these lands and structures are released, no additional surveys or decontamination of these areas will be required unless the NRC determines that the criteria of 10 CFR Part 20, Subpart E were not met.

2.0 Site Information and Physical Description

2.1 Physical Description of Land or Structures to be Released

The land and structures to be released will be described in the application for license amendment and is unchanged by this submittal.

2.2 Survey Unit Information Included in this Submittal

As discussed in section 1.0 above, this submittal provides detailed discussion on final status survey results for 35 survey units located within the IOSB and surrounding land to be released. Details are provided for each survey unit on survey methods, results, data analysis, and conclusions. In all cases, Rancho Seco is providing a complete package of information relating to each survey unit so that the NRC staff can verify that the License Termination Plan has been fully implemented for each survey unit and that the final status survey results support unrestricted release of the land from License DPR-54 in accordance with the proposed license amendment.

This submittal addresses FSS information for survey units associated with the IOSB and surrounding land. **Table 1** provides a description of the survey units addressed in this submittal.

Table 1, Survey Unit Description

Survey Unit	Class	General Description of Survey Unit
F8300001	3	DAW Bay- The back bay of the IOSB. The survey unit has a surface area of 348 m^2.
F8300002	3	DAW Staging Bay – The center bay of the IOSB. The survey unit has a surface area of 225 m^2.
F8300003	1	DAW Staging Bay Class 1 – A small elevated area located on the DAW Staging Bay floor. The survey unit has an area of 0.74 m^2.
F8300004	2	DAW Staging Bay Buffer Class 2 – A buffer to the class 1 survey unit area located on the DAW Staging Bay floor. The survey unit has an area of 2.22 m^2.
F8300005	3	Truck Bay – The entry bay of the IOSB where vehicles were loaded excluding the loading dock and the buffer area around the loading dock. The survey unit has an area of 379 m^2.
F8300006	1	Hot Cell Class 1 – A segregated area in the Truck Bay designed to hold containers with high dose rate. The survey unit has an area of 8 m^2.
F8300006	2	Hot Cell Class 2– A buffer area around the class 1 survey unit. The survey unit has an area of 7.6 m^2.
F8300007	1	Loading Dock Class 1 - The area at the end of the truck bay used to load material onto vehicles. The survey unit has an area of 7.5 m^2.

Survey Unit	Class	General Description of Survey Unit
F8300008	2	Loading Dock Buffer Class 2 – An area surrounding the class 1 survey unit at the loading dock. The survey unit has an area of 19.9 m^2.
F8300009	3	Cell Deck – The area above the lids of the storage cells with the northern end open to the Truck Bay. The size of the survey area is 460 m^2.
F8300010	3	Sumps – The upper and lower sump areas. While these were one survey unit, each sump was surveyed as a standalone survey unit. The two sumps combined survey area is 79.6 m^2.
F8300011	1	Hot Cell Embedded Pipe – The 4-foot-long run of drain pipe from the hot cell floor to the 90^0 elbow connection. No size was determined for the embedded piping as the survey design was the same for all segments of pipes.
F8300012	3	Embedded Piping – All runs of embedded piping leading to the sumps from the DAW, DAW Staging and Truck Bays. No size was determined for the embedded piping as the survey design was the same for all segments of pipes.
F8300013	3	Office – The area outside the RCA with the training and control rooms and the mezzanine. The size of the area is 370 m^2.
F8300014	3	Outside Area – The asphalt and soil berm surrounding the ISOB. The outside area is 5,853 m^2.
F8300014	1	Asphalt area Class 1 – Small area where remediation occurred of an area less than DCGL. The survey area is 0.37 m^2.
F8300014	2	Asphalt Buffer Class 2 - area surrounding the class 1 area. The survey area is 1.85 m^2.
F8300015	3	Roof – The roof of the IOSB. The survey area is 1,735 m^2.
F8300016	3	Cell A-1 – The storage cell A-1. The survey area is 27.5 m^2.
F8300017	3	Cell A-2 – The storage cell A-2. The survey area is 28.3 m^2.
F8300018	3	Cell A-3 – The storage cell A-3. The survey area is 27.5 m^2.
F8300019	3	Cell B-1 – The storage cell B-1. The survey area is 23.1 m^2.
F8300020	3	Cell B-2 – The storage cell B-2. The survey area is 23.7 m^2.
F8300021	3	Cell B-3 – The storage cell B-3. The survey area is 23.1 m^2.
F8300022	3	Cell C-1 – The storage cell C-1. The survey area is 23.1 m^2.
F8300023	3	Cell C-2 – The storage cell C-2. The survey area is 23.7 m^2.
F8300024	3	Cell C-3 – The storage cell C-3. The survey area is 23.1 m^2.

Survey Unit	Class	General Description of Survey Unit
F8300025	3	Cell D-1 – The storage cell D-1. The survey area is 23.1 m^2.
F8300026	3	Cell D-2 – The storage cell D-2. The survey area is 23.7 m^2.
F8300027	3	Cell D-3 – The storage cell D-2. The survey area is 23.1 m^2.
F8300028	3	Cell E-1 – The storage cell E-1. The survey area is 26.1 m^2.
F8300029	3	Cell E-2 – The storage cell E-2. The survey area is 28.3 m^2.
F8300030	3	Cell E-3 – The storage cell E-3. The survey area is 27.5 m^2.
F8300031	3	Exterior surface of IOSB – The outside wall surface of the IOSB. The survey area is 2,750 m^2.
F8300032	3	Cask Wash Down Area – The cask wash down area is located in the Truck Bay separated by a berm. The survey area is 13.9 m^2.

The locations of the structures listed in **Table 1** above are shown in **Figures 1-3**.

3.0 Potential for Cross-Contamination from Subsequent Activities

There were no other decommissioning activities occurring at the site during this survey effort. As each FSS was completed for the individual survey units, the area was posted as required in the LTP to preclude further entry into the area. Where possible, the entry doors were shut and locked or for the storage and hot cells, the lids were placed to preclude entry. Additionally, the entry gate to the area surrounding the IOSB was posted to restrict access to only decommissioning survey crew personnel. Since the number of personnel having access to the IOSB was limited to the survey crew, the potential for cross contamination was low.

4.0 Final Status Survey Report

Rancho Seco LTP section 5.7.3 identifies the contents of the written reports of final status survey results that are to be submitted to the NRC. The contents include the items described in NUREG-1757, Vol. 2, Section 4.5. The survey unit design details and results are provided below in summary fashion. Specific survey unit design details and results are provided in a copy of each survey unit summary report in **Attachment 1** of this submittal.

4.1 Overview of Results

Only the IOSB and surrounding land is included in this report. The summary report for each survey unit contains a description of the survey unit; design information, including classification, size, number of measurements, map, scan coverage, and DCGL; survey results; survey unit investigations (anomalous data); data assessment results, including statistical evaluations, if applicable; changes in initial survey unit assumptions on extent of residual activity, and survey unit conclusions.

Note that classification for the embedded piping does not affect the survey density (number of samples) as that is specified in the RSLTP as a measurement every six inches. As such, for the Hot Cell Pipe, the designation of the vertical section of pipe as a Class 1 was made to distinguish that section from the other sections as decontamination was performed on the Hot Cell pipe. No Class 2 buffer was established for this section of piping. The remainder of the embedded piping was designated as a Class 3 to denote the lack of detectable residual radioactivity.

Overall, the attached survey unit summary reports demonstrate that the survey units meet the criteria for release for unrestricted use in accordance with the NRC approved Rancho Seco License Termination Plan.

4.2 Discussion of Changes to FSS Program

The purpose of this section is to discuss changes to the FSS program. At the time of this submittal there have been no changes made to the FSS Program so there are no effects on the surveys.

4.3 Final Status Survey Methodology

This section summarizes the implementation of the LTP Final Status Survey methodology for the survey units that are included in this report supporting the release of the IOSB and surrounding land. **Table 2** is provided below that lists the key FSS design features for each survey unit. These design features include the survey unit classification and size, the standard deviation and Lower Boundary of the Gray Region (LBGR) used for determining the number of direct measurements taken, the percent scan coverage, the design $DCGL_{EMC}$ and the number of measurements required. The standard deviations listed were obtained from site characterization data or survey unit specific measurements. The Type 1 and 2 Errors are the default values of 0.05 and the LBGR is initially based on 50% of the DCGL.

Table 2, Survey Unit Design Parameters

Survey Unit ID	Class	SU Size (m^2)	Standard Deviation	LBGR	Design $DCGL_{EMC}$	Number of Measurements	% Scan
F830001	3	348	1,055	21,500	NA	14	1
F830002	3	225	598	21,500	NA	14	1
F830003	1	0.74	598	21,500	640,700	5	100
F830004	2	2.22	598	21,500	NA	10	50
F830005	3	379	466	21,500	NA	14	1
F830006	1	8	740	21,500	141,900	14	100
F830006	2	7.6	740	21,500	NA	14	100
F830007	1	7.5	466	21,500	146,200	14	100
F830008	2	19.9	466	21,500	NA	14	50
F830009	3	460	275	21,500	NA	14	1
F830010	3	79.6	466	21,500	NA	14	1

Survey Unit ID	Class	SU Size (m^2)	Standard Deviation	LBGR	Design $DCGL_{EMC}$	Number of Measurements	% Scan
F830011	1	NA	NA	50,000	NA	Every 6 inches	NA
F830012	3	NA	NA	50,000	NA	Every 6 inches	NA
F830013	3	370	334	21,500	NA	14	1
F830014	1	0.37	513	21,500	950,300	5	100
F830014	2	1.85	513	21,500	NA	10	50
F830014	3	5,853	513	21,500	NA	14	1
F830015	3	1,735	707	21,500	NA	14	1
F830016	3	27.5	303	21,500	NA	14	1
F830017	3	28.3	170	21,500	NA	14	1
F830018	3	27.5	175	21,500	NA	14	1
F830019	3	23.1	177	21,500	NA	14	1
F830020	3	23.7	183	21,500	NA	14	1
F830021	3	23.1	136	21,500	NA	14	1
F830022	3	23.1	198	21,500	NA	14	1
F830023	3	23.7	182	21,500	NA	14	1
F830024	3	23.1	365	21,500	NA	14	1
F830025	3	23.1	198	21,500	NA	14	1
F830026	3	23.7	174	21,500	NA	14	1
F830027	3	23.1	145	21,500	NA	14	1
F830028	3	26.1	197	21,500	NA	14	1
F830029	3	28.3	197	21,500	NA	14	1
F830030	3	27.5	182	21,500	NA	14	1
F830031	3	2,750	175	21,500	NA	14	1
F830032	3	13.9	466	21,500	NA	14	1

4.4 Final Status Survey Results

The methods used to determine the number of direct measurements to be taken is described in the LTP and the specific survey unit summary reports provided in **Attachment 1**. Key survey results are given in **Table 3** below.

Table 3, Survey Unit FSS Result Summary

Scan Measurement Range (dpm)	No. Direct Meas. Taken	Mean Direct Result	Maximum Direct Result	Direct Standard Deviation	Units	No. Scan Elevated Areas
F830001 DAW Bay						
1,717 – 3,017	15	2025	2,535	325	dpm/100 cm^2	0
F830002 DAW Staging Bay						
1,896 – 3,192	15	2,050	2,961	323	dpm/100 cm^2	0
F830003 DAW Staging Bay Class 1						
1,750[1]	5	2,617	3,946	747	dpm/100 cm^2	0
F830004 DAW Staging Bay Buffer Class 2						
777[1]	10	2,226	2,357	111	dpm/100 cm^2	0
F830005 Truck Bay						
1,992 – 2,708	15	2,240	3,402	582	dpm/100 cm^2	0
F830006 Hot Cell Class 1						
1,633 – 20,041	15	2,976	4,583	550	dpm/100 cm^2	0
F830006 Hot Cell Buffer Class 2						
2,550 – 23,583	15	2,324	2,970	296	dpm/100 cm^2	0
F830007 Loading Dock Class 1						
1,407 – 4,354	15	3,297	7,265	1,376	dpm/100 cm^2	0
F830008 Loading Dock Buffer Class 2						
1,310 – 6,963	15	2,807	3,106	231	dpm/100 cm^2	0
F830009 Cell Deck						
1,713 – 2,961	15	1,980	2,348	242	dpm/100 cm^2	0
F830010 Sumps						
2,157 – 2,883	30	1,891	2,364	249	dpm/100 cm^2	0
F830011 Hot Cell Embedded Pipe						
NA	10	15,669	16,718	806	dpm/100 cm^2	NA
F830012 Embedded Pipe						
NA	504	5,038	12,437	1,355	dpm/100 cm^2	NA
F830013 Office						
1,381 – 2,122	30	1,972	2,409	215	dpm/100 cm^2	0
F830014 Outside Area						
1,808 – 2,115	15	2,676	3,083	223	dpm/100 cm^2	0
F830014 Asphalt Class 1						
2,592[1,2]	5	2,626	2,803	158	dpm/100 cm^2	0
F830014 Asphalt Buffer Class 2						
2,400 – 2,832	10	2,572	2,826	247	dpm/100 cm^2	0

Scan Measurement Range (dpm)	No. Direct Meas. Taken	Mean Direct Result	Maximum Direct Result	Direct Standard Deviation	Units	No. Scan Elevated Areas
F830015 Roof						
1,692 – 3,317	15	1,552	2,341	425	dpm/100 cm^2	0
F830016 Storage Cell A-1						
1,986 – 2,645	15	1,850	2,093	145	dpm/100 cm^2	0
F830017 Storage Cell A-2						
2,192 – 2,858	15	2,010	2,349	165	dpm/100 cm^2	0
F830018 Storage Cell A-3						
2,367 – 2,858	15	2,012	2,167	91	dpm/100 cm^2	0
F830019 Storage Cell B-1						
1,527 – 2,679	15	1,842	2,078	123	dpm/100 cm^2	0
F830020 Storage Cell B-2						
2,203 – 2,646	15	2,013	2,333	173	dpm/100 cm^2	0
F830021 Storage Cell B-3						
2,225 – 2,709	15	1,926	2,106	124	dpm/100 cm^2	0
F830022 Storage Cell C-1						
1,682 – 2,547	15	1,869	2,078	124	dpm/100 cm^2	0
F830023 Storage Cell C-2						
2,125 – 2,658	15	2,011	3,318	383	dpm/100 cm^2	0
F830024 Storage Cell C-3						
1,961 – 2,512	15	2,045	2,288	127	dpm/100 cm^2	0
F830025 Storage Cell D-1						
1,589 – 2,295	15	1,956	2,295	186	dpm/100 cm^2	0
F830026 Storage Cell D-2						
2,242 – 2,817	15	2,012	2,250	135	dpm/100 cm^2	0
F830027 Storage Cell D-3						
1,958 – 2,658	15	2,008	2,333	161	dpm/100 cm^2	0
F830028 Storage Cell E-1						
1,566 – 2,171	15	1,901	2,154	170	dpm/100 cm^2	0
F830029 Storage Cell E-2						
2,192 – 2,625	15	2,035	2,326	180	dpm/100 cm^2	0
F830030 Storage Cell E-3						
2,230 – 2,795	15	2,088	2,409	118	dpm/100 cm^2	0
F830031 Exterior Surface of IOSB						
1,646 – 2,808	15	2,104	2,380	175	dpm/100 cm^2	0
F830032 Cask Wash Down Area						
2,518 – 3,270	15	2,197	2,644	237	dpm/100 cm^2	0

[1]Only a single scan measurement was collected due to the small size of the survey unit.
[2]Data was collected with a large area detector (584 cm^2) and normalized to activity per 100 cm^2 to be consistent with scanning data from other survey units.
NA – Not applicable. For survey units F830011 and F830012 embedded piping, scanning is not performed as measurements are collected every 6 inches of piping.

4.5 Survey Unit Conclusions

Rancho Seco concludes that this information is sufficient for the NRC to make a determination equivalent to 10CFR50.82 (a)(11) regarding the survey units contained in this submittal. The surveys for these survey units and associated documentation demonstrate that these areas of the facility and site are suitable for release in accordance with the criteria for decommissioning in 10CFR20, subpart E by meeting a site release criteria of 25 millirem TEDE per year over background for all dose pathways in accordance with the approved License Termination Plan.

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

5.0 References

Rancho Seco License Termination Plan, rev. 2, submitted 10/2014.

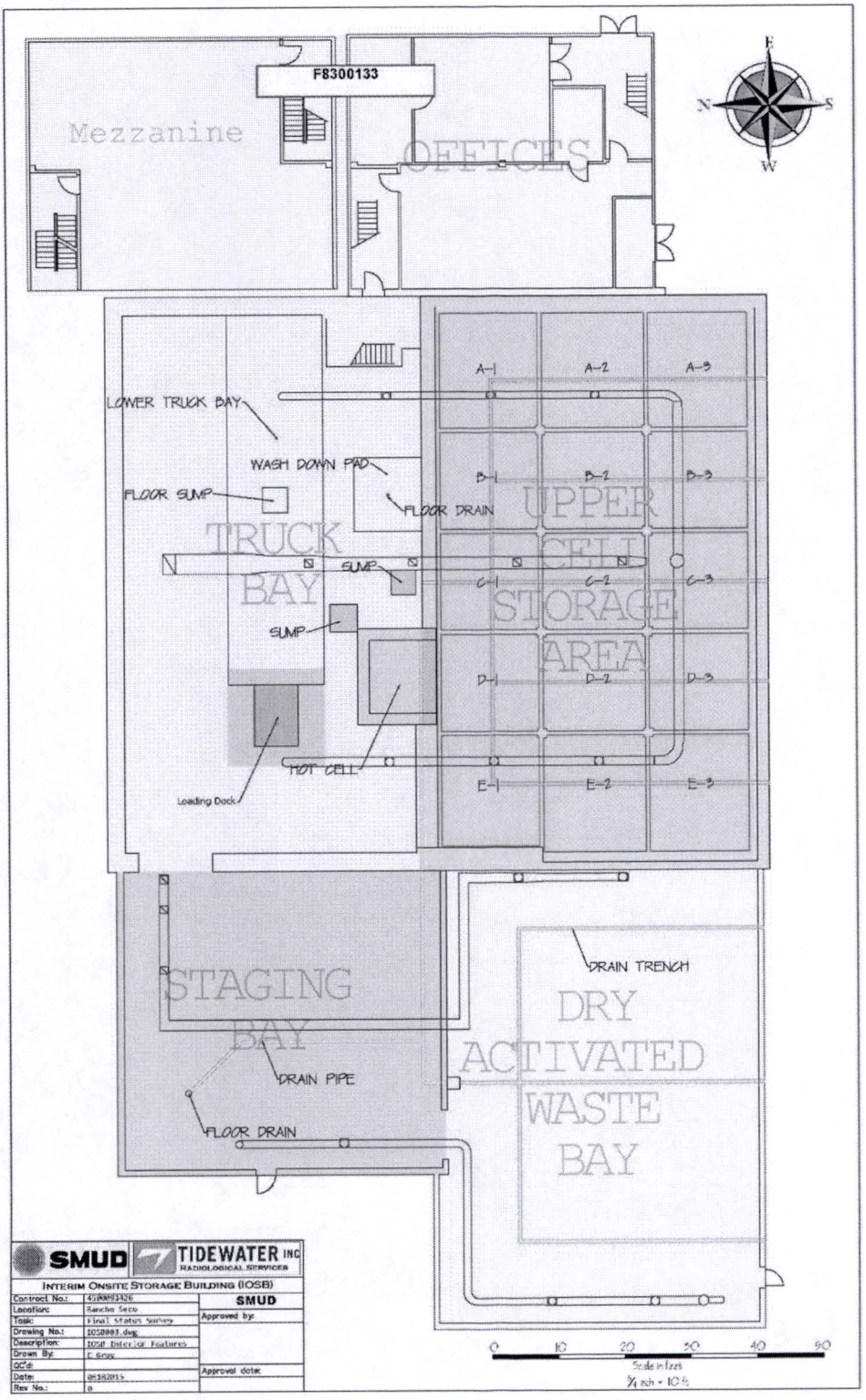


Figure 1, Interior Survey Units

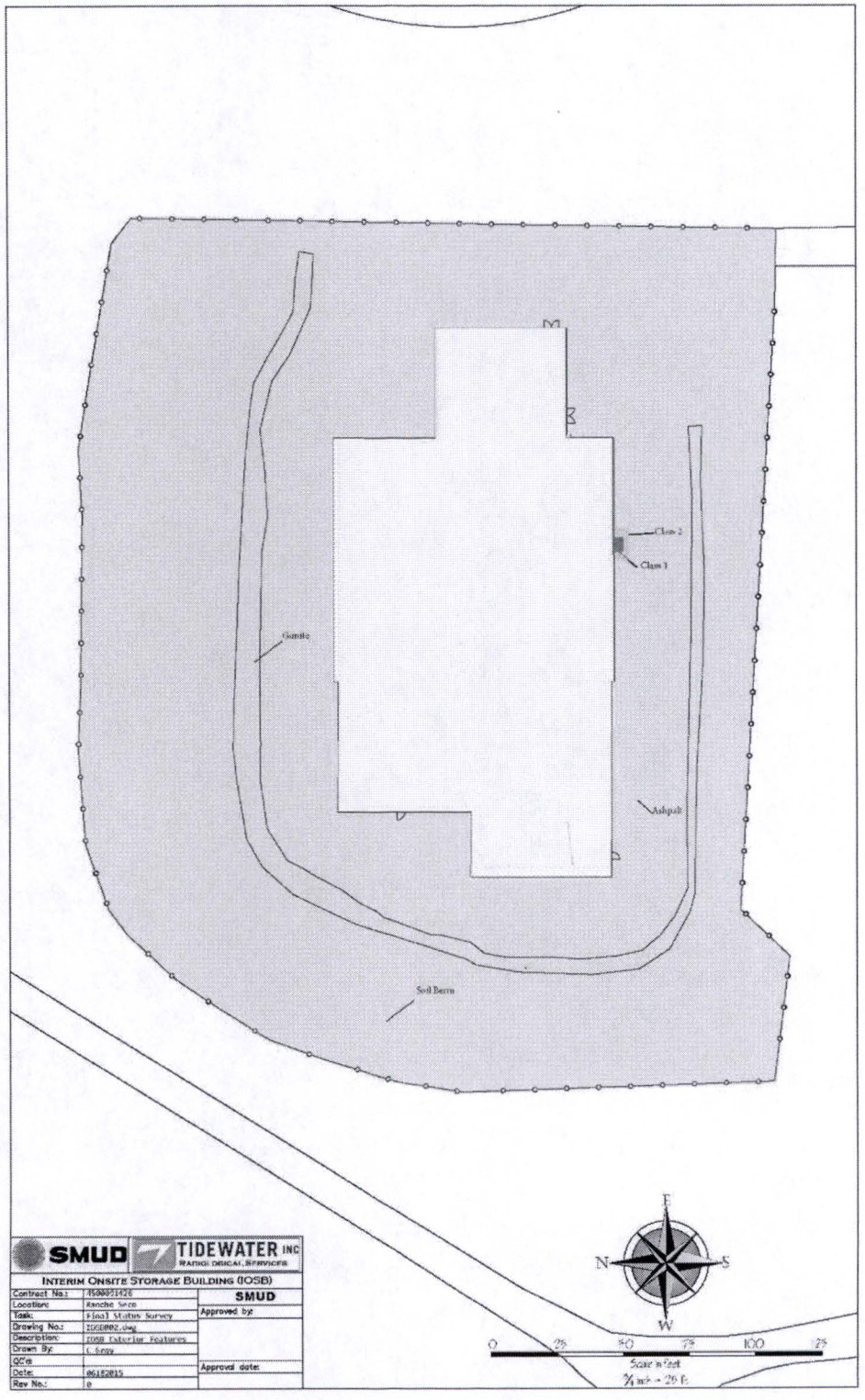


Figure 2, Outside Area Survey Units

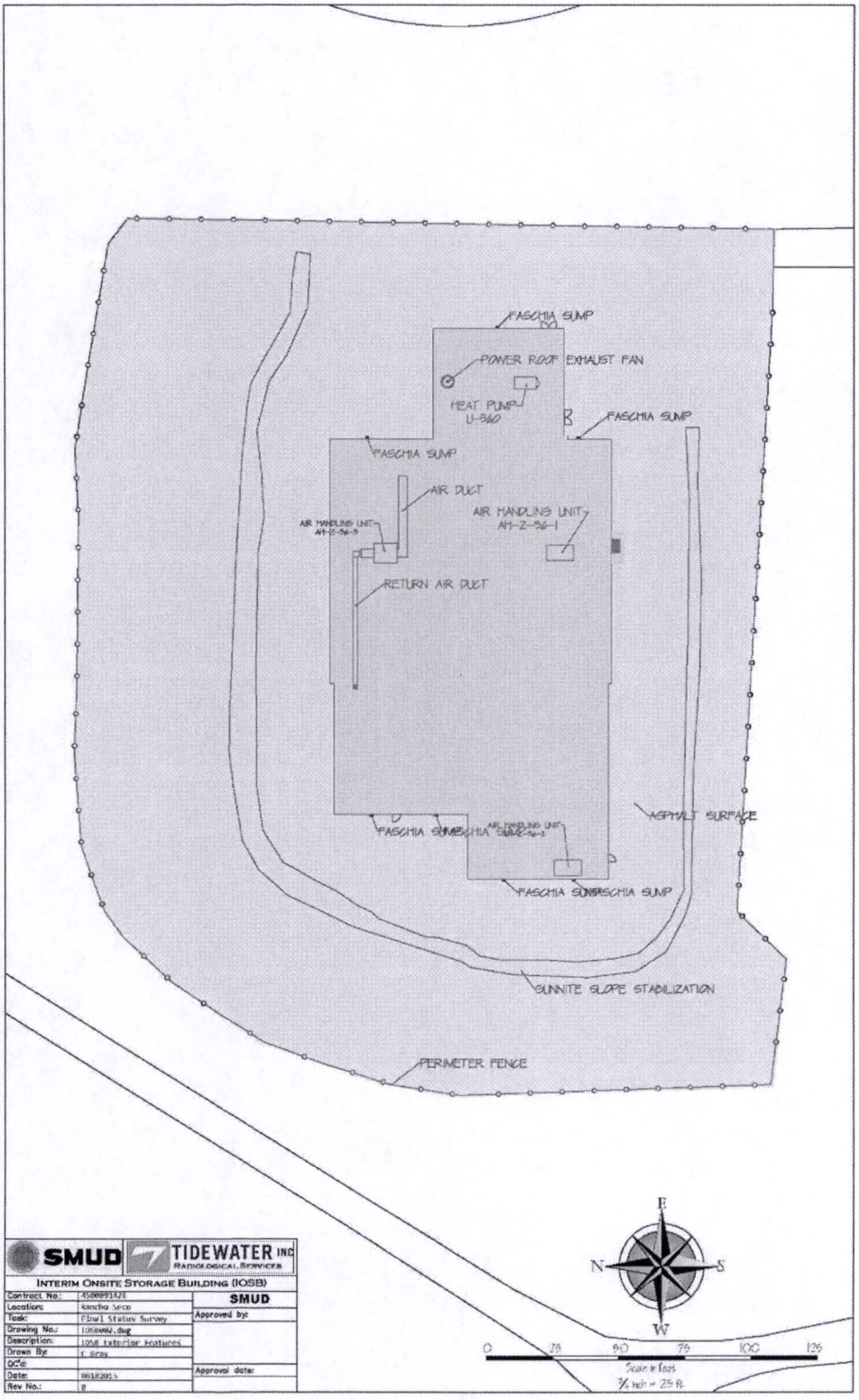


Figure 3, Roof Survey Area

ATTACHMENT 2

A revision was made to each of the following Final Status Survey Reports (FSSR) in the ALARA Statement section. Please replace original **page 4** of the FSSR with the current rev1 of **page 4** provided for the following FSSRs:

- F8300013
- F8300093
- F8300153
- F8300163
- F8300173
- F8300183
- F8300193
- F8300203
- F8300213
- F8300223
- F8300233
- F8300243
- F8300253
- F8300263
- F8300273
- F8300283
- F8300293
- F8300303
- F8300313
- F8300323

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL. The sample standard deviation was greater than the design standard deviation but both values of sigma resulted in a relative shift greater than three (3), no additional samples were required.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,062	
Mean:	2,025	
Static Data Standard Deviation:	325	
Maximum:	2,535	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{emc}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However this did not affect the relative shift

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,955	
Mean:	1,980	
Static Data Standard Deviation:	242	
Maximum:	2,348	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, based upon the adjustment of the relative shift, the calculated number of samples did not change. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,326	
Mean:	1,552	
Static Data Standard Deviation:	425	
Maximum:	2,341	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{emc}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was higher than the characterization data used for survey design. However the relative shift exceeded 3 and had to be adjusted. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL. The sample standard deviation was greater than the design standard deviation but both values of sigma resulted in a relative shift greater than three (3), no additional samples were required.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,868	
Mean:	1,850	
Static Data Standard Deviation:	145	
Maximum:	2,047	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,023	
Mean:	2,010	
Static Data Standard Deviation:	165	
Maximum:	2,349	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,023	
Mean:	2,012	
Static Data Standard Deviation:	91	
Maximum:	2,167	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design which would result in a larger relative shift value. Since both values are in excess of 3 the difference in the variability does not affect the power of the survey. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,868	
Mean:	1,842	
Static Data Standard Deviation:	123	
Maximum:	2,078	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,977	
Mean:	2,013	
Static Data Standard Deviation:	173	
Maximum:	2,333	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,909	
Mean:	1,926	
Static Data Standard Deviation:	124	
Maximum:	2,106	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design which would result in a larger relative shift value. Since both values are in excess of 3 the difference in the variability does not affect the power of the survey. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,891	
Mean:	1,869	
Static Data Standard Deviation:	124	
Maximum:	2,078	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was lower than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,899	
Mean:	2,011	
Static Data Standard Deviation:	383	
Maximum:	3,318	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,023	
Mean:	2,045	
Static Data Standard Deviation:	127	
Maximum:	2,288	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{emc}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,922	
Mean:	1,956	
Static Data Standard Deviation:	186	
Maximum:	2,295	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,038	
Mean:	2,012	
Static Data Standard Deviation:	135	
Maximum:	2,250	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{emc}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,985	
Mean:	2,008	
Static Data Standard Deviation:	161	
Maximum:	2,333	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, none of the survey results exceeded 10% of the DCGL. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	1,938	
Mean:	1,901	
Static Data Standard Deviation:	170	
Maximum:	2,154	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_w$:	Pass	
Median value <$DCGL_w$:	Pass	
Mean value <$DCGL_w$:	Pass	
Maximum value <$DCGL_{emc}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,083	
Mean:	2,035	
Static Data Standard Deviation:	180	
Maximum:	2,326	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,091	
Mean:	2,088	
Static Data Standard Deviation:	118	
Maximum:	2,409	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{emc}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,078	
Mean:	2,104	
Static Data Standard Deviation:	175	
Maximum:	2,380	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the scoping evaluation. The required number of direct measurements was made and the scan

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,174	
Mean:	2,197	
Static Data Standard Deviation:	237	
Maximum:	2,644	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	NA	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the results of the scoping survey. The required number of direct measurements was made and

A revision was made to each of the following Final Status Survey Reports (FSSR) in the ALARA Statement section. Please replace original **page 5** of the FSSR with the rev1 of **page 5** provided for the following FSSR:

- F8300133

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the results of the investigation survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

It is concluded that survey unit F8300133 meets the release criteria of 10CFR20.1402.

ATTACHMENT 3

A revision was made to each of the following Final Status Survey Reports (FSSR) in the Survey Unit Description, Site Characterization section and ALARA Statement. Please replace the original FSSRs listed below with the rev 1 FSSR provided in its entirety for the following FSSRs:

- F8300023
- F8300031
- F8300042
- F8300053
- F8300061
- F8300062
- F8300071
- F8300082
- F8300103*
- F8300111
- F8300123
- F8300141
- F8300142
- F8300143

*Minor editorial, non-technical corrections to survey unit name/identification on cover page and/or multiple pages of header and/or footer were made. Please replace the original FSSR in its entirety with the rev1 FSSR.

Rancho Seco

Final Status Survey Summary Report

December 28, 2016

IOSB DAW Staging Bay rev1

Survey Unit F8300023

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/18/17

Manager, Rancho Seco Assets

Survey Unit:

F8300023, Interim Onsite Storage Building (IOSB) DAW Staging Bay

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), the IOSB contained and possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Static measurements were made of the interior surfaces of the DAW Staging Bay to confirm the absence or presence of plant-derived radionuclides. Static measurements showed a mean gross beta activity level of 2,637 dpm/100 cm^2 and a maximum value of 4,505 dpm/100 cm^2. The statistics of the DAW Staging bay results combines all lower walls, upper walls, floor, and ceiling data. Based upon the scanning results two elevated areas were identified on the floor.

One of the areas exceeded the $DCGL_W$ but not the $DCGL_{EMC}$. This elevated measurement was acquired at a location on the staging bay floor adjacent to an expansion joint in the concrete. Investigatory measurements across the expansion joint revealed activity in excess of the $DCGL_W$. It was apparent that contamination had penetrated the the joint and an accurate measurement could not be made due to surface geometry considerations. Remediation was required for this area and it was classified as IOSB Staging Bay Class 1 (F8300031). The maximum static measurement documented for this expansion joint is 17,946 dpm/100 cm^2. The Staging Bay Class 1 (F8300031) Survey Unit is the subject of a separate report.

The other elevated area of the staging bay did not exceed the $DCGL_W$. In this area, only a fraction of the $DCGL_W$ was observed and therefore no remediation was required and it became a part of the IOSB Staging Bay Class 3 (F8300023) and is the subject of this report.

The IOSB Staging Bay Class 2 (F8300042) buffer was created around the Class 1 and is the subject of a separate report.

Survey Unit Design Information:

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were randomly determined and approximately 3% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2.**

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	DAW Staging Bay
Survey Unit:	**002**	
Class	**3**	
SU Area (m^2)	**248**	
Evaluator:	JR	
$DCGL_w$:	43,000	Gross Activity DCGL
Area Factor	N/A	Class 3
Design DCGLemc ($dpm/100cm^2$):	N/A	Class 3
$DCGL_{emc}$:	N/A	Class 3
LBGR:	21,500	Default = 50% DCGL
Sigma:	598	Scoping Survey Data
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.132	From 10/26/16 Survey
Total Area Scanned (m^2):	5.55	
Scan Coverage (%)	3%	Class 3
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	35.9	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	

Survey Results:

A total of 15 direct measurements were made in F8300023. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300023C00001	215	1,629
2	F8300023C00002	274	2,076
3	F8300023C00003	263	1,992
4	F8300023C00004	229	1,735
5	F8300023C00005	294	2,279
6	F8300023C00006	261	1,977
7	F8300023C00007	264	2,000
8	F8300023C00008	234	1,773
9	F8300023C00009	382	2,961
10	F8300023C00010	243	1,884
11	F8300023C00011	276	2,091
12	F8300023C00012	310	2,348
13	F8300023C00013	275	2,083
14	F8300023C00014	284	2,152
15	F8300023C00015	233	1,765

Table 3 contains the statistical summary of the static measurement data for the DAW Staging Bay.

Table 3, Beta Summary Statistics

Beta Static DAW Staging Bay	
Mean	2,050
Median	2,000
Standard Deviation	323
Minimum	1,629
Maximum	2,961
Count	15

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,000	
Mean:	2,050	
Static Data Standard Deviation:	323	
Maximum:	2,961	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

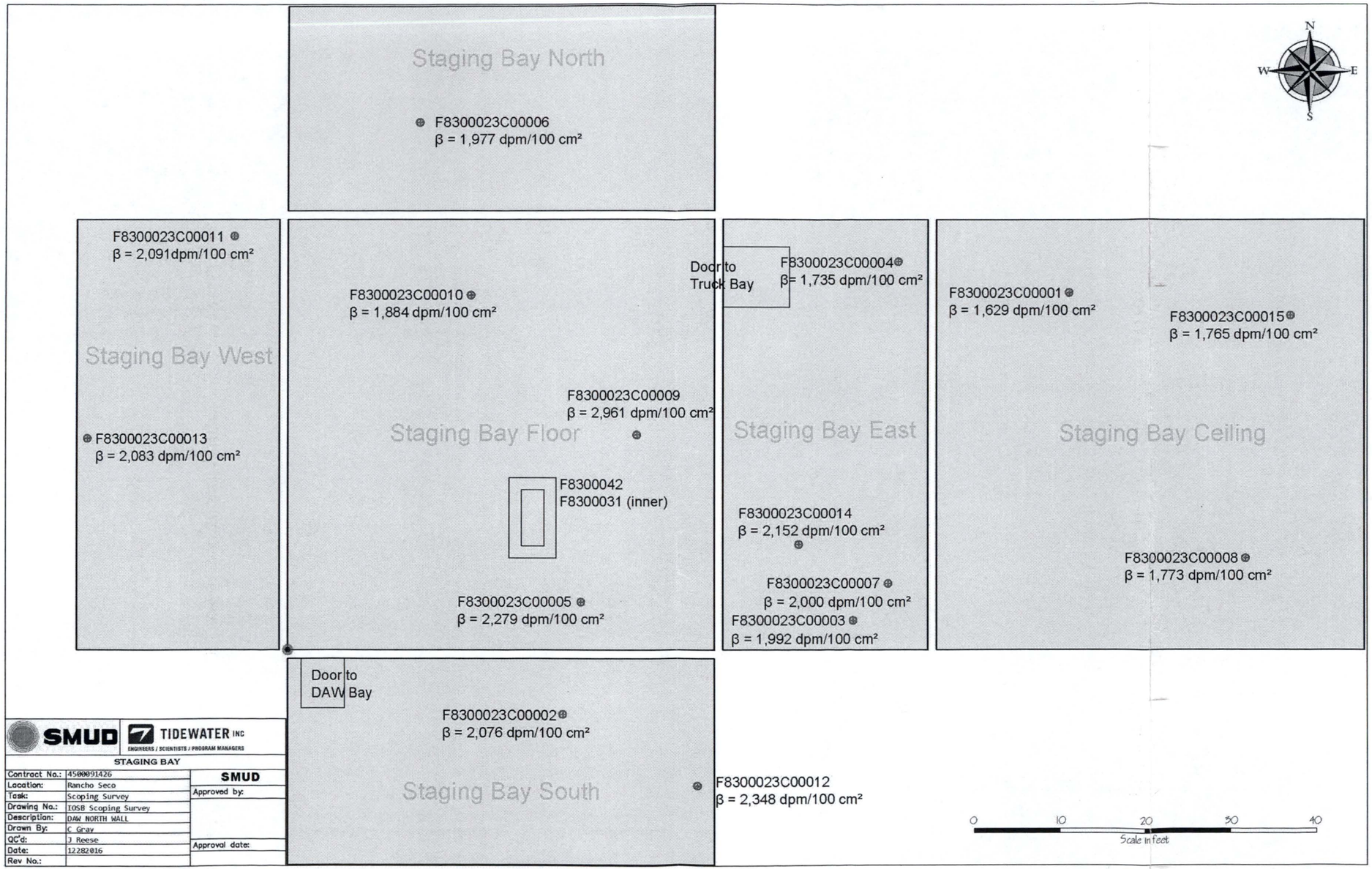
It is concluded that survey unit F8300023 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

December 28, 2016

Survey Unit F8300023


Staging Bay North
F8300023C00006
β = 1,977 dpm/100 cm²
N
W
E
S
F8300023C00011
β = 2,091dpm/100 cm²
Staging Bay West
F8300023C00013
β = 2,083 dpm/100 cm²
F8300023C00010
β = 1,884 dpm/100 cm²
Door to
Truck Bay
F8300023C00004
β = 1,735 dpm/100 cm²
F8300023C00009
β = 2,961 dpm/100 cm²
Staging Bay Floor
F8300042
F8300031 (inner)
F8300023C00005
β = 2,279 dpm/100 cm²
Staging Bay East
F8300023C00014
β = 2,152 dpm/100 cm²
F8300023C00007
β = 2,000 dpm/100 cm²
F8300023C00003
β = 1,992 dpm/100 cm²
F8300023C00001
β = 1,629 dpm/100 cm²
F8300023C00015
β = 1,765 dpm/100 cm²
Staging Bay Ceiling
F8300023C00008
β = 1,773 dpm/100 cm²
Door to
DAW Bay
F8300023C00002
β = 2,076 dpm/100 cm²
Staging Bay South
F8300023C00012
β = 2,348 dpm/100 cm²
0
10
20
30
40
Scale in feet
SMUD
TIDEWATER INC
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS
STAGING BAY
Contract No.: 4500091426
Location: Rancho Seco
Task: Scoping Survey
Drawing No.: IOSB Scoping Survey
Description: DAW NORTH WALL
Drawn By: C Gray
QC'd: J Reese
Date: 12282016
Rev No.:
SMUD
Approved by:
Approval date:

Attachment 2

Instrumentation

December 28, 2016

Survey Unit F8300023

Attachment 3

Investigation

December 28, 2016

Survey Unit F8300023

(none required)

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 492 dpm/100 cm^2	12.9%	317899/331973 2/10/17
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 559 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 73 dpm/100 cm^2 Beta – 75 dpm/100 cm^2	43.4%	182597/188736 5/13/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Variables

Beta	Survey Type
PR331973	Detector Number
169	Background count rate (cpm)
1	Count Time (min)
0.129	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * A/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 492 dpm/100 cm^2

Static Measurement MDA

Variables

Beta	Survey Type
PR331972	Detector Number
232	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $= 3 + 4.65(B_r * t)^{0.5}/t * E * A/100$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

