MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-0200 YARD EAST
SURVEY UNIT 2

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A. SURVEY UNIT DESCRIPTION

The survey unit is essentially land of the Industrial Area of the site that was outside of the current Restricted Area fence. Survey Unit 2 is a land area that has always been outside of the Restricted Area boundary during decommissioning operations. All temporary structures, with exception of the truck monitor and control shack, were removed and all former permanent structures were demolished to at least 3 feet below grade. All blacktop was removed within Survey Unit 2. Survey Unit 2 land encompassed the former Circulating Water Pump House (CWPH) which housed equipment to pump cooling water from the Back River to various heat exchangers in the plant. Negligible amounts of radioactive materials were identified in the CWPH equipment during plant operations and successful FSS was performed of the former structure. A soil sample processing hut used during site characterization formerly resided within the boundary of Survey Unit 2. However, there was no history of the inadvertent spread of contamination associated with the sample processing operations. Most recently, Survey Unit 2 was used as a truck/equipment maintenance area and a truck radiological monitoring station (i.e., clean side waste).

Survey Unit 2 was located at the NE corner of the site Industrial Area yard and is shown in relation to site landmarks on map FR0200-2 Site. Boundaries of Survey Unit 2 are shown on map FR0200-2 REF. The approximate center of survey unit is located at coordinates 624350E & 407540N using the Maine State Coordinate System (West Zone) NAD 1927. Survey Unit 2 is an area composed mainly of soil and back-fill and is relatively flat.

B. SURVEY UNIT DESIGN INFORMATION

The survey unit was designated a Class 3 land survey per the LTP (Table 5-1C). The survey unit design parameters are shown in Table 1. Given a relative shift of 3.0, it was determined that 14 direct measurements were required for the Sign Test. Measurement locations were randomly determined and are illustrated on Map FR0200-2a (Attachment 1). Direct measurements (soil samples) were collected from the required locations and analyzed with laboratory gamma spectroscopy instrumentation.

In accordance with the LTP Table 5-3, gamma scans were required for 1 to 10% of the survey design area. Scan grids typically measuring 2 m by 5 m (10 m^2) were established in the following areas:

- Along the four meter buffer from the west boundary of the current Restricted Area
- Maintenance area west of the former CWPH area
- Along Back River western shoreline

The specific scan grids are also depicted on map FR0200-2b.

E-600/SPA-3 instrumentation was used to perform the scan surveys. The survey instruments used are listed by model and serial number in Attachment 2 (Table 2-1). The original 31 scan grids provided a scan area of 310 m^2, exceeding 10% of the total survey area. Configuration of the original scan grids is illustrated on FR0200-2b (Attachment 1). Background values were established based on local scaler values in the survey unit. These background values were used to determine scan alarm set points and to divide the scan grids into five different background groups. Scan MDCs are listed in Attachment 2 (Table 2-2) and are compared to the DCGL and the investigation level.

TABLE 1

SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	2,752 m^2	No limit for Class 3, based on LTP Table 5-2
Number of Direct Measurements Required	14	Based on adjusted LBGR of 3.69 pCi/g, sigma[1] of 0.17 pCi/g, and a relative shift of 3.0. Type I = Type II = 0.05
Sample Area	N/A	Class 3 Area
Sample Grid Spacing	N/A	Class 3 Area
Scan Grid Area	2 m x 5 m (10 m^2)	Class 3 Area; $\leq$ 10 m^2
Area Factor	N/A	Class 3 Area
Scan Area	310 m^2, > 10%	Class 3 Area – 1% to 10% (LTP Table 5-3)
Background		
SPA-3 (Scan)	7,677 cpm	Group 1
	9,074 cpm	Group 2
	10,434 cpm	Group 3
	11,284 cpm	Group 4
	9,858 cpm	Group 5
Scan Investigation Level (E-600/SPA-3)	3 Sigma of Background plus Background	See Table 2-2, Attachment 2 (Reference 6)
DCGL	4.2 pCi/g Cs-137	LTP, Rev. 3, Section 6.7
Design $DCGL_{EMC}$	N/A	Class 3 Area

[1] LTP Revision 3, Table 5-1C for Yard East, R0200

C. SURVEY RESULTS

As required, 14 direct soil measurements were performed in Survey Unit 2 and the results are presented in Table 2. All direct measurements were below 50% of the DCGL. The sample analyses did not identify Co-60 or Cs-137 above the MDAs.

A total of 31 grids were initially scanned using E-600/SPA-3 instrumentation. Five verified scan alarms were received. The investigation results are discussed in Section D. During the scan surveys, approximately 1.5 m^2 of surface area could not be scanned. This had no affect on the design since the actual scan area exceeded 10% of the total area.

