MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FD-3500 STORM DRAINS
SURVEY UNIT 2

Prepared By:	Dale Randall **FSS Engineer** – Signature Dale Randall Printed Name	Date: 2-15-05
Reviewed By:	 **FSS Specialist** – Signature R. Tozzie Printed Name	Date: 2/16/05
Reviewed By:	 **Independent Review** – Signature CAOlsen Printed Name	Date: 16. FEB. 05
Approved By:	 **Superintendent, FSS** – Signature George Pillsbury Printed Name	Date: 2/17/05
Approved By:	 **FSS, MOP** – Signature James R. Packer Printed Name	Date: 4/5/05

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FD-3500 STORM DRAINS
SURVEY UNIT 2

A. SURVEY UNIT DESCRIPTION

Survey Unit 2 is a portion of Survey Area FD-3500, the Storm Drains survey area. The Storm Drains accommodated the overboard discharge of surface water through buried piping of varying diameters and material types across the developed portion of the site. The survey area consists of Class 1 and Class 3 piping sections. The classification of individual piping sections was based on their potential for contamination, this determination was based primarily on location. The survey classes for particular sections are specified in Attachment 5A of the License Termination Plan (LTP, Reference 1).

Survey Unit 2 consists of the piping leading into Outfalls 9 and 10 (Storm Drain Sections 1 and 2, respectively per LTP Attachment 5A). The outfalls are located near grid coordinate 407,500 N and 624,500 E using the Maine State Coordinate System (West Zone) NAD 1927. Outfalls 9 and 10 and the associated piping are shown in relation to other major site structures in map FD 3500-02 SITE and FD 3500-2 REF. All maps referenced in this release record are provided in Attachment 1 unless otherwise noted. The survey unit is approximately 416 m^2.

B. SURVEY UNIT DESIGN INFORMATION

These storm drain sections were designated Class 3 per the LTP Revision 3.

Aside from ground water drainage of Class 3 areas, the only known potential source for radiological contamination of the survey unit was the temporary liquid effluent[1] discharge hose that ran through the pipe. The line was a continuous piece of hose which ran from Manhole 20 to the Outfall 10 discharge point (see map FD 3500-2 REF of Attachment 1). Prior to and through the Spent Fuel Pool drain down, the hose was routinely pressure tested prior to each discharge. No evidence was found to indicate any leakage from the hose into the pipe. Following Spent Fuel Pool discharge, the hose was rerouted through Manhole 5. All effluent discharges through Outfall 10 were permanently discontinued prior to performing the FSS of the survey unit. It is, therefore, appropriate to retain the designation for this section of the storm drain piping system as a Class 3 survey unit.

The survey unit design parameters are shown in Table 1. Given an adjusted relative shift of 3, it was determined that 14 direct measurements were required for the Sign Test; however, the number of samples was increased because the LTP also requires a minimum of 30 direct samples points (to accommodate an efficient field layout, 32 were taken).

[1] All effluent concentrations were below 10 CFR 20 Subpart O, Appendix B, Table 2, Column 2 values.

Measurement locations were determined by equally distributing the measurement locations along the circumference and length of the accessible areas of the piping at the outfall. Since the outfall is the lowest elevation of the survey unit, it is considered to be an appropriate location for sampling, as is suggested by the LTP as a key element of the survey design for Class 3 piping. Locations are illustrated on the maps FD 3500-2c and FD 3500-2f. Removable contamination samples were obtained at each measurement location.

The survey was also designed to include 20 scan grids for surfaces, each of approximately 0.3 m^2 or smaller area (see maps FD 3500-2a, FD 3500-2b, FD 3500-2d, FD 3500-2e). The total area scanned was approximately 4.7 m^2 which is 1.1% of the survey unit area. Instrument scan setpoints were set at the DCGL plus background, as shown in Table 2-2 (Attachment 2).

To accommodate measurement geometry requirements for surfaces of differing curvatures and damp sample locations, 43-68 data was evaluated with different efficiencies, as appropriate. Due to the presence of 0.25" of water in the bottom of the piping in Outfall 10, two *in situ* gamma spectroscopy (ISOCS) measurements were made to completely scan accessible areas of the piping.

Background values were established for each particular instrument probe application based on ambient background scaler values in the survey unit and previously established material backgrounds. These background values, listed in Table 1, were used to establish net activity for direct measurements.

Since scan measurements are performed in peak hold mode, it is appropriate to apply a peak hold background for calculating scan setpoints. The background applied was the ambient peak hold average value used in determining the material background for concrete (622 cpm) Reference 5.