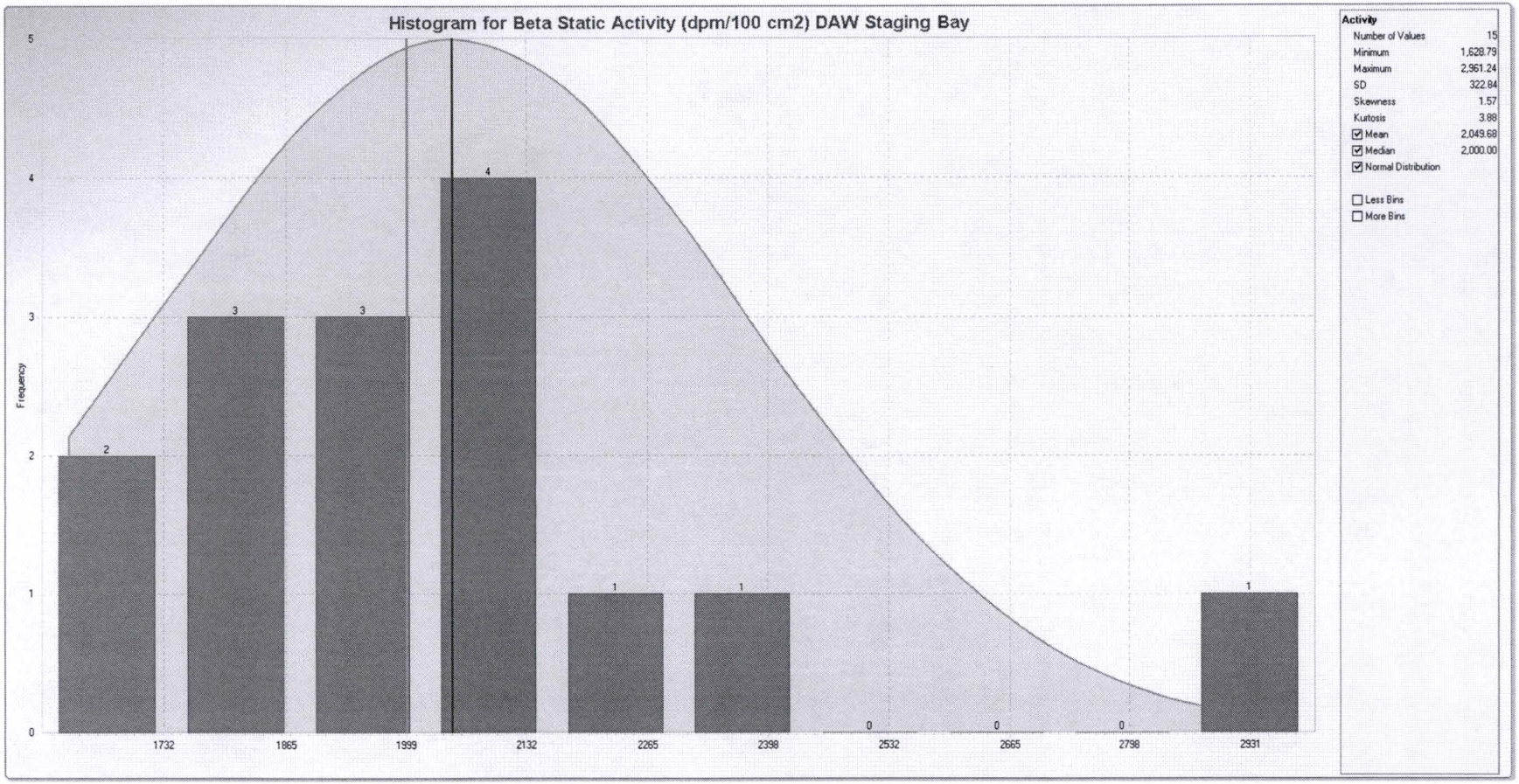
Static MDA 559 dpm/100 cm^2

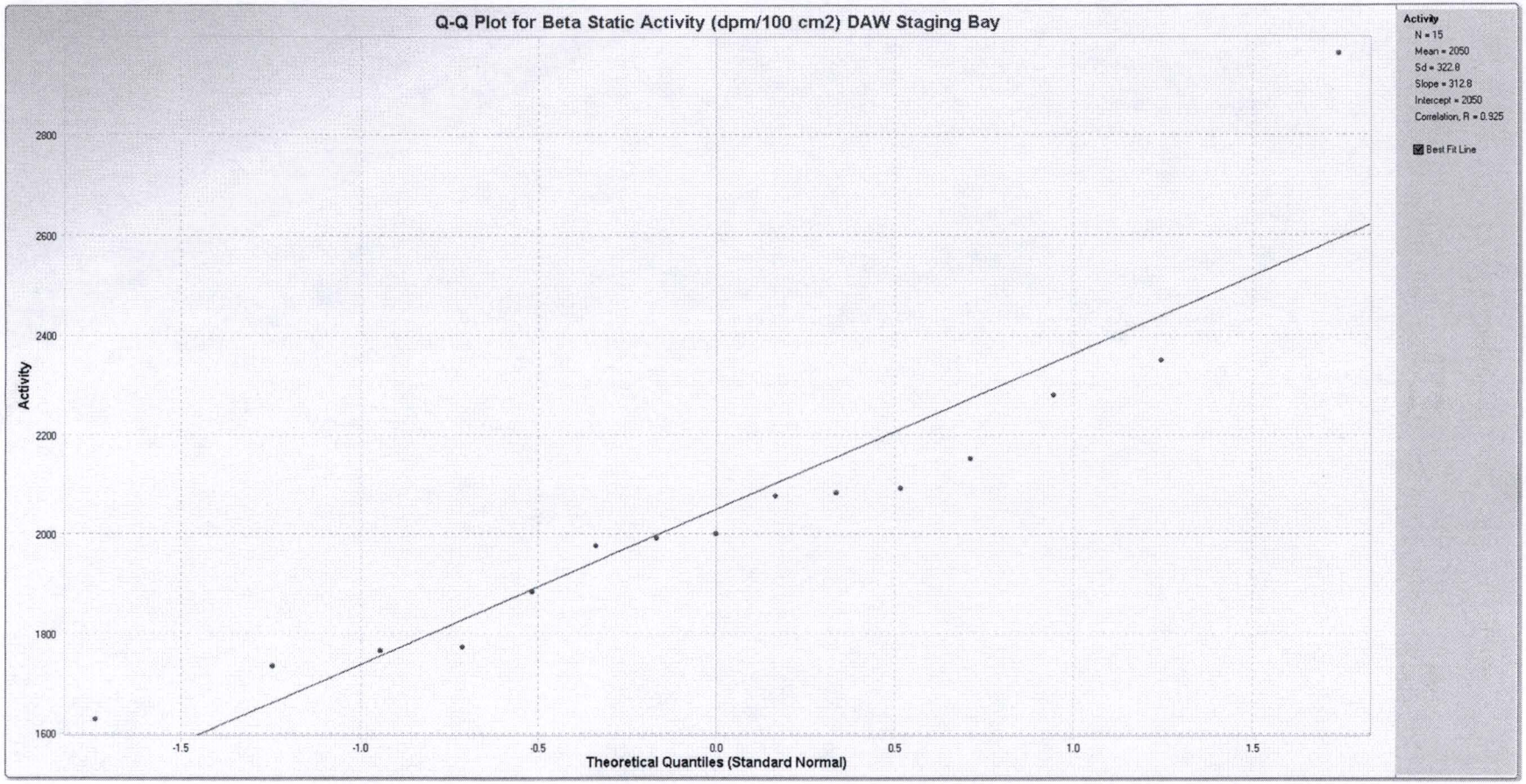
Attachment 4

Data Assessment

December 28, 2016

Survey Unit F8300023


Histogram for Beta Static Activity (dpm/100 cm2) DAW Staging Bay
Frequency
0
1
2
3
4
5
2
3
3
4
1
1
0
0
0
1
1732
1865
1999
2132
2265
2398
2532
2665
2798
2931
Activity
Number of Values 15
Minimum 1,628.79
Maximum 2,961.24
SD 322.84
Skewness 1.57
Kurtosis 3.88
Mean 2,049.68
Median 2,000.00
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100 cm2) DAW Staging Bay
Activity
2800
2600
2400
2200
2000
1800
1600
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity
N = 15
Mean = 2050
Sd = 322.8
Slope = 312.8
Intercept = 2050
Correlation, R = 0.925
Best Fit Line

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	F830	002	3	C	00001	SM	Stage Bay	50	17	10/26/16	1300	
2	F830	002	3	C	00002	SM	Stage Bay	44	3	10/26/16	1301	
3	F830	002	3	C	00003	SM	Stage Bay	38	-11	10/26/16	1302	
4	F830	002	3	C	00004	SM	Stage Bay	51	19	10/26/16	1304	
5	F830	002	3	C	00005	SM	Stage Bay	34	-20	12/12/16	0947	
6	F830	002	3	C	00006	SM	Stage Bay	45	5	10/26/16	1305	
7	F830	002	3	C	00007	SM	Stage Bay	52	21	10/26/16	1306	
8	F830	002	3	C	00008	SM	Stage Bay	53	24	10/26/16	1307	
9	F830	002	3	C	00009	SM	Stage Bay	46	8	12/12/16	0948	
10	F830	002	3	C	00010	SM	Stage Bay	40	-6	12/12/16	0950	
11	F830	002	3	C	00011	SM	Stage Bay	50	17	10/26/16	1309	
12	F830	002	3	C	00012	SM	Stage Bay	37	-13	10/26/16	1310	
13	F830	002	3	C	00013	SM	Stage Bay	41	-4	10/26/16	1311	
14	F830	002	3	C	00014	SM	Stage Bay	54	26	10/26/16	1312	
15	F830	002	3	C	00015	SM	Stage Bay	40	-6	10/26/16	1314	

Comments: By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date: Joe Kay 12-12-16

Tech B Sign/ Date: [signature] 12/12/16

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597

43-10-1 S/N: 188736

Cal Due Date: 5/13/2017

		efficiency	bkg rate	bkg count time	MDA
β 10/26/16	0.434	44.5 cpm	1 min	74.5 dpm per area	
β 12/12/16	0.434	42.7 cpm	1 min	73.0 dpm per area	

Rancho Seco

Final Status Survey Summary Report

January 5, 2017

IOSB DAW Staging Bay Class 1 rev1

Survey Unit F8300031

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/19/17

Manager, Rancho Seco Assets

Survey Unit:

F8300031, Interim Onsite Storage Building (IOSB) DAW Staging Bay Class 1

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), the IOSB contained and possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Static measurements were made of the interior surfaces of the DAW Staging Bay to confirm the absence or presence of plant-derived radionuclides. Static measurements showed a mean gross beta activity level of 2,637 dpm/100 cm^2 and a maximum value of 4,505 dpm/100 cm^2. The statistics of the DAW Staging bay results combines all lower walls, upper walls, floor, and ceiling data. Based upon the scanning results two elevated areas were identified on the floor.

One of the areas exceeded the $DCGL_w$ but not the $DCGL_{EMC}$. This elevated measurement was acquired at a location on the staging bay floor adjacent to an expansion joint in the concrete. Investigatory measurements across the expansion joint revealed activity in excess of the $DCGL_w$. It was apparent that contamination had penetrated the the joint and an accurate measurement could not be made due to surface geometry considerations. Remediation was required for this area and it was classified as IOSB Staging Bay Class 1 (F8300031). The maximum static measurement documented for this expansion joint is 17,946 dpm/100 cm^2. IOSB Staging Bay Class 1 (F8300031) is the subject of this report.

The other elevated area did not exceed the $DCGL_w$. In this area, only a fraction of the $DCGL_w$ was observed and therefore no remediation was required and it was incorporated into the IOSB Staging Bay Class 3 (F8300023) and is the subject of a separate report.

The IOSB Staging Bay Class 2 (F8300042) was created to buffer the IOSB Staging Bay Class 3 (F8300023) area and each is the subject of a separate report.

Survey Unit Design Information:

In accordance with MARSSIM Section 4.6, special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is unnecessarily large and not appropriate for smaller survey unit areas. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs. This survey unit meets this criterion as the size is less than one square meter (0.74 m^2).

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were based on professional judgement in accordance with the LTP and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	DAW Staging Bay Class 1
Survey Unit:	**03**	
Class	**01**	
SU Area (m^2)	**01**	
Evaluator:	JR	
$DCGL_w$:	43,000	Gross Activity DCGL
Area Factor	15	DTBD-05-003
Design DCGLemc (dpm/100cm^2):	640,700	
$DCGL_{emc}$:	640,700	
LBGR:	21,500	Default = 50% DCGL
Sigma:	598	Scoping Survey Data
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.132	From 10/26/16 Survey
Total Area Scanned (m^2):	0.74	
Scan Coverage (%)	100%	Class 1
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	35.9	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	5	Values selected based upon Judgement
N-Value+20%:	5	Values selected based upon Judgement

Survey Results:

A total of 5 direct measurements were made in F8300031. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300031C00001	288	2,233
2	F8300031C00002	304	2,357
3	F8300031C00003	305	2,364
4	F8300031C00004	282	2,186
5	F8300031C00005	509	3,946

Table 3 contains the statistical summary of the static measurement data for the DAW Staging Bay Class 1.

Table 3, Beta Summary Statistics

Beta Static DAW Staging Bay Class 1	
Mean	2,617
Median	2,357
Standard Deviation	747
Minimum	2,186
Maximum	3,946
Count	5

Survey Unit Data Assessment:

The survey design required 5 static measurements based upon the size of the survey unit (0.74 m^2). Following the guidance in MARSSIM Section 4.6, these values are compared directly to the $DCGL_w$. The data collected from location F8300031C00005 while less than 10% of the $DCGL_w$ was collected over a crevice. In order to evaluate the effect of the crevice on the resulting data, the guidance contained in Section 6.2 of DTBD 06-006 was followed and a follow up evaluation was performed using a gamma sensitive sodium iodide detector (Ludlum model 44-10). The results of the investigation confirmed no levels of residual radioactivity in excess of the DCGL. **Attachment 3** contains the results of the investigation.

The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	5	
Median:	2,357	
Mean:	2,617	
Static Data Standard Deviation:	747	
Maximum:	3,946	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	Pass	
Sign test results:	N/A	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

An investigation was required for follow up to direct beta measurement F8300031C00005 to evaluate response in relation to a crevice. The results are contained in Attachment 3.

ALARA Statement:

Residual radioactivity following remediation is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 1 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, no individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 1 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. Investigation, performed per Attachment 3 results were less than the DCGL.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

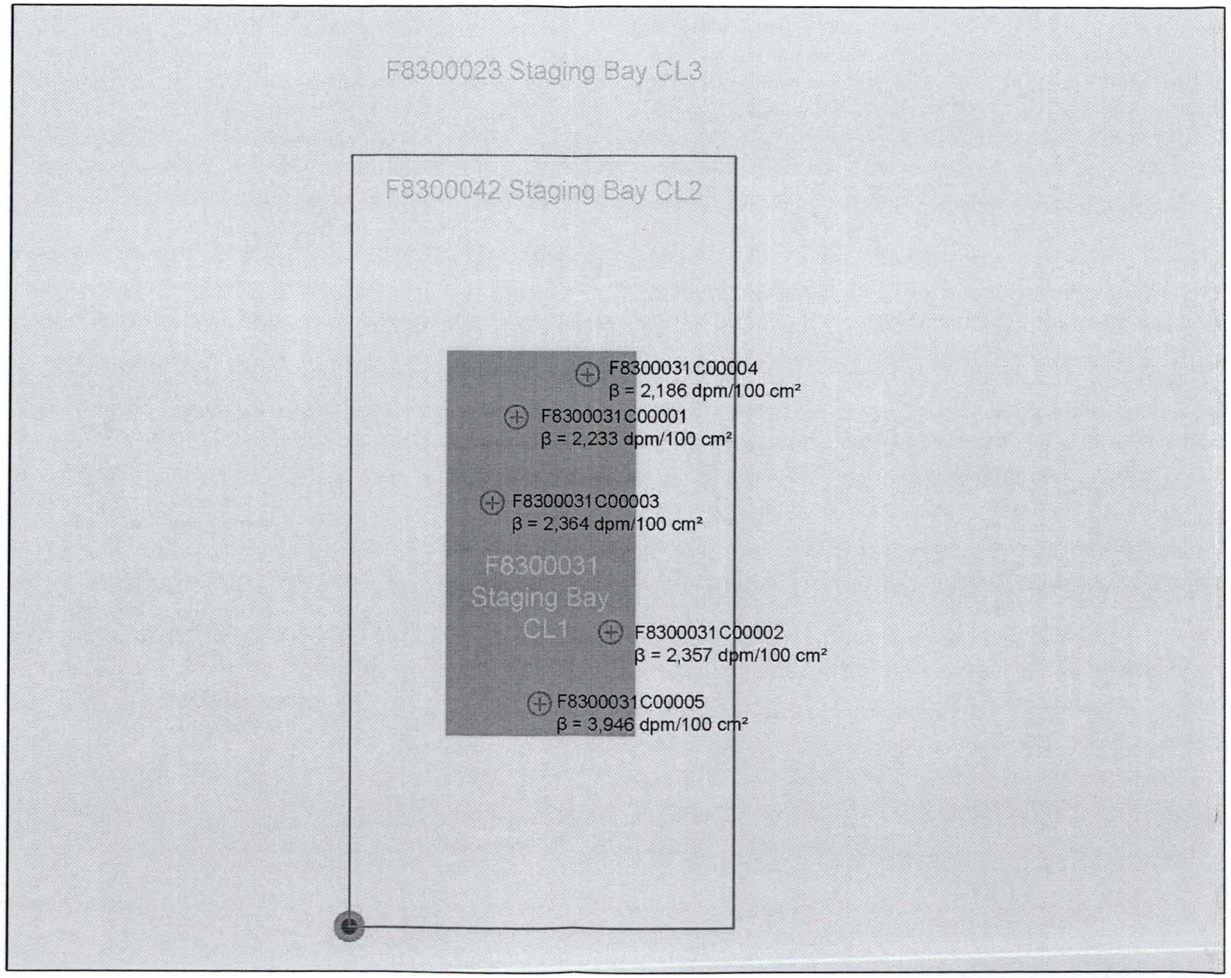
It is concluded that survey unit F8300031 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 6, 2017

Survey Unit F8300031



SMUD | TIDEWATER INC
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

STAGING BAY CLASS

Contract No.:	450089426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Scoping Survey	
Drawing No.:	IOSB Scoping Survey	
Description:	Staging bay	
Drawn By:	C Gray	
QC'd:	J Reese	Approval date:
Date:	01062017	
Rev No.:		

Attachment 2

Instrumentation

January 5, 2017

Survey Unit F8300031

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 454 dpm/100 cm^2	12.9%	317899/331973 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 78 dpm/100 cm^2	43.4%	182597/188736 5/13/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331973	Detector Number
143	Background count rate (cpm)
1	Count Time (min)
0.129	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * {}^{A}/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 454 dpm/100 cm^2

Attachment 3

Investigation

January 5, 2017

Survey Unit F8300031

Final Status Survey Data Investigation/Evaluation

FSS Package No.	X8300031	Date:	11-29-2016
Location/Description:	F8300031 IOSB Stage Bay CLASS 1 post remediation		

Instrumentation Involved: (include serial numbers) N/A

Data Investigation:

REASON:

During execution of F8300031, an elevated static (BD- beta direct) measurement above a floor crevice in the IOSB Staging Bay CLASS 1 resulted at location F8300031C00005.

These instructions will provide the data necessary to properly evaluate this elevated measurement location.

SURVEY INSTRUCTIONS:

Using a calibrated 2350-1 and 44-10 (2"x2" sodium iodide) detector, obtain a one minute gamma direct (GD) measurement in the same location (F8300031C00005) as the elevated beta direct measurement obtained in the execution of package F8300031.

Data Evaluation and Investigation Resolution:

1. Log the results of the GD measurement below along with instrument and detector serial number, calibration due date and the 2350-1 download file name.
2. Sign and date performance of the survey.

REFERENCE: Per section 6.2 of DTBD-06-006 elevated measurements will be investigated with 44-10 detector, collimated to a 20,000 cpm criterion.

EJG 11.29.16

INVESTIGATION LOCATION ID F830003C00005

RESULTS: 9640 gross counts. 9120 bkg counts. 20161129_133100 download file name

2350-1 S/N 317892 Detector S/N 208816 Cal due date ~~2/10/17~~ 12/29/16 ~~11~~ 11/29/16

PERFORMED BY:

Technician A	Date	Technician B	Date
KWhales	11/29/16	N/A	N/A

Based on the above resolution, the survey data is determined to be:

☒ **Acceptable for use and inclusion in FSS Package**

☐ **Not Acceptable for use**

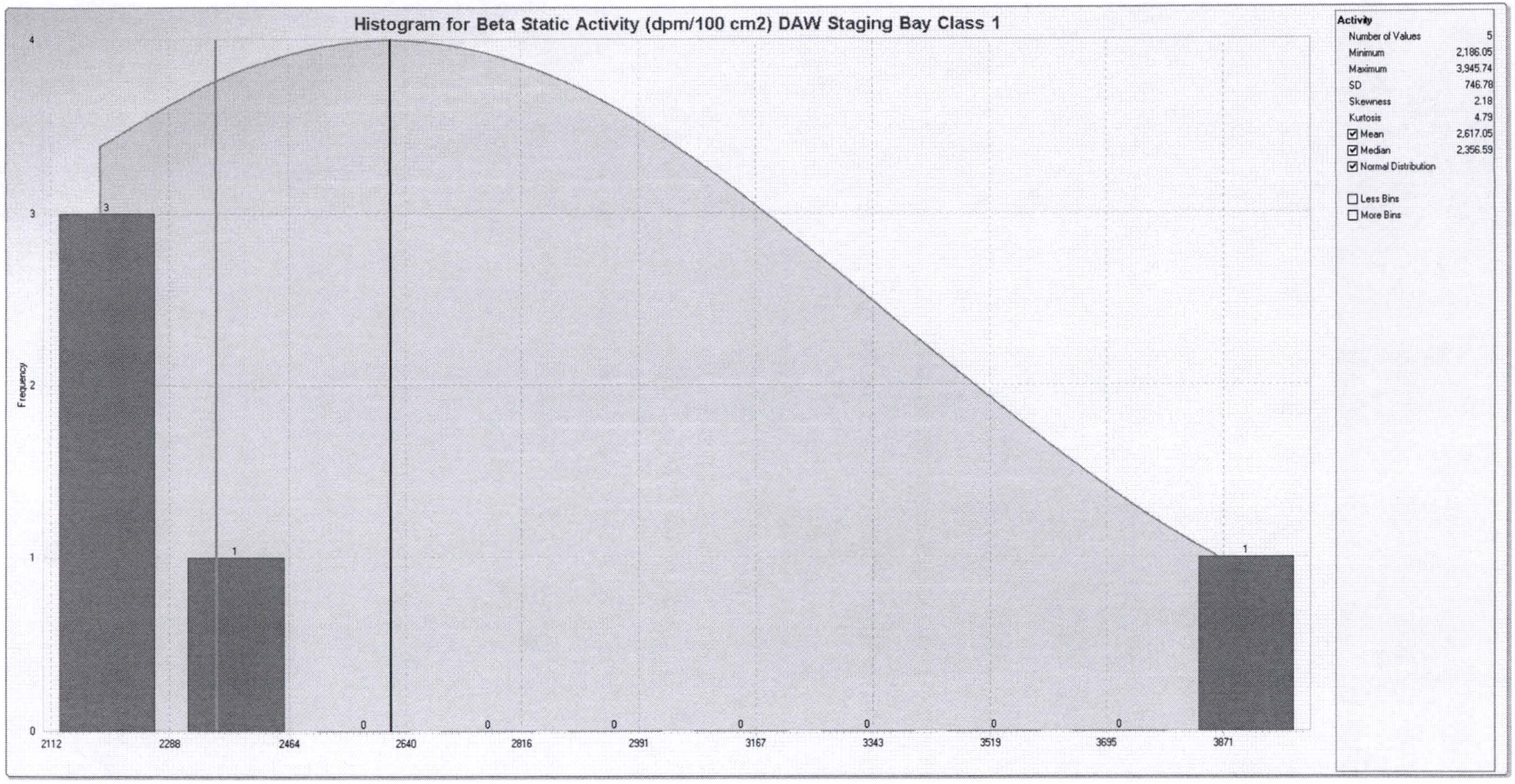
Prepared by:	FSSE	Date	11-29-2016
Reviewed by:	LFSSRE	Date	11-29-2016

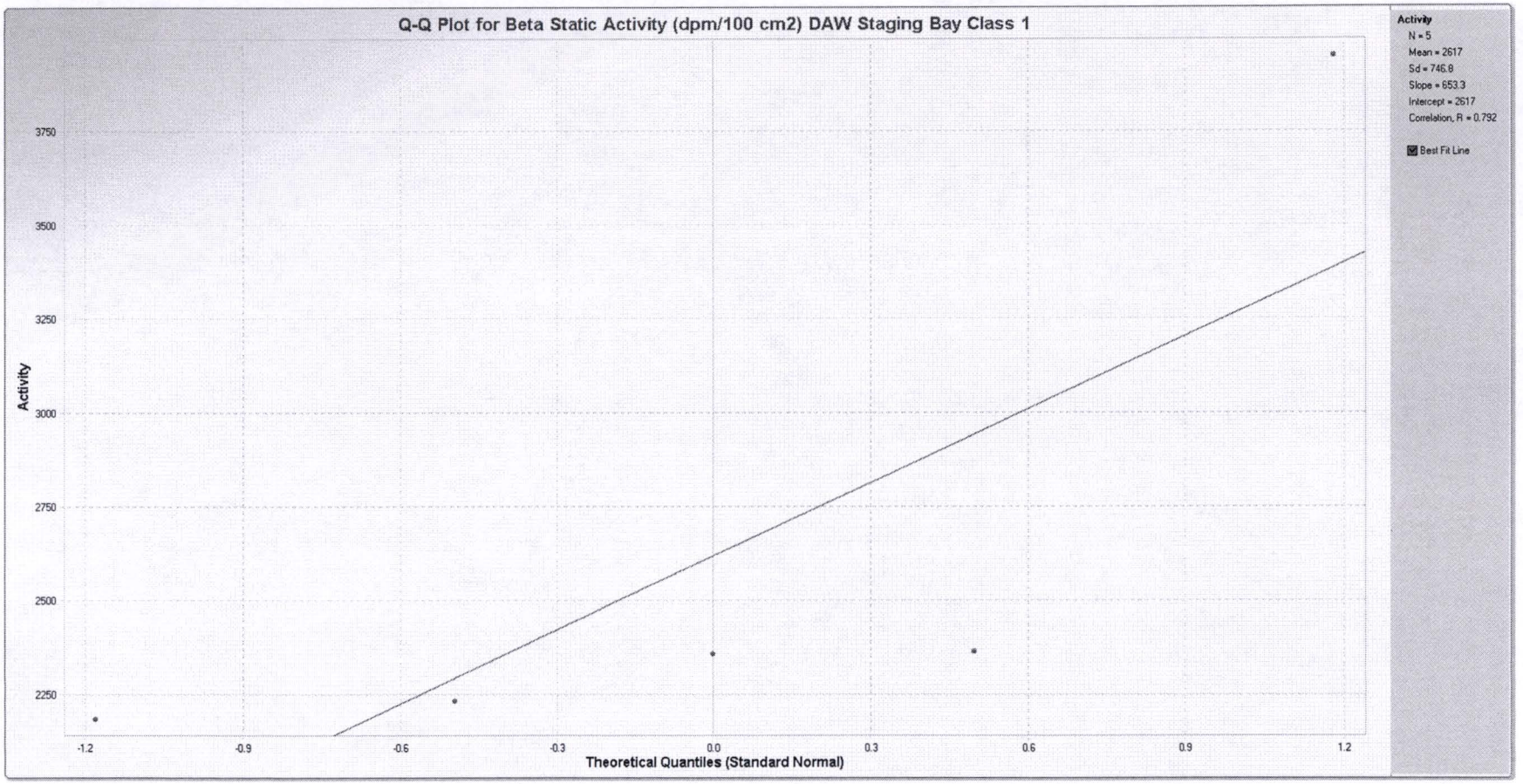
Attachment 4

Data Assessment

January 5, 2017

Survey Unit F8300031


Histogram for Beta Static Activity (dpm/100 cm2) DAW Staging Bay Class 1
Frequency
0
1
2
3
4
3
1
0
0
0
0
0
0
0
1
2112
2288
2464
2640
2816
2991
3167
3343
3519
3695
3871
Activity
Number of Values 5
Minimum 2,186.05
Maximum 3,945.74
SD 746.78
Skewness 2.18
Kurtosis 4.79
Mean 2,617.05
Median 2,356.59
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100 cm2) DAW Staging Bay Class 1
Activity
N = 5
Mean = 2617
Sd = 746.8
Slope = 653.3
Intercept = 2617
Correlation, R = 0.792
Best Fit Line
Activity
3750
3500
3250
3000
2750
2500
2250
-1.2
-0.9
-0.6
-0.3
0.0
0.3
0.6
0.9
1.2
Theoretical Quantiles (Standard Normal)

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	F830	003	1	C	00001	SM	Stage Bay Floor	48	-1	11/29/16	1109	
2	F830	003	1	C	00002	SM	Stage Bay Floor	48	-1	11/29/16	1111	
3	F830	003	1	C	00003	SM	Stage Bay Floor	51	6	11/29/16	1112	
4	F830	003	1	C	00004	SM	Stage Bay Floor	38	-24	11/29/16	1113	
5	F830	003	1	C	00005	SM	Stage Bay Floor	45	-8	11/29/16	1115	
6	F830	003	1	C	00006	SM	Stage Bay Floor					
7	F830	003	1	C	00007	SM	Stage Bay Floor					
8	F830	003	1	C	00008	SM	Stage Bay Floor					
9	F830	003	1	C	00009	SM	Stage Bay Floor					
10	F830	003	1	C	00010	SM	Stage Bay Floor					
11	F830	003	1	C	00011	SM	Stage Bay Floor					
12	F830	003	1	C	00012	SM	Stage Bay Floor					
13	F830	003	1	C	00013	SM	Stage Bay Floor					
14	F830	003	1	C	00014	SM	Stage Bay Floor					
15	F830	003	1	C	00015	SM	Stage Bay Floor					

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date Joe Norris 12-2-16

Tech B Sign/ Date N/A

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597		efficiency	bkg rate	bkg count time	MDA
43-10-1 S/N: 188736	α	0.364	cpm	min	#DIV/0! dpm per area
Cal Due Date: 5/13/2017	β	0.434	48.5 cpm	1 min	77.6 dpm per area

Rancho Seco

Final Status Survey Summary Report

January 6, 2017

IOSB DAW Staging Bay Class 2 rev1

Survey Unit F8300042

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/19/17

Manager, Rancho Seco Assets

Survey Unit:

F8300042, Interim Onsite Storage Building (IOSB) DAW Staging Bay Class 2

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), the IOSB contained and possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Static measurements were made of the interior surfaces of the DAW Staging Bay to confirm the absence or presence of plant-derived radionuclides. Static measurements showed a mean gross beta activity level of 2,637 dpm/100 cm^2 and a maximum value of 4,505 dpm/100 cm^2. The statistics of the DAW Staging bay results combines all lower walls, upper walls, floor, and ceiling data. Based upon the scanning results two elevated areas were identified on the floor.

One of the areas exceeded the $DCGL_w$ but not the $DCGL_{EMC}$. This elevated measurement was acquired at a location on the staging bay floor adjacent to an expansion joint in the concrete. Investigatory measurements across the expansion joint revealed activity in excess of the $DCGL_w$. It was apparent that contamination had penetrated the the joint and an accurate measurement could not be made due to surface geometry considerations. Remediation was required for this area and it was classified as IOSB Staging Bay Class 1 (F8300031). The maximum static measurement documented for this expansion joint is 17,946 dpm/100cm^2. Staging Bay Class 1 (F8300031) is the subject of a separate report.

The other elevated area did not exceed the $DCGL_w$. In this area, only a fraction of the $DCGL_w$ was observed and therefore no remediation was required and it became a part of the IOSB Staging Bay Class 3 (F8300023) and is also the subject of a separate report.

The IOSB Staging Bay Class 2 (F8300042) buffer was created between the Class 1 and Class 3 areas and is the subject of this report.

Survey Unit Design Information:

In accordance with MARSSIM Section 4.6, special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is unnecessarily large and not appropriate for smaller survey unit areas. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs. This survey unit meets this criterion as the size is less than ten square meters (2.22 m^2).

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were based on professional judgement in accordance with the LTP and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2.**

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	DAW Staging Bay Class 2
Survey Unit:	**004**	
Class	**2**	
SU Area (m^2)	**2**	
Evaluator:	JR	
$DCGL_w$:	43,000	Gross Activity DCGL
Area Factor	N/A	
Design DCGLemc ($dpm/100cm^2$):	N/A	
$DCGL_{emc}$:	N/A	
LBGR:	21,500	Default = 50% DCGL
Sigma:	598	Scoping Survey Data
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.132	From 10/26/16 Survey
Total Area Scanned (m^2):	2.22	
Scan Coverage (%)	100%	Class 2
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	35.9	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	10	Values selected based upon Judgement
N-Value+20%:	10	Values selected based upon Judgement

Survey Results:

A total of 10 direct measurements were made in F8300042. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300042C00001	300	2,326
2	F8300042C00002	300	2,326
3	F8300042C00003	280	2,171
4	F8300042C00004	304	2,357
5	F8300042C00005	269	2,085
6	F8300042C00006	281	2,178
7	F8300042C00007	261	2,023
8	F8300042C00008	296	2,295
9	F8300042C00009	287	2,225
10	F8300042C00010	294	2,279

Table 3 contains the statistical summary of the static measurement data for the DAW Staging Bay Class 2.

Table 3, Beta Summary Statistics

Beta Static DAW Staging Bay Class 2	
Mean	2,226
Median	2,252
Standard Deviation	111
Minimum	2,023
Maximum	2,357
Count	10

Survey Unit Data Assessment:

The survey design required 10 static measurements based upon the size of the survey unit (2.22 m^2). Following the guidance in MARSSIM Section 4.6, these values are compared directly to the $DCGL_W$. The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	10	
Median:	2,252	
Mean:	2,226	
Static Data Standard Deviation:	111	
Maximum:	2,357	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	Pass	
Sign test results:	N/A	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 2 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, no individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 2 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

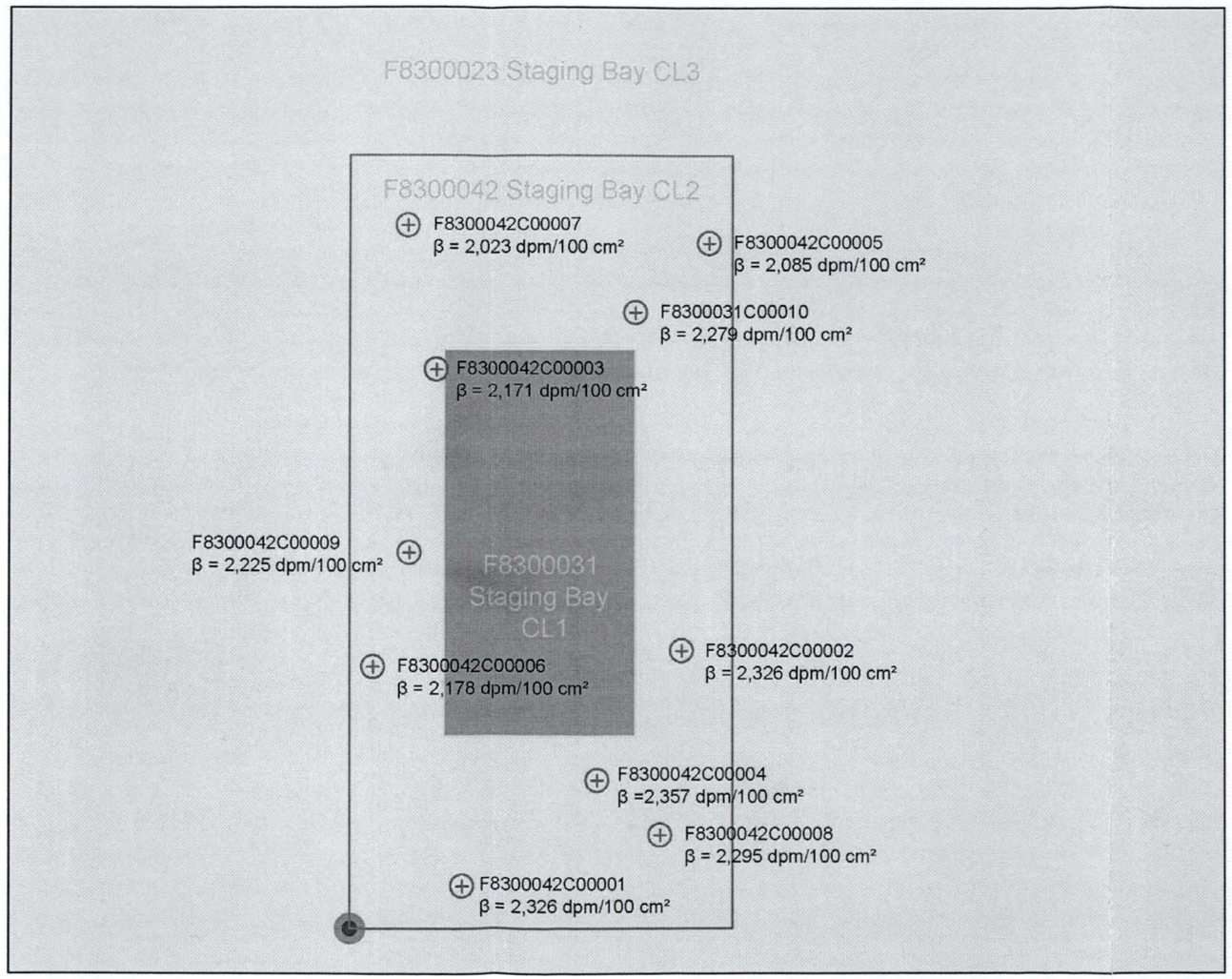
It is concluded that survey unit F8300042 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 6, 2017

Survey Unit F8300042



SMUD | TIDEWATER INC
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

STAGING BAY CLASS 2

Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Scoping Survey	
Drawing No.:	IOSB Scoping Survey	
Description:	Staging bay	
Drawn By:	C Gray	
QC'd:	J Reese	Approval date:
Date:	01062017	
Rev No.:		

Attachment 2

Instrumentation

January 6, 2017

Survey Unit F8300042

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 424 dpm/100 cm^2	12.9%	317899/331973 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 78 dpm/100 cm^2	43.4%	182597/188736 5/13/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331973	Detector Number
143	Background count rate (cpm)
1	Count Time (min)
0.129	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * A/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 454 dpm/100 cm^2

Attachment 3

Investigation

January 6, 2017

Survey Unit F8300042

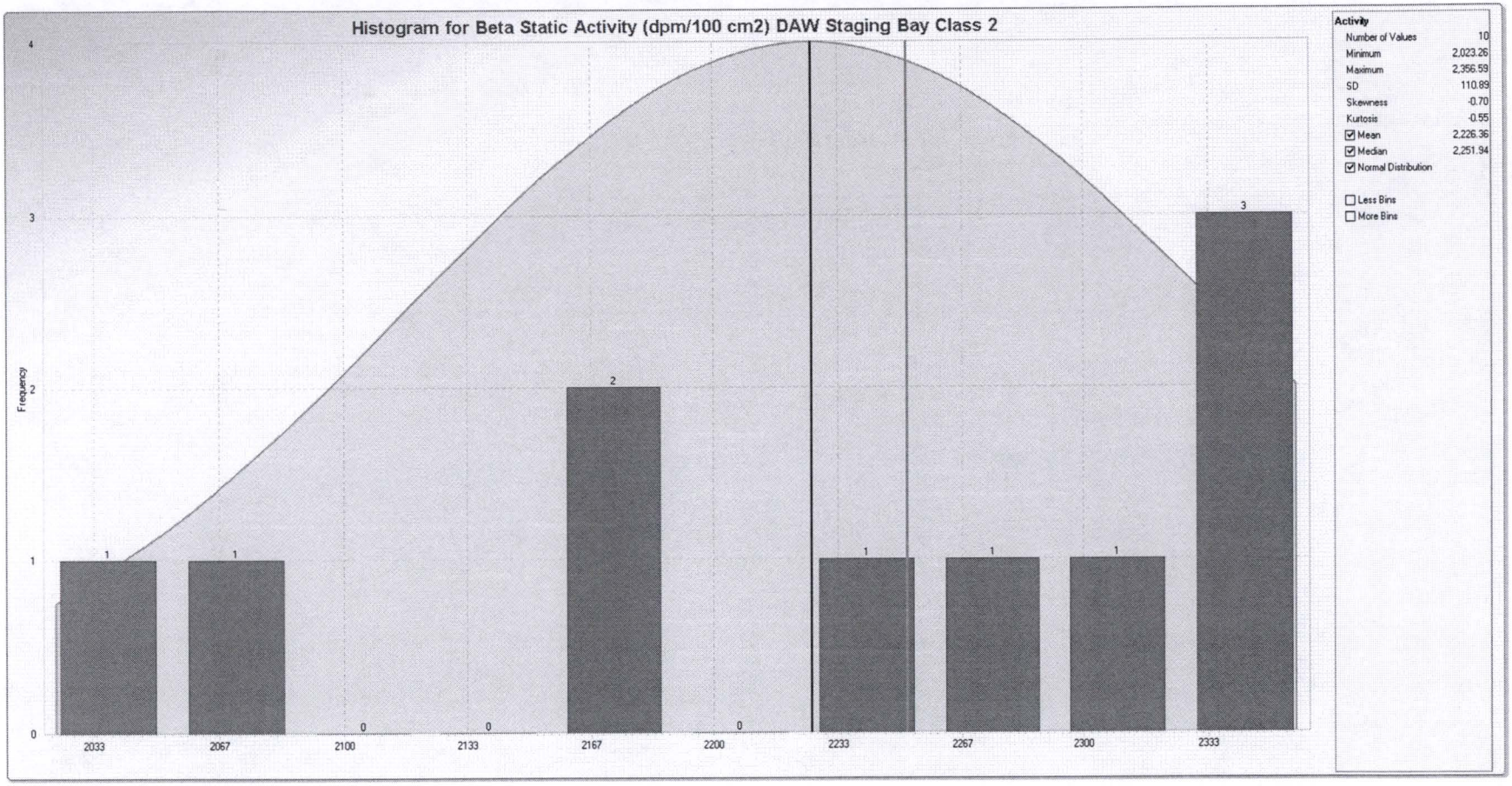
(none required)

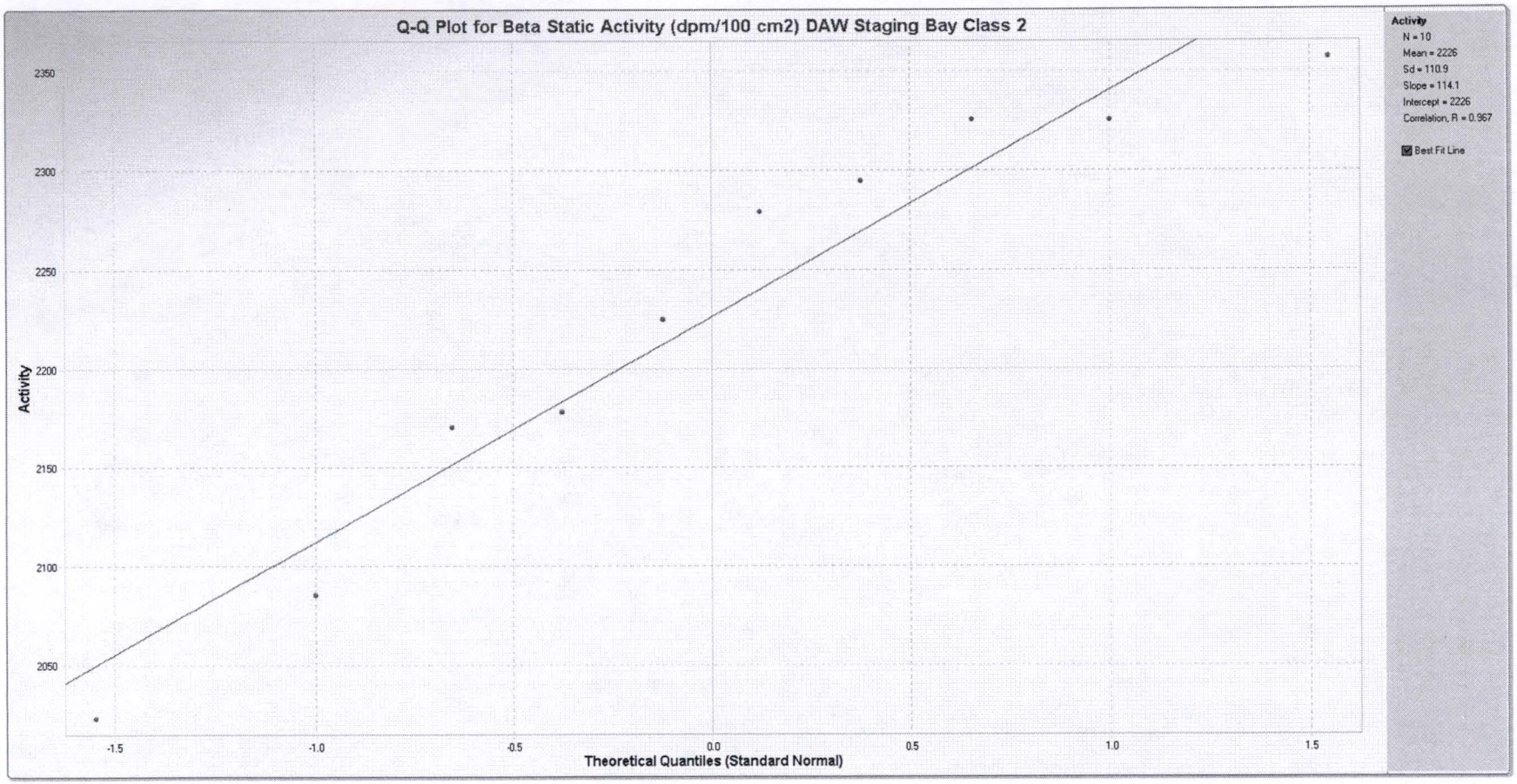
Attachment 4

Data Assessment

January 6, 2017

Survey Unit F8300042


Histogram for Beta Static Activity (dpm/100 cm2) DAW Staging Bay Class 2
Frequency
0
1
2
3
4
1
1
0
0
2
0
1
1
1
3
2033
2067
2100
2133
2167
2200
2233
2267
2300
2333
Activity
Number of Values 10
Minimum 2,023.26
Maximum 2,356.59
SD 110.89
Skewness -0.70
Kurtosis -0.55
Mean 2,226.36
Median 2,251.94
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100 cm2) DAW Staging Bay Class 2
Activity
2350
2300
2250
2200
2150
2100
2050
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity
N = 10
Mean = 2226
Sd = 110.9
Slope = 114.1
Intercept = 2226
Correlation, R = 0.967
Best Fit Line

Smear_Data_Calculation_Sheet_101316

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	F830	004	2	C	00001	SM	Stage Bay Flr Buffr	49	1	11/29/16	1056	
2	F830	004	2	C	00002	SM	Stage Bay Flr Buffr	40	-20	11/29/16	1057	
3	F830	004	2	C	00003	SM	Stage Bay Flr Buffr	45	-8	11/29/16	1058	
4	F830	004	2	C	00004	SM	Stage Bay Flr Buffr	45	-8	11/29/16	1100	
5	F830	004	2	C	00005	SM	Stage Bay Flr Buffr	42	-15	11/29/16	1101	
6	F830	004	2	C	00006	SM	Stage Bay Flr Buffr	43	-13	11/29/16	1102	
7	F830	004	2	C	00007	SM	Stage Bay Flr Buffr	45	-8	11/29/16	1104	
8	F830	004	2	C	00008	SM	Stage Bay Flr Buffr	43	-13	11/29/16	1105	
9	F830	004	2	C	00009	SM	Stage Bay Flr Buffr	51	6	11/29/16	1106	
10	F830	004	2	C	00010	SM	Stage Bay Flr Buffr	34	-33	11/29/16	1108	
11	F830	004	2	C	00011	SM	Stage Bay Flr Buffr					
12	F830	004	2	C	00012	SM	Stage Bay Flr Buffr					
13	F830	004	2	C	00013	SM	Stage Bay Flr Buffr					
14	F830	004	2	C	00014	SM	Stage Bay Flr Buffr					
15	F830	004	2	C	00015	SM	Stage Bay Flr Buffr					

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date Joe Nosis 12-2-16

Tech B Sign/ Date N/A

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597

43-10-1 S/N: 188736

Cal Due Date: 5/13/2017

	efficiency	bkg rate	bkg count time	MDA
α	0.364	cpm	min	#DIV/0! dpm per area
β	0.434	48.5 cpm	1 min	77.6 dpm per area

Rancho Seco

Final Status Survey Summary Report

February 2, 2017

IOSB Truck Bay rev1

Survey Unit F8300053

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/18/17

Manager, Rancho Seco Assets

Survey Unit:

F8300053, Interim Onsite Storage Building (IOSB) Truck Bay

Survey Unit Description:

Operating History: The Truck Bay was designed as a location for loading and unloading of transport vehicles. There was a known area of contamination near the loading dock. This area was fully characterized during the scoping surveys.