TABLE 2

DIRECT MEASUREMENTS

Sample Location	Cs-137 (pCi/g)
FR0200-02-3S001SS	< 8.75E-02
FR0200-02-3S002SS	< 6.21E-02
FR0200-02-3S003SS	< 6.75E-02
FR0200-02-3S004SS	< 6.36E-02
FR0200-02-3S005SS	< 4.97E-02
FR0200-02-3S006SS	< 5.05E-02
FR0200-02-3S007SS	< 5.47E-02
FR0200-02-3S008SS	< 4.70E-02
FR0200-02-3S009SS	< 4.65E-02
FR0200-02-3S010SS	< 5.94E-02
FR0200-02-3S011SS	< 3.88E-02
FR0200-02-3S012SS	< 4.43E-02
FR0200-02-3S013SS	< 9.28E-02
FR0200-02-3S014SS	< 4.22E-02
Mean	**5.76E-02**
Median	**5.26E-02**
Standard Deviation	**1.62E-02**
Sample Range	**3.88E-02 to 9.28E-02**

"<" Indicates MDA value.
Samples were also analyzed for Co-60. All were less than the MDA of 0.1 pCi/g.

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

Soil scans performed with the E-600/SPA-3 identified five scanned grids with verified alarms. All five cpm values ranged within 1.3 to 5.4 percent of the designated alarm set points. Three of the five scan grids with verified alarms (S011, S012, and S019) resided along the buffer to the west fence line between the current Restricted Area and the radiologically unrestricted area. The other two remaining scan grids were situated towards the center of SU2. As a result, investigation package XR0200-02 was written to perform additional scans within the five identified grids and to collect soil samples at the highest scan location within each grid. The grids requiring investigation scans are illustrated on XR0200-2a (Attachment 1). As a result of the investigations, a total of five soil samples were collected.

During the investigation of Survey Unit FR-0200-02, the soil sample results associated with those taken within each of the five grids did not identify Cs-137 nor Co-60 above MDA values.

E. SURVEY UNIT DATA ASSESSMENT

An analysis of the direct sample measurement results, including the mean, median, standard deviation, and sample result range, is provided in Table 2. Of the 14 soil samples collected, no samples identified Cs-137 above the MDA values. The identified MDAs are listed in Table 2. The mean and median activities for Cs-137 were also less than 50% of the DCGL. In addition, Co-60 was not identified in any of the 14 samples.

For illustrative purposes, as indicated in LTP Section 5.9.3, a simplified general retrospective dose estimate can be calculated from the average residual contamination level by subtracting the mean fallout Cs-137 value (0.19 pCi/g)[2] for disturbed soil from the survey unit sample mean activity (0.0576 pCi/g). The net result is negative and would equate to an annual dose rate of 0.0 mrem/year. However, for purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State criteria, background activity was not subtracted from the soil sample analysis activity values.

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with this Survey Unit, including relevant statistical information. Based on survey unit direct measurement data, this attachment provides the Sign Test Summary, Quantile Plot, Histogram, and Retrospective Power Curve.

1. The Sign Test Summary provides an overall summary of design input (Table 1) and resulting calculated values used to determine the required number (N) of direct measurements (per LTP Section 5.4.2). The Sign Test Summary is a separate statistical analysis that also calculates the mean, median, and standard deviation of the direct measurements.

   The critical value and the result of the Sign Test are provided in the Sign Test Summary table, as well as a listing of the key release criteria. As is shown in the table, all of the key release criteria were satisfied for the FSS of this survey unit. The sample standard deviation is smaller than the design sigma; therefore no additional samples were required.

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[2] See attachment E to Maine Yankee Procedure PMP 6.7.8 (Reference 5)

2. The Quantile Plot was generated from the direct measurement data listed in Table 2. The data set and plot are consistent with expectations for a Class 3 survey unit. All of the measurements are well below the DCGL of 4.2 pCi/g for land outside the restricted area.

3. A Histogram Plot was also developed based on the direct measurement data values. This plot shows a log-normal distribution with two outliers.

4. A Retrospective Power Curve was constructed, based on FSS results. The curve shows that this survey unit having a mean residual activity at a small fraction of the DCGL has a high probability ("power") of meeting the release criteria. Thus, it can be concluded that the direct 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.

G. CHANGES IN INITIAL SURVEY UNIT ASSUMPTIONS ON EXTENT OF RESIDUAL ACTIVITY

The survey was designed as a Class 3 land survey area. A four meter wide portion of the survey area that was directly adjacent to the current Restricted Area boundary was removed to provide a buffer. This buffer area will be surveyed as a Class 1 area. The FSS results (all direct measurements, initial scan results, and investigation results) were consistent with the Class 3 land survey classification. The direct measurement sample standard deviation was less than the design sigma. Thus, a sufficient number of sample measurements were taken and no additional measurements were required.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 2 was designed, performed, and evaluated in the February 2005 to March 2005 time frame. The design was performed to the criteria of the LTP Revision 3 (Reference 1). The only subsequent LTP change modified the Table 6-11 "Contaminated Material DCGL" to reflect an increased Deep Soil DCGL for Co-60 inside the Restricted Area. However, the Deep Soil DCGL change does not apply to this survey unit as the surface soil DCGL for areas outside the restricted area remained unchanged. No subsequent LTP changes with potential impact to this survey unit need to be evaluated.

I. CONCLUSION

The FSS of this survey unit was designed based on the LTP designation as a Class 3 area. The survey design parameters are presented in Table 1. The required number of direct measurements was determined for the Sign Test in accordance with the LTP. As presented in Table 2, all of the direct measurements were less than 50% of the DCGL.

A Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied. The direct measurement sigma was determined to be less than that used for design, thus indicating that a sufficient number of samples was taken.

The Retrospective Power Curve shown in Attachment 4 confirmed that sufficient samples were taken to support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and the data quality objectives were met. Attachment 4 also revealed that direct measurement data represented essentially a log-normal distribution with two outliers.

The scan survey design for this survey unit was developed in accordance with the LTP Revision 3 Addenda (Reference 1) with significant aspects of the design discussed in Section B and Table 1. Scans performed with E-600/SPA-3 instrumentation resulted in a total of five verified alarms. Therefore, five investigations were conducted via package XR0200-02. As a result of the investigations, a total of five additional soil samples were obtained. All sample measurements were less than the DCGL of 4.2 pCi/g Cs-137. No detectable Co-60 and/or Cs-137 were identified.

It is concluded that FR-0200 Survey Unit 2 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

J. REFERENCES

1. Maine Yankee License Termination Plan, Revision 3, October 15, 2002 and Addenda provided by Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002

2. NRC letter to Maine Yankee, dated February 28, 2003

3. Maine Yankee letter to the NRC, MN-03-049, dated September 11, 2003 (LTP Supplement to LTP Revision 3)

4. Issuance of License Amendment No. 170, NRC letter to Maine Yankee, dated February 18, 2004

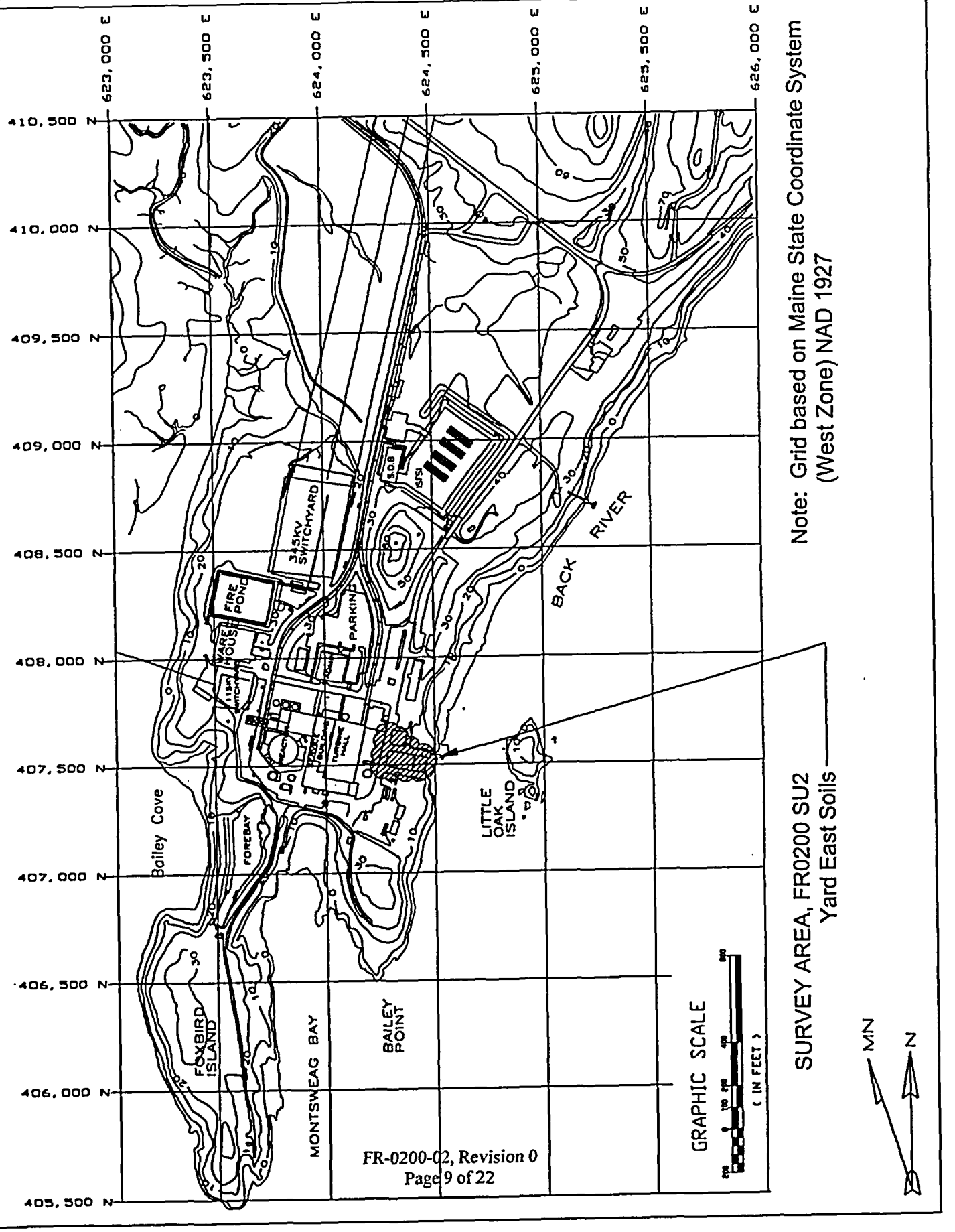
5. Maine Yankee Procedure PMP 6.7.8, FSS Data Processing and Reporting, Attachment E, Approach for Dealing With Background Radioactivity for Maine Yankee Final Status Surveys