The instruments used in this survey are listed by model and serial number in Attachment 2 (Table 2-1). Scan MDCs are also listed in Attachment 2 (Table 2-2) and are compared to the DCGL and the investigation level. As shown in this table, the scan MDC is less than the scan investigation level in all cases, thus providing high confidence (95% or higher) that an elevated area would be detected in the scanning process.

In addition to FSS measurements, one sediment sample was removed from each of the first catch basins above Outfalls 9 and 10. These two samples were counted to environmental LLDs by laboratory gamma spectroscopy.

TABLE 1
SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	416 m^2	
Number of Direct Measurements Required	30	Based on an LBGR of 4,900 dpm/100cm^2, sigma[2] of 727 dpm/100 cm^2, and an adjusted relative shift of 3.0, N = 14 for Type I = Type II = 0.05 (Minimum = 30 per the LTP)
Sample Area	N/A	Class 3
Sample Grid Spacing	N/A	Class 3
Scan Grid Area	0.18 m^2, 0.29 m^2	6-inch bands for 15" and 24" diameter piping.
Area Factor	N/A	Class 3
Scan Survey Area	4.7 m^2 (1.1%)	Class 3 (1– 10%) required
Background		
Outfall 9 (24" diameter) 43-68 Direct (dry concrete surfaces)	3,358 dpm/100 cm^2	Ambient and Material Scaler Value
Outfall 9 (24" diameter) 43-68 Direct (damp concrete surfaces)	7,569 dpm/100 cm^2	Ambient and Material Scaler Value
Outfall 10 (15" diameter) 43-68 Direct (dry concrete surfaces)	3,312 dpm/100 cm^2	Ambient and Material Scaler Value
Outfall 9 (24" diameter) 43-68 Scan (dry concrete surfaces)	3,797 dpm/100 cm^2	Peak hold ambient value
Outfall 10 (15" diameter) 43-68 Scan (dry surfaces)	4,747 dpm/100 cm^2	Peak hold ambient value
Outfall 9 (24" diameter) 43-68 Scan (damp surfaces)	10,034 dpm/100 cm^2	Peak hold ambient value
Scan Investigation Level	DCGL plus background	See Table 2-2 (Attachment 2)
DCGL	9,800 dpm/100 cm^2	LTP, Rev. 3
Design $DCGL_{EMC}$	N/A	Class 3

C. SURVEY RESULTS

Thirty-two direct measurements were made in Survey Unit 2. Once corrected for ambient and material background, all direct measurements were less than 50% of the DCGL. The resulting data are presented in Table 2 below. No verified alarms were received during the surface scans. The two ISOCS measurements performed in Outfall 10 were less than MDA for Cs-137 and Co-60. Therefore, no investigations were required.

[2] Design sigma is based on sigma values of Turbine Building draining into these Class 3 portions of FD-3500.

TABLE 2
DIRECT MEASUREMENTS

Sample Location	Gross Activity dpm/100 cm^2	Net Activity (Table 1 Background Subtracted) dpm/100 cm^2
FD3500-02-C001	8,727	1,158
FD3500-02-C002	3,150	-208
FD3500-02-C003	4,585	1,227
FD3500-02-C004	3,199	-159
FD3500-02-C005	9,421	1,852
FD3500-02-C006	3,309	-49
FD3500-02-C007	4,664	1,306
FD3500-02-C008	3,492	134
FD3500-02-C009	10,388	2,820
FD3500-02-C010	3,523	165
FD3500-02-C011	4,518	1,160
FD3500-02-C012	3,315	-43
FD3500-02-C013	10,259	2,691
FD3500-02-C014	3,370	12
FD3500-02-C015	4,866	1,508
FD3500-02-C016	3,846	488
FD3500-02-C027	3,342	31
FD3500-02-C028	3,274	-38
FD3500-02-C029	3,976	664
FD3500-02-C030	3,365	53
FD3500-02-C031	3,526	214
FD3500-02-C032	3,167	-145
FD3500-02-C033	3,083	-229
FD3500-02-C034	3,404	92
FD3500-02-C035	3,907	595
FD3500-02-C036	3,434	122
FD3500-02-C037	3,549	237
FD3500-02-C038	3,831	519
FD3500-02-C039	3,648	336
FD3500-02-C040	3,793	481
FD3500-02-C041	3,770	458
FD3500-02-C042	3,556	244
Mean	**4,414**	**553**
Median	**3,552**	**240**
Standard Deviation	**2,092**	**788**
Sample Range	**3,083 to 10,388**	**-229 to 2,820**

NOTE: Measurements C001 through C016 were obtained in the 24" pipe.
The efficiency and background values for damp concrete were applied to locations C001, C005, C009, and C013.