Site Characterization: Static measurements were made on the floor, walls, and ceiling, to confirm the absence or presence of plant-derived radionuclides. Static measurements showed a mean gross beta activity level of 2,374 dpm/100 cm^2 and a maximum value of 3,517 dpm/100 cm^2.

Based upon the scanning results of the Truck Bay, an elevated area was identified on the floor around and including the loading dock. Certain spots in the area exceeded the $DCGL_w$ but not the $DCGL_{EMC}$. An area of known contamination was identified at the loading dock area. This area was characterized to determine the extent and highest activity. The area of elevated activity was approximately 7.5 m^2 around the loading dock. A smaller area (less than 1.0 m^2) exceeded the $DCGL_w$ with activity detected as high as 249,491 dpm/100 cm^2. The smaller elevated area was designated as Loading Dock Class 1 (F8300071), requiring remediation and was buffered from the Truck Bay Class 3 (F8300053) with the Loading Dock Class 2 (F8300082) Survey Unit. The Loading Dock Class 1 and Class 2 Survey Units are each the subject of separate reports.

The remainder of the truck bay is a Class 3 and identified as IOSB Truck Bay (F8300053) Survey Unit and is the subject of this report.

Survey Unit Design Information:

The Survey Unit Design Parameters are presented in **Table 1**. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were randomly determined and approximately 11% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	IOSB Truck Bay
Survey Unit:	**005**	
Class	**3**	
SU Area (m^2)	**379**	
Evaluator:	JR	
$DCGL_W$:	43,000	Gross Activity DCGL
Area Factor	N/A	Class 3
Design DCGLemc ($dpm/100cm^2$):	N/A	Class 3
$DCGL_{emc}$:	N/A	Class 3
LBGR:	21,500	Default = 50% DCGL
Sigma:	466	Scoping Survey Data
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.132	
Total Area Scanned (m^2):	45.5	
Scan Coverage (%)	11%	Class 3
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	46.1	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	

Survey Results:

A total of 15 direct measurements were made in F8300053. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm/100 cm²)
1	F8300053C00001	222	1,721
2	F8300053C00002	225	1,744
3	F8300053C00003	238	1,845
4	F8300053C00004	279	2,163
5	F8300053C00005	268	2,078
6	F8300053C00006	221	1,713
7	F8300053C00007	238	1,845
8	F8300053C00008	256	1,984
9	F8300053C00009	264	2,047
10	F8300053C00010	219	1,698
11	F8300053C00011	332	2,515
12	F8300053C00012	361	2,735
13	F8300053C00013	446	3,379
14	F8300053C00014	449	3,402
15	F8300053C00015	360	2,727

Table 3 contains the statistical summary of the static measurement data for the Truck Bay.

Table 3, Beta Summary Statistics

Beta Static Truck Bay	
Mean	2,240
Median	2,047
Standard Deviation	582
Minimum	1,698
Maximum	3,402
Count	15

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL. The sample standard deviation was greater than the design standard deviation but both values of sigma resulted in a relative shift greater than three (3), no additional samples were required.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,047	
Mean:	2,240	
Static Data Standard Deviation:	582	
Maximum:	3,402	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, this did not affect the relative shift

as both were in excess of maximum amount and required adjustment to 3.0 No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

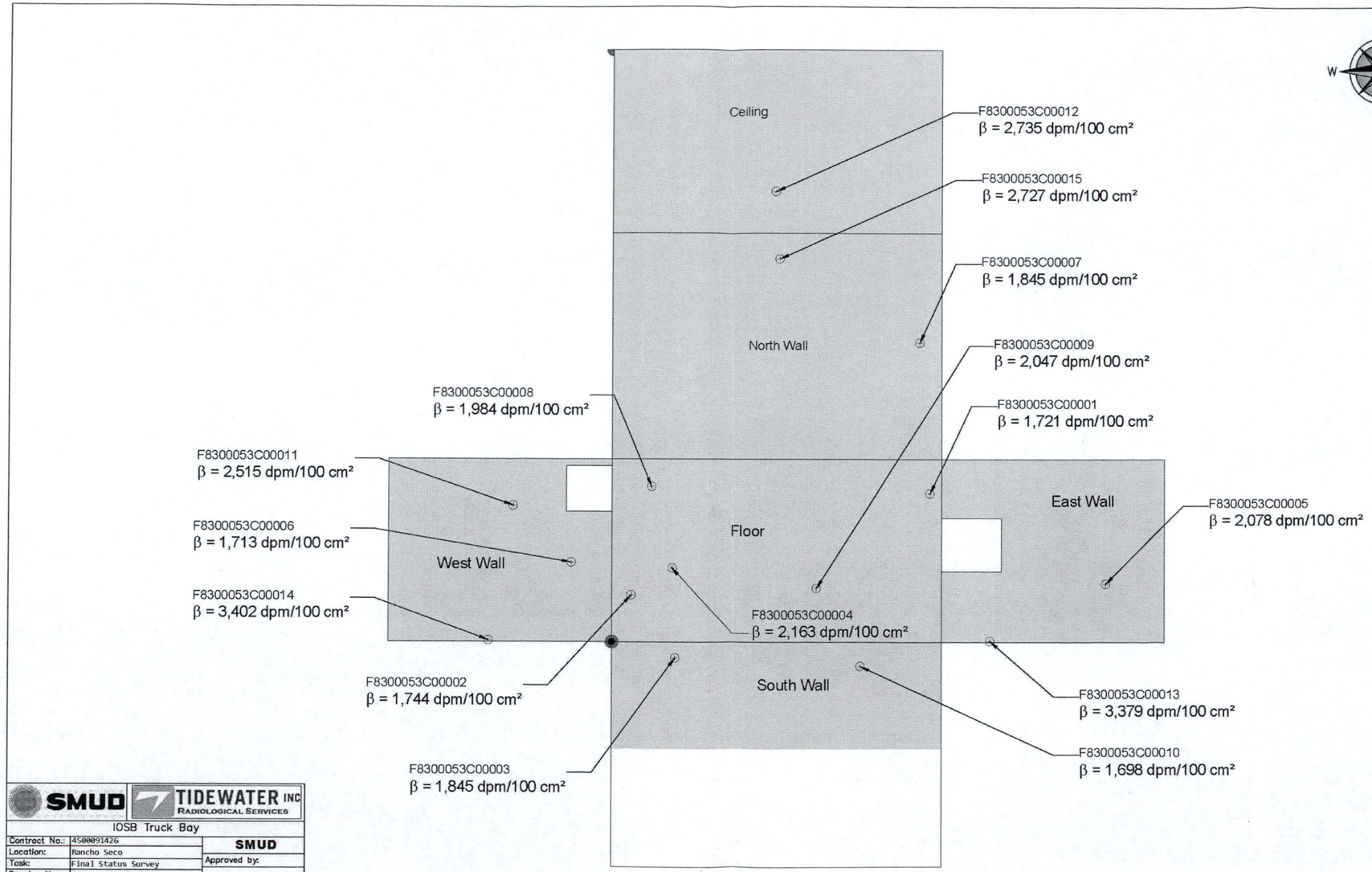
It is concluded that survey unit F8300053 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

February 2, 2017

Survey Unit F8300053



SMUD | TIDEWATER INC Radiological Services

IOSB Truck Bay

Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Final Status Survey	
Drawing No.:	NA	
Description:	Truck Bay Map Results	
Drawn By:	J Gonzales	
QC'd:	J Reese	Approval date:
Date:	02022017	
Rev No.:	2	

Attachment 2

Instrumentation

February 3, 2017

Survey Unit F8300053

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 510 dpm/100 cm^2	12.9%	317899/331973 2/10/17
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 556 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 74 dpm/100 cm^2	43.4%	182597/188736 5/13/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 77 dpm/100 cm^2	43.4%	182597/188736 5/13/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331973	Detector Number
182	Background count rate (cpm)
1	Count Time (min)
0.129	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $= 3 + 4.65(B_r * t)^{0.5}/t * E * A/100$ (NUREG 1507)

Where:

B_r	Background Countrate
t	Count Time (min)
E	Efficiency
A	Area of detector (cm^2)

Static MDA 510 dpm/100 cm^2

Beta	Survey Type
PR331972	Detector Number
229	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * {}^{A}/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 556 dpm/100 cm^2

Attachment 3

Investigation

February 2, 2017

Survey Unit F8300053

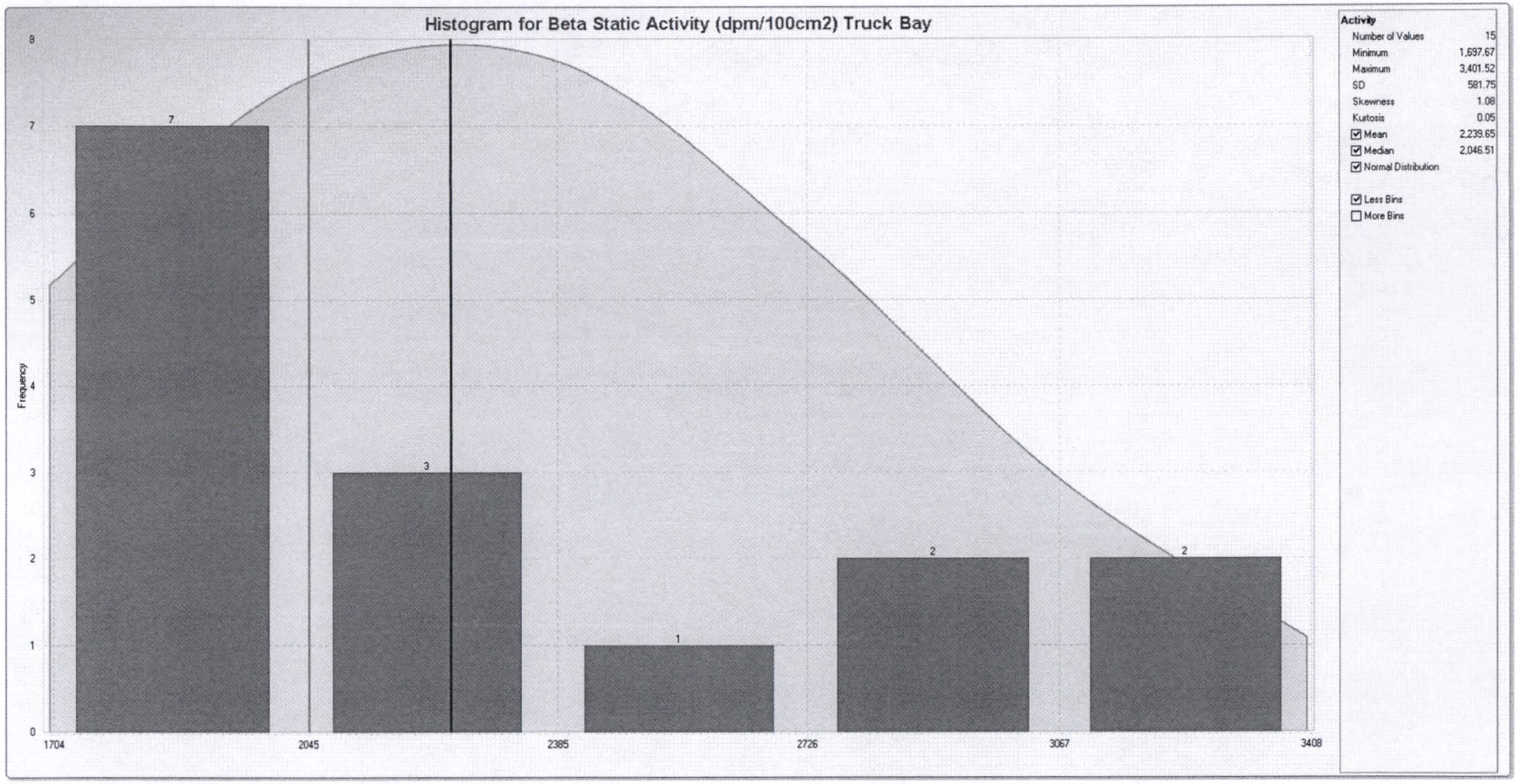
(none required)

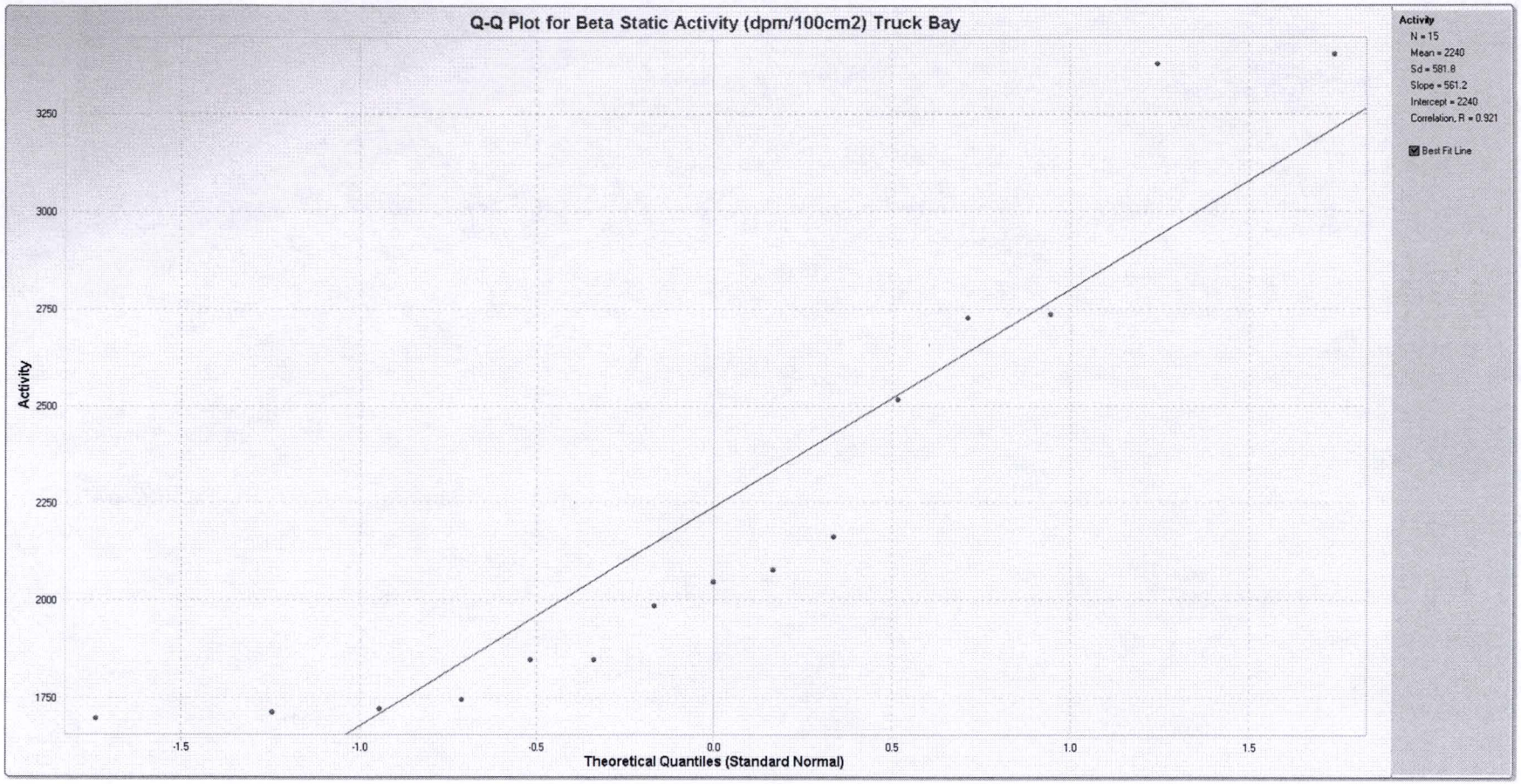
Attachment 4

Data Assessment

February 3, 2017

Survey Unit F8300053


Histogram for Beta Static Activity (dpm/100cm2) Truck Bay
Frequency
0
1
2
3
4
5
6
7
8
7
3
1
2
2
1704
2045
2385
2726
3067
3408
Activity
Number of Values 15
Minimum 1,697.67
Maximum 3,401.52
SD 581.75
Skewness 1.08
Kurtosis 0.05
Mean 2,239.65
Median 2,046.51
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100cm2) Truck Bay
Activity
3250
3000
2750
2500
2250
2000
1750
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity
N = 15
Mean = 2240
Sd = 581.8
Slope = 561.2
Intercept = 2240
Correlation, R = 0.921
Best Fit Line

Swipe Sheet truck bay

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	F830	005	3	C	00001	SM	Truck Bay	63	35	01/04/17	1419	
2	F830	005	3	C	00002	SM	Truck Bay	51	8	01/04/17	1416	
3	F830	005	3	C	00003	SM	Truck Bay	63	35	09/21/16	0846	
4	F830	005	3	C	00004	SM	Truck Bay	47	-2	01/04/17	1418	
5	F830	005	3	C	00005	SM	Truck Bay	43	-11	09/21/16	0847	
6	F830	005	3	C	00006	SM	Truck Bay	42	-13	09/21/16	0848	
7	F830	005	3	C	00007	SM	Truck Bay	39	-20	09/21/16	0849	
8	F830	005	3	C	00008	SM	Truck Bay	49	3	01/04/17	1421	
9	F830	005	3	C	00009	SM	Truck Bay	41	-15	01/04/17	1422	
10	F830	005	3	C	00010	SM	Truck Bay	50	5	09/21/16	0850	
11	F830	005	3	C	00011	SM	Truck Bay	45	-6	09/21/16	0852	
12	F830	005	3	C	00012	SM	Truck Bay	41	-15	09/21/16	0853	
13	F830	005	3	C	00013	SM	Truck Bay	52	10	09/21/16	0855	
14	F830	005	3	C	00014	SM	Truck Bay	46	-4	09/21/16	0857	
15	F830	005	3	C	00015	SM	Truck Bay	52	10	09/21/16	0858	

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

First Beta background = 1/4/17. Second Beta background = 9/21/16

Tech A Sign/ Date Tom Mott 2/3/17

Tech B Sign/ Date

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597

43-10-1 S/N: 188736

Cal Due Date: 5/13/2017

		efficiency	bkg rate	bkg count time	MDA
β	0.434		44.8 cpm	1 min	74.7 dpm per area
β	0.434		47.7 cpm	1 min	77.0 dpm per area

Page 1 of 1

Rancho Seco

Final Status Survey Summary Report

January 30, 2017

IOSB Hot Cell rev1

Survey Unit F8300061

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/19/17

Manager, Rancho Seco Assets

Survey Unit:

F8300061, Interim Onsite Storage Building (IOSB) Hot Cell

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), each storage cell possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Static measurements were made on the floor and wall surfaces, to confirm the absence or presence of plant-derived radionuclides. Static measurements showed a mean gross beta activity level of 2,880 dpm/100 cm^2 and a maximum value of 5,112 dpm/100 cm^2. Previous surveys and floor scanning indicated significant contamination in excess of the $DCGL_W$. This Hot Cell area was identified and characterized separately as a hot spot. The average static measurement in this hot spot was 390,104 dpm/100 cm^2 and a maximum value of 2,285,418 dpm/100 cm^2. The hot spot was remediated prior to performance of the FSS. Based upon the hot spot, the Hot Cell was classified as a MARSSIM Class 1 survey unit.

An adjacent Survey Unit, Hot Cell Buffer Class 2 (F8300062) was created as the buffer between the Hot Cell Class 1 (F8300061) and the remainder of the IOSB Truck Bay Class 1 (F8300053). The Hot Cell Buffer Class 2 (F8300062) Survey Unit is identified as the horizontal and vertical surfaces at the top of each of the four walls at the Hot Cell cover seating surface. The Hot Cell Buffer Class 2 (F8300062) and IOSB Truck Bay Class 3 (F8300053) Survey units each are the subject of separate reports.

Survey Unit Design Information:

In accordance with MARSSIM Section 4.6, special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is unnecessarily large and not appropriate for smaller survey unit areas. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs. This survey unit meets this criterion as the size is less than ten square meter (8 m^2).

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were based upon professional judgment in accordance with MARSSIM guidance and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Hot Cell
Survey Unit:	**006**	
Class	**1**	
SU Area (m^2)	**8**	
Evaluator:	JR	
$DCGL_w$:	43,000	Gross Activity DCGL
Area Factor	3.3	Class 1
Design DCGLemc ($dpm/100cm^2$):	141,900	Class 1
LBGR:	21,500	Default = 50% DCGL
Sigma:	740	Scoping Survey Data
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.129	
Total Area Scanned (m^2):	8	
Scan Coverage (%)	100%	Class 1
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	29.0	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	

Survey Results:

A total of 15 direct measurements were made in F8300061. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300061X00001	364	2,758
2	F8300061X00002	396	3,000
3	F8300061X00003	425	3,220
4	F8300061X00004	362	2,742
5	F8300061X00005	350	2,652
6	F8300061X00006	435	3,295
7	F8300061X00007	605	4,583
8	F8300061X00008	397	3,008
9	F8300061X00009	414	3,136
10	F8300061X00010	314	2,379
11	F8300061X00011	362	2,742
12	F8300061X00012	282	2,136
13	F8300061X00013	357	2,705
14	F8300061X00014	423	3,205
15	F8300061X00015	407	3,083

Table 3 contains the statistical summary of the static measurement data for the Hot Cell.

Table 3, Beta Summary Statistics

Beta Static Hot Cell	
Mean	2,976
Median	3,000
Standard Deviation	550
Minimum	2,136
Maximum	4,583
Count	15

Survey Unit Data Assessment:

The survey design required 15 static measurements located based upon professional judgment. Following the guidance in MARSSIM Section 4.6, these values are compared directly to the $DCGL_W$.

The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	3,000	
Mean:	2,976	
Static Data Standard Deviation:	550	
Maximum:	4,583	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{emc}$:	N/A	
Sign test results:	N/A	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

Residual radioactivity following remediation is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 1 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 1 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

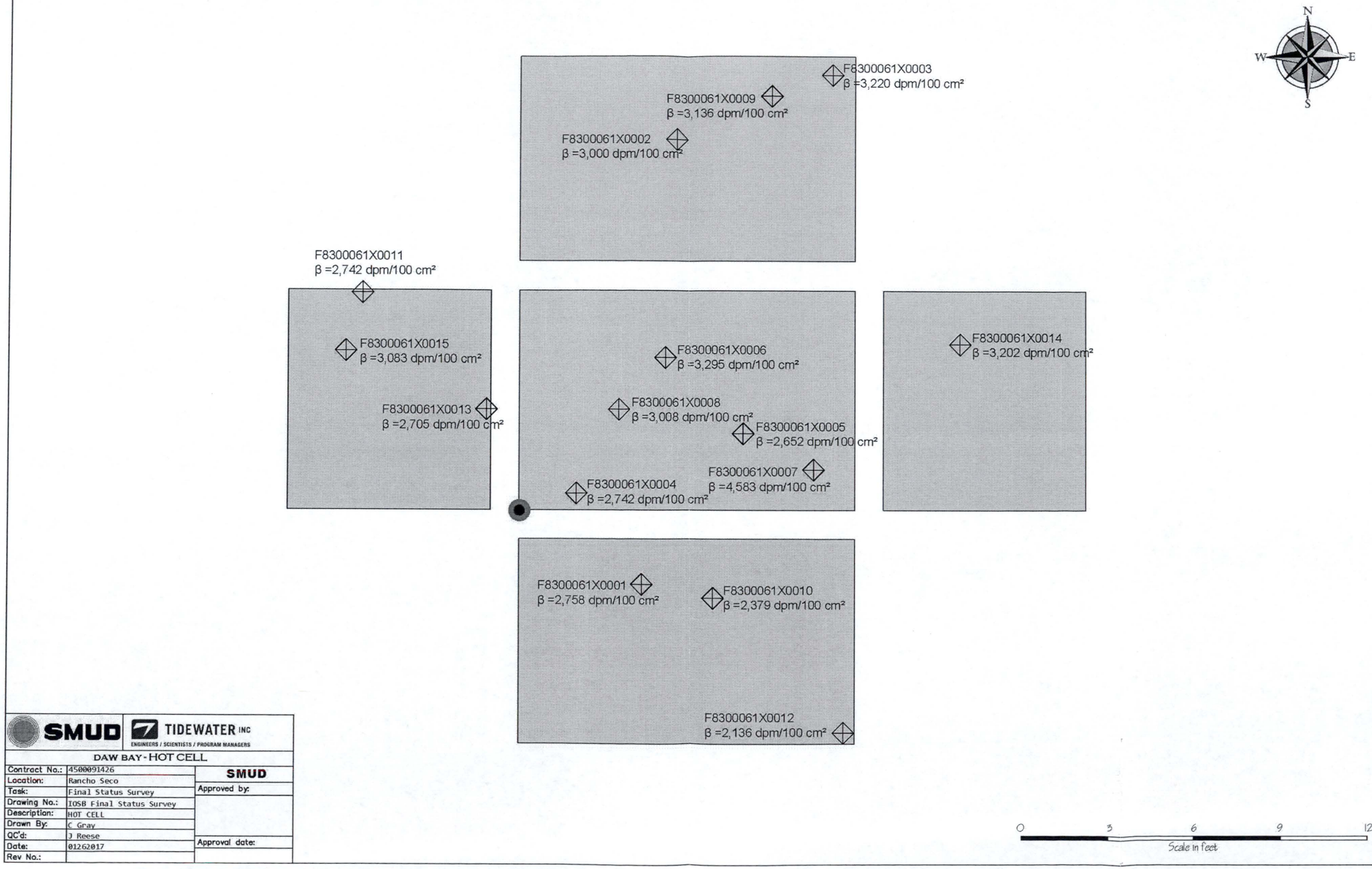
It is concluded that survey unit F8300061 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

Survey Unit F8300061


N
W
E
S
F8300061X0003
β =3,220 dpm/100 cm²
F8300061X0009
β =3,136 dpm/100 cm²
F8300061X0002
β =3,000 dpm/100 cm²
F8300061X0011
β =2,742 dpm/100 cm²
F8300061X0015
β =3,083 dpm/100 cm²
F8300061X0013
β =2,705 dpm/100 cm²
F8300061X0006
β =3,295 dpm/100 cm²
F8300061X0008
β =3,008 dpm/100 cm²
F8300061X0005
β =2,652 dpm/100 cm²
F8300061X0007
β =4,583 dpm/100 cm²
F8300061X0004
β =2,742 dpm/100 cm²
F8300061X0014
β =3,202 dpm/100 cm²
F8300061X0001
β =2,758 dpm/100 cm²
F8300061X0010
β =2,379 dpm/100 cm²
F8300061X0012
β =2,136 dpm/100 cm²
SMUD
TIDEWATER INC
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS
DAW BAY - HOT CELL
Contract No.: 4500091426
Location: Rancho Seco
Task: Final Status Survey
Drawing No.: IOSB Final Status Survey
Description: HOT CELL
Drawn By: C Gray
QC'd: J Reese
Date: 01262017
Rev No.:
SMUD
Approved by:
Approval date:
0 3 6 9 12
Scale in feet

Attachment 2

Instrumentation

January 25, 2017

Survey Unit F83000061

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 466 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 74.5 dpm/100 cm^2	43.4%	182597/188736 5/13/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
158	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $= 3 + 4.65(B_r * t)^{0.5}/t * E * A/_{100}$ (NUREG 1507)

Where:

B_r	Background Countrate
t	Count Time (min)
E	Efficiency
A	Area of detector (cm^2)

Static MDA 466 dpm/100 cm^2

Attachment 3

Investigation

January 30, 2017

Survey Unit F8300061

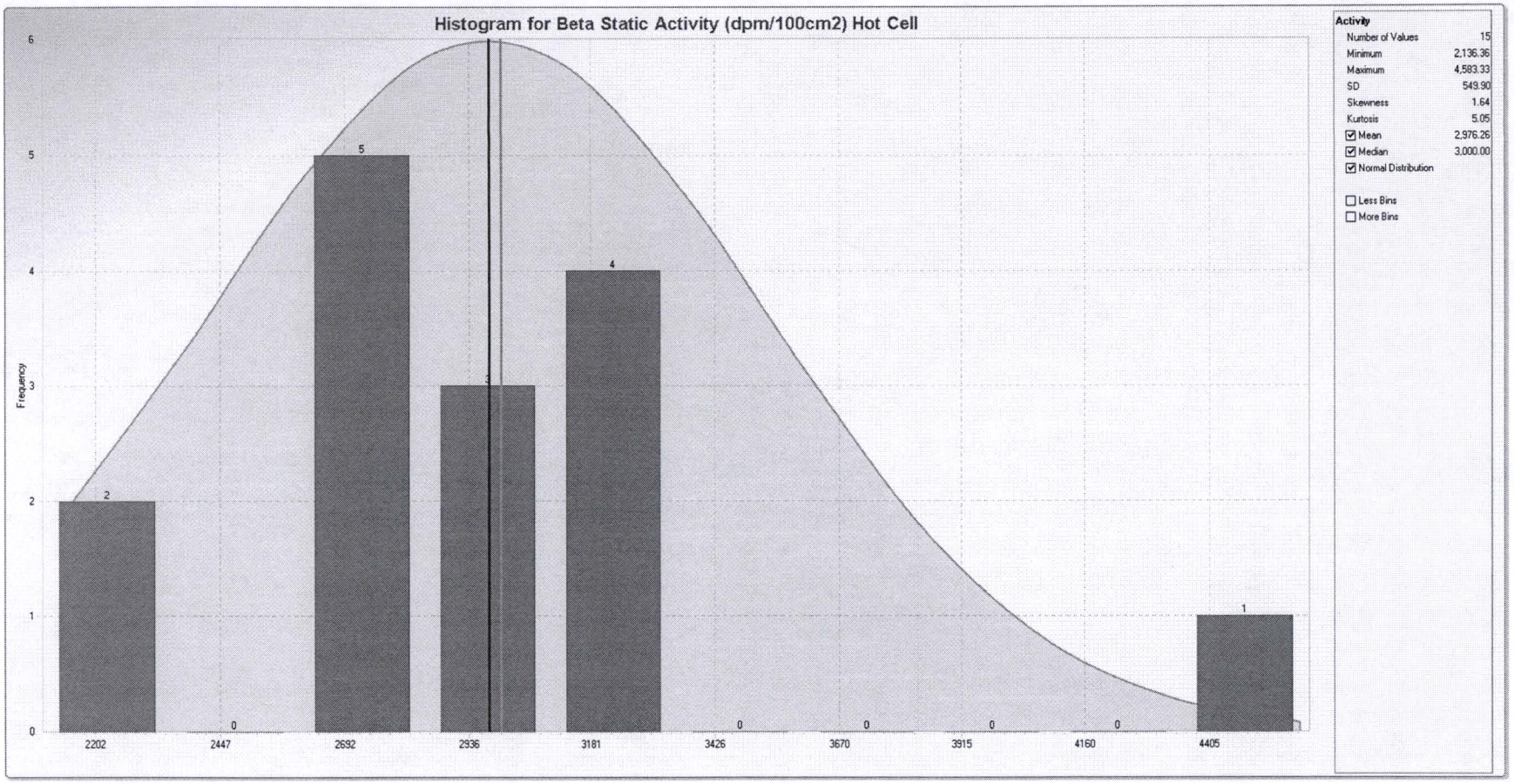
(none required)

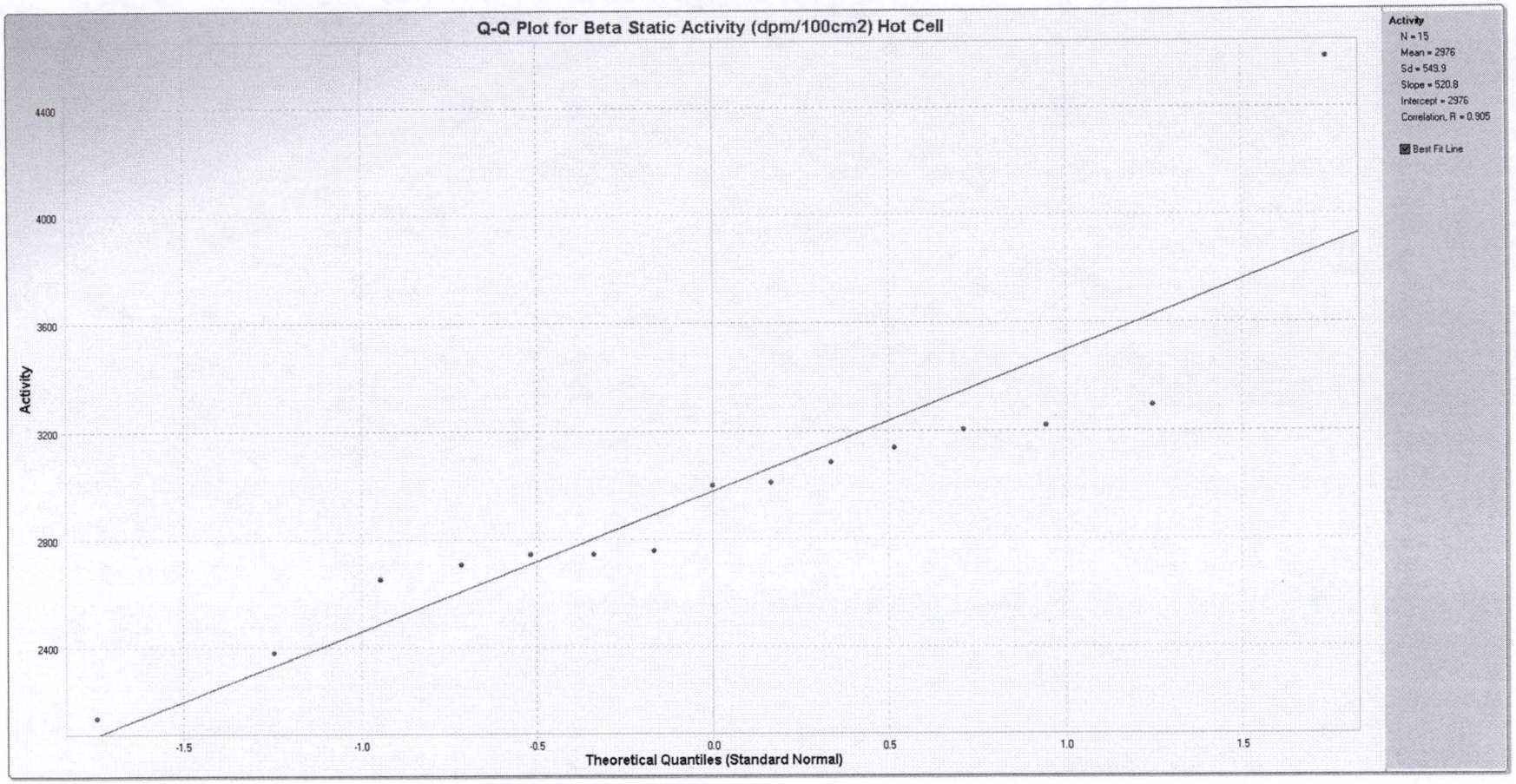
Attachment 4

Data Assessment

January 25, 2017

Survey Unit F8300061


Histogram for Beta Static Activity (dpm/100cm2) Hot Cell
Frequency
0
1
2
3
4
5
6
2202
2447
2692
2936
3181
3426
3670
3915
4160
4405
2
0
5
3
4
0
0
0
0
1
Activity
Number of Values 15
Minimum 2,136.36
Maximum 4,583.33
SD 549.90
Skewness 1.64
Kurtosis 5.05
Mean 2,976.26
Median 3,000.00
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100cm2) Hot Cell
Activity
4400
4000
3600
3200
2800
2400
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity
N = 15
Mean = 2976
Sd = 549.9
Slope = 520.8
Intercept = 2976
Correlation, R = 0.905
Best Fit Line

Smear_Data_Calculation_Sheet_101316

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	F830	006	1	C	00001	SM	Hot Cell	49	10	11/01/16	1210	
2	F830	006	1	C	00002	SM	Hot Cell	53	20	11/01/16	1211	
3	F830	006	1	C	00003	SM	Hot Cell	50	13	11/01/16	1212	
4	F830	006	1	C	00004	SM	Hot Cell	58	31	11/01/16	1214	
5	F830	006	1	C	00005	SM	Hot Cell	44	-1	11/01/16	1215	
6	F830	006	1	C	00006	SM	Hot Cell	47	6	11/01/16	1216	
7	F830	006	1	C	00007	SM	Hot Cell	53	20	11/01/16	1217	
8	F830	006	1	C	00008	SM	Hot Cell	53	20	11/01/16	1219	
9	F830	006	1	C	00009	SM	Hot Cell	52	17	11/01/16	1220	
10	F830	006	1	C	00010	SM	Hot Cell	59	33	11/01/16	1221	
11	F830	006	1	C	00011	SM	Hot Cell	47	6	11/01/16	1222	
12	F830	006	1	C	00012	SM	Hot Cell	49	10	11/01/16	1224	
13	F830	006	1	C	00013	SM	Hot Cell	51	15	11/01/16	1225	
14	F830	006	1	C	00014	SM	Hot Cell	62	40	11/01/16	1226	
15	F830	006	1	C	00015	SM	Hot Cell	42	-6	11/01/16	1227	

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date Joe Norris 12-2-16

Tech B Sign/ Date N/A

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597

43-10-1 S/N: 188736

Cal Due Date: 5/13/2017

	efficiency	bkg rate	bkg count time	MDA
α	0.364	cpm	min	#DIV/0! dpm per area
β	0.434	44.5 cpm	1 min	74.5 dpm per area

Rancho Seco

Final Status Survey Summary Report

January 30, 2017

IOSB Hot Cell Class 2 rev1

Survey Unit F8300062

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/18/17

Manager, Rancho Seco Assets

Survey Unit:

F8300062, Interim Onsite Storage Building (IOSB) Hot Cell Class 2

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), the hot cell possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items. The Class 2 survey area encompasses the the walls above six feet up to and including the ledge where the lid rests.