6. Maine Yankee Calculation No. EC 009-01 (MY), Instrumentation Selection and MDC Calculation

Attachment 1

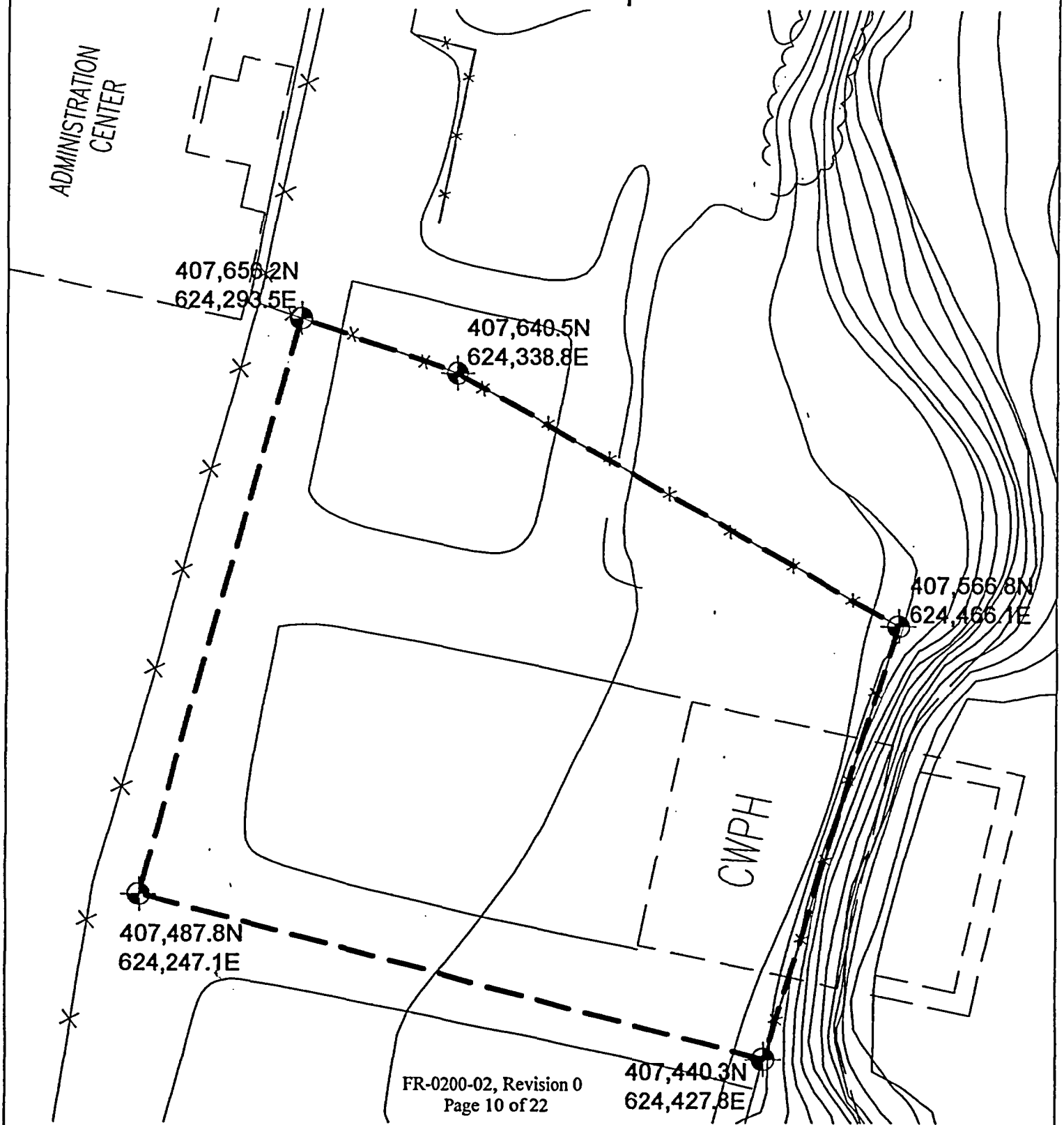
Survey Unit Maps

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FR 0200-2 SITE Revised: 2/03/05
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Yard East Soil, Survey Unit 2	



Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FR0200-2 REF Revised : 2/21/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Yard East Soil Survey Unit 2	