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

No investigations were required as there were no verified scan alarms.

E. SURVEY UNIT DATA ASSESSMENT

An analysis of the direct sample measurement results, including the mean, median, standard deviation, and sample result range, are provided in Table 2. The maximum direct sample result with background subtracted was equivalent to 2,820 dpm/100 cm^2.

All 43-68 scan data was less than the investigation levels; therefore, there were no investigations required. The ISOCS scan measurements did not detect plant-derived activity in excess of the MDAs. The maximum ISOCS scan measurement MDAs were 201 dpm/100 cm^2 and 268 dpm/100 cm^2 for Co-60 and Cs-137 respectively.

When adjusted for background, the mean residual contamination level is 553 dpm/100 cm^2. This is equivalent to an annual dose of 0.0001 mrem[3].

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with Survey Unit 2, 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, key release criteria were satisfied, with one exception. An "investigate" flag was produced because the direct measurement sigma exceeded the design sigma, however, sufficient power is evident, particularly when one considers that 32 samples were taken for the FSS of this survey unit.

[3] From Table 6-11 of the LTP, the buried piping dose is 2.52E-03 mrem/y, therefore, (553/9,800) x 2.52E-03 = 0.0001 mrem/y.

2. The Quantile Plot was generated from direct measurement data listed in Table 2 and indicates general symmetry about the median. The data set and plot are consistent with expectations for a Class 3 survey unit. There is no reason to conclude that the data set represents other than random variations in a Class 3 concrete surface survey unit. It also should be noted that the maximum net activity (2,820 dpm/100 cm^2 at location C009) is well below 50% of the DCGL.

3. A Histogram Plot was also developed based on the direct measurement values. This plot shows that the direct data were essentially a normal distribution.

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.

As mentioned in Section B, removable contamination samples were obtained at each (direct) measurement location. In that this survey unit involved buried piping area and not a standing building, the removable contamination measurements were not applicable to release decisions for the survey unit. However, the samples were obtained and evaluated, indicating alpha activity less than the MDA values (i.e., < 3.8 dpm/100 cm^2) and the beta activity also generally less than the MDA values. Two of the 32 samples indicated beta activity above MDA with a maximum value of 3.5 dpm/100 cm^2. Thus, in comparison with the mean survey unit net activity (Table 2), the removable contamination sampling effort indicated that the majority of activity is fixed. Smears are typically taken immediately after performing direct measurements. Due to an instrument failure, this was not the case in Outfall 10 where measurements were repeated. The removable contamination was negligible; consequently, this has no impact on the validity of direct measurement results.

Although not applicable to the release decisions, the gamma spectroscopy analyses of catch basin sediment samples found no plant-derived nuclides in excess of environmental MDA values which further demonstrates that the system was appropriately classified.

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

The survey was designed as a Class 3 area; the FSS results were consistent with that classification. The direct measurement sample standard deviation was greater than the design sigma. However, the survey unit easily passed the Sign Test. Thus, a sufficient number of sample measurements were taken.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 2 was designed, performed, evaluated, and reviewed from late 2004 to early 2005. The design was performed to the criteria of the approved LTP (Revision 3 Addenda). There were no subsequent LTP changes with the potential to impact the design, conduct, or assessment of the final status survey of Survey Unit 2.

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 beta direct measurements were less than 50% of the DCGL (9,800 dpm/100 cm^2) after being corrected for background.

A Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied. The direct measurement sigma was determined to be greater than that used for design, but a sufficient number of samples were taken to produce adequate power.

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 normal distribution, with variance consistent with expectations for a Class 3 survey unit.

The scan survey design for this survey unit was developed in accordance with the LTP with significant aspects of the design discussed in Section B and Table 1. Scanning resulted in no verified alarms. ISOCS measurements were used to supplement the scan data due to water on the bottom of the pipe. The ISOCS results did not identify any plant-derived activity.

In addition, while not part of the release decision criteria, removable contamination sampling confirmed that the majority of remaining activity in this survey unit was fixed. Sediment samples taken from the catch basins did not identify plant-derived activity.