Site Characterization: Static measurements were made on the floor and wall surfaces, to confirm the absence or presence of plant-derived radionuclides. Static measurements within the hot cell showed a mean gross beta activity level of 2,880 dpm/100 cm^2 and a maximum value of 5,112 dpm/100 cm^2. Previous surveys and floor scanning indicated significant contamination in excess of the DCGLw. This Hot Cell Class 1 (F8300061) area was identified and characterized separately as a hot spot. The average static measurement in this hot spot was 390,104 dpm/100 cm2 and a maximum value of 2,285,418 dpm/100 cm2. The hot spot was remediated prior to performance of the FSS. Based upon the hot spot, the Hot Cell was classified as a MARSSIM Class 1 survey unit.

An adjacent Survey Unit, Hot Cell Buffer Class 2 (F8300062), the subject of this report, was created as the buffer between the Hot Cell Class 1 (F8300061) and the remainder of the IOSB Truck Bay Class 3 (F8300053). This Hot Cell Buffer Survey Unit (F8300062) is identified as the horizonal and vertical surfaces (above seven feet) at the top of each of the four walls of the hot cell cover seating surface.

The Hot Cell Class 1 (F8300061) and IOSB Truck Bay Class 3 (F8300053) Survey units each are the subject of separate FSS reports.

Survey Unit Design Information:

In accordance with MARSSIM Section 4.6, special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is unnecessarily large and not appropriate for smaller survey unit areas. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs. This survey unit meets this criterion as the size is less than ten square meter (7.6 m^2).

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were determined by professional judgment in accordance with MARSSIM guidance and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Hot Cell Class 2
Survey Unit:	**006**	
Class	**2**	
SU Area (m^2)	**8**	
Evaluator:	JR	
$DCGL_w$:	43,000	Gross Activity DCGL
Area Factor	NA	Class 2
Design DCGLemc ($dpm/100cm^2$):	NA	Class 2
LBGR:	21,500	Default = 50% DCGL
Sigma:	740	Scoping Survey Data
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.129	
Total Area Scanned (m^2):	7.6	
Scan Coverage (%)	100%	Class 2
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	29.0	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	15	Values selected based upon Judgement
N-Value+20%:	15	Values selected based upon Judgement

Survey Results:

A total of 15 direct measurements were made in F8300062 following the guidance from MARSSIM section 4.6. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300062X00001	314	2,379
2	F8300062X00002	299	2,265
3	F8300062X00003	392	2,970
4	F8300062X00004	272	2,061
5	F8300062X00005	378	2,864
6	F8300062X00006	303	2,295
7	F8300062X00007	324	2,455
8	F8300062X00008	311	2,356
9	F8300062X00009	313	2,371
10	F8300062X00010	310	2,348
11	F8300062X00011	245	1,856
12	F8300062X00012	255	1,932
13	F8300062X00013	279	2,114
14	F8300062X00014	306	2,318
15	F8300062X00015	300	2,273

Table 3 contains the statistical summary of the static measurement data for the Hot Cell Class 2.

Table 3, Beta Summary Statistics

Beta Static Hot Cell Class 2	
Mean	2,324
Median	2,318
Standard Deviation	296
Minimum	1,856
Maximum	2,970
Count	15

Survey Unit Data Assessment:

The survey design was based upon professional judgement and resulted in 15 static measurements. Following the guidance in MARSSIM Section 4.6, these values are compared directly to the DCGLw.

The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,318	
Mean:	2,324	
Static Data Standard Deviation:	296	
Maximum:	2,970	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	N/A	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 2 survey and the sample results are consistent with that classification. The variability of the survey results was less than the characterization data used for survey design. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 2 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

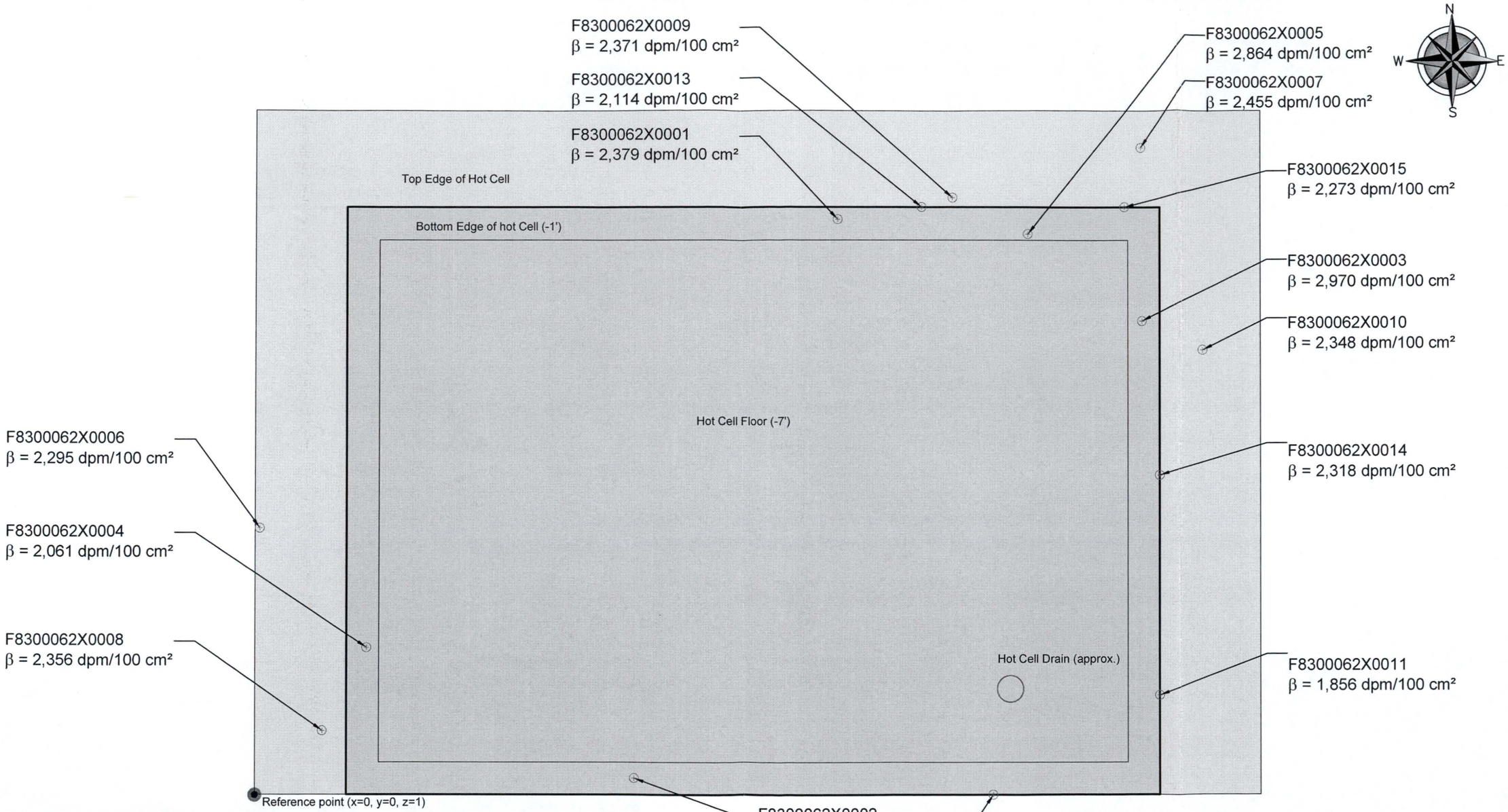
It is concluded that survey unit F8300062 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

Survey Unit F8300062



SMUD | TIDEWATER INC RADIOLOGICAL SERVICES

IOSB Hot Cell Class 2

Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Final Status Survey	
Drawing No.:	NA	
Description:	IOSB Hot Cell Class 2	
Drawn By:	J Gonzales	
QC'd:	J Reese	Approval date:
Date:	01292017	
Rev No.:	2	

Attachment 2

Instrumentation

January 30, 2017

Survey Unit F83000062

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 499 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 77 dpm/100 cm^2	43.4%	182597/188736 5/13/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
183	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $= 3 + 4.65(B_r * t)^{0.5}/t * E * {}^{A}/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 499 dpm/100 cm^2

Attachment 3

Investigation

January 30, 2017

Survey Unit F8300062

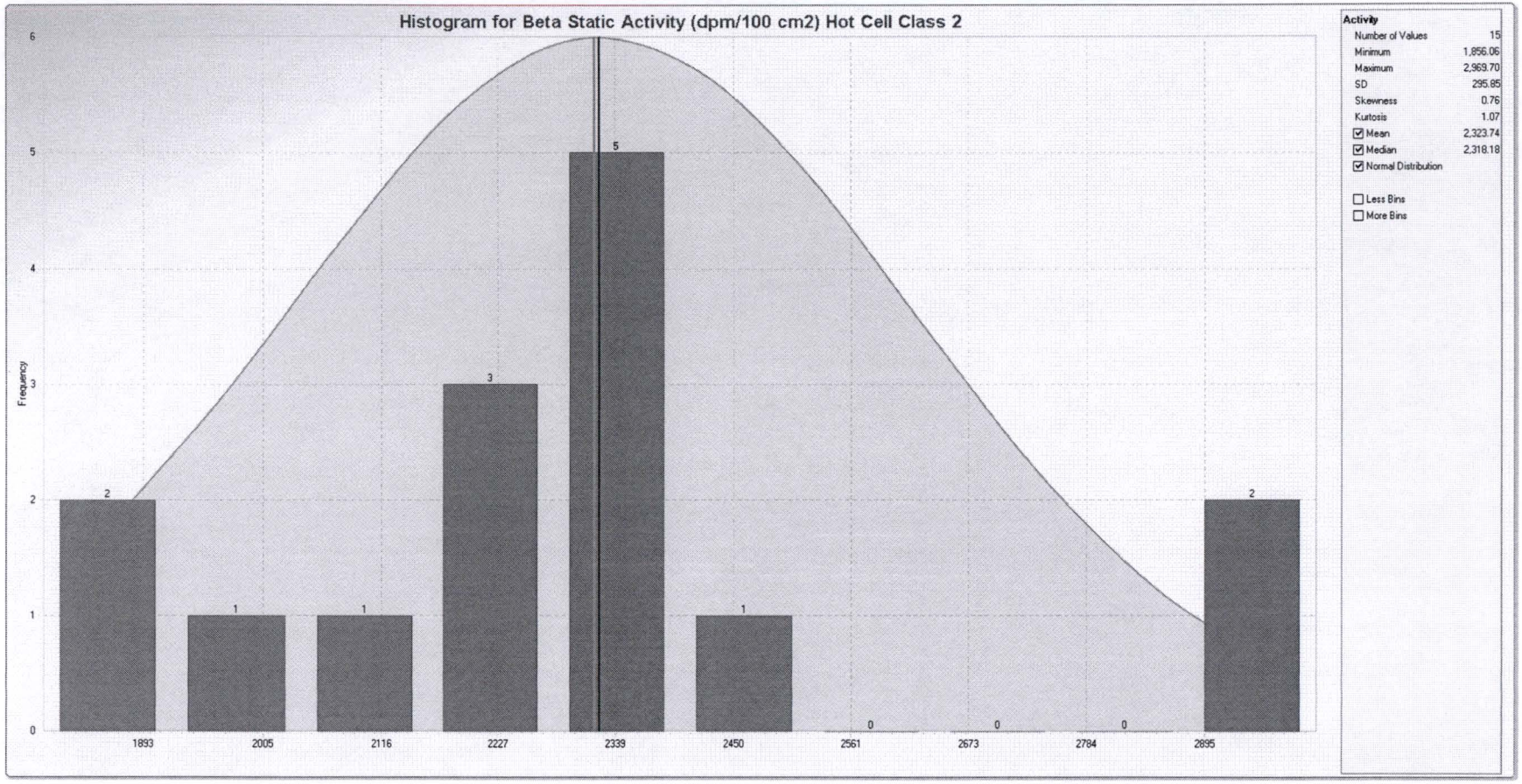
(none required)

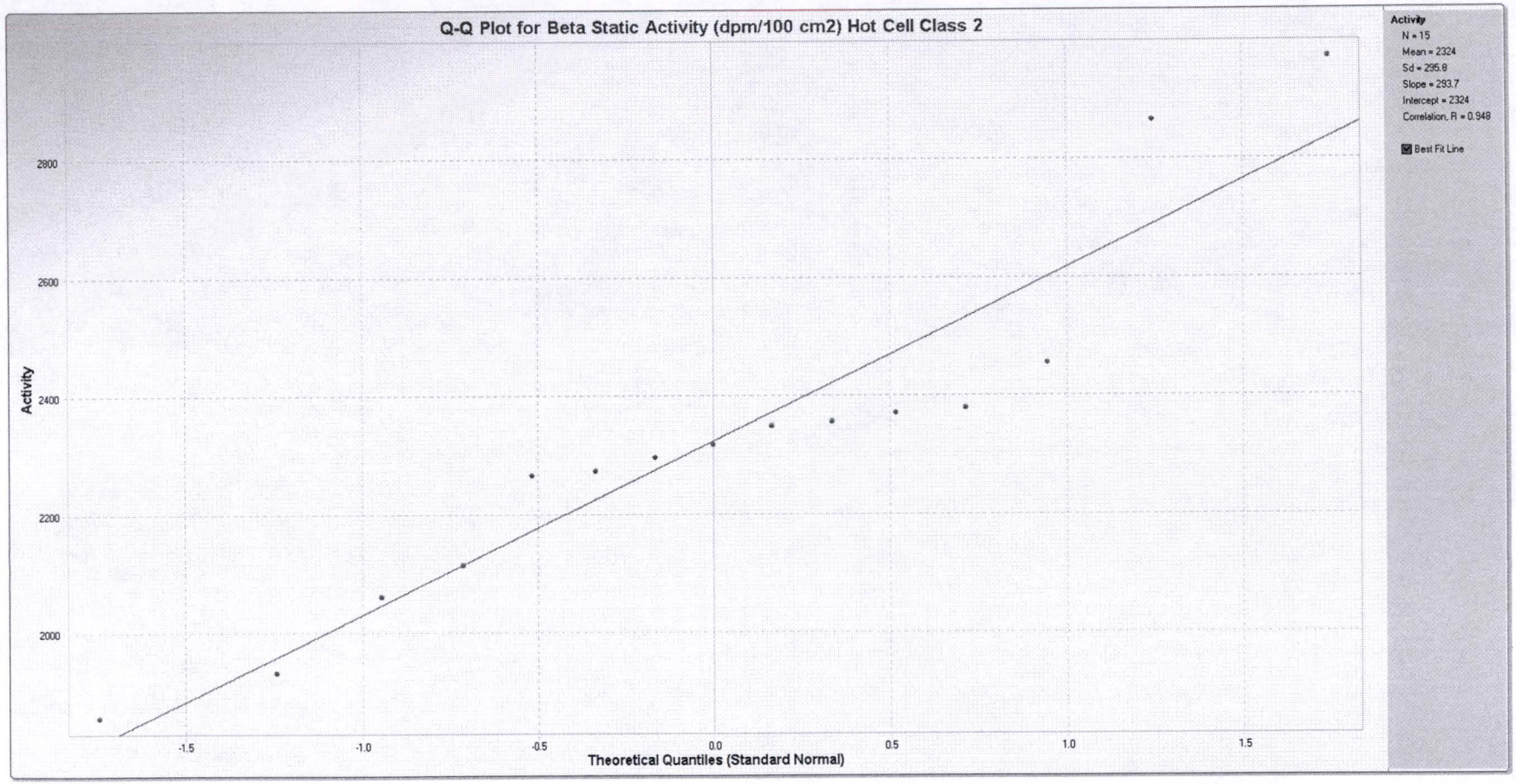
Attachment 4

Data Assessment

January 30, 2017

Survey Unit F8300062


Histogram for Beta Static Activity (dpm/100 cm2) Hot Cell Class 2
Frequency
0
1
2
3
4
5
6
2
1
1
3
5
1
0
0
0
2
1893
2005
2116
2227
2339
2450
2561
2673
2784
2895
Activity
Number of Values 15
Minimum 1,856.06
Maximum 2,969.70
SD 295.85
Skewness 0.76
Kurtosis 1.07
Mean 2,323.74
Median 2,318.18
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100 cm2) Hot Cell Class 2
Activity
N = 15
Mean = 2324
Sd = 295.8
Slope = 293.7
Intercept = 2324
Correlation, R = 0.948
Best Fit Line
Activity
2800
2600
2400
2200
2000
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	F830	006	2	C	00001	SM	Hot Cell Buffer	42	-14	11/04/16	1323	
2	F830	006	2	C	00002	SM	Hot Cell Buffer	50	5	11/04/16	1324	
3	F830	006	2	C	00003	SM	Hot Cell Buffer	58	23	11/04/16	1325	
4	F830	006	2	C	00004	SM	Hot Cell Buffer	50	5	11/04/16	1326	
5	F830	006	2	C	00005	SM	Hot Cell Buffer	41	-16	11/04/16	1328	
6	F830	006	2	C	00006	SM	Hot Cell Buffer	57	21	11/04/16	1329	
7	F830	006	2	C	00007	SM	Hot Cell Buffer	45	-7	11/04/16	1330	
8	F830	006	2	C	00008	SM	Hot Cell Buffer	49	2	11/04/16	1331	
9	F830	006	2	C	00009	SM	Hot Cell Buffer	46	-5	11/04/16	1333	
10	F830	006	2	C	00010	SM	Hot Cell Buffer	49	2	11/04/16	1334	
11	F830	006	2	C	00011	SM	Hot Cell Buffer	37	-25	11/04/16	1335	
12	F830	006	2	C	00012	SM	Hot Cell Buffer	45	-7	11/04/16	1336	
13	F830	006	2	C	00013	SM	Hot Cell Buffer	54	14	11/04/16	1337	
14	F830	006	2	C	00014	SM	Hot Cell Buffer	52	9	11/04/16	1339	
15	F830	006	2	C	00015	SM	Hot Cell Buffer	45	-7	11/04/16	1340	

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date 12-2-16

Tech B Sign/ Date N/A

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597		efficiency	bkg rate	bkg count time	MDA
43-10-1 S/N: 188736	α	0.364	cpm	min	#DIV/0! dpm per area
Cal Due Date: 5/13/2017	β	0.434	48 cpm	1 min	77.2 dpm per area

Rancho Seco

Final Status Survey Summary Report

January 25, 2017

IOSB Loading Dock rev1

Survey Unit F8300071

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/19/17

Manager, Rancho Seco Assets

Survey Unit:

F8300071, Interim Onsite Storage Building (IOSB) Loading Dock Class 1

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), each storage cell possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Based upon the scanning results of the Truck Bay, an elevated area was identified on the floor around and including the loading dock. Certain spots in the area exceeded the $DCGL_W$ but not the $DCGL_{EMC}$. An area of known contamination was identified at the loading dock area. This area was characterized to determine the extent and highest activity. The area of elevated activity was approximately 7.5 m^2 around the loading dock. A smaller area (less than 1.0 m^2) exceeded the $DCGL_W$ with activity detected as high as 249,491 dpm/100cm^2. The elevated area was designated as a Loading Dock Class 1 (F8300071), requiring remediation and is the subject of this report.

The Loading Dock Class 2 (F8300082) area buffers the elevated area from the remainder of the IOSB Truck Bay Class 3 (F8300053) and each is the subject of a separate report.

Survey Unit Design Information:

In accordance with MARSSIM Section 4.6, special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is unnecessarily large and not appropriate for smaller survey unit areas. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs. This survey unit meets this criterion as the size is less than ten square meters (7.5 m^2).

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were based on professional judgement in accordance with the LTP and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Loading Dock Class 1
Survey Unit:	**007**	
Class	**1**	
SU Area (m^2)	**7.5**	
Evaluator:	JR	
$DCGL_W$:	43,000	Gross Activity DCGL
Area Factor	3.4	DTBD-05-003
Design DCGLemc (dpm/100cm^2):	146,200	
$DCGL_{emc}$:	146,200	
LBGR:	21,500	Default = 50% DCGL
Sigma:	466	Truck Bay Scoping
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.130	
Total Area Scanned (m^2):	7.5	
Scan Coverage (%)	100%	Class 1
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	46.1	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	15	Values selected based upon Judgement
N-Value+20%:	15	Values selected based upon Judgement

Survey Results:

A total of 15 direct measurements were made in F8300071. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300071C00001	959	7,265
2	F8300071C00002	360	2,727
3	F8300071C00003	377	2,856
4	F8300071C00004	407	3,083
5	F8300071C00005	533	4,038
6	F8300071C00006	477	3,614
7	F8300071C00007	390	2,955
8	F8300071C00008	331	2,508
9	F8300071C00009	254	1,924
10	F8300071C00010	321	2,432
11	F8300071M00011	280	2,121
12	F8300071M00012	634	4,803
13	F8300071M00013	425	3,220
14	F8300071M00014	532	4,030
15	F8300071M00015	249	1,886

Table 3 contains the statistical summary of the static measurement data for the Loading Dock Class 1.

Table 3, Beta Summary Statistics

Beta Static Loading Dock Class 1	
Mean	3,297
Median	2,955
Standard Deviation	1,376
Minimum	1,886
Maximum	7,265
Count	15

Survey Unit Data Assessment:

The survey design was based upon professional judgement and resulted in 15 static measurements. Following the guidance in MARSSIM Section 4.6, these values are compared directly to the $DCGL_W$.

The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,955	
Mean:	3,297	
Static Data Standard Deviation:	1,376	
Maximum:	7,265	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	N/A	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

Residual radioactivity following remediation is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 1 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, no individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 1 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

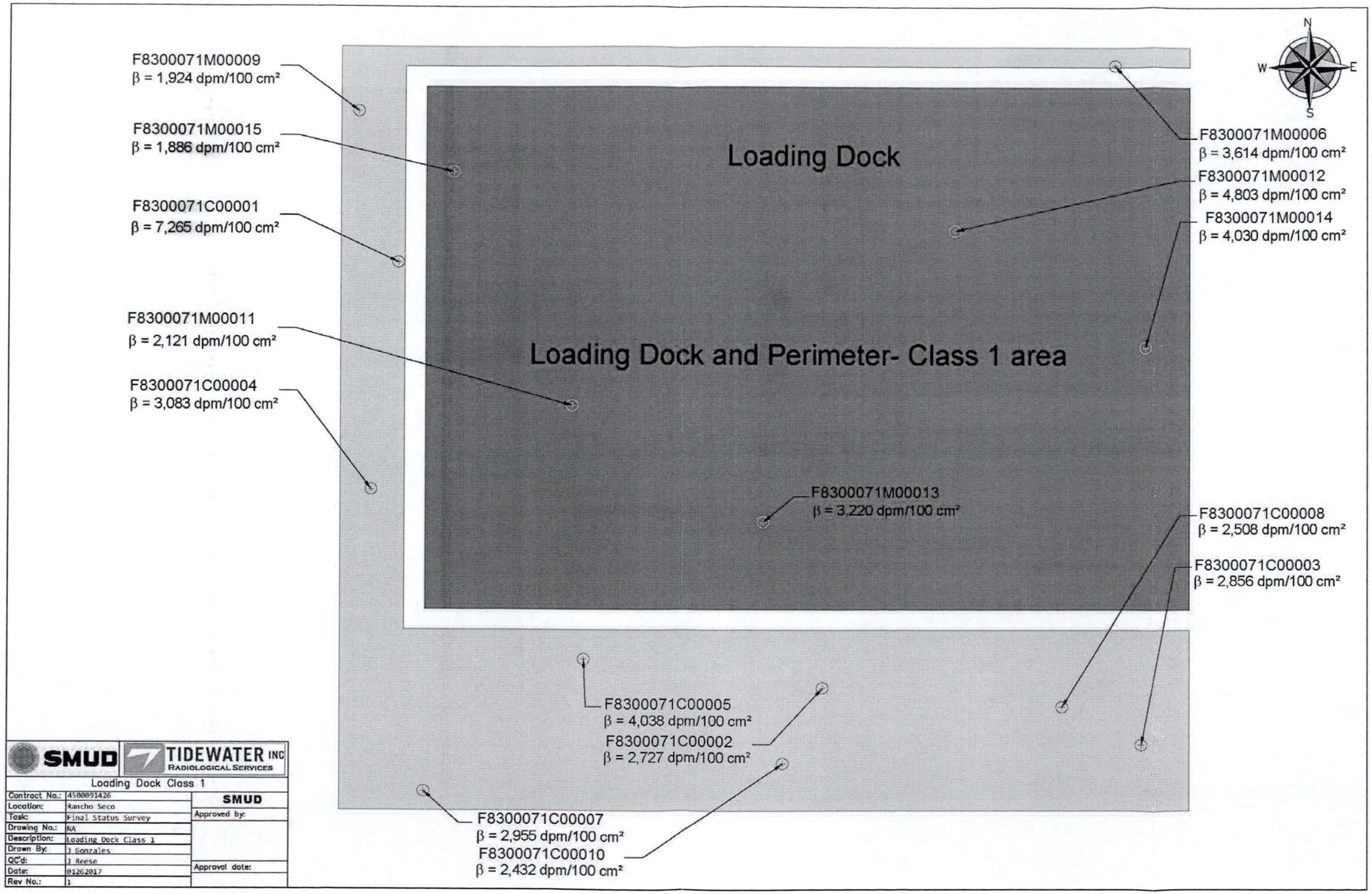
It is concluded that survey unit F8300071 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

Survey Unit F8300071


F8300071M00009
β = 1,924 dpm/100 cm²
F8300071M00015
β = 1,886 dpm/100 cm²
F8300071C00001
β = 7,265 dpm/100 cm²
F8300071M00011
β = 2,121 dpm/100 cm²
F8300071C00004
β = 3,083 dpm/100 cm²
Loading Dock
Loading Dock and Perimeter- Class 1 area
N
W
E
S
F8300071M00006
β = 3,614 dpm/100 cm²
F8300071M00012
β = 4,803 dpm/100 cm²
F8300071M00014
β = 4,030 dpm/100 cm²
F8300071M00013
β = 3,220 dpm/100 cm²
F8300071C00008
β = 2,508 dpm/100 cm²
F8300071C00003
β = 2,856 dpm/100 cm²
F8300071C00005
β = 4,038 dpm/100 cm²
F8300071C00002
β = 2,727 dpm/100 cm²
F8300071C00007
β = 2,955 dpm/100 cm²
F8300071C00010
β = 2,432 dpm/100 cm²
SMUD
TIDEWATER INC
RADIOLOGICAL SERVICES
Loading Dock Class 1
Contract No.: 4500891426
Location: Rancho Seco
Task: Final Status Survey
Drawing No.: NA
Description: Loading Dock Class 1
Drawn By: J Gonzales
QC'd: J Reese
Date: 01262017
Rev No.: 1
SMUD
Approved by:
Approval date:

Attachment 2

Instrumentation

January 30, 2017

Survey Unit F8300071

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 556 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 76 dpm/100 cm^2	43.4%	182597/188736 5/13/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
238	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $= 3 + 4.65(B_r * t)^{0.5}/t * E * A/100$ (NUREG 1507)

Where:

B_r	Background Countrate
t	Count Time (min)
E	Efficiency
A	Area of detector (cm^2)

Static MDA 566 dpm/100 cm^2

Attachment 3

Investigation

January 30, 2017

Survey Unit F8300071

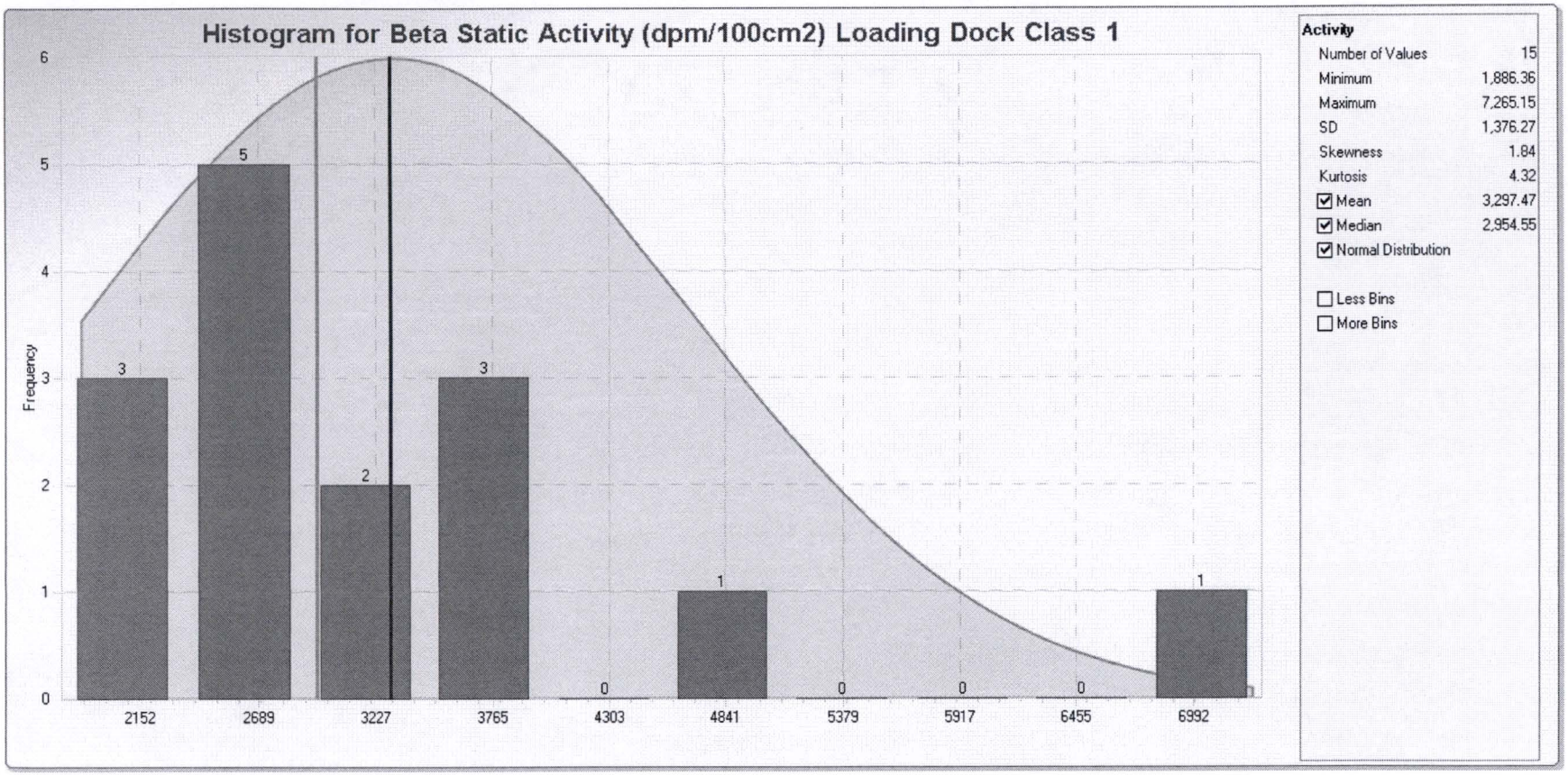
(none required)

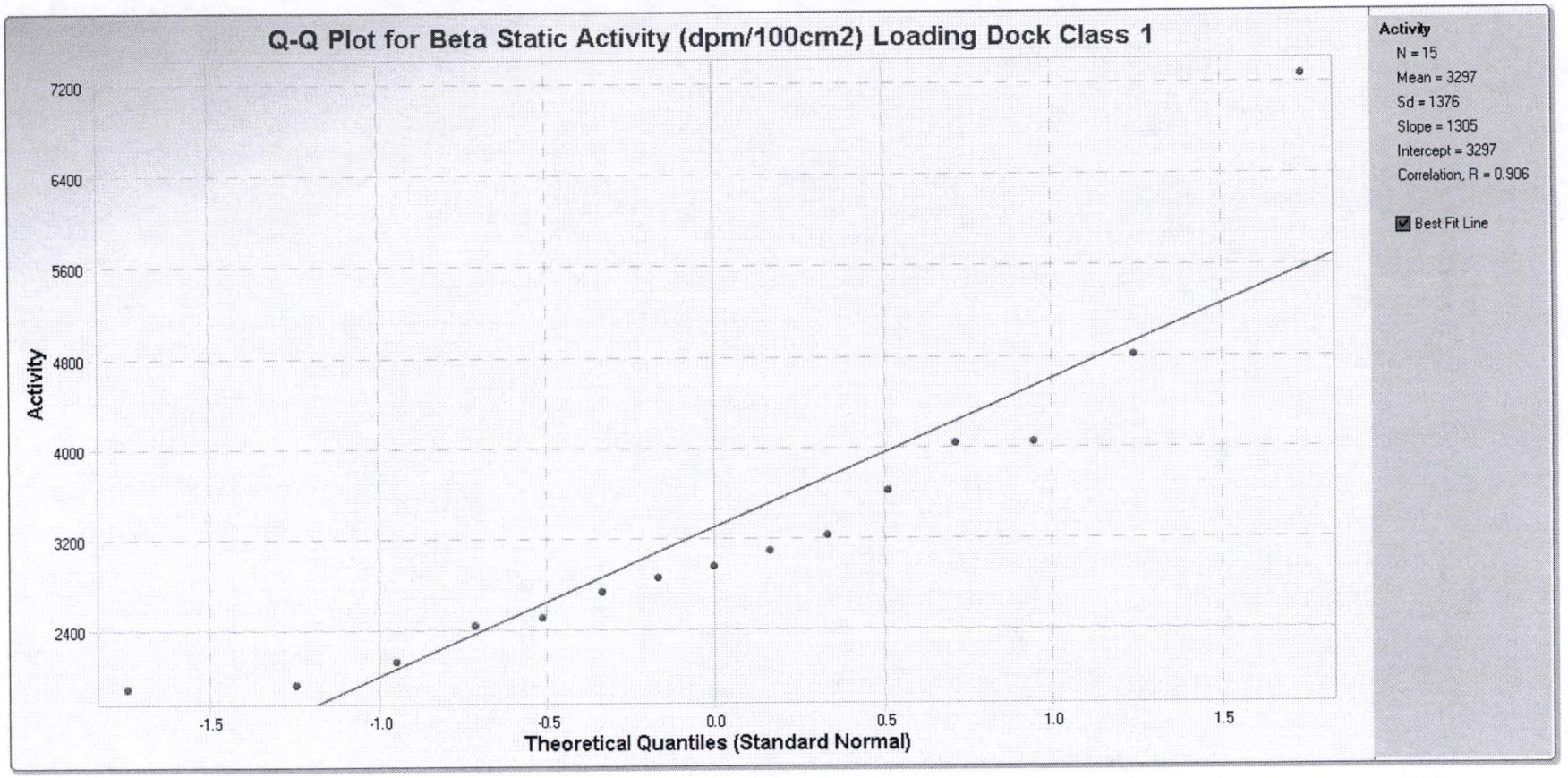
Attachment 4

Data Assessment

January 30, 2017

Survey Unit F8300071


Histogram for Beta Static Activity (dpm/100cm2) Loading Dock Class 1
Frequency
0
1
2
3
4
5
6
3
5
2
3
0
1
0
0
0
1
2152
2689
3227
3765
4303
4841
5379
5917
6455
6992
Activity
Number of Values 15
Minimum 1,886.36
Maximum 7,265.15
SD 1,376.27
Skewness 1.84
Kurtosis 4.32
Mean 3,297.47
Median 2,954.55
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100cm2) Loading Dock Class 1
Activity
7200
6400
5600
4800
4000
3200
2400
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity
N = 15
Mean = 3297
Sd = 1376
Slope = 1305
Intercept = 3297
Correlation, R = 0.906
Best Fit Line

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	*F830*	*007*	*1*	*C*	*00001*	*SM*	Load Dock	39	-18	12/29/16	1303	
2	F830	007	1	C	*00002*	SM	Load Dock	44	-6	12/29/16	1304	
3	F830	007	1	C	*00003*	SM	Load Dock	42	-11	12/29/16	1305	
4	F830	007	1	C	*00004*	SM	Load Dock	36	-25	12/29/16	1306	
5	F830	007	1	C	*00005*	SM	Load Dock	45	-4	12/29/16	1307	
6	F830	007	1	C	*00006*	SM	Load Dock	46	-2	12/29/16	1308	
7	F830	007	1	C	*00007*	SM	Load Dock	57	24	12/29/16	1311	
8	F830	007	1	C	*00008*	SM	Load Dock	60	31	12/29/16	1312	
9	F830	007	1	C	*00009*	SM	Load Dock	36	-25	12/29/16	1313	
10	F830	007	1	C	*00010*	SM	Load Dock	43	-9	12/29/16	1314	
11	F830	007	1	C	*00011*	SM	Load Dock	53	15	12/29/16	1315	
12	F830	007	1	C	*00012*	SM	Load Dock	40	-15	12/29/16	1316	
13	F830	007	1	C	*00013*	SM	Load Dock	42	-11	12/29/16	1317	
14	F830	007	1	C	*00014*	SM	Load Dock	45	-4	12/29/16	1319	
15	F830	007	1	C	*00015*	SM	Load Dock	41	-13	12/29/16	1320	

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date 12/29/2016

Tech B Sign/ Date

Ludlum 2929 Benchtop Instrument

		efficiency	bkg rate	bkg count time	MDA
2929 S/N: 182597					
43-10-1 S/N: 188736	α	0.364	0.1 cpm	1 min	7.0 dpm per area
Cal Due Date: 5/13/2017	β	0.434	46.7 cpm	1 min	76.2 dpm per area

Rancho Seco

Final Status Survey Summary Report

January 25, 2017

IOSB Loading Dock Class 2 rev1

Survey Unit F8300082

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/19/17

Manager, Rancho Seco Assets

Survey Unit:

F8300082, Interim Onsite Storage Building (IOSB) Loading Dock Class 2

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), each storage cell possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Based upon the scanning results of the Truck Bay, an elevated area was identified on the floor around and including the loading dock. Certain spots in the area exceeded the $DCGL_w$ but not the $DCGL_{EMC}$. An area of known contamination was identified at the loading dock area. This area was characterized to determine the extent and highest activity.

The elevated activity area around the loading dock was approximately 7.5 m^2 and was designated as the Loading Dock Class 1 (F8300071). Within this elevated activity area, a portion (less than 1.0 m^2) exceeded the $DCGL_w$, with activity detected as high as 249,491 dpm/100 cm^2. This smaller elevated activity area within the Class 1 (F8300071), required remediation. The Loading Dock Class 1 (F8300071) was buffered from the Truck Bay Class 3 (F8300053) with the Loading Dock Class 2 (F8300082) Survey Unit which was approximately 19.9 m^2 total. The Loading Dock Class 1 and Truck Bay Class 3 Survey Units are each the subject of separate reports.

The Loading Dock Class 2 (F8300082) is the subject of this report.

Survey Unit Design Information:

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were randomly determined in accordance with MARSSIM guidance and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Loading Dock Class 2
Survey Unit:	**008**	
Class	**2**	
SU Area (m^2)	**19.9**	
Evaluator:	JR	
$DCGL_W$:	43,000	Gross Activity DCGL
Area Factor	NA	Class 2
Design DCGLemc ($dpm/100cm^2$):	NA	Class 2
$DCGL_{emc}$:	NA	Class 2
LBGR:	21,500	Default = 50% DCGL
Sigma:	466	Truck Bay Scoping
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.132	
Total Area Scanned (m^2):	15.2	
Scan Coverage (%)	76%	Class 2
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	46.1	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	

Survey Results:

A total of 15 direct measurements were made in F8300082. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300082C00001	379	2,871
2	F8300082C00002	383	2,902
3	F8300082C00003	373	2,826
4	F8300082C00004	380	2,879
5	F8300082C00005	389	2,947
6	F8300082C00006	349	2,644
7	F8300082C00007	405	3,068
8	F8300082C00008	410	3,106
9	F8300082C00009	366	2,773
10	F8300082C00010	390	2,955
11	F8300082C00011	376	2,848
12	F8300082C00012	337	2,553
13	F8300082C00013	327	2,477
14	F8300082C00014	299	2,265
15	F8300082C00015	394	2,985

Table 3 contains the statistical summary of the static measurement data for the Loading Dock Class 2.

Table 3, Beta Summary Statistics

Beta Static Loading Dock Class 2	
Mean	2,807
Median	2,871
Standard Deviation	231
Minimum	2,265
Maximum	3,106
Count	15

Survey Unit Data Assessment:

The survey design was based upon randomly selected locations and resulted in 15 static measurements. Following the guidance in MARSSIM Section 4.6, these values are compared directly to the $DCGL_W$.