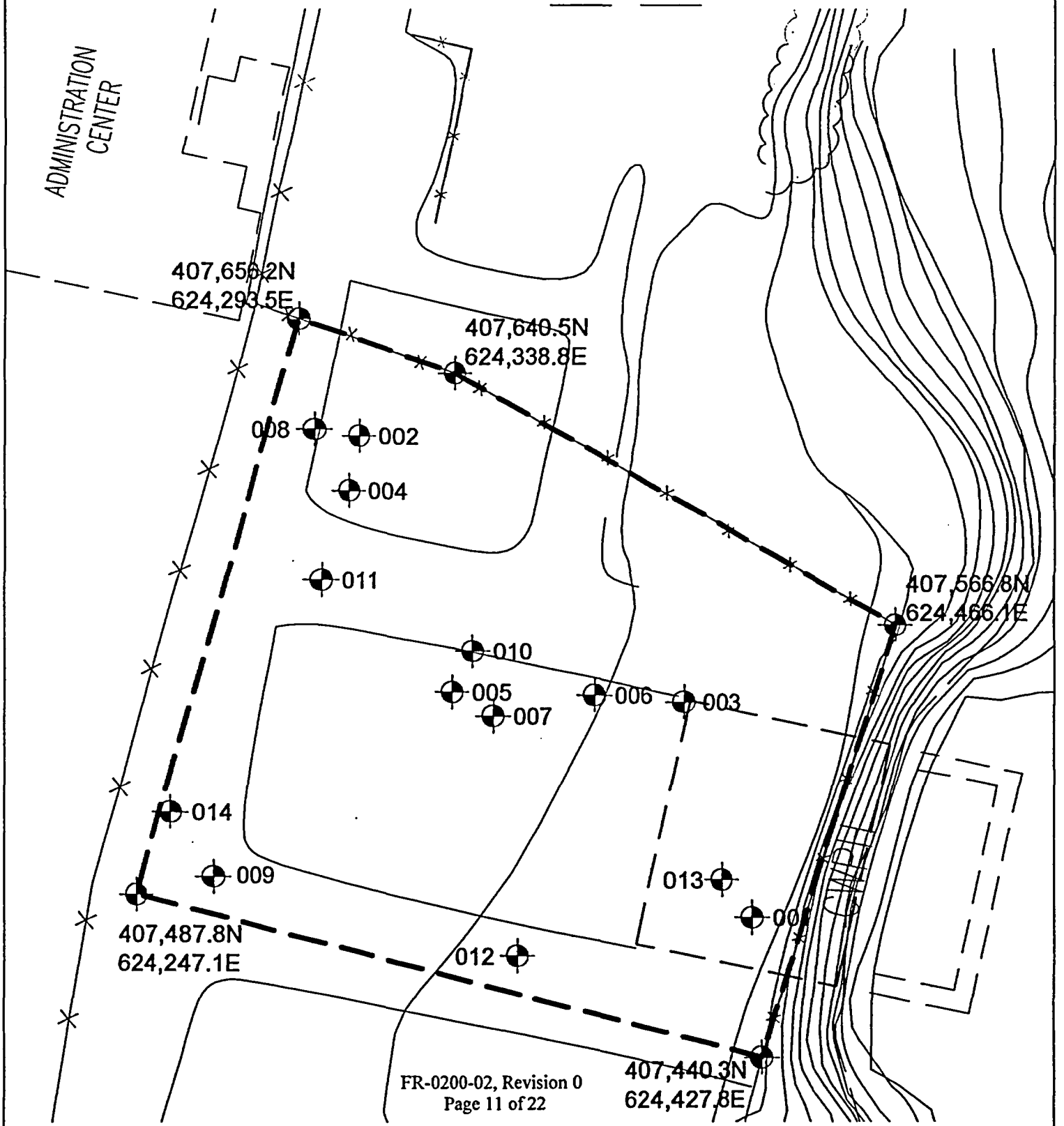
Final Status Survey
FR0200 SU2: Yard East Soil Area
Reference Map



FR0200 SU2 Total Surface Area = 2752 m ²

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FR0200-2a Revised : 2/21/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Yard East Soil Survey Unit 2	