It is concluded that FD-3500 Survey Unit 2 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

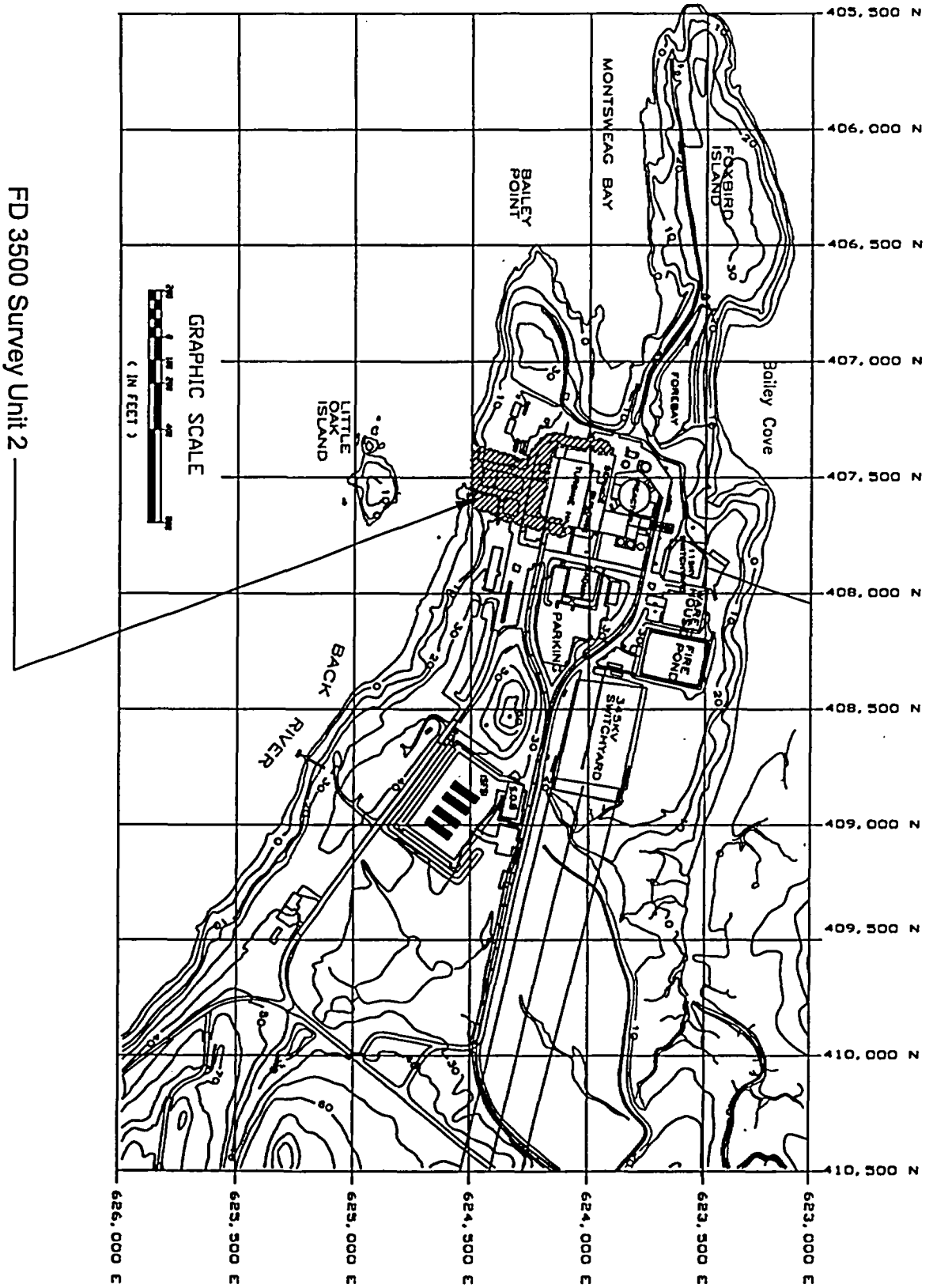
J. REFERENCES

1. Maine Yankee License Termination Plan, Revision 3, October 15, 2002
2. Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002
3. NRC letter to Maine Yankee, dated February 28, 2003
4. Maine Yankee letter to the NRC, MN-03-049, dated September 11, 2003
5. Maine Yankee Engineering Calculation EC-039-01

Attachment 1

Survey Unit Maps

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FD 3500-2 SITE Revised: 3-28-05
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Outfalls 9&10	