The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,871	
Mean:	2,807	
Static Data Standard Deviation:	231	
Maximum:	3,106	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	11	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	NA	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 2 survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, no individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 2 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

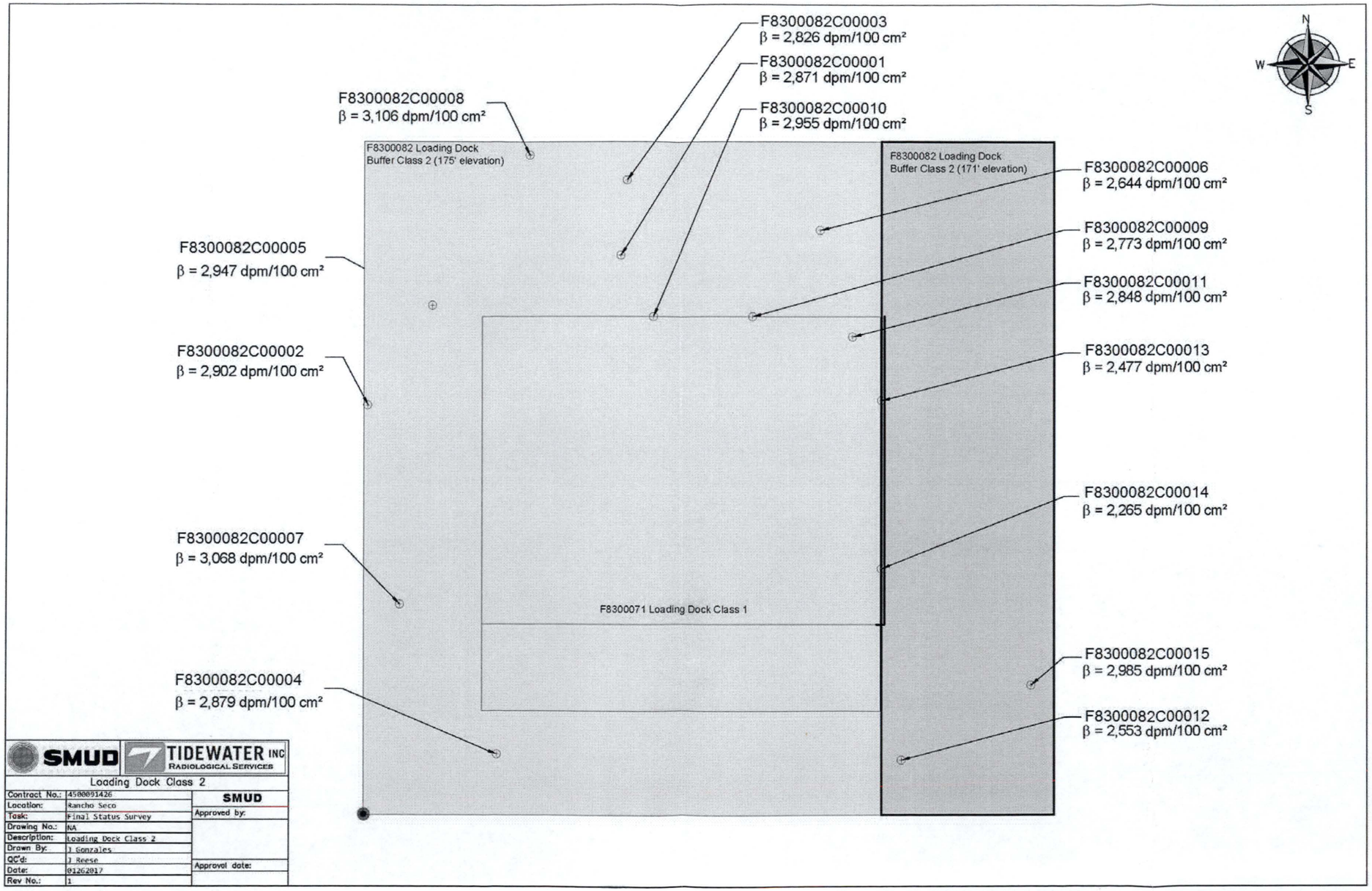
It is concluded that survey unit F8300082 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

Survey Unit F8300082


F8300082C00003
β = 2,826 dpm/100 cm²
F8300082C00001
β = 2,871 dpm/100 cm²
F8300082C00010
β = 2,955 dpm/100 cm²
F8300082C00008
β = 3,106 dpm/100 cm²
F8300082 Loading Dock
Buffer Class 2 (175' elevation)
F8300082 Loading Dock
Buffer Class 2 (171' elevation)
F8300082C00006
β = 2,644 dpm/100 cm²
F8300082C00005
β = 2,947 dpm/100 cm²
F8300082C00009
β = 2,773 dpm/100 cm²
F8300082C00011
β = 2,848 dpm/100 cm²
F8300082C00002
β = 2,902 dpm/100 cm²
F8300082C00013
β = 2,477 dpm/100 cm²
F8300082C00014
β = 2,265 dpm/100 cm²
F8300082C00007
β = 3,068 dpm/100 cm²
F8300071 Loading Dock Class 1
F8300082C00015
β = 2,985 dpm/100 cm²
F8300082C00004
β = 2,879 dpm/100 cm²
F8300082C00012
β = 2,553 dpm/100 cm²
N
W
E
S
SMUD
TIDEWATER INC
RADIOLOGICAL SERVICES
Loading Dock Class 2
Contract No.: 4500091426
Location: Rancho Seco
Task: Final Status Survey
Drawing No.: NA
Description: Loading Dock Class 2
Drawn By: J Gonzales
QC'd: J Reese
Date: 01262017
Rev No.: 1
SMUD
Approved by:
Approval date:

Attachment 2

Instrumentation

January 30, 2017

Survey Unit F8300082

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 520 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 75 dpm/100 cm^2	42.8%	166716/170380 11/3/16

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
199	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * A/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 520 dpm/100 cm^2

Attachment 3

Investigation

January 25, 2017

Survey Unit F8300082

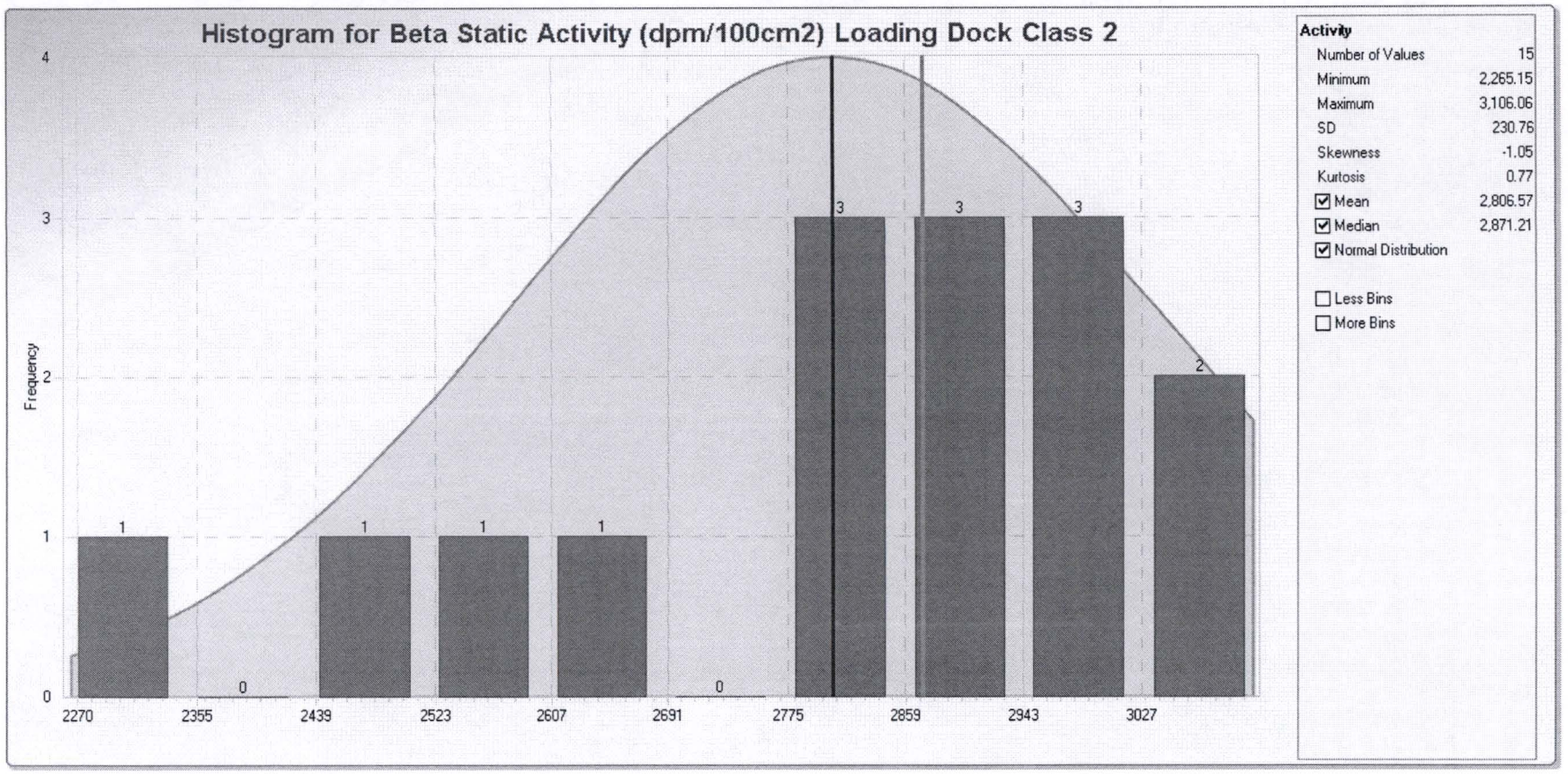
(none required)

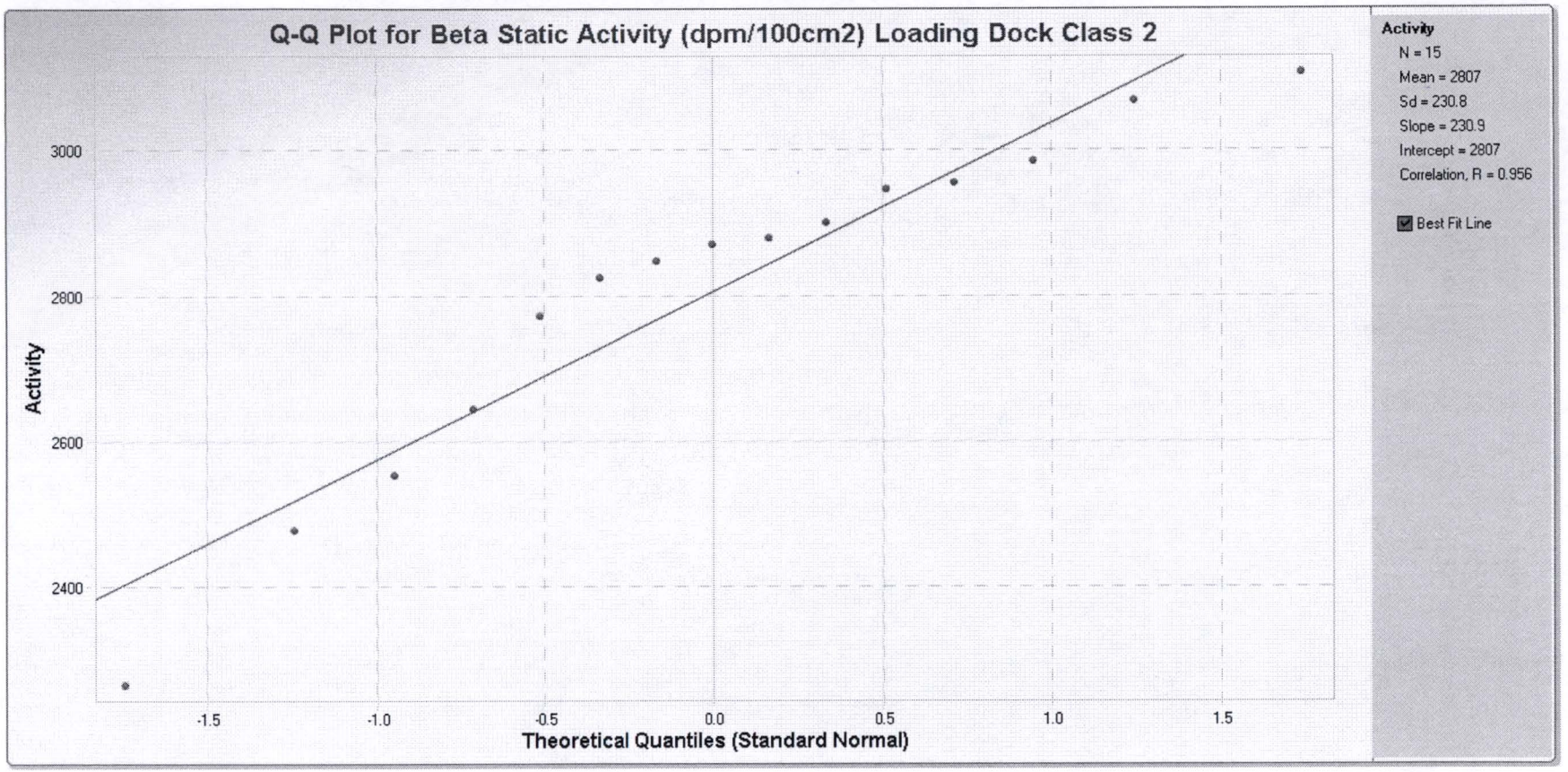
Attachment 4

Data Assessment

January 30, 2017

Survey Unit F8300082


Histogram for Beta Static Activity (dpm/100cm2) Loading Dock Class 2
Frequency
0
1
2
3
4
1
0
1
1
1
0
3
3
3
2
2270
2355
2439
2523
2607
2691
2775
2859
2943
3027
Activity
Number of Values 15
Minimum 2,265.15
Maximum 3,106.06
SD 230.76
Skewness -1.05
Kurtosis 0.77
Mean 2,806.57
Median 2,871.21
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100cm2) Loading Dock Class 2
Activity
N = 15
Mean = 2807
Sd = 230.8
Slope = 230.9
Intercept = 2807
Correlation, R = 0.956
Best Fit Line
3000
2800
2600
2400
Activity
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	F830	008	2	C	00001	SM	Load Dock Buffer	57	28	01/04/17	1140	
2	F830	008	2	C	00002	SM	Load Dock Buffer	50	12	01/04/17	1142	
3	F830	008	2	C	00003	SM	Load Dock Buffer	60	35	01/04/17	1143	
4	F830	008	2	C	00004	SM	Load Dock Buffer	54	21	01/04/17	1145	
5	F830	008	2	C	00005	SM	Load Dock Buffer	45	0	01/04/17	1146	
6	F830	008	2	C	00006	SM	Load Dock Buffer	54	21	01/04/17	1148	
7	F830	008	2	C	00007	SM	Load Dock Buffer	47	5	01/04/17	1150	
8	F830	008	2	C	00008	SM	Load Dock Buffer	46	3	01/04/17	1151	
9	F830	008	2	C	00009	SM	Load Dock Buffer	44	-2	01/04/17	1153	
10	F830	008	2	C	00010	SM	Load Dock Buffer	48	7	01/04/17	1155	
11	F830	008	2	C	00011	SM	Load Dock Buffer	48	7	01/04/17	1157	
12	F830	008	2	C	00012	SM	Load Dock Buffer	45	0	01/04/17	1159	
13	F830	008	2	C	00013	SM	Load Dock Buffer	49	10	01/04/17	1200	
14	F830	008	2	C	00014	SM	Load Dock Buffer	42	-6	01/04/17	1202	
15	F830	008	2	C	00015	SM	Load Dock Buffer	45	0	01/04/17	1204	

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date Joe Nanni 1-4-2017

Tech B Sign/ Date N/A

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597		efficiency	bkg rate	bkg count time	MDA
43-10-1 S/N: 188736	α	0.364	cpm	1 min	3.0 dpm per area
Cal Due Date: 5/13/2017	β	0.434	44.8 cpm	1 min	74.7 dpm per area

Rancho Seco

Final Status Survey Summary Report

January 30, 2017

IOSB Main Sump rev1

Survey Unit F8300103

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/18/17

Manager, Rancho Seco Assets

Survey Unit:

F8300103, Interim Onsite Storage Building (IOSB) Main Sump

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), each storage cell possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Static measurements were made of the interior surfaces of the sump, to confirm the absence or presence of plant-derived radionuclides. Static measurements showed a mean gross activity level of 2,401 dpm/100 cm^2 and a maximum value of 3,056 dpm/100 cm^2. The statistics of the sump results combines walls, floor, and ceiling data. Based on the levels of gross activity reported, the area was determined to be a Class 3 area.

Survey Unit Design Information:

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were randomly determined and approximately 14% of the area scanned by beta scanning. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Main Sump
Survey Unit:	**010**	
Class	**3**	
SU Area (m^2)	**80**	
Evaluator:	JR	
$DCGL_w$:	43,000	Gross Activity DCGL
Area Factor	NA	Class 3
Design DCGLemc ($dpm/100cm^2$):	NA	Class 3
$DCGL_{emc}$:	NA	Class 3
LBGR:	21,500	Default = 50% DCGL
Sigma:	466	Scoping Survey Data for Truck Bay
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.132	
Total Area Scanned (m^2):	11.1	
Scan Coverage (%)	14%	Class 3
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	46.1	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	

Survey Results:

A total of 30 direct measurements were made in F8300103 with 15 each being collected in the upper and lower sumps. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Swipe data did not indicate elevated activity levels above the MDA.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300103X00001	307	2,326
2	F8300103X00002	302	2,288
3	F8300103X00003	312	2,364
4	F8300103X00004	206	1,561
5	F8300103X00005	234	1,773
6	F8300103X00006	244	1,848
7	F8300103X00007	260	1,970
8	F8300103X00008	215	1,629
9	F8300103X00009	243	1,841
10	F8300103X00010	209	1,583
11	F8300103X00011	248	1,879
12	F8300103X00012	220	1,667
13	F8300103X00013	288	2,182
14	F8300103X00014	294	2,227
15	F8300103X00015	234	1,773
16	F8300103X00016	249	1,886
17	F8300103X00017	258	1,955
18	F8300103X00018	255	1,932
19	F8300103X00019	296	2,242
20	F8300103X00020	208	1,576
21	F8300103X00021	229	1,735
22	F8300103X00022	215	1,629
23	F8300103X00023	242	1,833
24	F8300103X00024	208	1,576
25	F8300103X00025	247	1,871
26	F8300103X00026	258	1,955
27	F8300103X00027	228	1,727
28	F8300103X00028	223	1,689
29	F8300103X00029	252	1,909
30	F8300103X00030	305	2,311

Table 3 contains the statistical summary of the static measurement data for the IOSB Main Sump.

Table 3, Beta Summary Statistics

Beta Static Sumps	
Mean	1,891
Median	1,860
Standard Deviation	249
Minimum	1,561
Maximum	2,364
Count	30

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 30 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL. The sample standard deviation was greater than the design standard deviation but both values of sigma resulted in a relative shift greater than three (3), no additional samples were required.

Table 4, Data Assessment Results

Static Data Values		**Comments**
Number of Samples:	30	
Median:	1,860	
Mean:	1,891	
Static Data Standard Deviation:	249	
Maximum:	2,364	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	30	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	NA	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the results of the investigation survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

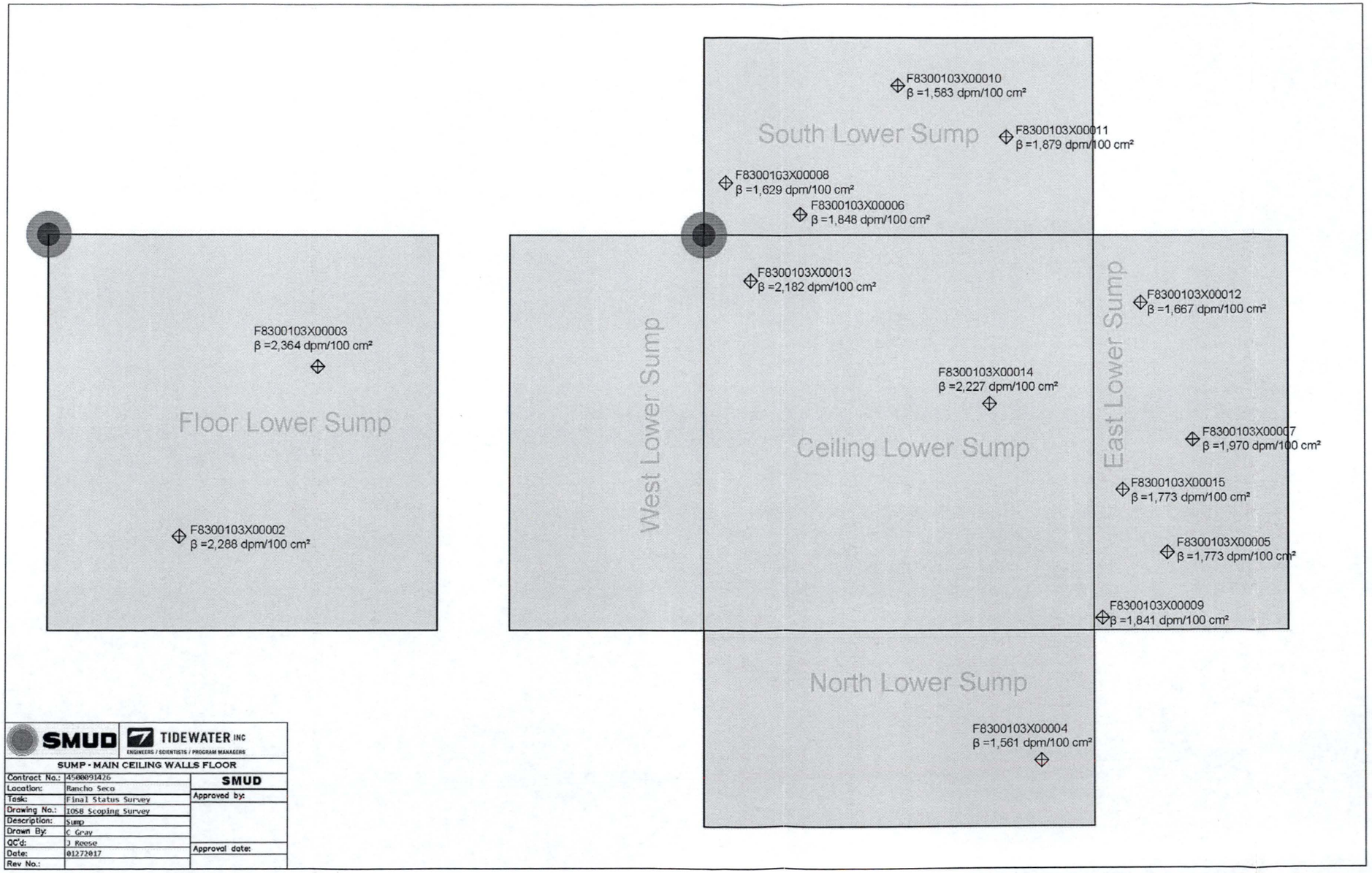
It is concluded that survey unit F83001043 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

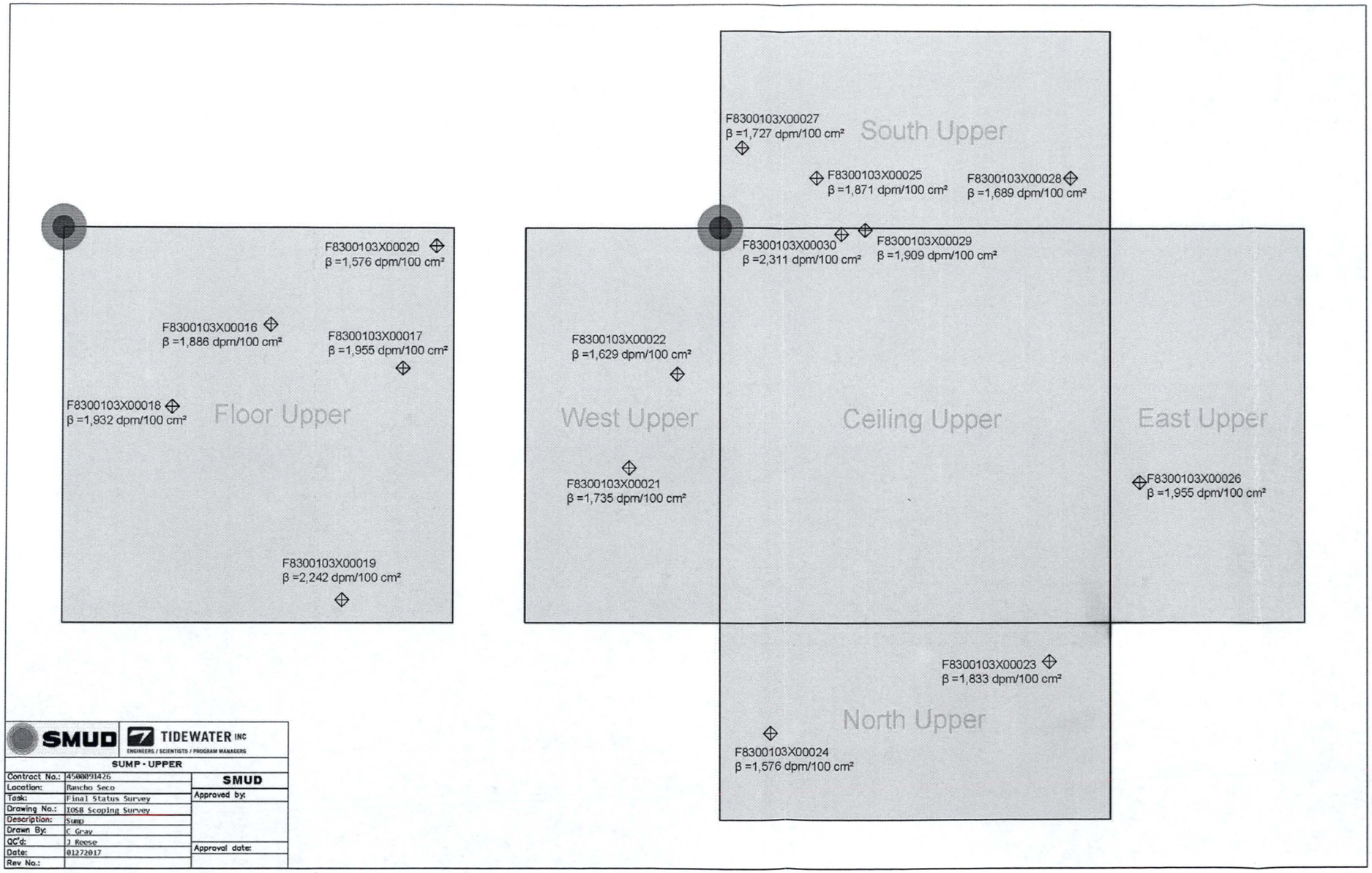
Survey Unit F8300103



SMUD | TIDEWATER INC
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

SUMP - MAIN CEILING WALLS FLOOR

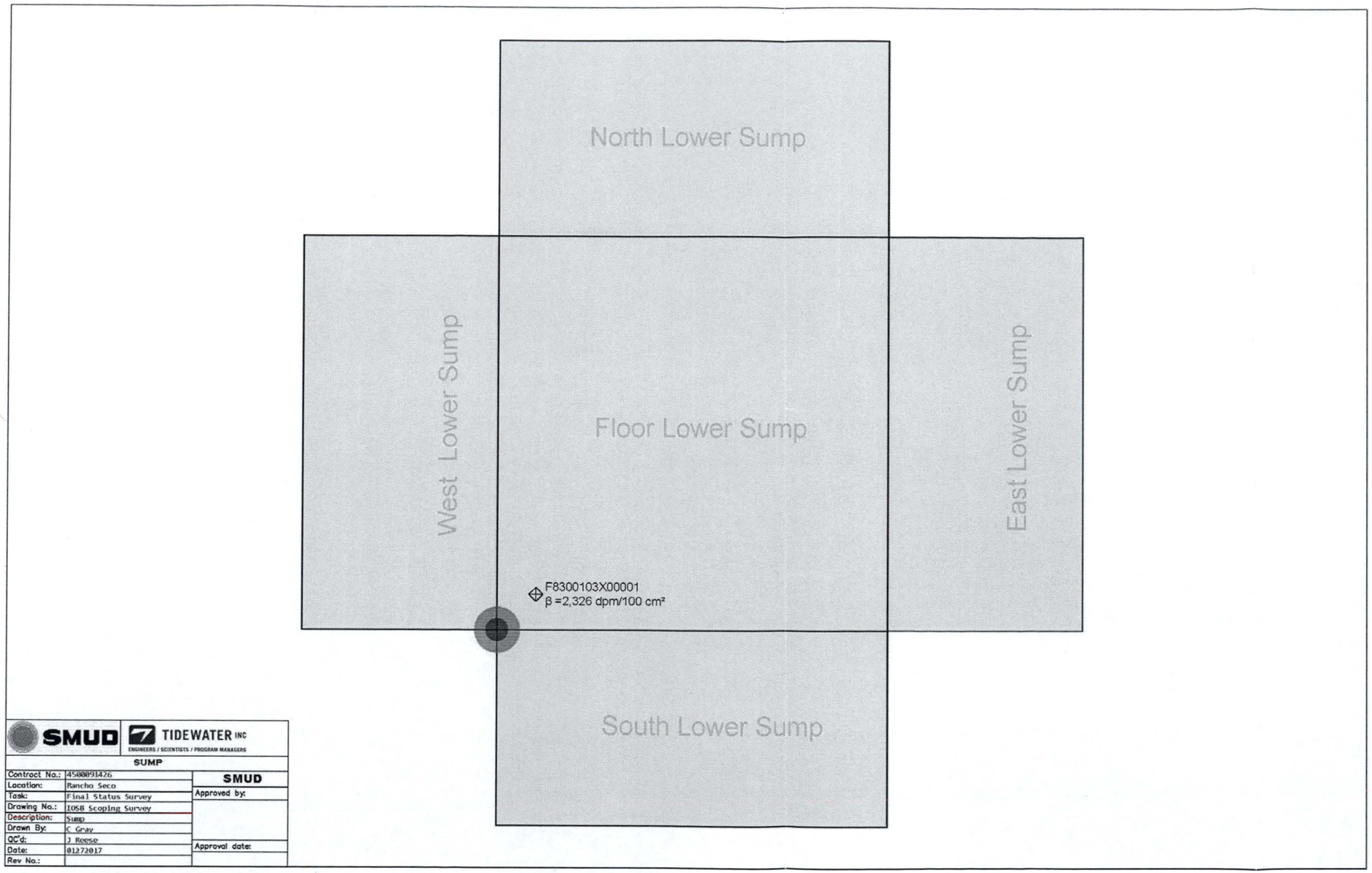
Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Final Status Survey	
Drawing No.:	IOSB Scoping Survey	
Description:	Sump	
Drawn By:	C Gray	
QC'd:	J Reese	Approval date:
Date:	01272017	
Rev No.:		



SMUD | TIDEWATER INC
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

SUMP - UPPER

Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Final Status Survey	
Drawing No.:	IOSB Scoping Survey	
Description:	Sump	
Drawn By:	C Gray	
QC'd:	J Reese	Approval date:
Date:	01272017	
Rev No.:		



SMUD | TIDEWATER INC ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

SUMP

Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Final Status Survey	
Drawing No.:	IOSB Scoping Survey	
Description:	Sump	
Drawn By:	C Gray	
QC'd:	J Reese	Approval date:
Date:	01272017	
Rev No.:		

Attachment 2

Instrumentation

December 12, 2016

Survey Unit F8300103

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 447 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 504 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 74 dpm/100 cm^2	42.8%	166716/170380 11/3/16
Swipe Measurements	Ludlum Model 2929 Ludlum Model 44-10-1	Beta – 79 dpm/100 cm^2	42.8%	166716/170380 11/3/16

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
187	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $= 3 + 4.65(B_r * t)^{0.5}/t * E * A/100$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 504 dpm/100 cm^2

Beta	Survey Type
PR331972	Detector Number
145	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * {}^{A}/_{100}$ (NUREG 1507)

Where:

B_r	Background Countrate
t	Count Time (min)
E	Efficiency
A	Area of detector (cm^2)

Static MDA 447 dpm/100 cm^2

Attachment 3

Investigation

January 30, 2017

Survey Unit F8300103

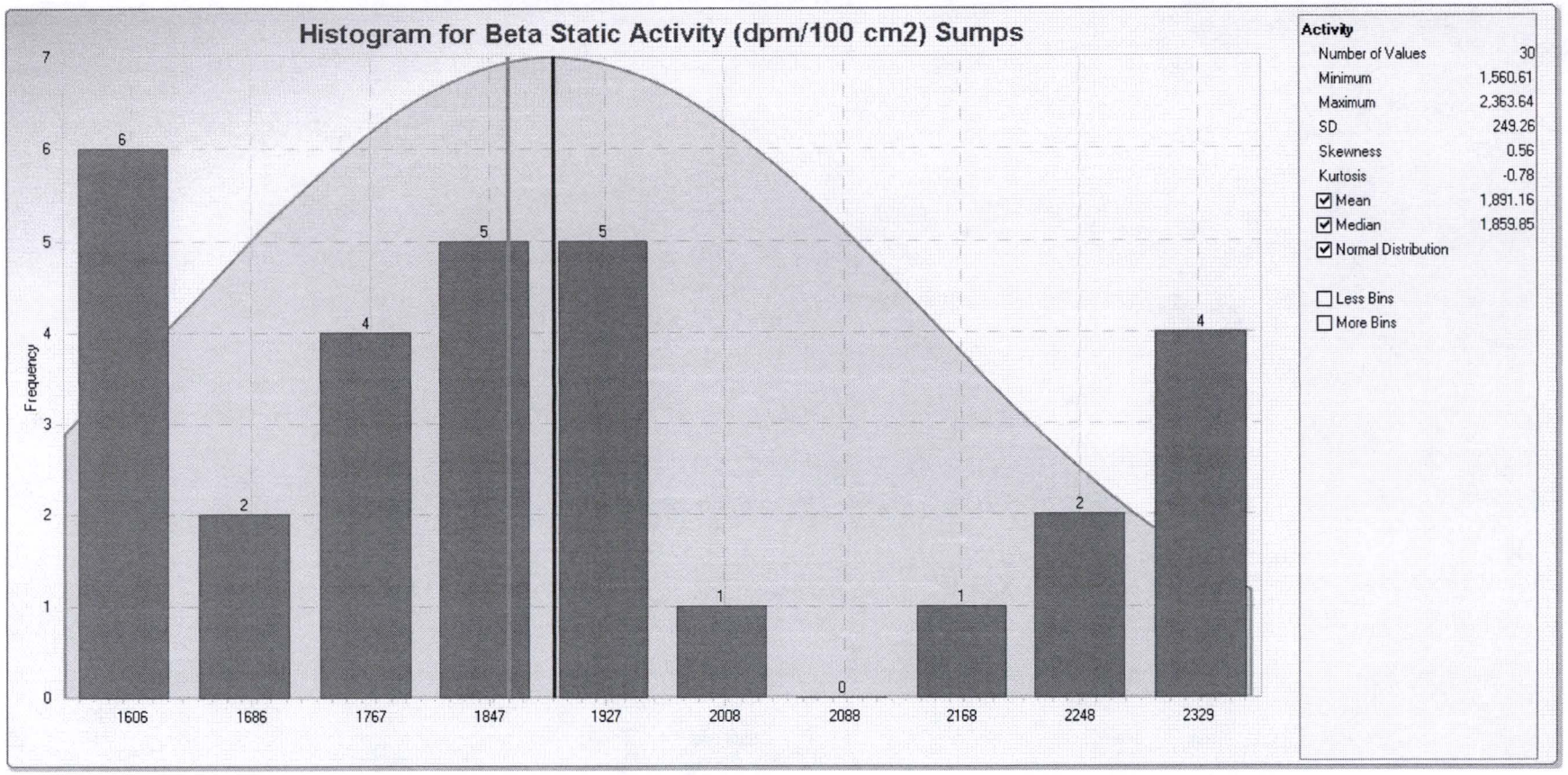
(none required)

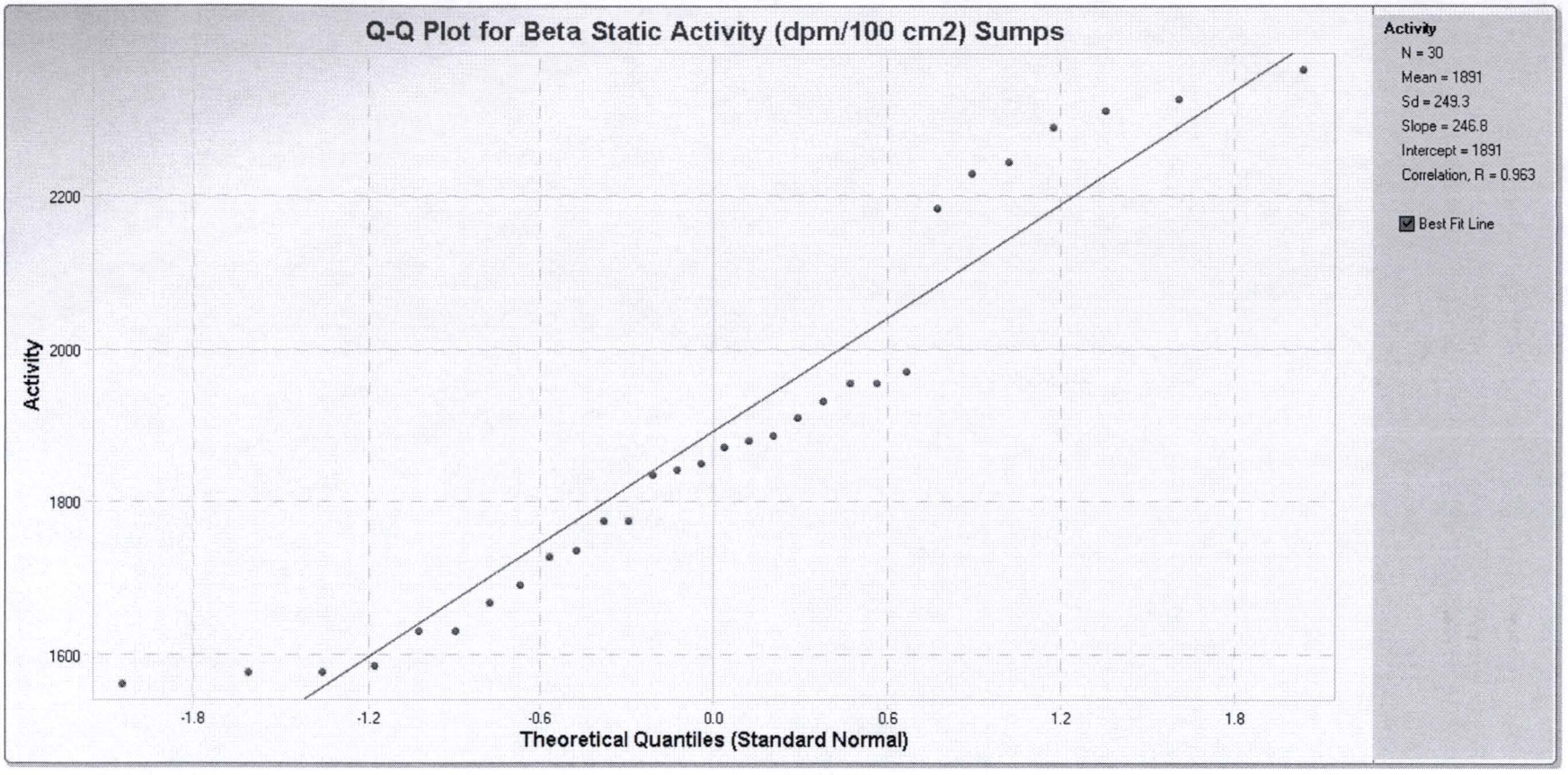
Attachment 4

Data Assessment

February 2, 2017

Survey Unit F8300103


Histogram for Beta Static Activity (dpm/100 cm2) Sumps
Frequency
0
1
2
3
4
5
6
7
6
2
4
5
5
1
0
1
2
4
1606
1686
1767
1847
1927
2008
2088
2168
2248
2329
Activity
Number of Values 30
Minimum 1,560.61
Maximum 2,363.64
SD 249.26
Skewness 0.56
Kurtosis -0.78
Mean 1,891.16
Median 1,859.85
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100 cm2) Sumps
Activity
2200
2000
1800
1600
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Activity
N = 30
Mean = 1891
Sd = 249.3
Slope = 246.8
Intercept = 1891
Correlation, R = 0.963
Best Fit Line

Smear_Data_Calculation_Sheet_101316

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
1	*F830*	*010*	*3*	*C*	*00001*	*SM*	Lower Sump	47	-7	10/21/16	0930	
2	F830	010	3	C	*00002*	SM	Lower Sump	41	-21	10/21/16	0932	
3	F830	010	3	C	*00003*	SM	Lower Sump	44	-14	10/21/16	0935	
4	F830	010	3	C	*00004*	SM	Lower Sump	42	-18	10/21/16	0937	
5	F830	010	3	C	*00005*	SM	Lower Sump	56	14	10/21/16	0938	
6	F830	010	3	C	*00006*	SM	Lower Sump	58	19	10/21/16	0940	
7	F830	010	3	C	*00007*	SM	Lower Sump	48	-4	10/21/16	0941	
8	F830	010	3	C	*00008*	SM	Lower Sump	38	-27	10/21/16	0943	
9	F830	010	3	C	*00009*	SM	Lower Sump	40	-23	10/21/16	0945	
10	F830	010	3	C	*00010*	SM	Lower Sump	46	-9	10/21/16	0947	
11	F830	010	3	C	*00011*	SM	Lower Sump	50	0	10/21/16	0948	
12	F830	010	3	C	*00012*	SM	Lower Sump	56	14	10/21/16	0950	
13	F830	010	3	C	*00013*	SM	Lower Sump	48	-4	10/21/16	0951	
14	F830	010	3	C	*00014*	SM	Lower Sump	53	7	10/21/16	0953	
15	F830	010	3	C	*00015*	SM	Lower Sump	53	7	10/21/16	0944	

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date Ben Wilkins 12-2-16

Tech B Sign/ Date N/A

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597

43-10-1 S/N: 188736

Cal Due Date: 5/13/2017

	efficiency	bkg rate	bkg count time	MDA
α	~~0.364~~	3 cpm	1 min	~~25.1~~ 12.2.16 dpm per area
β	0.434	49.9 cpm	1 min	78.7 dpm per area

Copy of Smear_Data_Calculation_Sheet12517jr.xlsx

IOSB Final Status Survey

	LC1	LC2	LC3	LC4	LC6	LC5		β CPM	β dpm	Date/Time of Count		Sample Comments
16	F830	010	3	C	00016	SM	Sumps	43	-1	12/05/16	1045	
17	F830	010	3	C	00017	SM	Sumps	41	-6	12/05/16	1046	
18	F830	010	3	C	00018	SM	Sumps	45	4	12/05/16	1047	
19	F830	010	3	C	00019	SM	Sumps	31	-29	12/05/16	1049	
20	F830	010	3	C	00020	SM	Sumps	37	-15	12/05/16	1050	
21	F830	010	3	C	00021	SM	Sumps	46	6	12/05/16	1051	
22	F830	010	3	C	00022	SM	Sumps	44	1	12/05/16	1053	
23	F830	010	3	C	00023	SM	Sumps	50	15	12/05/16	1054	
24	F830	010	3	C	00024	SM	Sumps	42	-3	12/05/16	1055	
25	F830	010	3	C	00025	SM	Sumps	41	-6	12/05/16	1057	
26	F830	010	3	C	00026	SM	Sumps	40	-8	12/05/16	1058	
27	F830	010	3	C	00027	SM	Sumps	39	-10	12/05/16	1059	
28	F830	010	3	C	00028	SM	Sumps	35	-19	12/05/16	1100	
29	F830	010	3	C	00029	SM	Sumps	48	11	12/05/16	1102	
30	F830	010	3	C	00030	SM	Sumps	44	1	12/05/16	1103	

Comments By signature below, the required source check and background checks were satisfactorily performed prior to use of the instrument identified below.