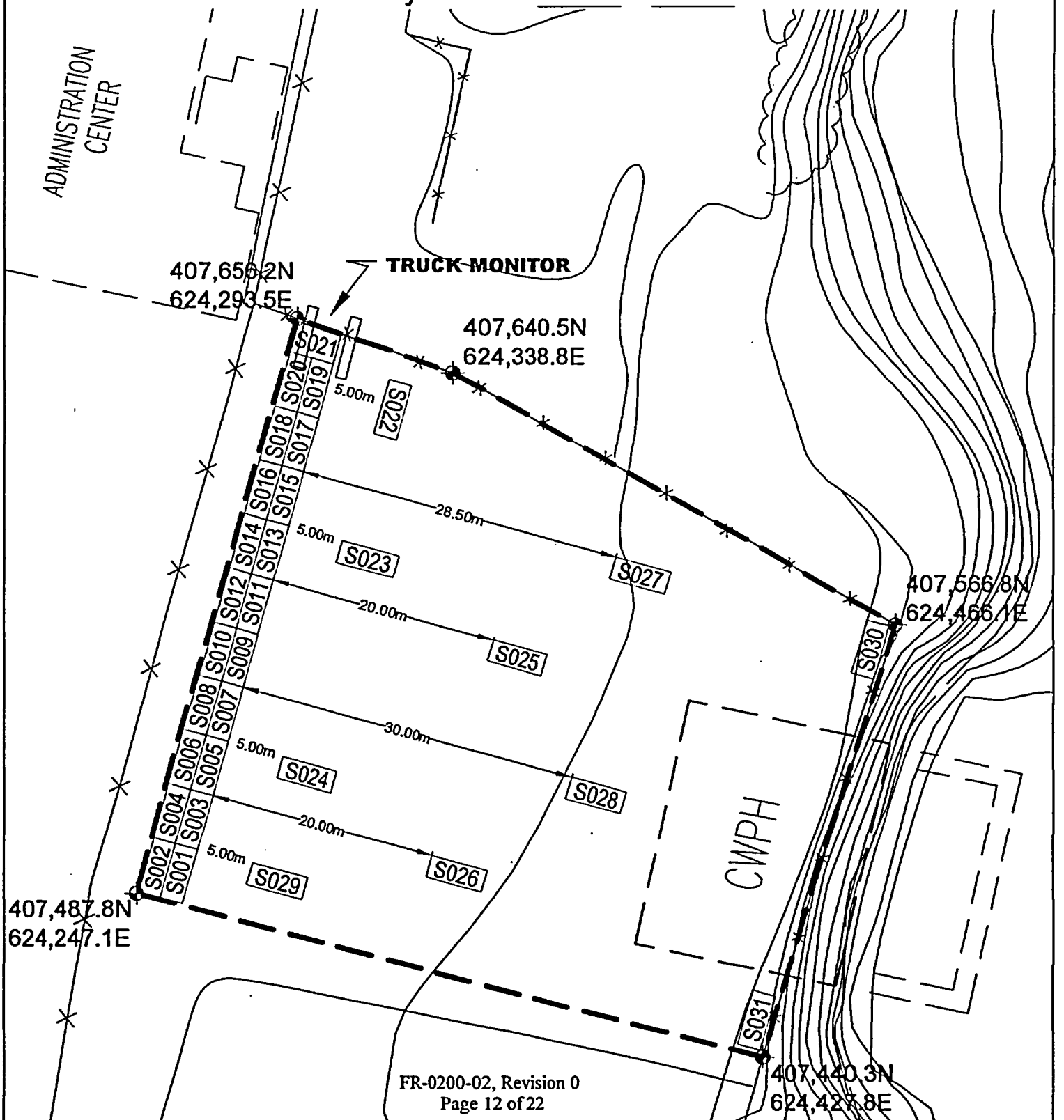
Final Status Survey
FR0200 SU2: Yard East Soil Area
Direct Points 001 - 014



FR0200 SU2 Total Surface Area = 2752 m² N = 14, Random Direct Points (Class 3)

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FR0200-2b Revised : 3/14/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Yard East Soil Survey Unit 2	

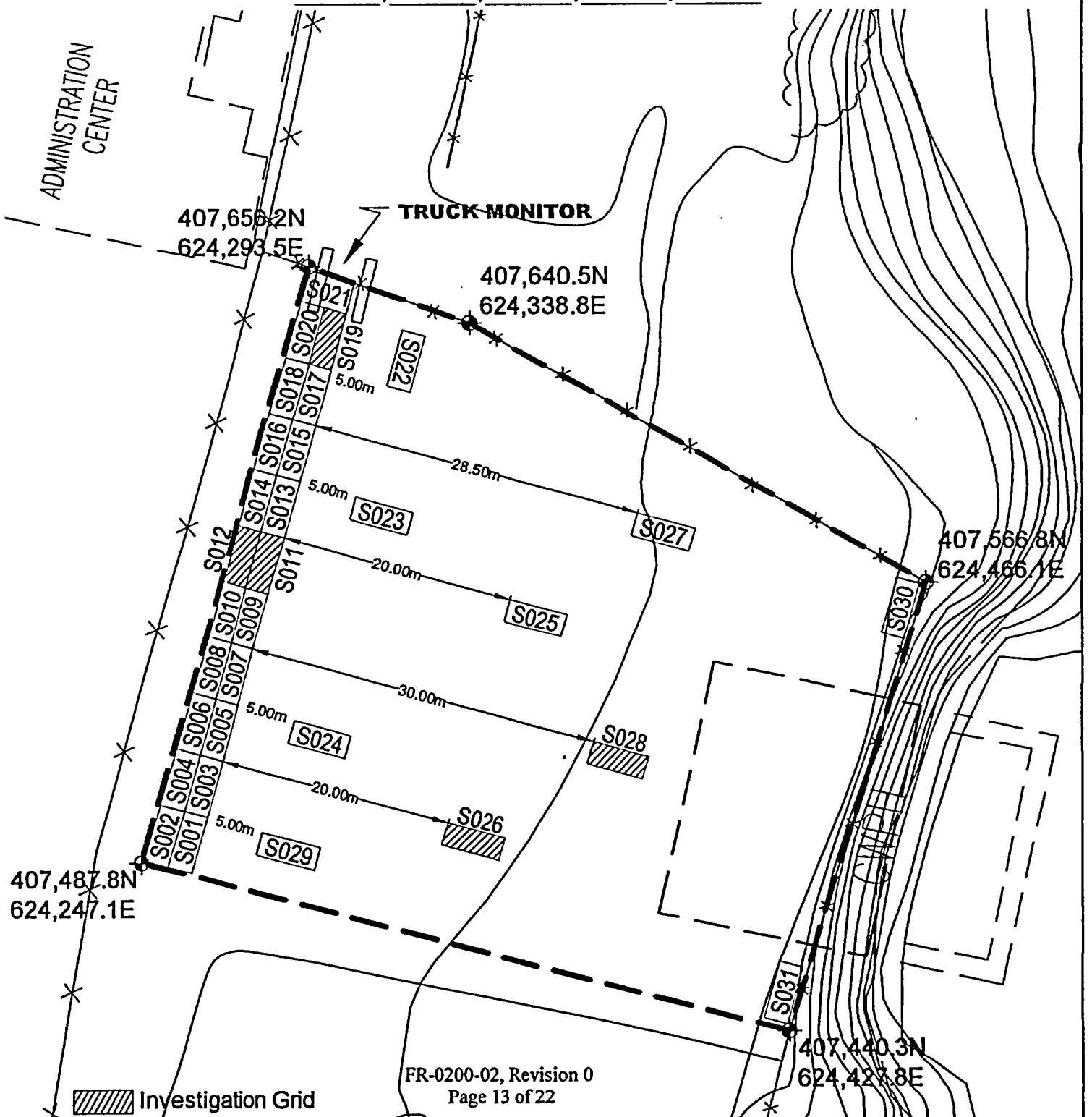
Final Status Survey
FR0200 SU2: Yard East Soil Area
Survey Scans S001 - S031