Tech A Sign/ Date Joe Norris / 12-5-16

Tech B Sign/ Date NA

Ludlum 2929 Benchtop Instrument

2929 S/N: 182597

43-10-1 S/N: 188736

Cal Due Date: 5/13/2017

	efficiency	bkg rate	bkg count time	MDA
α	0.364	3 cpm	1 min	25.1 dpm per area
β	0.434	43.4 cpm	1 min	73.6 dpm per area

Page 1 of 1

Rancho Seco

Final Status Survey Summary Report

February 3, 2017

IOSB Hot Cell Pipe rev1

Survey Unit F8300111

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/19/17

Manager, Rancho Seco Assets

Survey Unit:

F8300111, Interim Onsite Storage Building (IOSB) Hot Cell Drain Pipe

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), the hot cell possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items. Indications of a spill near the hot cell drain were found during the scoping surveys.

Site Characterization: Gamma static measurements were collected approximately every six inches through the various runs of embedded piping (EP) using a pipe detector. Beta static measurements were also collected in the drain trenches in each storage cell, the Truck Bay, and in the DAW Bay. The highest measurement obtained in the EP was collected near the middle of the vertical hot cell drain line at 26,766 dpm. Static measurements in the Hot Cell drain exceeded the grouting action level of 21,000 dpm but did not exceed the DCGL of 100,000 dpm in the vertical run of EP from the hot cell floor to the 90° connection elbow leading to the sump. The drain piping in the Hot Cell was designated as a Class 1 survey unit to distinguish this section of pipe from the remainder of the embedded piping.

Remediation in the form of mechanical decontamination reduced the level of residual contamination below the grouting limit for the vertical run of EP in the Hot Cell Drain (F8300111) and is the subject of this report.

The remainder of the EP was designated as IOSB Embedded Piping Class 3 (F8300123) and is the subject of a separate report.

Survey Unit Design Information:

Static measurement locations were collected approximately every six inches of accessible piping as specified in the License Termination Plan. Scanning of the length of piping was not conducted due to the number of static measurements collected. Following the scoping survey, decontamination was performed in the vertical section of pipe leading from the hot cell to the 90^0 elbow, a distance of approximately four feet.

A total of 10 static measurements were collected in a total of 5.5 linear feet of the hot cell vertical section of embedded piping. Data collected was compared directly to the DCGL for embedded piping of 100,000 dpm/100 cm^2. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Survey Results:

A total of 10 direct measurements were made in F8300111 for the final status survey. **Table 1** provides a listing of the direct measurement results. A statistical summary of the results of the static measurements are summarized in **Table 2**. All of the static measurements were less than the DCGL of 100,000 dpm/100 cm^2. None of the scan measurements indicated areas of elevated activity or required grouting of the piping (>21,000 dpm/100 cm^2).

Table 1, Gamma Static Measurements

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300011M00001	10,897	13,776
2	F8300011M00002	12,497	15,798
3	F8300011M00003	12,524	15,833
4	F8300011M00004	12,790	16,169
5	F8300011M00005	12,414	15,694
6	F8300011M00006	12,497	15,798
7	F8300011M00007	12,875	16,276
8	F8300011M00008	12,378	15,648
9	F8300011M00009	13,224	16,718
10	F8300011M00010	11,844	14,973

Table 2, Static Measurement Results

Gamma Static Hot Cell Drain Pipe	
Mean	15,669
Median	15,799
Standard Deviation	806
Minimum	13,776
Maximum	16,718
Count	10

Survey Unit Data Assessment:

The survey design was based upon guidance in the RSLTP and resulted in 10 static measurements. Following the guidance in the RSLTP, these values are compared directly to the DCGL of 100,000 dpm/100 cm^2.

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

Residual radioactivity following remediation is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed in accordance with the RSLTP. The section of pipe was designated as a Class 1 survey area to distinguish it from the other embedded pipe as scoping measurements exceed the grout action level of 21,000 dpm/100 cm^2. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 1 survey based on the results of the scoping survey and the need to perform remediation. The sample density as specified in the RSLTP for embedded piping was met. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

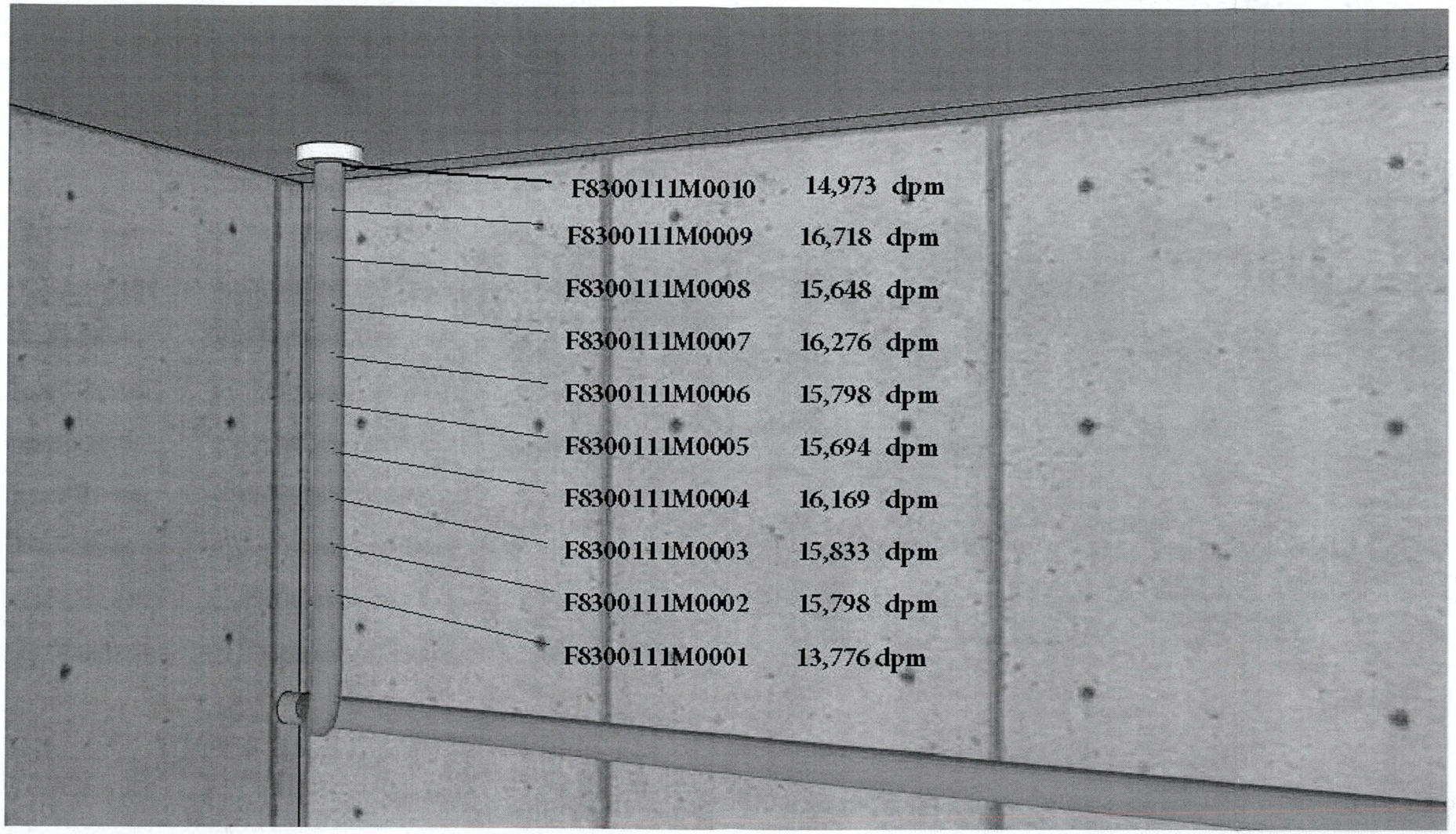
It is concluded that survey unit F8300111meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

February 9, 2017

Survey Unit F8300111


F8300111M0010 14,973 dpm
F8300111M0009 16,718 dpm
F8300111M0008 15,648 dpm
F8300111M0007 16,276 dpm
F8300111M0006 15,798 dpm
F8300111M0005 15,694 dpm
F8300111M0004 16,169 dpm
F8300111M0003 15,833 dpm
F8300111M0002 15,798 dpm
F8300111M0001 13,776 dpm

Attachment 2

Instrumentation

February 6, 2017

Survey Unit F8300111

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Gamma Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-157 Detector	398 dpm/100 cm^2	0.791%	203481/201151 4/15/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Gamma	Survey Type
201151	Detector Number
4500	Background count rate (cpm)
1	Count Time (min)
0.791	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $= 3 + 4.65(B_r * t)^{0.5}/t * E * A/100$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 398 dpm/100 cm^2

Attachment 3

Investigation

February 6, 2017

Survey Unit F8300111

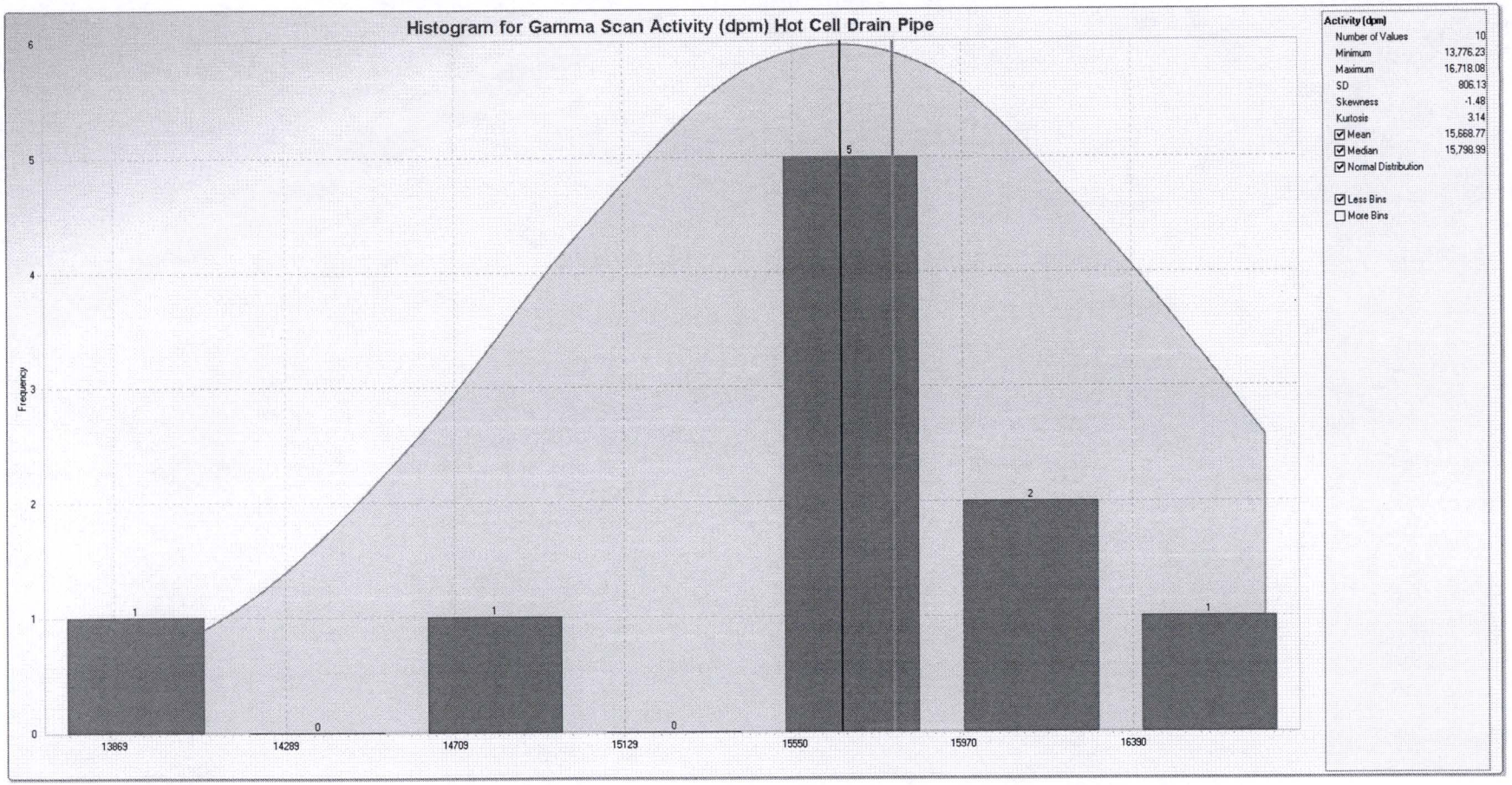
(none required)

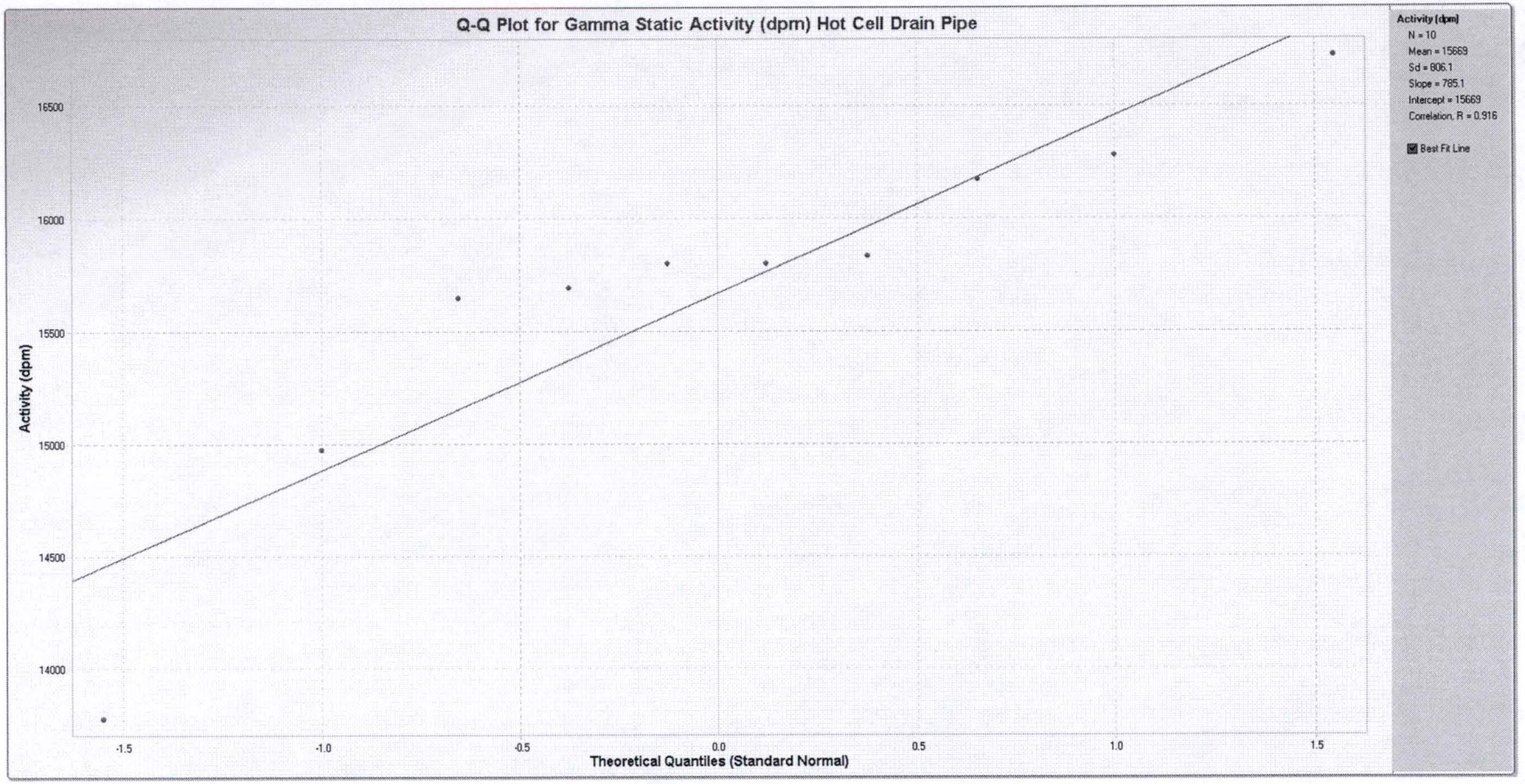
Attachment 4

Data Assessment

February 9, 2017

Survey Unit F8300111


Histogram for Gamma Scan Activity (dpm) Hot Cell Drain Pipe
Frequency
0
1
2
3
4
5
6
13869
14289
14709
15129
15550
15970
16390
1
0
1
0
5
2
1
Activity (dpm)
Number of Values 10
Minimum 13,776.23
Maximum 16,718.08
SD 806.13
Skewness -1.48
Kurtosis 3.14
Mean 15,668.77
Median 15,798.99
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Gamma Static Activity (dpm) Hot Cell Drain Pipe
Activity (dpm)
16500
16000
15500
15000
14500
14000
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity (dpm)
N = 10
Mean = 15669
Sd = 806.1
Slope = 785.1
Intercept = 15669
Correlation, R = 0.916
Best Fit Line

Rancho Seco

Final Status Survey Summary Report

January 25, 2017

IOSB Embedded Pipe rev1

Survey Unit F8300123

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/18/17

Manager, Rancho Seco Assets

Survey Unit:

F8300123, Interim Onsite Storage Building (IOSB) Embedded Piping

Survey Unit Description:

Operating History: The drain and piping system in the IOSB collected liquids from the building either via trench drains (storage cells, DAW Bay, and Truck Bay), or via floor drains. Areas of elevated residual radioactivity were identified in close proximity to the trench drains or floor drains indicating the potential for a spill of radioactive liquid to have traversed down the embedded piping to the sump.

Site Characterization: Gamma static measurements were collected approximately every six inches through the various runs of embedded piping using a pipe detector. Beta static measurements were also collected in the drain trenches in each storage cell, the Truck Bay, and in the DAW Bay.

Measurements indicated residual radioactivity in the embedded piping (EP) of the hot cell drain. The highest measurement obtained in the embedded piping was collected in the hot cell drain line at 26,766 dpm. This value exceeds the level for grouting of piping listed in the RSLTP. Based upon this level, the Hot Cell Drain Pipe (F8300111) was designated as a Class 1 Survey Unit to allow it to be handled separately from the remaining EP. The purpose of designating this section of pipe as a Class 1 was because of the residual activity and the need to perform remediation. A Class 2 buffer survey area was not designated because the density of survey points for EP is independent of classification and is dictated by the RSLTP. Based on the levels of gross activity reported, the remaining EP was determined to be a Class 3 (F8300123) area as residual radioactivity was not detected during scoping surveys.

The IOSB Embedded Pipe (F8300123) is the Class 3 EP and is the subject of this report and the Hot Cell Embedded Pipe (F8300111) is the Class 1 EP associated with the hot cell drain and is the subject of a separate report.

Survey Unit Design Information:

Static measurement locations were collected every six inches of accessible piping as specified in the License Termination Plan. Scanning of the length of piping was not conducted due to the number of static measurements collected. Piping was surveyed in defined segments as shown in **Table 1**.

A total of 504 static measurements were collected in a total of 255 linear feet of embedded piping. This corresponds to a measurement collected on average every 6.07 inches of piping and is consistent with the guidance from the RSLTP for embedded piping. Data collected was compared directly to the DCGL for embedded piping of 100,000 dpm. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Survey Results:

A total of 504 direct measurements were made in F8300123. The results of the static measurements are summarized in **Table 1**. All of the static measurements were less than the DCGL of 100,000 dpm. None of the measurements indicated areas of elevated activity or required grouting of the piping (>21,000 dpm).

Table 1, Static Measurement Results

Section of Embedded Piping	Length of Pipe Run (feet)	Number of Measurements	Range of Measurements (dpm)
DAW Bay to Sump	86	154	4,090 – 7,168
DAW Staging Bay to DAW line	40	87	3,819 – 12,437
Cell C-1 to Sump	6	11	6,195 – 6,915
Truck Bay Trench to Truck Bay Sump	28	61	5,764 – 6,657
Truck Bay Sump to Sump 4 inch	16	34	1,100 – 1,659
Truck Bay Sump to Sump 6 inch	23	47	5,935 – 9,376
Cask Wash Down to Sump	20	40	3,620 – 5,518
Expansion line from Sump	36	70	4,880 – 6,700

Table 2 contains the statistical summary of the static measurement data for the Embedded Piping.

Table 2, Gamma Summary Statistics

	Embedded Piping
Mean	5,038
Median	5,097
Standard Deviation	1,355
Minimum	1,100
Maximum	12,437
Count	504

Survey Unit Data Assessment:

The survey design required a static measurement every six inches of accessible piping. Based upon the estimated length of piping and the number of measurements collected, the FSS resulted in a measurement roughly every 6.07 inches. All measurements were less than the DCGL.

Survey Unit Investigations and Results:

No investigations were required for the direct measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designated as a Class 3 survey area and surveyed in accordance with the RSLTP for embedded pipe. Measurements were collected every 6.07 inches on average per the RSLTP. However this did not affect the survey effectiveness as no potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the results of the scoping survey. The required number of direct measurements made met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

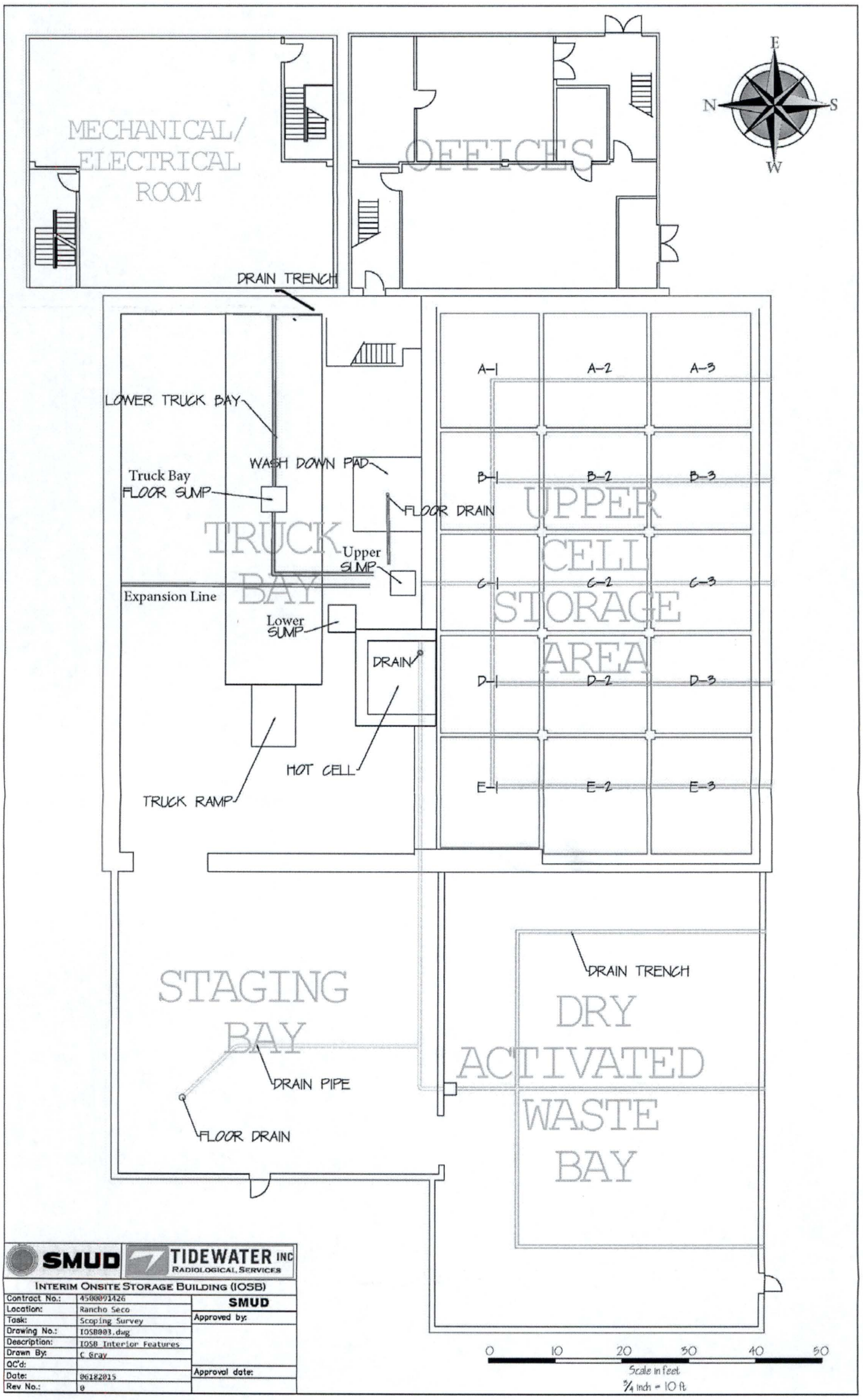
It is concluded that survey unit F8300123 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

February 9, 2017

Survey Unit F8300123


MECHANICAL/
ELECTRICAL
ROOM
OFFICES
E
N
S
W
DRAIN TRENCH
LOWER TRUCK BAY
WASH DOWN PAD
Truck Bay
FLOOR SUMP
FLOOR DRAIN
TRUCK
BAY
Upper
SUMP
Expansion Line
Lower
SUMP
DRAIN
HOT CELL
TRUCK RAMP
A-1
A-2
A-3
B-1
B-2
B-3
UPPER
CELL
STORAGE
AREA
C-1
C-2
C-3
D-1
D-2
D-3
E-1
E-2
E-3
STAGING
BAY
DRAIN PIPE
FLOOR DRAIN
DRAIN TRENCH
DRY
ACTIVATED
WASTE
BAY
0
10
20
30
40
50
Scale in feet
3/4 inch = 10 ft
SMUD
TIDEWATER INC
RADIOLOGICAL SERVICES
INTERIM ONSITE STORAGE BUILDING (IOSB)
Contract No.: 4500091426
Location: Rancho Seco
Task: Scoping Survey
Drawing No.: IOSB003.dwg
Description: IOSB Interior Features
Drawn By: C Gray
QC'd:
Date: 06182015
Rev No.: 0
SMUD
Approved by:
Approval date:

Attachment 2

Instrumentation

January 25, 2017

Survey Unit F8300123

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Gamma Static Measurement 4 inch pipe	Ludlum Model 2350-1 Ludlum Model 44-157 Detector	398 dpm/100 cm^2	0.791%	203481/201151 4/15/17
Gamma Static Measurement 6 inch pipe	Ludlum Model 2350-1 Ludlum Model 44-159 Detector	247 dpm/100 cm^2	0.511%	203482/010057 6/30/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Gamma	Survey Type
201151	Detector Number
4500	Background count rate (cpm)
1	Count Time (min)
0.791	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * {}^{A}/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 398 dpm/100 cm^2

Gamma	Survey Type
10057	Detector Number
700	Background count rate (cpm)
1	Count Time (min)
0.511	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * A/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 247 dpm/100 cm^2

Attachment 3

Investigation

January 25, 2017

Survey Unit F8300123

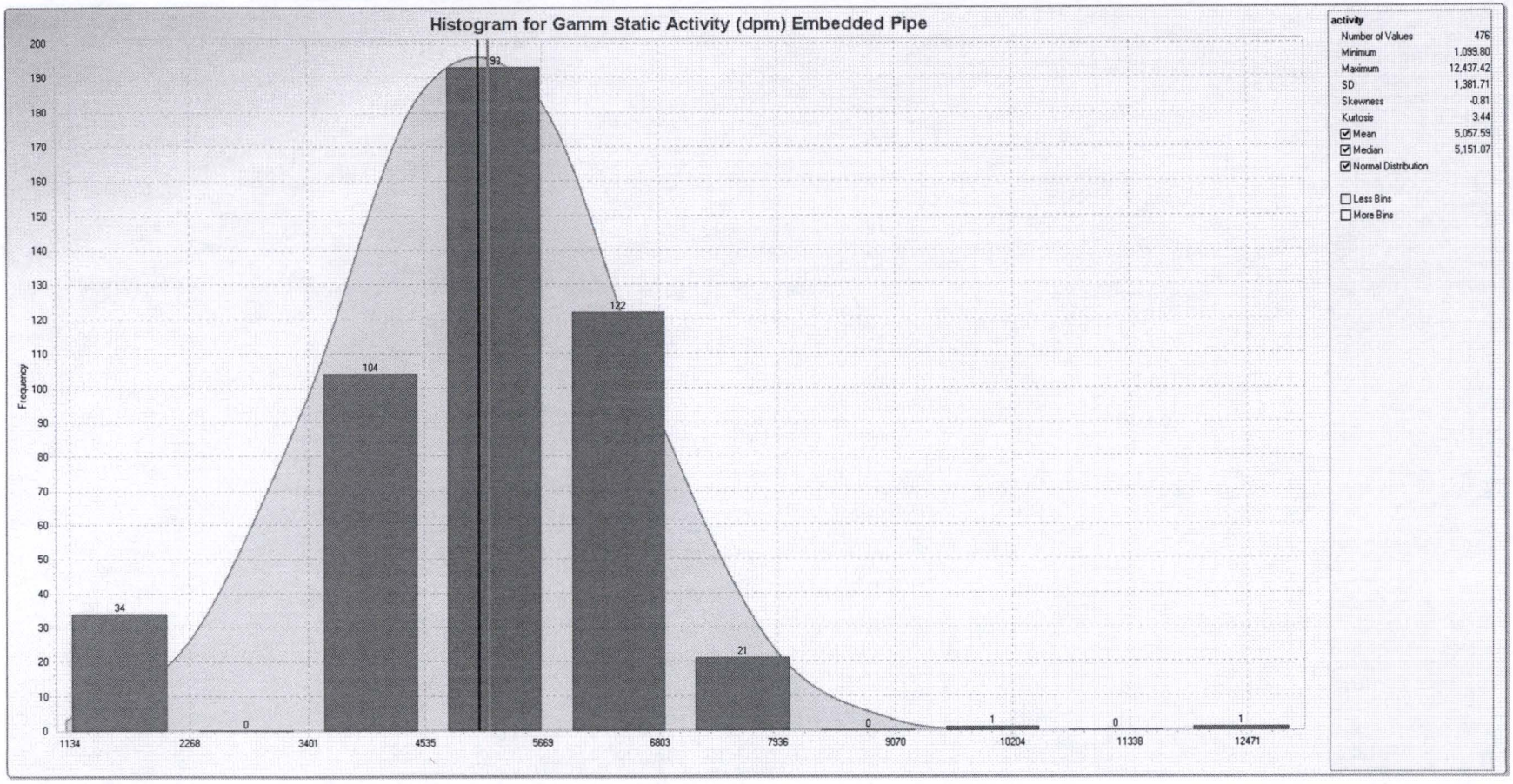
(none required)

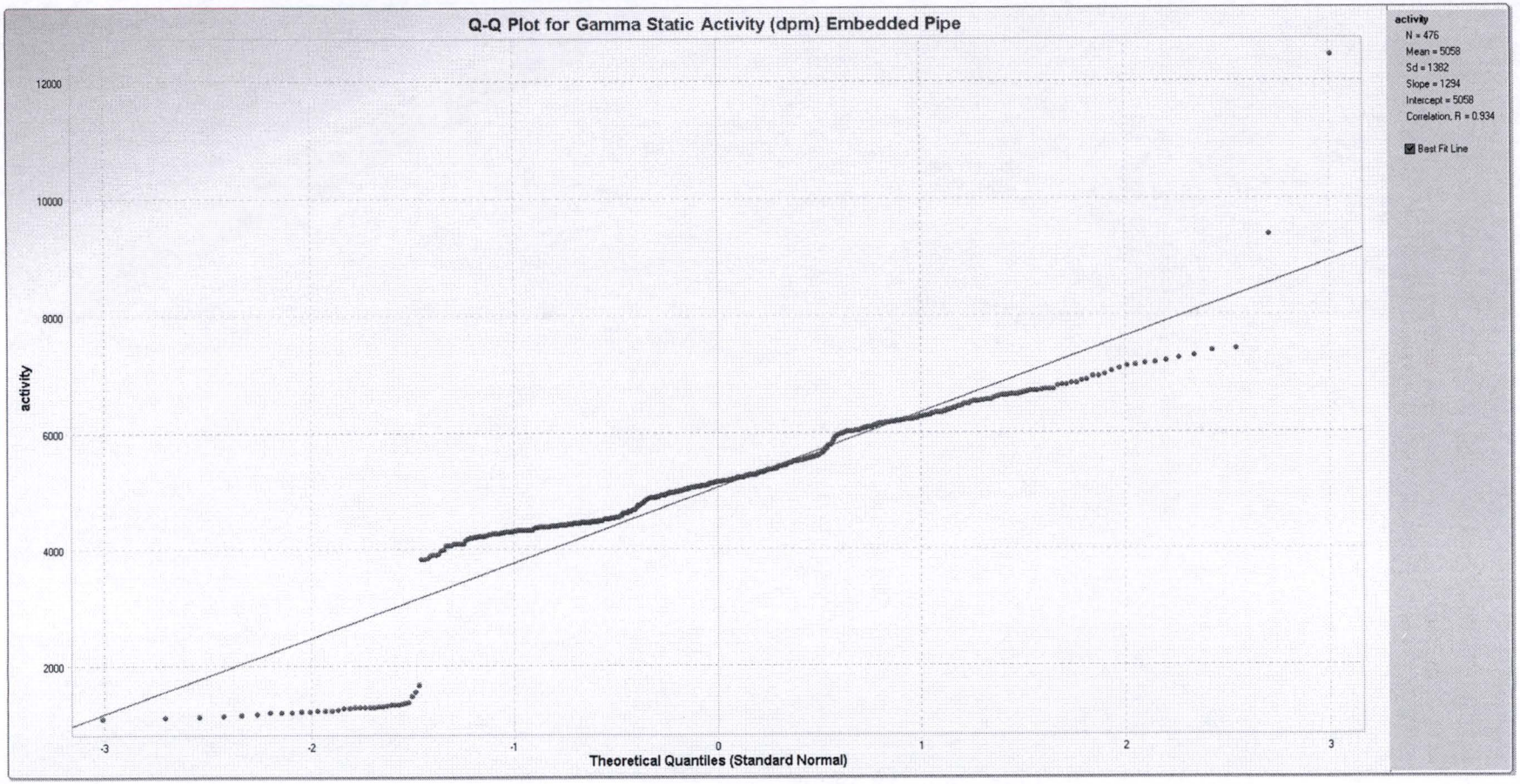
Attachment 4

Data Assessment

January 25, 2017

Survey Unit F8300123


Histogram for Gamm Static Activity (dpm) Embedded Pipe
Frequency
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
34
0
104
193
122
21
0
1
0
1
1134
2268
3401
4535
5669
6803
7936
9070
10204
11338
12471
activity
Number of Values 476
Minimum 1,099.80
Maximum 12,437.42
SD 1,381.71
Skewness -0.81
Kurtosis 3.44
Mean 5,057.59
Median 5,151.07
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Gamma Static Activity (dpm) Embedded Pipe
activity
N = 476
Mean = 5058
Sd = 1382
Slope = 1294
Intercept = 5058
Correlation, R = 0.934
Best Fit Line
12000
10000
8000
6000
4000
2000
activity
-3
-2
-1
0
1
2
3
Theoretical Quantiles (Standard Normal)

Rancho Seco

Final Status Survey Summary Report

January 30, 2017

IOSB Outside Area Class 1 rev1

Survey Unit F8300141

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/18/17

Manager, Rancho Seco Assets

Survey Unit:

F8300141, Interim Onsite Storage Building (IOSB) Outside Area Class 1

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), the IOSB possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items. The outside asphalt area at times held waste ready to ship in storage containers and a respiratory cleaning facility.

Site Characterization: Scanning of the outside asphalt area identified an elevated area requiring remediation adjacent to the IOSB. Certain spots in the area exceeded the $DCGL_W$ but not the $DCGL_{EMC}$. The Outside area was divided into a small Class 1 Survey Unit, buffered by a Class 2 Survey Unit. The remaining environmental areas, Outside Area Class 3 (F8300143) Survey Unit is the subject of a separate report. The Outside Area Class 1 (F8300141) requiring remediation had a maximum static value of approximately 242,497 dpm/100 cm^2. The Outside Area Class 1 (F8300141) is the subject of this report.

The Outside Area Class 2 (F8300142) and Class 3 (F8300143) are the subject of separate reports.

Survey Unit Design Information:

In accordance with MARSSIM Section 4.6, special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is unnecessarily large and not appropriate for smaller survey unit areas. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs. This survey unit meets this criterion as the size is less than one square meter (0.37 m^2).

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were based upon professional judgment in accordance with MARSSIM guidance and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Outside Asphalt Class 1
Survey Unit:	**014**	
Class	**1**	
SU Area (m^2)	**0.37**	0.37 m^2
Evaluator:	JR	
$DCGL_W$:	43,000	Gross Activity DCGL
Area Factor	22.1	DTBD-05-003
Design DCGLemc (dpm/100cm^2):	950,300	
$DCGL_{emc}$:	950,300	
LBGR:	21,500	Default = 50% DCGL
Sigma:	513	Generic Sigma
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.130	
Total Area Scanned (m^2):	0.37	
Scan Coverage (%)	100%	Class 1
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	41.9	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	5	Values selected based upon Judgement
N-Value+20%:	N/A	

Survey Results:

A total of 5 direct measurements were made in F8300141. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300141A00001	370	2,803
2	F8300141A00002	353	2,674
3	F8300141A00003	313	2,371
4	F8300141A00004	347	2,629
5	F8300141A00005	350	2,652

Table 3 contains the statistical summary of the static measurement data for the Outside Area Class 1.

Table 3, Beta Summary Statistics

Beta Static Outside Asphalt Class 1	
Mean	2,626
Median	2,652
Standard Deviation	158
Minimum	2,371
Maximum	2,803
Count	5

Survey Unit Data Assessment:

The survey design was based upon professional judgement and resulted in 5 static measurements. Following the guidance in MARSSIM Section 4.6, these values are compared directly to the $DCGL_W$.

The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	5	
Median:	2,652	
Mean:	2,626	
Static Data Standard Deviation:	158	
Maximum:	2,803	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	N/A	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements collected for the FSS and no investigation results are reported.

ALARA Statement:

Residual radioactivity following remediation is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 1 survey and the sample results are consistent with that classification. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 1 survey based on the results of the investigation survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

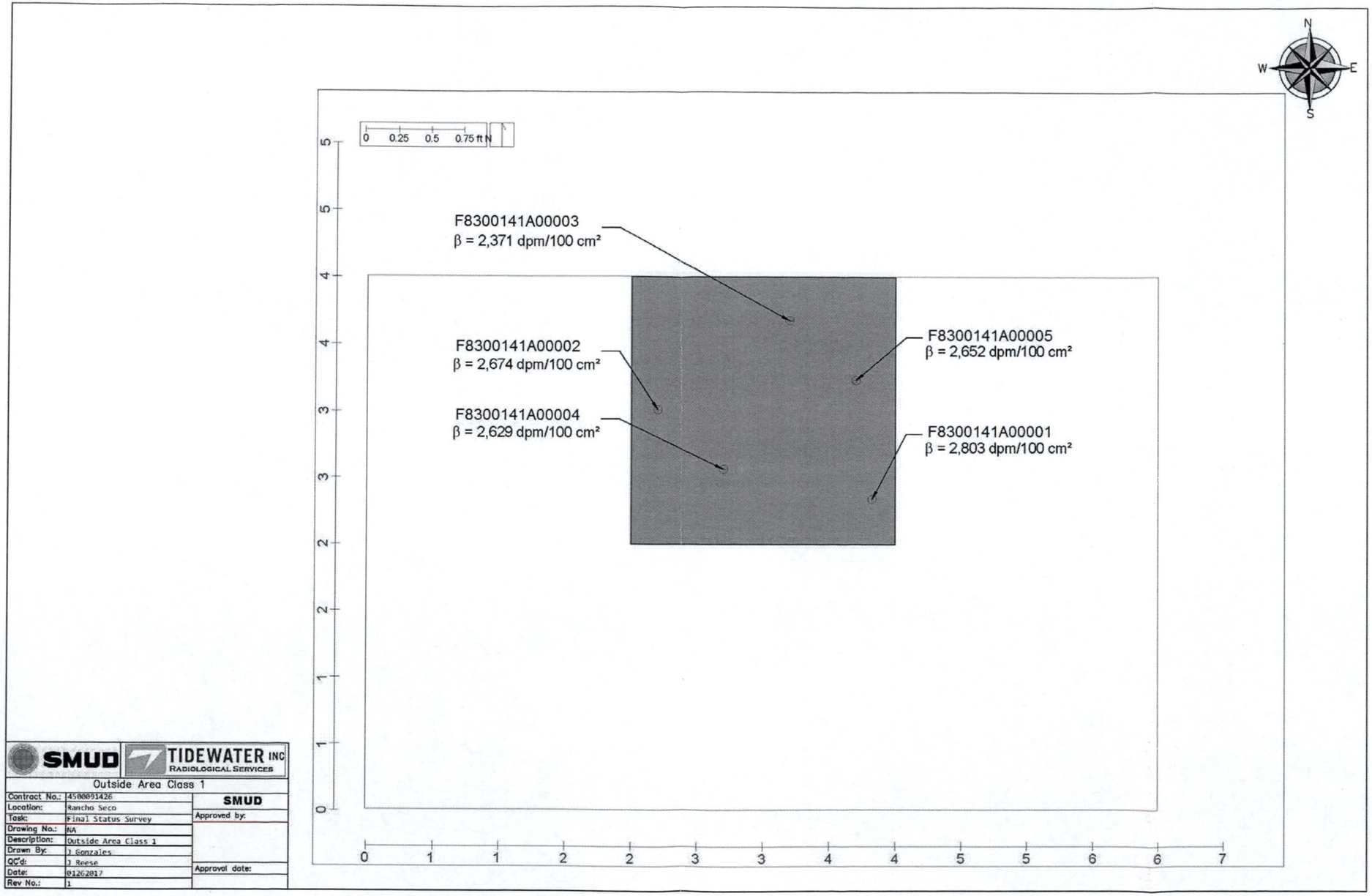
It is concluded that survey unit F8300141 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

Survey Unit F8300141



SMUD | TIDEWATER INC RADIOLOGICAL SERVICES

Outside Area Class 1

Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Final Status Survey	
Drawing No.:	NA	
Description:	Outside Area Class 1	
Drawn By:	J Gonzales	
QC'd:	J Reese	Approval date:
Date:	01262017	
Rev No.:	1	

Attachment 2

Instrumentation

January 30, 2017

Survey Unit F83000141

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 515 dpm/100 cm^2	13.2%	317897/331972 2/10/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
195	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * {}^{A}/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 515 dpm/100 cm^2

Attachment 3

Investigation

January 30, 2017

Survey Unit F8300141

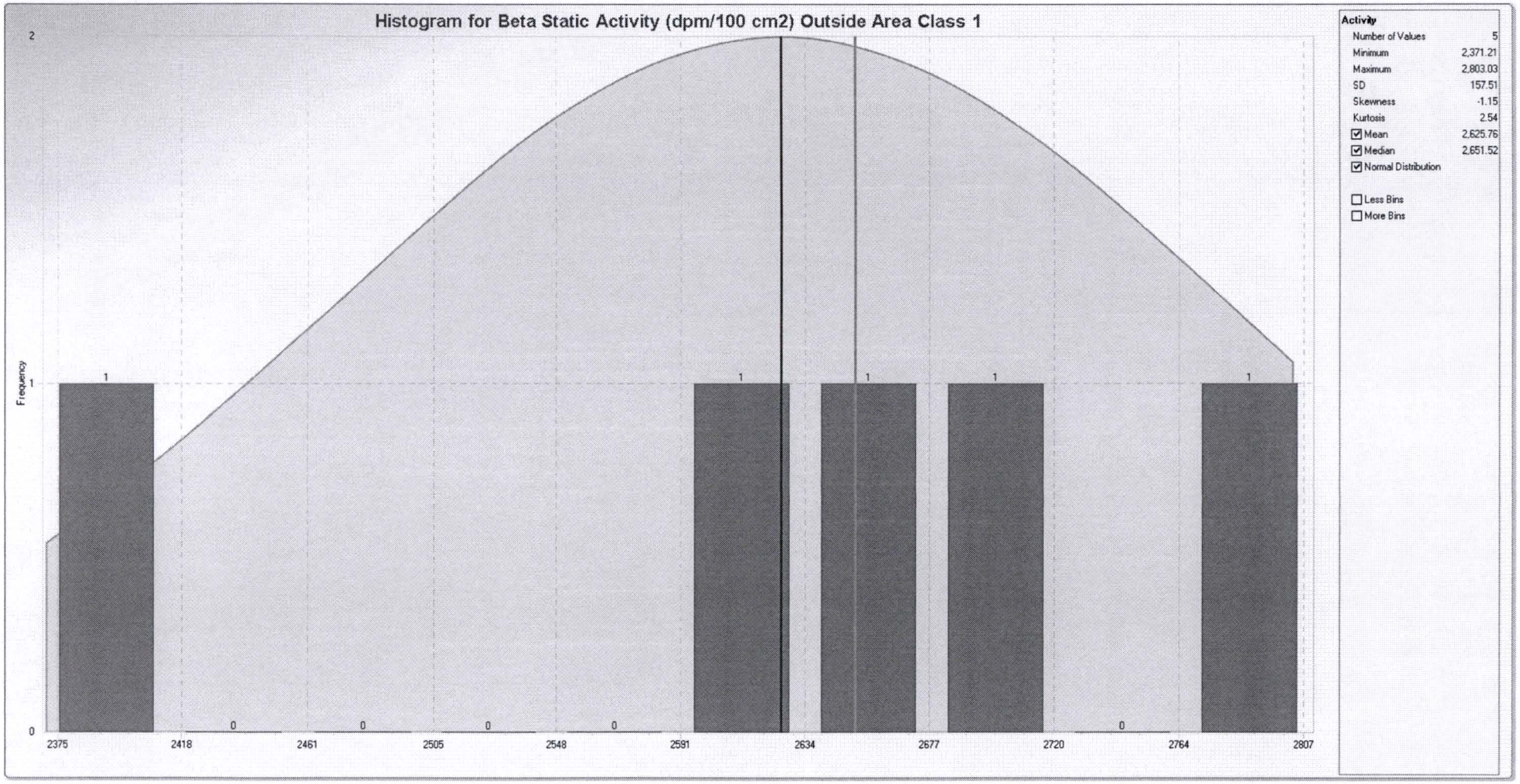
(none)

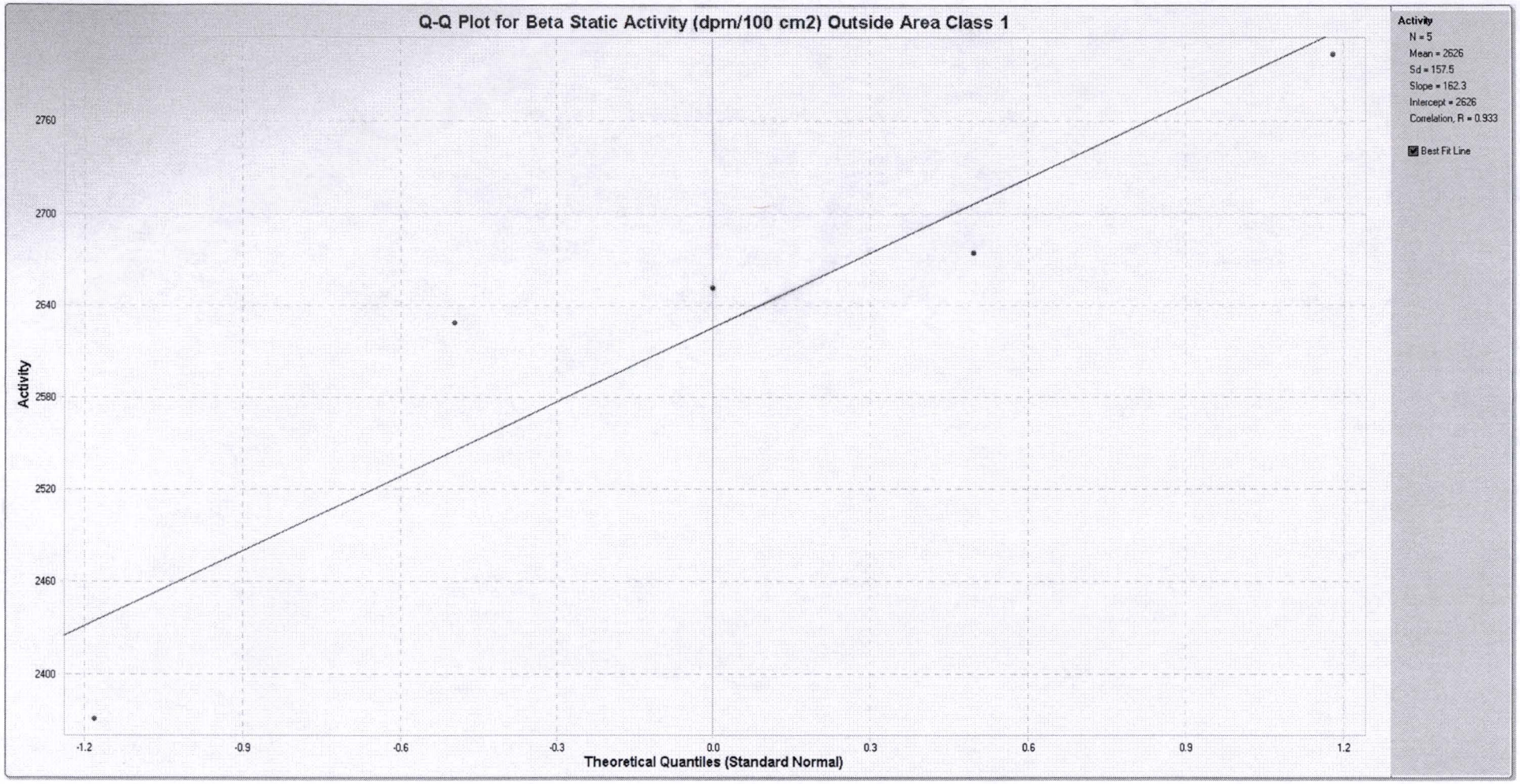
Attachment 4

Data Assessment

January 25, 2017

Survey Unit F8300141


Histogram for Beta Static Activity (dpm/100 cm2) Outside Area Class 1
Frequency
2
1
0
1
0
0
0
0
1
1
1
1
0
1
2375
2418
2461
2505
2548
2591
2634
2677
2720
2764
2807
Activity
Number of Values 5
Minimum 2,371.21
Maximum 2,803.03
SD 157.51
Skewness -1.15
Kurtosis 2.54
Mean 2,625.76
Median 2,651.52
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100 cm2) Outside Area Class 1
Activity
N = 5
Mean = 2626
Sd = 157.5
Slope = 162.3
Intercept = 2626
Correlation, R = 0.933
Best Fit Line
Activity
2760
2700
2640
2580
2520
2460
2400
-1.2
-0.9
-0.6
-0.3
0.0
0.3
0.6
0.9
1.2
Theoretical Quantiles (Standard Normal)

Rancho Seco

Final Status Survey Summary Report

January 30, 2017

IOSB Outside Area Class 2 rev1

Survey Unit F8300142

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/18/17

Manager, Rancho Seco Assets

Survey Unit:

F8300142, Interim Onsite Storage Building (IOSB) Outside Area Class 2

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), the IOSB possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items. The outside asphalt area at times held waste ready to ship in storage containers and a respiratory cleaning facility.

Site Characterization: Scanning of the outside asphalt area identified an elevated area requiring remediation adjacent to the IOSB. Certain spots in the area exceeded the $DCGL_W$ but not the $DCGL_{EMC}$. The outside area was divided into a small Outside Area Class 1 (F8300141) Survey Unit, buffered by a Class 2 (F8300142) Survey Unit. The remainder of the outside area was designated as Outside Area Class 3 (F8300143) Survey Unit. The Class 1 (F8300141) area requiring remediation had a maximum static value of approximately 242,497 dpm/100 cm^2.

The Outside area Class 2 (F8300142) is the subject of this report and the Outside Area Class 1 (F8300141) and Class 3 (F8300143) are separate reports.

Survey Unit Design Information:

In accordance with MARSSIM Section 4.6, special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is unnecessarily large and not appropriate for smaller survey unit areas. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs. This survey unit meets this criterion as the size is less than ten square meters (1.85 m^2).

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were determined by professional judgment in accordance with MARSSIM guidance and approximately 100% of the area scanned. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Outside Asphalt Class 2
Survey Unit:	**014**	
Class	**2**	
SU Area (m^2)	**1.85**	
Evaluator:	JR	
$DCGL_w$:	43,000	Gross Activity DCGL
Area Factor	NA	Class 2
Design DCGLemc ($dpm/100cm^2$):	NA	Class 2
$DCGL_{emc}$:	NA	Class 2
LBGR:	21,500	Default = 50% DCGL
Sigma:	513	
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.132	
Total Area Scanned (m^2):	1.85	
Scan Coverage (%)	100%	Class 2
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	41.9	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	10	Values selected based upon Judgement
N-Value+20%:	NA	Values selected based upon Judgement

Survey Results:

A total of 10 direct measurements were made in F8300142. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300142A00001	266	2,015
2	F8300142A00002	316	2,394
3	F8300142A00003	345	2,614
4	F8300142A00004	340	2,576
5	F8300142A00005	320	2,424
6	F8300142A00006	373	2,826
7	F8300142A00007	350	2,652
8	F8300142A00008	369	2,795
9	F8300142A00009	373	2,826
10	F8300142A00010	343	2,598

Table 3 contains the statistical summary of the static measurement data for the Outside Area Class 2.

Table 3, Beta Summary Statistics

Beta Static Outside Asphalt Class 2	
Mean	2,572
Median	2,606
Standard Deviation	247
Minimum	2,015
Maximum	2,826
Count	10

Survey Unit Data Assessment:

The survey design was based upon professional judgement and resulted in 10 static measurements. Following the guidance in MARSSIM Section 4.6, these values are compared directly to the $DCGL_w$.

The comparison and the results are presented in **Table 4**. The sample mean and median values were less than the DCGL.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	10	
Median:	2,606	
Mean:	2,572	
Static Data Standard Deviation:	247	
Maximum:	2,826	
Sign Test Results		**Comments**
Adjusted N Value:	10	
S+ Value:	10	
Critical Value:	NA	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	NA	
Sign test results:	NA	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 2 survey and the sample results are consistent with that classification. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 2 survey based on the results of the scoping survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

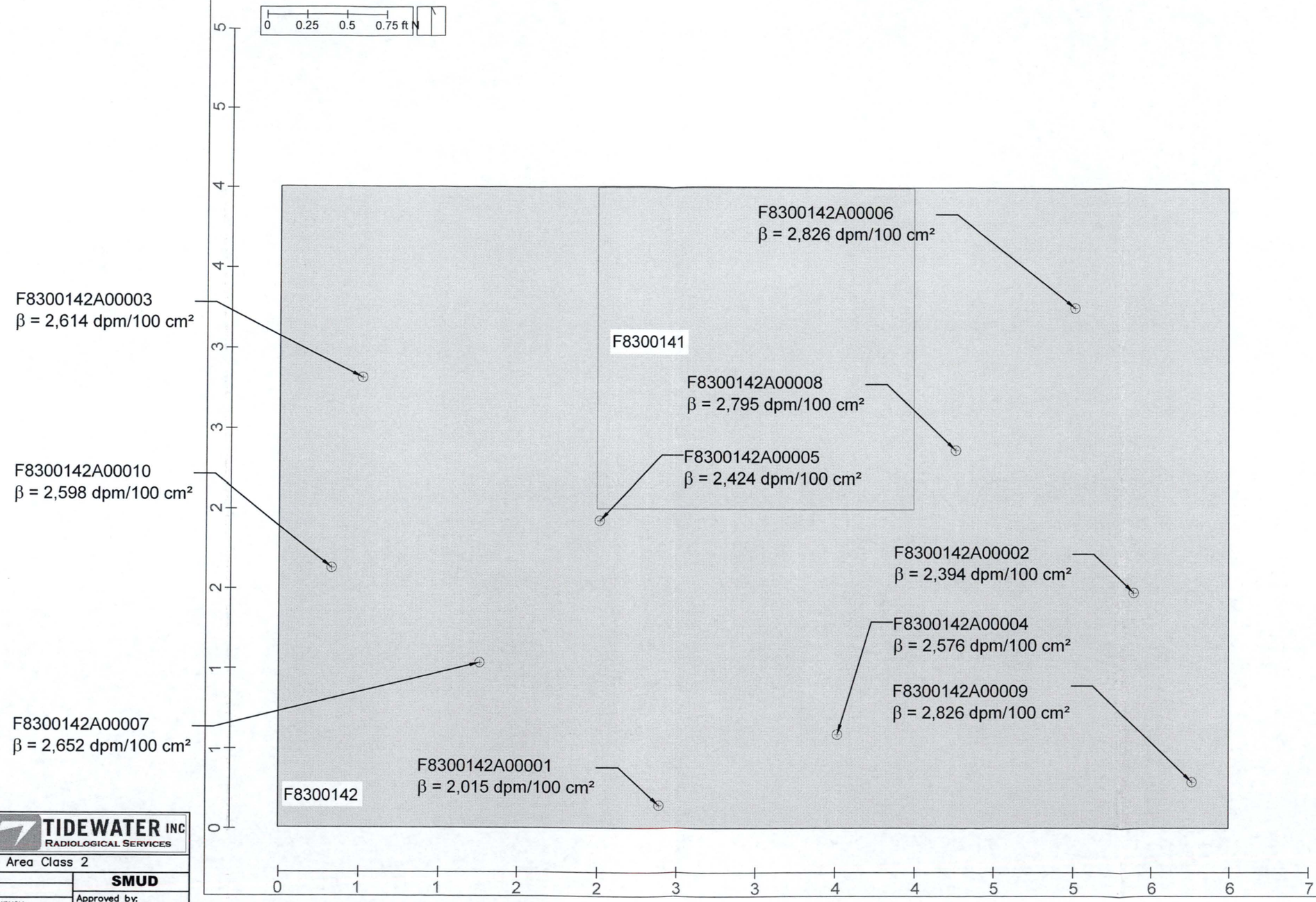
It is concluded that survey unit F8300142 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

Survey Unit F8300142



SMUD | TIDEWATER INC RADIOLOGICAL SERVICES

Outside Area Class 2

Contract No.:	4500091426	SMUD
Location:	Rancho Seco	Approved by:
Task:	Final Status Survey	
Drawing No.:	NA	
Description:	Outside Area Class 2	
Drawn By:	J Gonzales	
QC'd:	J Reese	Approval date:
Date:	01262017	
Rev No.:	2	

Attachment 2

Instrumentation

January 30, 2017

Survey Unit F83000142

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 522 dpm/100 cm^2	13.2%	317897/331972 2/10/17

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
201	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * A/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 522 dpm/100 cm^2

Attachment 3

Investigation

January 30, 2017

Survey Unit F8300142

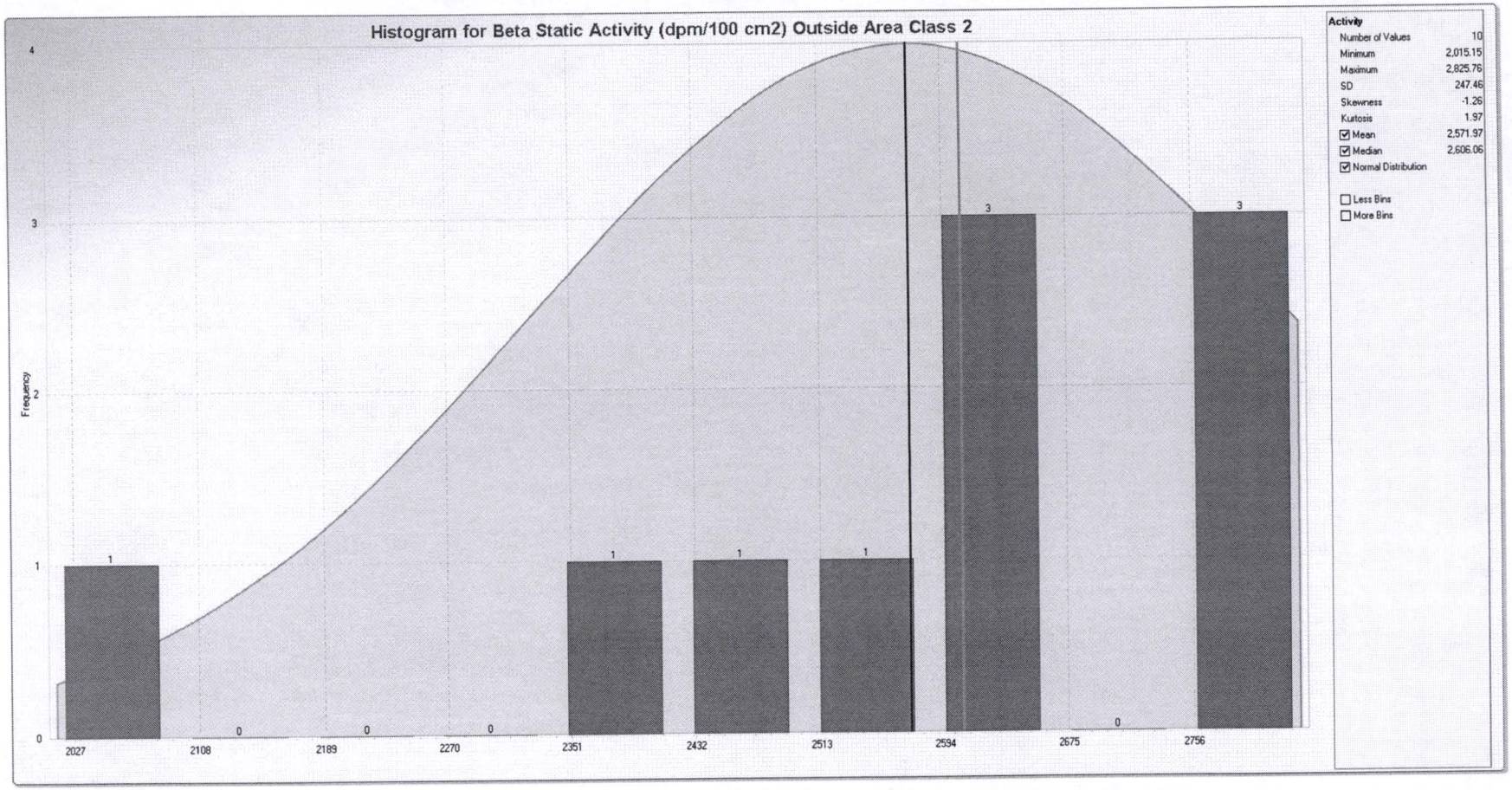
(none)

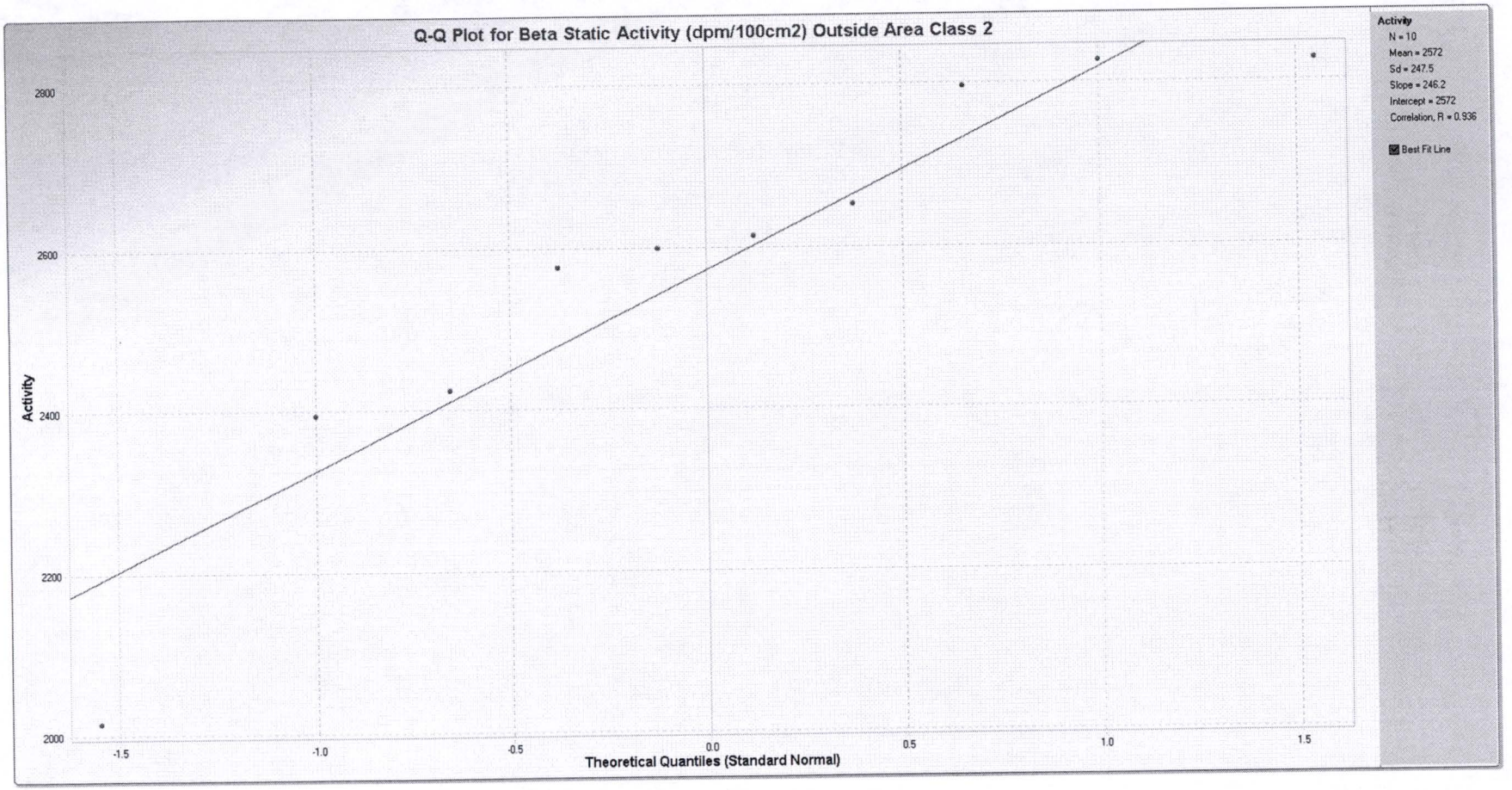
Attachment 4

Data Assessment

January 30, 2017

Survey Unit F8300142


Histogram for Beta Static Activity (dpm/100 cm2) Outside Area Class 2
Frequency
0
1
2
3
4
1
0
0
0
1
1
1
3
0
3
2027
2108
2189
2270
2351
2432
2513
2594
2675
2756
Activity
Number of Values 10
Minimum 2,015.15
Maximum 2,825.76
SD 247.46
Skewness -1.26
Kurtosis 1.97
Mean 2,571.97
Median 2,606.06
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100cm2) Outside Area Class 2
Activity
2800
2600
2400
2200
2000
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity
N = 10
Mean = 2572
Sd = 247.5
Slope = 246.2
Intercept = 2572
Correlation, R = 0.936
Best Fit Line

Rancho Seco

Final Status Survey Summary Report

January 30, 2017

IOSB Outside Area Class 3 rev1

Survey Unit F8300143

Prepared By: _____ **Date:** 4-13-2017

FSS Engineer

Reviewed By: _____ **Date:** 4-13-2017

Lead FSS Engineer

Approved By: _____ **Date:** 4/19/17

Manager, Rancho Seco Assets

Survey Unit:

F8300143, Interim Onsite Storage Building (IOSB) Outside Area Class 3

Survey Unit Description:

Operating History: Designed primarily to store packaged radioactive waste containers safely, protected from the elements, and maintain radiological dose as low as reasonably achievable (ALARA), each storage cell possibly stored media of many types, including filters, resins, contaminated chemicals, DAW, activated reactor components, contaminated plant components and other contaminated items.

Site Characterization: Scanning of the outside asphalt area identified an elevated area requiring remediation adjacent to the IOSB. Certain spots in the area exceeded the $DCGL_W$ but not the $DCGL_{EMC}$. The Outside area was divided into a small Class 1, Outside Area Class 1 (F8300141) Survey Unit, buffered by a Class 2 (F8300142). The Class 1 (F8300141) area requiring remediation had a maximum static value of approximately 242,497 dpm/100 cm^2. The remaining, Outside Area (F8300143) was designated as a Class 3 Survey Unit and is the subject of this report.

The Outside Area Class 1 (F8300141) and Class 2 (F8300142) are separate reports.

Survey Unit Design Information:

The Survey Unit Design Parameters are presented in **Table 1** below. The survey unit and measurement locations are depicted on the maps in **Attachment 1**. Static measurement locations were randomly determined and approximately 100% of the area scanned by gamma scanning. A total of 7 soil samples were collected from the berm area and analyzed by gamma spectroscopy at an offsite laboratory. The instrumentation used for the survey along with the MDC values are listed in **Table 2-1 Attachment 2**.

Table 1, Survey Unit Design Parameters

Evaluation Input Values		Comments
Survey Package:	**F830**	Outside
Survey Unit:	**014**	
Class	**3**	
SU Area (m^2)	**5853**	
Evaluator:	JR	
$DCGL_W$:	43,000	Gross Activity DCGL
Area Factor	NA	Class 3
Design DCGLemc (dpm/100cm^2):	NA	Class 3
LBGR:	21,500	Default = 50% DCGL
Sigma:	513	Scoping Survey Data
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide	Cs-137	
Sample Area (m^2)	N/A	
Total Instrument Efficiency:	0.129	
Total Area Scanned (m^2):	2643	
Scan Coverage (%)	45%	Includes gamma scan of soil and asphalt
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	41.9	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	

Survey Results:

A total of 15 direct measurements were made in F8300143 on the asphalt surface. The results of the static measurements are shown in **Table 2**. All of the static measurements were less than the DCGL. Gamma scanning results identified an area of elevated activity. The DCGL was exceeded and was separated as a Class 1 survey area. All soil sample results did not have detectable activity. The results of the soil samples are contained in **Attachment 5 (Laboratory Analysis- Gamma Spectrometry)** of this report.

Table 2, Static Measurement Results

Number	Sample #	Beta (cpm)	Beta (dpm)
1	F8300143A00015	324	2,455
2	F8300143A00006	340	2,576
3	F8300143A00011	399	3,023
4	F8300143A00013	352	2,667
5	F8300143A00002	393	2,977
6	F8300143A00012	366	2,773
7	F8300143A00004	331	2,508
8	F8300143A00007	356	2,697
9	F8300143A00016	328	2,485
10	F8300143A00017	339	2,568
11	F8300143K00018	341	2,583
12	F8300143A00019	407	3,083
13	F8300143A00020	362	2,742
14	F8300143A00021	301	2,280
15	F8300143A00022	360	2,727

Table 3 contains the statistical summary of the static measurement data for the Outside Area Class 3.

Table 3, Beta Summary Statistics

Beta Static Outside	
Mean	2,676
Median	2,667
Standard Deviation	223
Minimum	2,280
Maximum	3,083
Count	15

Survey Unit Data Assessment:

The survey design required 14 static measurements for the Sign Test. A total of 15 static measurements were collected. The critical value and the results of the Sign Test are presented in **Table 4**. The sample mean and median values were less than the DCGL. The sample standard deviation was greater than the design standard deviation but both values of sigma resulted in a relative shift greater than three (3), no additional samples were required.

Table 4, Data Assessment Results

Static Data Values		Comments
Number of Samples:	15	
Median:	2,667	
Mean:	2,676	
Static Data Standard Deviation:	223	
Maximum:	3,083	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	15	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_W$:	Pass	
Median value <$DCGL_W$:	Pass	
Mean value <$DCGL_W$:	Pass	
Maximum value <$DCGL_{EMC}$:	N/A	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	

Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

ALARA Statement:

The residual activity within the survey unit is less than the DCGL and meets the ALARA criterion as determined in Chapter 4 of the LTP.

Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 survey and the sample results are consistent with that classification. No individual measurement exceeded the DCGL. No potential areas of elevated activity were detected.

Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on the results of the investigation survey. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. All of the static measurements were less than the DCGL. No investigations were required.

The static measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

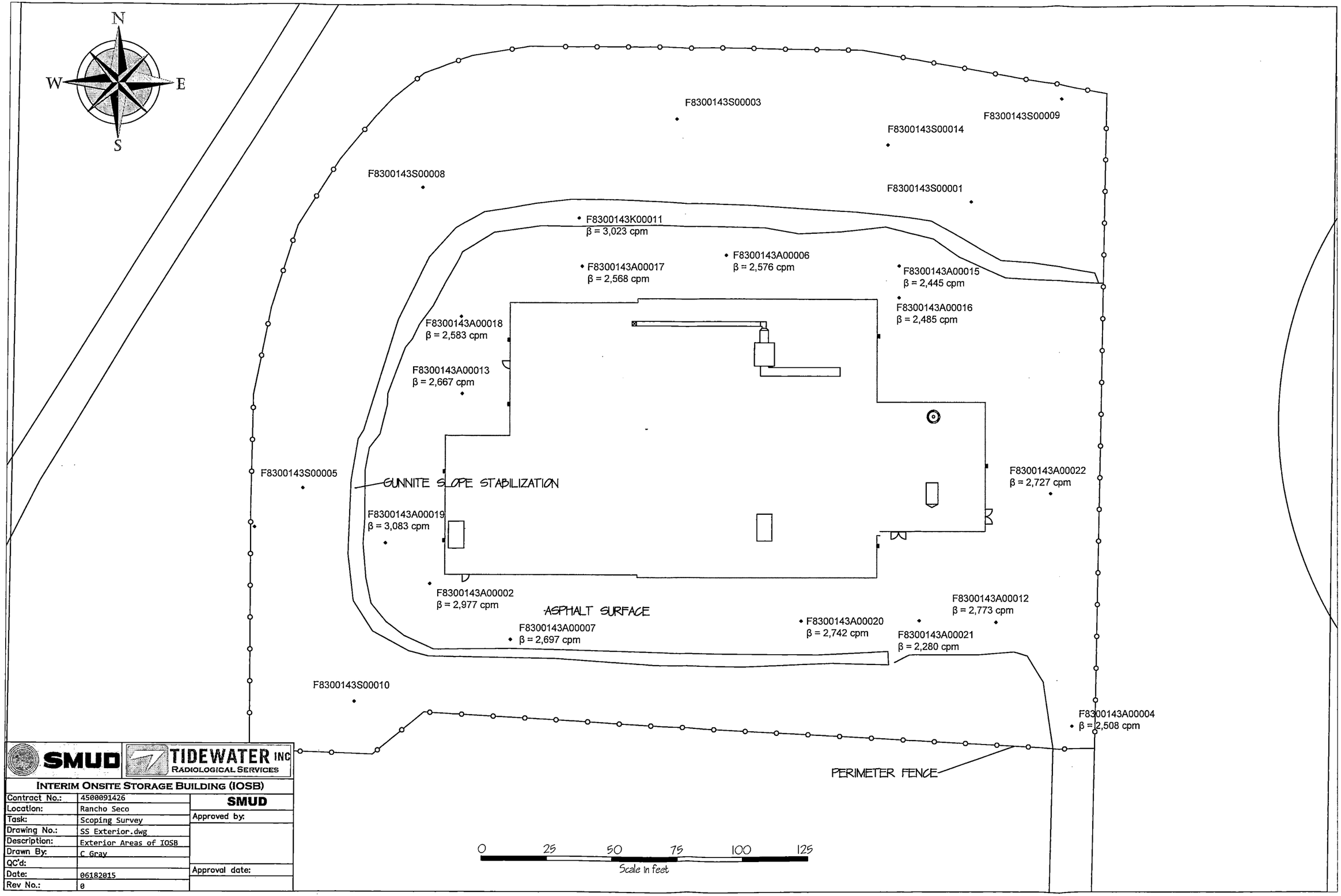
It is concluded that survey unit F8300143 meets the release criteria of 10CFR20.1402.

Attachment 1

Maps

January 30, 2017

Survey Unit F8300143



SMUD | TIDEWATER INC RADIOLOGICAL SERVICES

INTERIM ONSITE STORAGE BUILDING (IOSB)

Contract No.:	4500091426	**SMUD**
Location:	Rancho Seco	Approved by:
Task:	Scoping Survey	
Drawing No.:	SS Exterior.dwg	
Description:	Exterior Areas of IOSB	
Drawn By:	C Gray	
QC'd:		Approval date:
Date:	06182015	
Rev No.:	0	

Attachment 2

Instrumentation

January 30, 2017

Survey Unit F8300143

Table 2-1. Survey Unit Instrumentation

Measurement Type	Instrument Type	Minimum Detectable Activity[a]	Detector Efficiencies	Calibration Due Date[b]
Beta Static Measurement	Ludlum Model 2350-1 Ludlum Model 44-116 B Detector	Beta – 477 dpm/100 cm^2	13.2%	317897/331972 2/10/17
Gamma Scan	Ludlum Model 2350 Ludlum Model 44-10	927 cpm	NA	317892/208816 12/29/16
Gamma Scan	Ludlum Model 2350 Ludlum Model 44-10	945 cpm	NA	317894/300786 12/29/16

[a] Minimum detectable activities for the count rate instrumentation were calculated in accordance with NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (U.S. NRC, 1997).

[b] Detectors are required to be calibrated once every 12 months. Calibration due date indicates the date by which the detector must be calibrated again.

cm^2 = square centimeters
cpm = counts per minute
dpm = disintegrations per minute

Static Measurement MDA

Beta	Survey Type
PR331972	Detector Number
166	Background count rate (cpm)
1	Count Time (min)
0.132	Efficiency
100	Area of Detector (cm^2)

Constants

60	sec/min
2.54	cm/in

Assumptions

Background count time and sample count time are equivalent

Calculate Static MDA

Static MDA $=3 + 4.65(B_r * t)^{0.5}/t * E * {}^{A}/_{100}$ (NUREG 1507)

Where:	B_r	Background Countrate
	t	Count Time (min)
	E	Efficiency
	A	Area of detector (cm^2)

Static MDA 477 dpm/100 cm^2

Minimum Detectable Count Rate for Outside Scanning

Variables

7810	Background count rate (cpm)
0.5	Surveyor Efficiency (p)
1.38	Dectability performance (d), based upon acceptable true and false positives (MARRSIM Tble 6-5)
0.027	Detector Efficiency

Constants

60	sec/min
2.54	cm/in
100	cm/m

10.16 cm Size of Detector in direction of scan

Average Scan Speed for Survey Unit

5.08 cm/sec Average Scan Speed for Survey Unit

Determine Observation Interval for Scan Speed (i)

2.00 sec Observation Interval for scan speed of 5.08

Calculate Net Source Counts in Observation Interval (i)

$S_i = d * (b_i)^{0.5}$ Equation 6-8 from MARSSIM

Where:
- S_i Minimum detectable number of net source counts in the observation interval
- d detectabilitiy performance based on acceptable rate of true and false positives
- b_i Background counts in interval, I

22 cpm = S_i

Calculate the MDCR

$MDCR = S_i \times (60/i)/p^{0.5}$ Equation 6-9 from MARSSIM

Where:
- MDCR Minimum Detectable Count Rate (cpm)
- I Observation Interval 2.00 sec

945 cpm (MDCR)

8,626 dpm

1

Minimum Detectable Count Rate for Outside Scanning

Variables

7519	Background count rate (cpm)
0.5	Surveyor Efficiency (p)
1.38	Dectability performance (d), based upon acceptable true and false positives (MARRSIM Thle 6-5)
0.027	Detector Efficiency

Constants

60	sec/min
2.54	cm/in
100	cm/m

10.16 cm Size of Detector in direction of scan

Average Scan Speed for Survey Unit

5.08 cm/sec Average Scan Speed for Survey Unit

Determine Observation Interval for Scan Speed (I)

2.00 sec Observation Interval for scan speed of 5.08

Calculate Net Source Counts in Observation Interval (I)

$S_i = d * (b_i)^{0.5}$ Equation 6-8 from MARSSIM

Where:
- S_i Minimum detectable number of net source counts in the observation interval
- d detectability performance based on acceptable rate of true and false positives
- b_i Background counts in interval, I

22 cpm = S_i

Calculate the MDCR

$MDCR = S_i \times (60/I)p^{0.5}$ Equation 6-9 from MARSSIM

Where:
- MDCR Minimum Detectable Count Rate (cpm)
- I Observation Interval 2.00 sec

927 cpm (MDCR)

8,483 dpm

1

Attachment 3

Investigation

January 30, 2017

Survey Unit F8300143

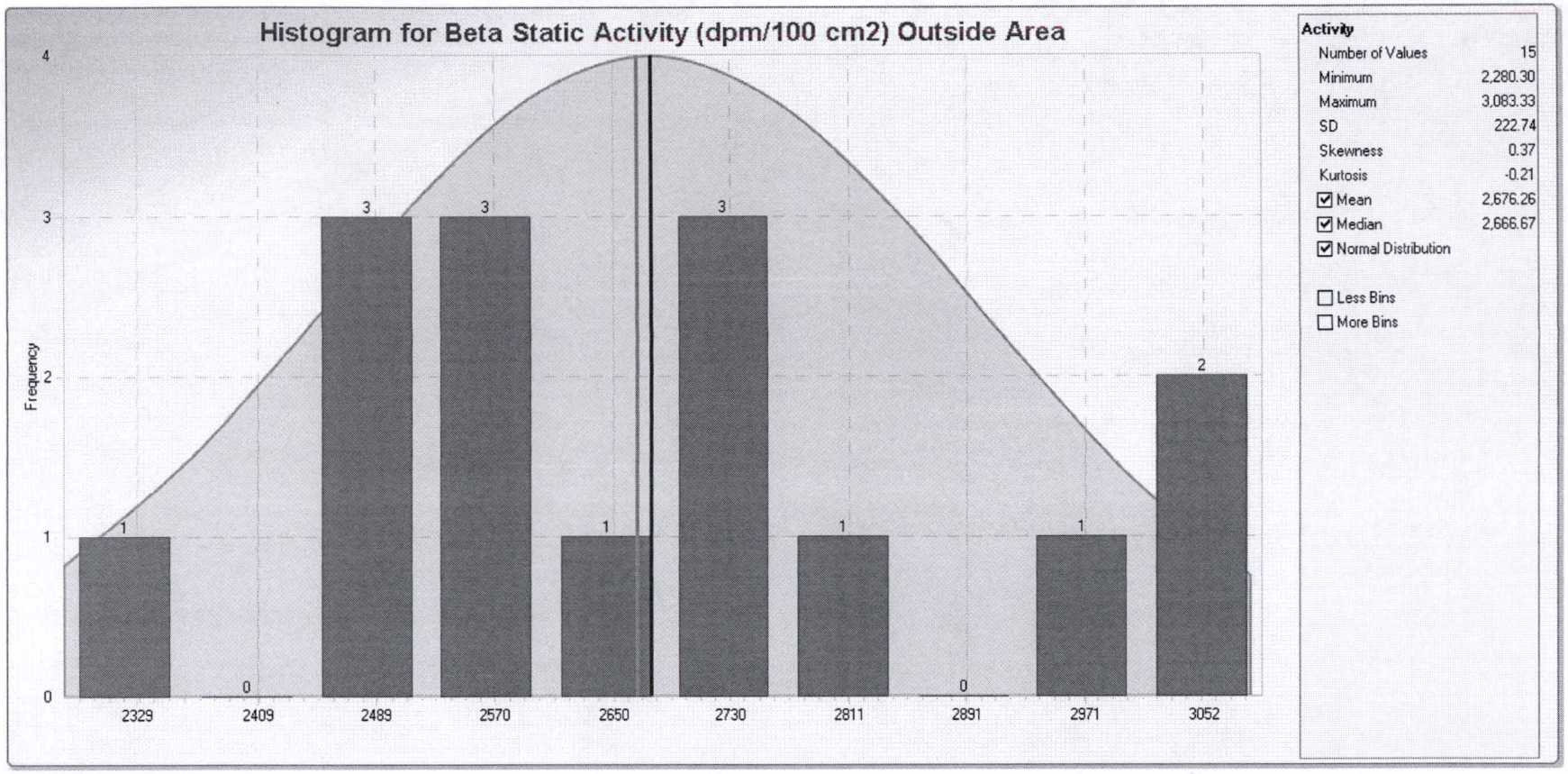
(none)