FR0200 SU2 Total Surface Area = 2752 m²

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: XR0200-2a Revised : 3/14/05
Survey Type: ☒ Investigation ☐ Turnover ☐ Final Status Survey		Survey Area Name: Yard East Soil Survey Unit 2

Final Status Survey
XR0200 SU2: Yard East Soil Area
Investigation Scan Locations
S011,S012,S019,S026,S028



XR0200 SU2 Total Surface Area = 2752 m ^{2}

Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

E-600 S/N	SPA-3 Probe S/N
1648	725890
1933	726557
2618	2366

HPGe Detectors (Laboratory Analysis)

Detector No.	MDC (pCi/g)
FSS1	0.04 to 0.10
FSS2	0.03 to 0.07

TABLE 2-2

INSTRUMENT SCAN MDC, DCGL, AND INVESTIGATION LEVEL

Parameter	Instrument: SPA-3	Comments
Scan MDC	5.9 pCi/g Cs-137	LTP Rev 3 Table 5-6 (Reference 2)
DCGL	4.2 pCi/g Cs-137	Approved DCGL for land areas outside the Restricted Area, LTP Section 6.7 (References 2 and 4)
Investigation Level (Alarm Setpoint)	9,700 cpm	Group 1: Grids S002, S028, S031
	11,300 cpm	Group 2: Grids S001, S003 through S012, S024, S026, S029, S030
	12,800 cpm	Group 3: Grids S013 through S017, S019, S023
	13,800 cpm	Group 4: Grids S018, S020, S021, S027
	12,200 cpm	Group 5: Grids S022, S025

Attachment 3

Investigation Table

TABLE 3-1

XR0200-02 INVESTIGATION SOIL SAMPLING RESULTS

Elevated Grid Sample Location	Initial Scan Value (cpm)	Alarm Set point (cpm)	Invest. Scaler Value (cpm)	Activity (pCi/g Cs-137)	Uncertainty (pCi/g Cs-137)	DCGL Comparison
XR0200023S011	11,870	11,300	9,400	< 5.33E-02	N/A	< DCGL
XR0200023S012	11,810	11,300	9,580	< 4.36E-02	N/A	< DCGL
XR0200023S019	12,970	12,800	11,090	< 5.76E-02	N/A	< DCGL
XR0200023S026	11,910	11,300	9,840	< 4.75E-02	N/A	< DCGL
XR0200023S028	9,880	9,700	9,470	< 4.94E-02	N/A	< DCGL
					Survey Unit Mean / DCGL	**0.014**
					Total	**0.014**