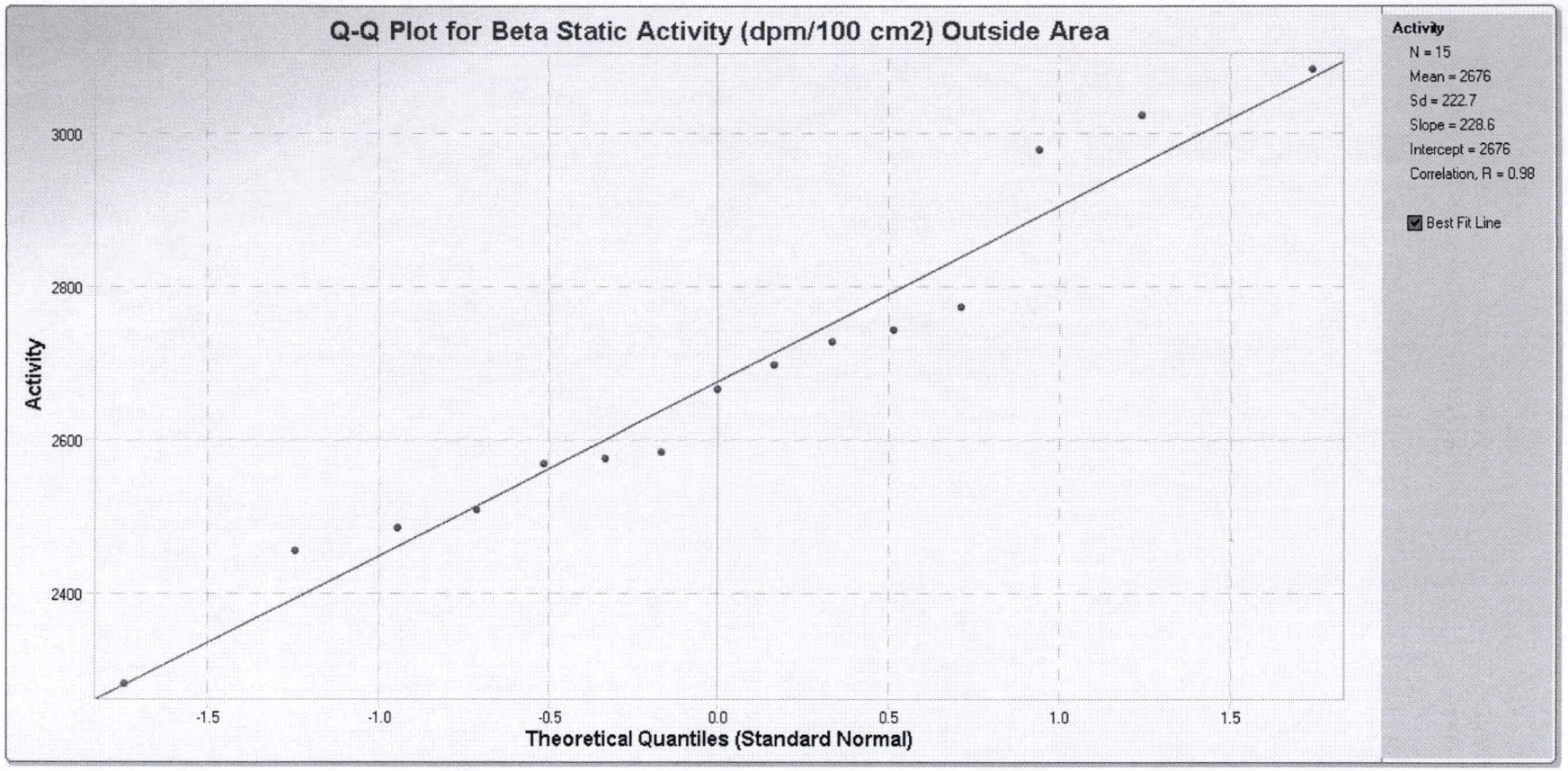
Attachment 4

Data Assessment

January 30, 2017

Survey Unit F8300143


Histogram for Beta Static Activity (dpm/100 cm2) Outside Area
Frequency
0
1
2
3
4
1
0
3
3
1
3
1
0
1
2
2329
2409
2489
2570
2650
2730
2811
2891
2971
3052
Activity
Number of Values 15
Minimum 2,280.30
Maximum 3,083.33
SD 222.74
Skewness 0.37
Kurtosis -0.21
Mean 2,676.26
Median 2,666.67
Normal Distribution
Less Bins
More Bins


Q-Q Plot for Beta Static Activity (dpm/100 cm2) Outside Area
Activity
3000
2800
2600
2400
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
Activity
N = 15
Mean = 2676
Sd = 222.7
Slope = 228.6
Intercept = 2676
Correlation, R = 0.98
Best Fit Line

Attachment 5

Laboratory Analysis

Gamma Spectrometry Report (14 pgs)

January 30, 2017

Survey Unit F8300143

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: October 27, 2016

Company :	Sacramento Municipal Utility District
Address :	14440 Twin Cites Road
	Herald, California 95638
Contact:	Mr. Dave Koontz
Project:	Rancho Seco IOSB Soil and Water Analysis

Client Sample ID:	2016-0030 (F8300143-1)	Project:	SMUD00201
Sample ID:	407403001	Client ID:	SMUD002
Matrix:	Soil		
Collect Date:	22-SEP-16 13:50		
Receive Date:	04-OCT-16		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Actinium-228		7.10E-07	+/-2.87E-07	2.34E-07		uCi/g			MXR1 10/21/16	1428	1604416	1
Americium-241	U	1.92E-08	+/-1.44E-07	2.61E-07		uCi/g						
Antimony-124	U	-6.20E-08	+/-7.66E-08	1.07E-07		uCi/g						
Antimony-125	U	-2.97E-08	+/-7.58E-08	1.40E-07		uCi/g						
Barium-133	U	-3.85E-09	+/-3.53E-08	6.11E-08		uCi/g						
Barium-140	U	1.41E-07	+/-5.30E-07	1.05E-06		uCi/g						
Beryllium-7	U	1.86E-07	+/-3.78E-07	7.64E-07		uCi/g						
Bismuth-212		9.35E-07	+/-7.38E-07	8.90E-07		uCi/g						
Bismuth-214		6.43E-07	+/-1.98E-07	1.27E-07		uCi/g						
Cerium-139	U	3.45E-09	+/-2.67E-08	4.89E-08		uCi/g						
Cerium-141	U	-4.19E-08	+/-8.07E-08	1.40E-07		uCi/g						
Cerium-144	U	-2.44E-08	+/-1.77E-07	3.20E-07		uCi/g						
Cesium-134	U	-4.22E-09	+/-4.52E-08	8.21E-08		uCi/g						
Cesium-136	U	-8.25E-08	+/-2.05E-07	3.80E-07		uCi/g						
Cesium-137	U	9.37E-09	+/-3.81E-08	7.56E-08	1.00E-07	uCi/g						
Chromium-51	U	-2.32E-07	+/-4.45E-07	8.18E-07		uCi/g						
Cobalt-56	U	6.78E-09	+/-3.99E-08	8.25E-08		uCi/g						
Cobalt-57	U	-2.22E-08	+/-2.30E-08	3.83E-08		uCi/g						
Cobalt-58	U	-1.69E-08	+/-3.43E-08	6.48E-08		uCi/g						
Cobalt-60	U	9.67E-09	+/-2.89E-08	6.54E-08	1.00E-07	uCi/g						
Europium-152	U	-1.59E-08	+/-9.48E-08	1.77E-07		uCi/g						
Europium-154	U	2.22E-08	+/-9.82E-08	2.07E-07		uCi/g						
Europium-155	U	4.09E-08	+/-9.26E-08	1.78E-07		uCi/g						
Iridium-192	U	-9.77E-09	+/-3.30E-08	6.23E-08		uCi/g						
Iron-59	U	-1.13E-07	+/-8.81E-08	1.30E-07		uCi/g						
Lead-210	U	1.76E-06	+/-3.85E-06	7.74E-06		uCi/g						
Lead-212		8.25E-07	+/-1.17E-07	9.62E-08		uCi/g						
Lead-214		8.47E-07	+/-1.71E-07	3.05E-07		uCi/g						
Manganese-54	U	4.48E-09	+/-3.10E-08	6.44E-08		uCi/g						
Mercury-203	U	1.71E-09	+/-3.91E-08	7.65E-08		uCi/g						
Neodymium-147	U	2.12E-07	+/-1.20E-06	2.38E-06		uCi/g						
Neptunium-239	U	2.53E-07	+/-3.54E-07	3.88E-07		uCi/g						
Niobium-94	U	1.98E-09	+/-4.10E-08	7.55E-08		uCi/g						
Niobium-95	U	-2.03E-08	+/-5.02E-08	7.55E-08		uCi/g						
Potassium-40		9.76E-06	+/-1.35E-06	6.15E-07		uCi/g						
Promethium-144	U	-1.90E-08	+/-3.65E-08	6.26E-08		uCi/g						

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0030 (F8300143-1) Project: SMUD00201
Sample ID: 407403001 Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Promethium-146	U	1.72E-08	+/-3.79E-08	7.72E-08		uCi/g						
Radium-223	U	-4.08E-07	+/-5.93E-07	1.07E-06		uCi/g						
Radium-224	UI	0.00	+/-1.07E-06	1.03E-06		uCi/g						
Radium-228		7.10E-07	+/-2.87E-07	2.34E-07		uCi/g						
Ruthenium-106	U	1.41E-07	+/-3.37E-07	6.69E-07		uCi/g						
Silver-110m	U	1.01E-08	+/-3.96E-08	8.53E-08		uCi/g						
Sodium-22	U	8.78E-09	+/-3.51E-08	7.44E-08		uCi/g						
Thallium-208		3.20E-07	+/-8.54E-08	5.53E-08		uCi/g						
Thorium-234	UI	0.00	+/-2.69E-06	1.97E-06		uCi/g						
Tin-113	U	3.91E-09	+/-3.99E-08	7.86E-08		uCi/g						
Uranium-235	U	-5.14E-08	+/-1.82E-07	3.23E-07		uCi/g						
Uranium-238	UI	0.00	+/-2.69E-06	1.97E-06		uCi/g						
Yttrium-88	U	-1.30E-08	+/-2.71E-08	5.38E-08		uCi/g						
Zinc-65	U	6.77E-08	+/-7.32E-08	1.62E-07		uCi/g						
Zirconium-95	U	1.30E-08	+/-8.49E-08	1.63E-07		uCi/g						

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/05/16	0854	1604293

The following Analytical Methods were performed:

Method	Description	Analyst Comments
	DOE HASL 300, 4.5.2.3/Ga-01-R	

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: October 27, 2016

Company :	Sacramento Municipal Utility District
Address :	14440 Twin Cites Road
	Herald, California 95638
Contact:	Mr. Dave Koontz
Project:	Rancho Seco IOSB Soil and Water Analysis

Client Sample ID:	2016-0031 (F8300143-3)	Project:	SMUD00201
Sample ID:	407403002	Client ID:	SMUD002
Matrix:	Soil		
Collect Date:	22-SEP-16 13:39		
Receive Date:	04-OCT-16		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"													
Actinium-228		7.29E-07	+/-2.84E-07	2.29E-07		uCi/g			MXR1	10/21/16	1429	1604416	1
Americium-241	U	-5.33E-08	+/-2.05E-07	3.65E-07		uCi/g							
Antimony-124	U	4.80E-08	+/-9.29E-08	2.32E-07		uCi/g							
Antimony-125	U	2.14E-08	+/-8.30E-08	1.66E-07		uCi/g							
Barium-133	U	-7.09E-09	+/-5.82E-08	7.66E-08		uCi/g							
Barium-140	U	-1.67E-07	+/-4.71E-07	8.64E-07		uCi/g							
Beryllium-7	U	3.79E-07	+/-4.00E-07	8.54E-07		uCi/g							
Bismuth-212	UI	0.00	+/-6.72E-07	1.41E-06		uCi/g							
Bismuth-214		5.59E-07	+/-1.64E-07	1.43E-07		uCi/g							
Cerium-139	U	3.15E-09	+/-2.99E-08	5.81E-08		uCi/g							
Cerium-141	U	1.08E-08	+/-7.57E-08	1.49E-07		uCi/g							
Cerium-144	U	5.07E-08	+/-1.95E-07	3.55E-07		uCi/g							
Cesium-134	U	3.53E-08	+/-3.80E-08	8.53E-08		uCi/g							
Cesium-136	U	-1.33E-07	+/-1.93E-07	3.45E-07		uCi/g							
Cesium-137	U	-3.07E-08	+/-3.91E-08	6.56E-08	1.00E-07	uCi/g							
Chromium-51	U	-2.63E-07	+/-4.93E-07	8.87E-07		uCi/g							
Cobalt-56	U	-1.44E-08	+/-4.81E-08	8.57E-08		uCi/g							
Cobalt-57	U	2.14E-08	+/-2.63E-08	5.04E-08		uCi/g							
Cobalt-58	U	-3.74E-09	+/-4.08E-08	7.75E-08		uCi/g							
Cobalt-60	U	6.49E-09	+/-3.27E-08	7.22E-08	1.00E-07	uCi/g							
Europium-152	U	5.92E-08	+/-8.56E-08	1.74E-07		uCi/g							
Europium-154	U	-1.05E-08	+/-7.99E-08	1.68E-07		uCi/g							
Europium-155	U	1.61E-08	+/-1.12E-07	2.02E-07		uCi/g							
Iridium-192	U	6.61E-09	+/-3.50E-08	6.92E-08		uCi/g							
Iron-59	U	-5.10E-08	+/-7.99E-08	1.44E-07		uCi/g							
Lead-210	U	-1.43E-06	+/-8.81E-06	1.59E-05		uCi/g							
Lead-212		7.66E-07	+/-1.15E-07	8.72E-08		uCi/g							
Lead-214		6.17E-07	+/-1.60E-07	1.37E-07		uCi/g							
Manganese-54	U	2.03E-08	+/-3.82E-08	7.90E-08		uCi/g							
Mercury-203	U	-1.32E-08	+/-4.02E-08	7.49E-08		uCi/g							
Neodymium-147	U	1.25E-07	+/-1.35E-06	2.62E-06		uCi/g							
Neptunium-239	U	-1.94E-07	+/-2.87E-07	4.71E-07		uCi/g							
Niobium-94	U	1.64E-08	+/-3.55E-08	7.16E-08		uCi/g							
Niobium-95	U	5.27E-08	+/-6.28E-08	6.64E-08		uCi/g							
Potassium-40		8.67E-06	+/-1.33E-06	6.09E-07		uCi/g							
Promethium-144	U	2.25E-08	+/-3.85E-08	7.63E-08		uCi/g							

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0031 (F8300143-3) Project: SMUD00201
Sample ID: 407403002 Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Promethium-146	U	4.82E-10	+/-3.71E-08	7.23E-08		uCi/g						
Radium-223	U	3.33E-07	+/-5.65E-07	1.16E-06		uCi/g						
Radium-224	U	3.89E-07	+/-1.05E-06	9.34E-07		uCi/g						
Radium-228		7.29E-07	+/-2.84E-07	2.29E-07		uCi/g						
Ruthenium-106	U	1.02E-07	+/-3.04E-07	6.19E-07		uCi/g						
Silver-110m	U	8.67E-10	+/-3.79E-08	7.66E-08		uCi/g						
Sodium-22	U	-4.04E-09	+/-2.83E-08	5.93E-08		uCi/g						
Thallium-208		2.57E-07	+/-8.27E-08	7.34E-08		uCi/g						
Thorium-234	U	2.53E-08	+/-1.89E-06	3.43E-06		uCi/g						
Tin-113	U	-2.99E-08	+/-4.05E-08	7.03E-08		uCi/g						
Uranium-235	U	-6.98E-08	+/-1.90E-07	3.57E-07		uCi/g						
Uranium-238	U	2.53E-08	+/-1.89E-06	3.43E-06		uCi/g						
Yttrium-88	U	2.51E-08	+/-3.65E-08	9.85E-08		uCi/g						
Zinc-65	U	-6.75E-08	+/-9.73E-08	1.71E-07		uCi/g						
Zirconium-95	U	7.31E-09	+/-7.09E-08	1.41E-07		uCi/g						

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/05/16	0854	1604293

The following Analytical Methods were performed:

Method	Description	Analyst Comments
	DOE HASL 300, 4.5.2.3/Ga-01-R	

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0032 (F8300143-5)
Sample ID: 407403003
Matrix: Soil
Collect Date: 22-SEP-16 14:17
Receive Date: 04-OCT-16
Collector: Client

Project: SMUD00201
Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"													
Actinium-228		7.73E-07	+/-2.89E-07	2.18E-07		uCi/g			MXR1	10/21/16	1429	1604416	1
Americium-241	U	-3.93E-08	+/-1.46E-07	2.63E-07		uCi/g							
Antimony-124	U	-3.12E-08	+/-7.58E-08	1.52E-07		uCi/g							
Antimony-125	U	8.03E-09	+/-7.90E-08	1.58E-07		uCi/g							
Barium-133	U	2.86E-08	+/-5.01E-08	6.39E-08		uCi/g							
Barium-140	U	-1.36E-07	+/-4.15E-07	7.93E-07		uCi/g							
Beryllium-7	U	-7.31E-08	+/-3.06E-07	5.92E-07		uCi/g							
Bismuth-212	UI	0.00	+/-8.15E-07	1.09E-06		uCi/g							
Bismuth-214		9.35E-07	+/-1.70E-07	1.11E-07		uCi/g							
Cerium-139	U	-8.56E-09	+/-2.58E-08	4.68E-08		uCi/g							
Cerium-141	U	1.07E-07	+/-1.73E-07	1.17E-07		uCi/g							
Cerium-144	U	-2.83E-08	+/-1.48E-07	2.78E-07		uCi/g							
Cesium-134	U	4.79E-08	+/-4.29E-08	6.99E-08		uCi/g							
Cesium-136	U	-1.52E-07	+/-1.32E-07	2.08E-07		uCi/g							
Cesium-137	U	4.29E-08	+/-4.43E-08	5.75E-08	1.00E-07	uCi/g							
Chromium-51	U	-1.99E-08	+/-3.60E-07	7.29E-07		uCi/g							
Cobalt-56	U	-1.79E-08	+/-3.30E-08	5.80E-08		uCi/g							
Cobalt-57	U	1.68E-09	+/-1.97E-08	3.81E-08		uCi/g							
Cobalt-58	U	-7.88E-09	+/-3.29E-08	6.22E-08		uCi/g							
Cobalt-60	U	-1.02E-09	+/-2.30E-08	4.99E-08	1.00E-07	uCi/g							
Europium-152	U	-9.10E-08	+/-6.93E-08	1.18E-07		uCi/g							
Europium-154	U	4.91E-08	+/-8.75E-08	1.99E-07		uCi/g							
Europium-155	U	7.63E-08	+/-9.08E-08	1.86E-07		uCi/g							
Iridium-192	U	-1.60E-08	+/-3.02E-08	5.77E-08		uCi/g							
Iron-59	U	-3.40E-08	+/-7.39E-08	1.42E-07		uCi/g							
Lead-210	U	1.36E-06	+/-4.78E-06	9.94E-06		uCi/g							
Lead-212		8.66E-07	+/-1.22E-07	8.03E-08		uCi/g							
Lead-214		8.21E-07	+/-1.69E-07	1.14E-07		uCi/g							
Manganese-54	U	7.13E-09	+/-2.84E-08	5.83E-08		uCi/g							
Mercury-203	U	3.00E-08	+/-5.48E-08	6.46E-08		uCi/g							
Neodymium-147	U	-7.91E-07	+/-9.64E-07	1.68E-06		uCi/g							
Neptunium-239	U	3.91E-08	+/-2.06E-07	4.03E-07		uCi/g							
Niobium-94	U	-1.24E-08	+/-2.59E-08	4.68E-08		uCi/g							
Niobium-95	U	7.23E-09	+/-4.49E-08	8.01E-08		uCi/g							
Potassium-40		7.56E-06	+/-1.16E-06	5.54E-07		uCi/g							
Promethium-144	U	-8.52E-09	+/-2.70E-08	5.05E-08		uCi/g							

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Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
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Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0032 (F8300143-5) Project: SMUD00201
Sample ID: 407403003 Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Promethium-146	U	-3.47E-08	+/-3.46E-08	6.00E-08		uCi/g						
Radium-223	U	-1.23E-08	+/-4.80E-07	9.65E-07		uCi/g						
Radium-224	UI	0.00	+/-9.76E-07	1.29E-06		uCi/g						
Radium-228		7.73E-07	+/-2.89E-07	2.18E-07		uCi/g						
Ruthenium-106	U	-5.45E-08	+/-2.54E-07	4.87E-07		uCi/g						
Silver-110m	U	-3.39E-09	+/-3.50E-08	6.86E-08		uCi/g						
Sodium-22	U	1.51E-08	+/-3.06E-08	6.90E-08		uCi/g						
Thallium-208		2.77E-07	+/-8.18E-08	6.21E-08		uCi/g						
Thorium-234	U	9.02E-07	+/-3.14E-06	2.16E-06		uCi/g						
Tin-113	U	-9.06E-11	+/-3.82E-08	7.66E-08		uCi/g						
Uranium-235	U	3.40E-07	+/-4.03E-07	3.56E-07		uCi/g						
Uranium-238	U	9.02E-07	+/-3.14E-06	2.16E-06		uCi/g						
Yttrium-88	U	-1.93E-08	+/-3.39E-08	5.98E-08		uCi/g						
Zinc-65	U	-1.11E-08	+/-7.40E-08	1.37E-07		uCi/g						
Zirconium-95	U	2.43E-08	+/-4.76E-08	1.09E-07		uCi/g						

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/05/16	0854	1604293

The following Analytical Methods were performed:

Method	Description	Analyst Comments
	DOE HASL 300, 4.5.2.3/Ga-01-R	

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0033 (F8300143-8) Project: SMUD00201
Sample ID: 407403004 Client ID: SMUD002
Matrix: Soil
Collect Date: 22-SEP-16 14:10
Receive Date: 04-OCT-16
Collector: Client

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"													
Actinium-228		4.46E-07	+/-3.91E-07	3.90E-07		uCi/g			MXR1	10/21/16	1429	1604416	1
Americium-241	U	-1.14E-08	+/-5.74E-08	9.13E-08		uCi/g							
Antimony-124	U	6.05E-08	+/-9.59E-08	2.68E-07		uCi/g							
Antimony-125	U	-1.40E-08	+/-1.00E-07	1.85E-07		uCi/g							
Barium-133	U	1.59E-08	+/-4.26E-08	8.45E-08		uCi/g							
Barium-140	U	-2.24E-08	+/-7.14E-07	1.19E-06		uCi/g							
Beryllium-7	U	-1.52E-07	+/-3.91E-07	6.94E-07		uCi/g							
Bismuth-212	U	3.19E-07	+/-9.22E-07	1.39E-06		uCi/g							
Bismuth-214		5.62E-07	+/-1.70E-07	1.53E-07		uCi/g							
Cerium-139	U	1.01E-08	+/-2.73E-08	5.42E-08		uCi/g							
Cerium-141	U	7.40E-08	+/-7.55E-08	1.56E-07		uCi/g							
Cerium-144	U	-7.66E-08	+/-1.96E-07	3.23E-07		uCi/g							
Cesium-134	U	5.69E-08	+/-5.10E-08	1.17E-07		uCi/g							
Cesium-136	U	9.08E-08	+/-1.98E-07	4.58E-07		uCi/g							
Cesium-137	U	-3.75E-09	+/-4.08E-08	8.10E-08	1.00E-07	uCi/g							
Chromium-51	U	-2.44E-07	+/-4.39E-07	7.75E-07		uCi/g							
Cobalt-56	U	-3.21E-08	+/-4.48E-08	7.81E-08		uCi/g							
Cobalt-57	U	-4.65E-10	+/-2.07E-08	4.01E-08		uCi/g							
Cobalt-58	U	5.48E-08	+/-4.15E-08	9.09E-08		uCi/g							
Cobalt-60	U	-2.92E-08	+/-4.28E-08	7.14E-08	1.00E-07	uCi/g							
Europium-152	U	-1.62E-08	+/-9.28E-08	1.72E-07		uCi/g							
Europium-154	U	-7.26E-08	+/-1.39E-07	2.45E-07		uCi/g							
Europium-155	U	1.42E-07	+/-1.60E-07	1.58E-07		uCi/g							
Iridium-192	U	1.41E-08	+/-3.73E-08	7.45E-08		uCi/g							
Iron-59	U	1.51E-08	+/-1.00E-07	2.18E-07		uCi/g							
Lead-210	U	3.40E-07	+/-8.17E-07	7.95E-07		uCi/g							
Lead-212		7.29E-07	+/-1.22E-07	1.02E-07		uCi/g							
Lead-214		6.68E-07	+/-1.62E-07	3.18E-07		uCi/g							
Manganese-54	U	5.88E-09	+/-4.49E-08	9.12E-08		uCi/g							
Mercury-203	U	3.08E-08	+/-4.66E-08	9.45E-08		uCi/g							
Neodymium-147	U	2.91E-07	+/-1.53E-06	2.98E-06		uCi/g							
Neptunium-239	U	-3.29E-08	+/-2.08E-07	3.97E-07		uCi/g							
Niobium-94	U	-1.52E-08	+/-3.60E-08	6.76E-08		uCi/g							
Niobium-95	U	-1.05E-08	+/-5.66E-08	1.09E-07		uCi/g							
Potassium-40		8.54E-06	+/-1.46E-06	6.36E-07		uCi/g							
Promethium-144	U	5.00E-09	+/-4.40E-08	8.81E-08		uCi/g							

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0033 (F8300143-8) Project: SMUD00201
Sample ID: 407403004 Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Promethium-146	U	-2.19E-08	+/-5.13E-08	8.97E-08		uCi/g						
Radium-223	U	8.64E-07	+/-5.82E-07	1.32E-06		uCi/g						
Radium-224	U	5.19E-07	+/-1.06E-06	1.09E-06		uCi/g						
Radium-228		4.46E-07	+/-3.91E-07	3.90E-07		uCi/g						
Ruthenium-106	U	3.29E-07	+/-4.03E-07	8.46E-07		uCi/g						
Silver-110m	U	-7.24E-09	+/-5.55E-08	1.10E-07		uCi/g						
Sodium-22	U	-2.16E-08	+/-4.69E-08	8.46E-08		uCi/g						
Thallium-208		2.44E-07	+/-6.61E-08	7.06E-08		uCi/g						
Thorium-234	U	8.68E-07	+/-1.07E-06	9.99E-07		uCi/g						
Tin-113	U	-8.49E-09	+/-4.45E-08	8.28E-08		uCi/g						
Uranium-235	U	1.10E-07	+/-2.03E-07	4.04E-07		uCi/g						
Uranium-238	U	8.68E-07	+/-1.07E-06	9.99E-07		uCi/g						
Yttrium-88	U	-1.80E-08	+/-3.92E-08	7.83E-08		uCi/g						
Zinc-65	U	9.66E-08	+/-1.07E-07	2.34E-07		uCi/g						
Zirconium-95	U	1.70E-09	+/-8.17E-08	1.68E-07		uCi/g						

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/05/16	0854	1604293

The following Analytical Methods were performed:

Method	Description	Analyst Comments
	DOE HASL 300, 4.5.2.3/Ga-01-R	

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: October 27, 2016

Company :	Sacramento Municipal Utility District
Address :	14440 Twin Cites Road
	Herald, California 95638
Contact:	Mr. Dave Koontz
Project:	Rancho Seco IOSB Soil and Water Analysis

Client Sample ID:	2016-0034 (F8300143-9)	Project:	SMUD00201
Sample ID:	407403005	Client ID:	SMUD002
Matrix:	Soil		
Collect Date:	22-SEP-16 13:53		
Receive Date:	04-OCT-16		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"													
Actinium-228		7.32E-07	+/-3.45E-07	2.78E-07		uCi/g			MXR1	10/21/16	1429	1604416	1
Americium-241	U	2.28E-07	+/-3.85E-07	3.96E-07		uCi/g							
Antimony-124	U	-1.05E-07	+/-1.13E-07	1.81E-07		uCi/g							
Antimony-125	U	-3.98E-08	+/-7.31E-08	1.27E-07		uCi/g							
Barium-133	U	5.12E-08	+/-5.42E-08	7.28E-08		uCi/g							
Barium-140	U	-2.48E-07	+/-4.96E-07	9.29E-07		uCi/g							
Beryllium-7	U	4.04E-07	+/-4.18E-07	8.77E-07		uCi/g							
Bismuth-212	U	5.33E-07	+/-6.05E-07	1.29E-06		uCi/g							
Bismuth-214		6.38E-07	+/-1.46E-07	1.22E-07		uCi/g							
Cerium-139	U	3.21E-08	+/-2.70E-08	5.41E-08		uCi/g							
Cerium-141	U	1.88E-11	+/-7.12E-08	1.39E-07		uCi/g							
Cerium-144	U	-8.07E-08	+/-1.72E-07	3.25E-07		uCi/g							
Cesium-134	U	3.85E-08	+/-5.13E-08	8.36E-08		uCi/g							
Cesium-136	U	3.60E-08	+/-2.30E-07	4.61E-07		uCi/g							
Cesium-137	U	2.27E-08	+/-4.37E-08	9.03E-08	1.00E-07	uCi/g							
Chromium-51	U	-2.23E-07	+/-5.00E-07	8.96E-07		uCi/g							
Cobalt-56	U	-7.14E-09	+/-4.44E-08	8.51E-08		uCi/g							
Cobalt-57	U	-9.55E-09	+/-2.42E-08	4.15E-08		uCi/g							
Cobalt-58	U	2.48E-08	+/-4.23E-08	9.28E-08		uCi/g							
Cobalt-60	U	6.05E-09	+/-4.90E-08	9.01E-08	1.00E-07	uCi/g							
Europium-152	U	-3.89E-08	+/-1.13E-07	1.61E-07		uCi/g							
Europium-154	U	3.64E-08	+/-1.12E-07	2.46E-07		uCi/g							
Europium-155	U	-1.02E-08	+/-9.84E-08	1.77E-07		uCi/g							
Iridium-192	U	2.53E-08	+/-4.09E-08	7.58E-08		uCi/g							
Iron-59	U	4.64E-09	+/-1.01E-07	2.02E-07		uCi/g							
Lead-210	U	6.65E-06	+/-9.61E-06	1.94E-05		uCi/g							
Lead-212		7.03E-07	+/-1.10E-07	8.66E-08		uCi/g							
Lead-214		7.00E-07	+/-1.43E-07	2.84E-07		uCi/g							
Manganese-54	U	1.13E-08	+/-3.77E-08	7.78E-08		uCi/g							
Mercury-203	U	-2.14E-11	+/-4.26E-08	8.10E-08		uCi/g							
Neodymium-147	U	-1.45E-07	+/-1.32E-06	2.61E-06		uCi/g							
Neptunium-239	U	-1.74E-09	+/-2.37E-07	4.29E-07		uCi/g							
Niobium-94	U	2.55E-08	+/-3.38E-08	7.34E-08		uCi/g							
Niobium-95	U	2.71E-08	+/-4.59E-08	9.24E-08		uCi/g							
Potassium-40		8.18E-06	+/-1.36E-06	7.07E-07		uCi/g							
Promethium-144	U	3.60E-08	+/-9.64E-08	7.19E-08		uCi/g							

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0034 (F8300143-9) Project: SMUD00201
Sample ID: 407403005 Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Promethium-146	U	8.39E-09	+/-3.75E-08	7.39E-08		uCi/g						
Radium-223	U	7.04E-08	+/-6.30E-07	1.20E-06		uCi/g						
Radium-224	UI	0.00	+/-1.30E-06	9.28E-07		uCi/g						
Radium-228		7.32E-07	+/-3.45E-07	2.78E-07		uCi/g						
Ruthenium-106	U	-4.00E-08	+/-3.66E-07	7.07E-07		uCi/g						
Silver-110m	U	-1.27E-08	+/-4.19E-08	7.97E-08		uCi/g						
Sodium-22	U	1.22E-08	+/-3.97E-08	8.70E-08		uCi/g						
Thallium-208		2.35E-07	+/-7.98E-08	7.56E-08		uCi/g						
Thorium-234	U	9.13E-07	+/-2.07E-06	3.17E-06		uCi/g						
Tin-113	U	-1.60E-08	+/-4.01E-08	7.18E-08		uCi/g						
Uranium-235	U	2.37E-08	+/-1.76E-07	3.46E-07		uCi/g						
Uranium-238	U	9.13E-07	+/-2.07E-06	3.17E-06		uCi/g						
Yttrium-88	U	-5.45E-10	+/-2.52E-08	6.46E-08		uCi/g						
Zinc-65	U	6.93E-09	+/-8.72E-08	1.55E-07		uCi/g						
Zirconium-95	U	1.39E-08	+/-5.95E-08	1.30E-07		uCi/g						

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/05/16	0854	1604293

The following Analytical Methods were performed:

Method	Description	Analyst Comments
	DOE HASL 300, 4.5.2.3/Ga-01-R	

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID:	2016-0035 (F8300143-10)	Project:	SMUD00201
Sample ID:	407403006	Client ID:	SMUD002
Matrix:	Soil		
Collect Date:	22-SEP-16 14:23		
Receive Date:	04-OCT-16		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"													
Actinium-228		9.63E-07	+/-2.39E-07	1.71E-07		uCi/g			MXR1	10/21/16	1431	1604416	1
Americium-241	UI	0.00	+/-1.34E-07	1.23E-07		uCi/g							
Antimony-124	U	2.25E-08	+/-7.94E-08	1.74E-07		uCi/g							
Antimony-125	U	-5.45E-09	+/-6.52E-08	1.28E-07		uCi/g							
Barium-133	U	-1.60E-08	+/-2.73E-08	4.48E-08		uCi/g							
Barium-140	U	1.23E-07	+/-3.83E-07	7.88E-07		uCi/g							
Beryllium-7	U	-5.84E-08	+/-2.60E-07	5.01E-07		uCi/g							
Bismuth-212	U	7.89E-07	+/-6.93E-07	1.01E-06		uCi/g							
Bismuth-214		5.66E-07	+/-1.53E-07	1.05E-07		uCi/g							
Cerium-139	U	3.81E-09	+/-2.10E-08	3.98E-08		uCi/g							
Cerium-141	U	-2.52E-08	+/-6.17E-08	1.11E-07		uCi/g							
Cerium-144	U	4.70E-08	+/-1.50E-07	2.68E-07		uCi/g							
Cesium-134	U	5.86E-08	+/-5.02E-08	7.68E-08		uCi/g							
Cesium-136	U	1.37E-07	+/-1.50E-07	3.44E-07		uCi/g							
Cesium-137	UI	0.00	+/-3.52E-08	3.20E-08	1.00E-07	uCi/g							
Chromium-51	U	2.49E-08	+/-3.56E-07	7.17E-07		uCi/g							
Cobalt-56	U	2.70E-08	+/-3.35E-08	7.17E-08		uCi/g							
Cobalt-57	U	2.13E-09	+/-1.76E-08	3.37E-08		uCi/g							
Cobalt-58	U	1.05E-08	+/-3.15E-08	6.41E-08		uCi/g							
Cobalt-60	U	-8.45E-09	+/-2.88E-08	5.61E-08	1.00E-07	uCi/g							
Europium-152	U	-4.87E-08	+/-6.70E-08	1.24E-07		uCi/g							
Europium-154	U	2.31E-08	+/-7.16E-08	1.56E-07		uCi/g							
Europium-155	U	7.20E-08	+/-6.65E-08	1.38E-07		uCi/g							
Iridium-192	U	-1.59E-08	+/-2.60E-08	4.90E-08		uCi/g							
Iron-59	U	-8.18E-10	+/-5.10E-08	1.10E-07		uCi/g							
Lead-210	U	1.82E-07	+/-1.04E-06	2.16E-06		uCi/g							
Lead-212		1.04E-06	+/-1.12E-07	7.03E-08		uCi/g							
Lead-214		9.36E-07	+/-1.45E-07	9.13E-08		uCi/g							
Manganese-54	U	5.41E-08	+/-3.80E-08	5.84E-08		uCi/g							
Mercury-203	U	-1.41E-08	+/-3.24E-08	6.25E-08		uCi/g							
Neodymium-147	U	4.29E-07	+/-8.84E-07	1.87E-06		uCi/g							
Neptunium-239	U	-4.17E-08	+/-1.70E-07	3.16E-07		uCi/g							
Niobium-94	U	5.63E-09	+/-2.04E-08	4.19E-08		uCi/g							
Niobium-95	U	-2.48E-08	+/-3.95E-08	5.82E-08		uCi/g							
Potassium-40		7.79E-06	+/-9.78E-07	4.83E-07		uCi/g							
Promethium-144	U	5.45E-09	+/-2.83E-08	5.52E-08		uCi/g							

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0035 (F8300143-10) Project: SMUD00201
Sample ID: 407403006 Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Promethium-146	U	3.16E-08	+/-3.11E-08	6.78E-08		uCi/g						
Radium-223	U	-3.25E-07	+/-4.32E-07	8.00E-07		uCi/g						
Radium-224	U	7.30E-07	+/-1.33E-06	7.53E-07		uCi/g						
Radium-228		9.63E-07	+/-2.39E-07	1.71E-07		uCi/g						
Ruthenium-106	U	-6.75E-08	+/-2.19E-07	4.09E-07		uCi/g						
Silver-110m	U	1.15E-08	+/-4.20E-08	8.27E-08		uCi/g						
Sodium-22	U	1.01E-08	+/-2.59E-08	5.68E-08		uCi/g						
Thallium-208		2.35E-07	+/-6.12E-08	5.01E-08		uCi/g						
Thorium-234	UI	0.00	+/-1.36E-06	1.21E-06		uCi/g						
Tin-113	U	1.87E-08	+/-3.06E-08	6.55E-08		uCi/g						
Uranium-235	U	-1.40E-08	+/-1.42E-07	2.63E-07		uCi/g						
Uranium-238	UI	0.00	+/-1.36E-06	1.21E-06		uCi/g						
Yttrium-88	U	-6.88E-09	+/-3.13E-08	6.17E-08		uCi/g						
Zinc-65	U	-1.86E-08	+/-5.38E-08	8.98E-08		uCi/g						
Zirconium-95	U	5.28E-08	+/-6.13E-08	1.32E-07		uCi/g						

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/05/16	0854	1604293

The following Analytical Methods were performed:

Method	Description	Analyst Comments
	DOE HASL 300, 4.5.2.3/Ga-01-R	

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

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MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: October 27, 2016

Company : Sacramento Municipal Utility District
Address : 14440 Twin Cites Road

Herald, California 95638
Contact: Mr. Dave Koontz
Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0036 (F8300143-14)
Sample ID: 407403007
Matrix: Soil
Collect Date: 22-SEP-16 14:00
Receive Date: 04-OCT-16
Collector: Client

Project: SMUD00201
Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"													
Actinium-228		8.18E-07	+/-2.25E-07	1.96E-07		uCi/g			MXR1	10/21/16	1432	1604416	1
Americium-241	U	4.48E-08	+/-7.44E-08	1.41E-07		uCi/g							
Antimony-124	U	-1.27E-08	+/-4.18E-08	8.96E-08		uCi/g							
Antimony-125	U	-1.51E-08	+/-6.89E-08	1.31E-07		uCi/g							
Barium-133	U	4.48E-10	+/-3.37E-08	5.99E-08		uCi/g							
Barium-140	U	-4.40E-08	+/-4.04E-07	7.79E-07		uCi/g							
Beryllium-7	U	-1.44E-07	+/-2.55E-07	4.63E-07		uCi/g							
Bismuth-212	UI	0.00	+/-6.07E-07	9.63E-07		uCi/g							
Bismuth-214		7.22E-07	+/-1.69E-07	1.09E-07		uCi/g							
Cerium-139	U	-2.00E-09	+/-2.46E-08	3.59E-08		uCi/g							
Cerium-141	U	3.07E-08	+/-5.64E-08	1.09E-07		uCi/g							
Cerium-144	U	2.93E-10	+/-1.43E-07	2.63E-07		uCi/g							
Cesium-134	U	1.35E-08	+/-3.14E-08	6.39E-08		uCi/g							
Cesium-136	U	6.84E-08	+/-1.44E-07	3.19E-07		uCi/g							
Cesium-137	UI	0.00	+/-5.20E-08	4.86E-08	1.00E-07	uCi/g							
Chromium-51	U	8.29E-09	+/-3.72E-07	7.37E-07		uCi/g							
Cobalt-56	U	1.79E-08	+/-2.84E-08	6.22E-08		uCi/g							
Cobalt-57	U	9.60E-09	+/-1.86E-08	3.63E-08		uCi/g							
Cobalt-58	U	1.40E-08	+/-3.29E-08	6.77E-08		uCi/g							
Cobalt-60	U	2.30E-08	+/-2.34E-08	5.88E-08	1.00E-07	uCi/g							
Europium-152	U	-8.91E-09	+/-6.82E-08	1.33E-07		uCi/g							
Europium-154	U	-8.95E-09	+/-6.75E-08	1.38E-07		uCi/g							
Europium-155	U	2.72E-08	+/-7.35E-08	1.42E-07		uCi/g							
Iridium-192	U	-5.72E-09	+/-2.87E-08	5.55E-08		uCi/g							
Iron-59	U	3.46E-08	+/-7.93E-08	1.58E-07		uCi/g							
Lead-210	U	1.15E-06	+/-2.85E-06	2.61E-06		uCi/g							
Lead-212		8.48E-07	+/-1.22E-07	9.59E-08		uCi/g							
Lead-214		7.64E-07	+/-1.79E-07	1.10E-07		uCi/g							
Manganese-54	U	1.46E-08	+/-3.04E-08	6.17E-08		uCi/g							
Mercury-203	U	4.66E-10	+/-3.11E-08	6.18E-08		uCi/g							
Neodymium-147	U	5.11E-07	+/-1.05E-06	2.16E-06		uCi/g							
Neptunium-239	U	1.19E-07	+/-1.81E-07	3.57E-07		uCi/g							
Niobium-94	U	5.13E-08	+/-3.22E-08	5.68E-08		uCi/g							
Niobium-95	U	1.17E-09	+/-4.07E-08	6.95E-08		uCi/g							
Potassium-40		8.45E-06	+/-1.23E-06	4.46E-07		uCi/g							
Promethium-144	U	-6.94E-09	+/-2.70E-08	4.72E-08		uCi/g							

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Project: Rancho Seco IOSB Soil and Water Analysis

Client Sample ID: 2016-0036 (F8300143-14) Project: SMUD00201
Sample ID: 407403007 Client ID: SMUD002

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gammaspec, Gamma, Solid (Standard List) "Dry Weight Corrected"												
Promethium-146	U	1.89E-09	+/-2.48E-08	5.03E-08		uCi/g						
Radium-223	U	2.20E-07	+/-4.29E-07	8.29E-07		uCi/g						
Radium-224	UI	0.00	+/-8.18E-07	1.21E-06		uCi/g						
Radium-228		8.18E-07	+/-2.25E-07	1.96E-07		uCi/g						
Ruthenium-106	U	-1.59E-07	+/-2.41E-07	4.20E-07		uCi/g						
Silver-110m	U	6.29E-08	+/-6.81E-08	7.87E-08		uCi/g						
Sodium-22	U	-6.42E-09	+/-2.47E-08	4.89E-08		uCi/g						
Thallium-208		2.64E-07	+/-5.86E-08	3.61E-08		uCi/g						
Thorium-234	U	1.21E-06	+/-2.21E-06	1.38E-06		uCi/g						
Tin-113	U	-2.17E-10	+/-3.19E-08	6.32E-08		uCi/g						
Uranium-235	U	8.83E-08	+/-1.36E-07	2.66E-07		uCi/g						
Uranium-238	U	1.21E-06	+/-2.21E-06	1.38E-06		uCi/g						
Yttrium-88	U	4.14E-09	+/-2.40E-08	5.76E-08		uCi/g						
Zinc-65	U	-4.50E-08	+/-5.17E-08	6.80E-08		uCi/g						
Zirconium-95	U	1.05E-07	+/-1.39E-07	1.31E-07		uCi/g						

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