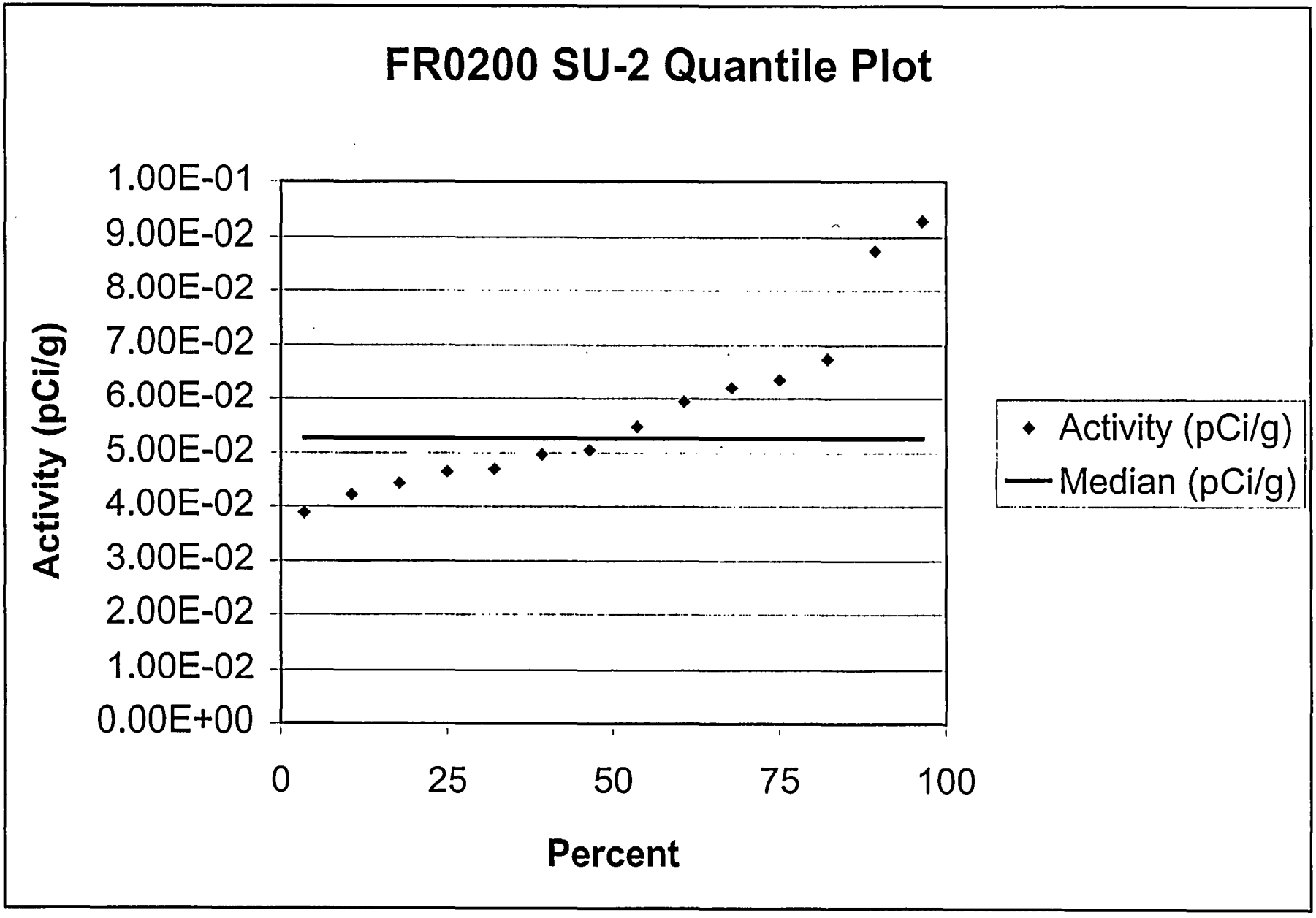
NOTES: 1. "<" indicates value less than MDA, MDA value is reported.
3. The samples were also analyzed for Co-60; all were less than an MDA of 0.062 pCi/g.

Attachment 4

Statistical Data

Survey Package FR0200 Unit 2 CS-137 Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FR0200	
Survey Unit:	02	
Evaluator:	Jeff Ambrose	
$DCGL_w$:	4.20E+00	Cs-137
$DCGL_{emc}$:	n/a	Class 3
LBGR:	2.10E+00	50% of DCGL
Sigma:	1.70E-01	LTP Rev 3, Table 5-1C
Type I error:	0.05	
Type II error:	0.05	
Nuclide:	CS-137	
Soil Type:	N/A	No material background is applied.
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	12.3	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift is >3
N-Value:	11	
N-Value+20%:	14	
Sample Data Values		**Comments**
Number of Samples:	14	
Median:	5.26E-02	
Mean:	5.76E-02	
Net Sample Standard Deviation:	1.62E-02	
Total Standard Deviation:	1.62E-02	Sum of samples and reference
Maximum:	9.28E-02	
Sign Test Results		**Comments**
Adjusted N Value:	14	
S+ Value:	14	
Critical Value:	10	
Sign test results:	Pass	
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	
Total Standard Deviation <=Sigma:	Pass	
Criteria comparison results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	


FR0200 SU-2 Quantile Plot
Activity (pCi/g)
1.00E-01
9.00E-02
8.00E-02
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
0
25
50
75
100
Percent
Activity (pCi/g)
Median (pCi/g)

One-Sample T-Test Report

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Database
Variable C2

Plots Section

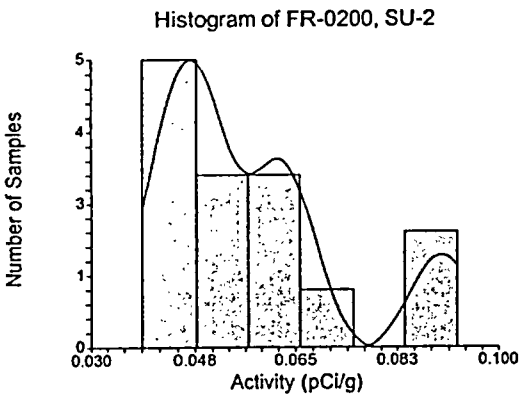

Chart Section