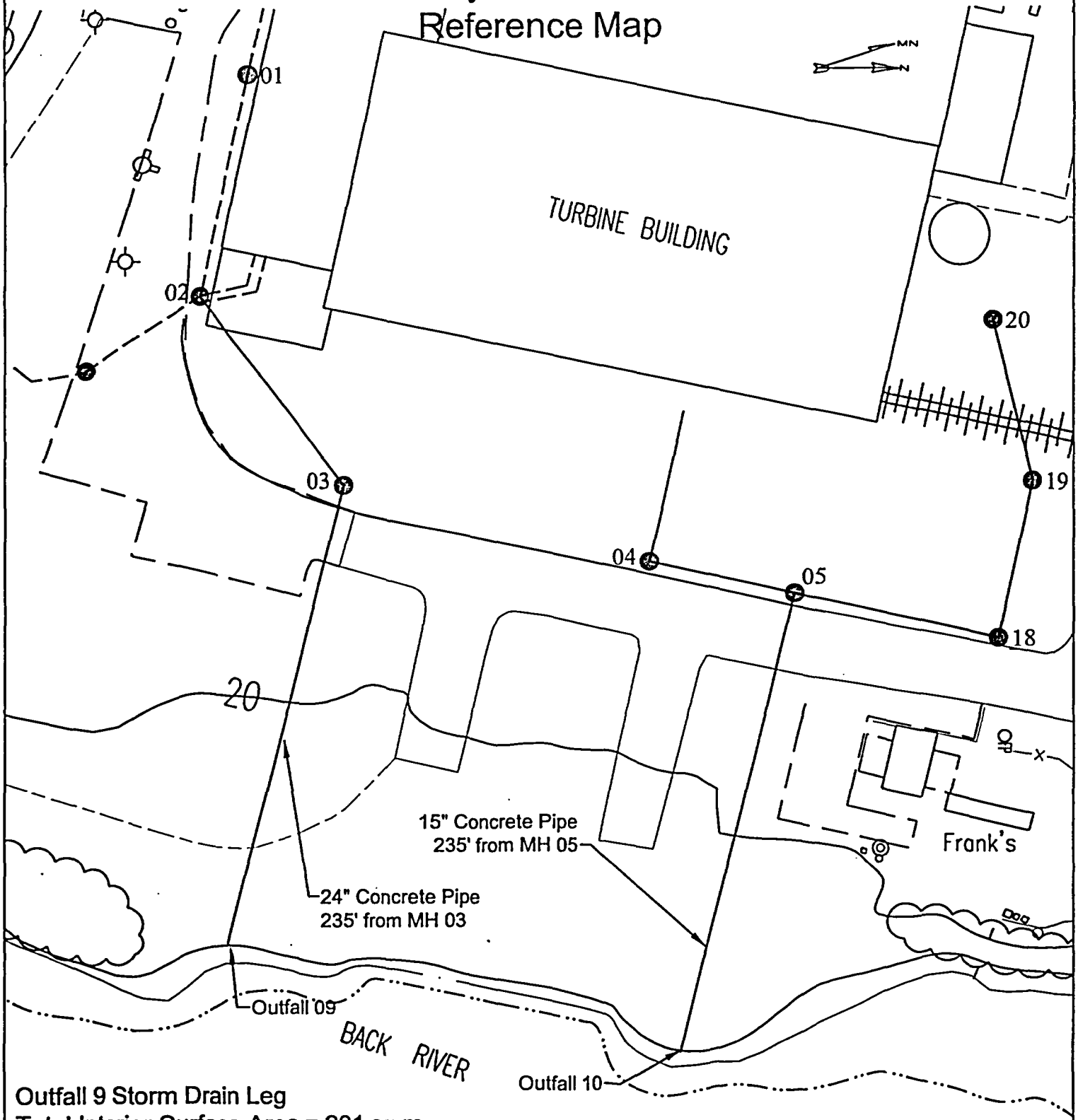


FD 3500 Survey Unit 2

Note: Grid based on Maine State Coordinate System (West Zone) NAD 1927

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FD 3500-2 REF Revised : 1/31/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Outfalls 9 & 10	

Final Status Survey
FD3500 Survey Unit 2: Outfalls 9 & 10
Reference Map

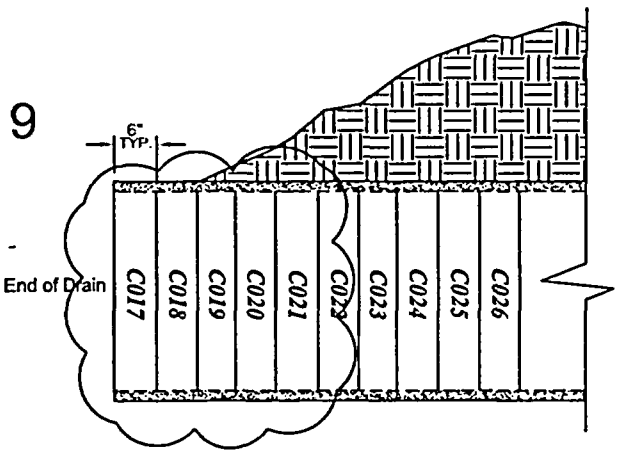


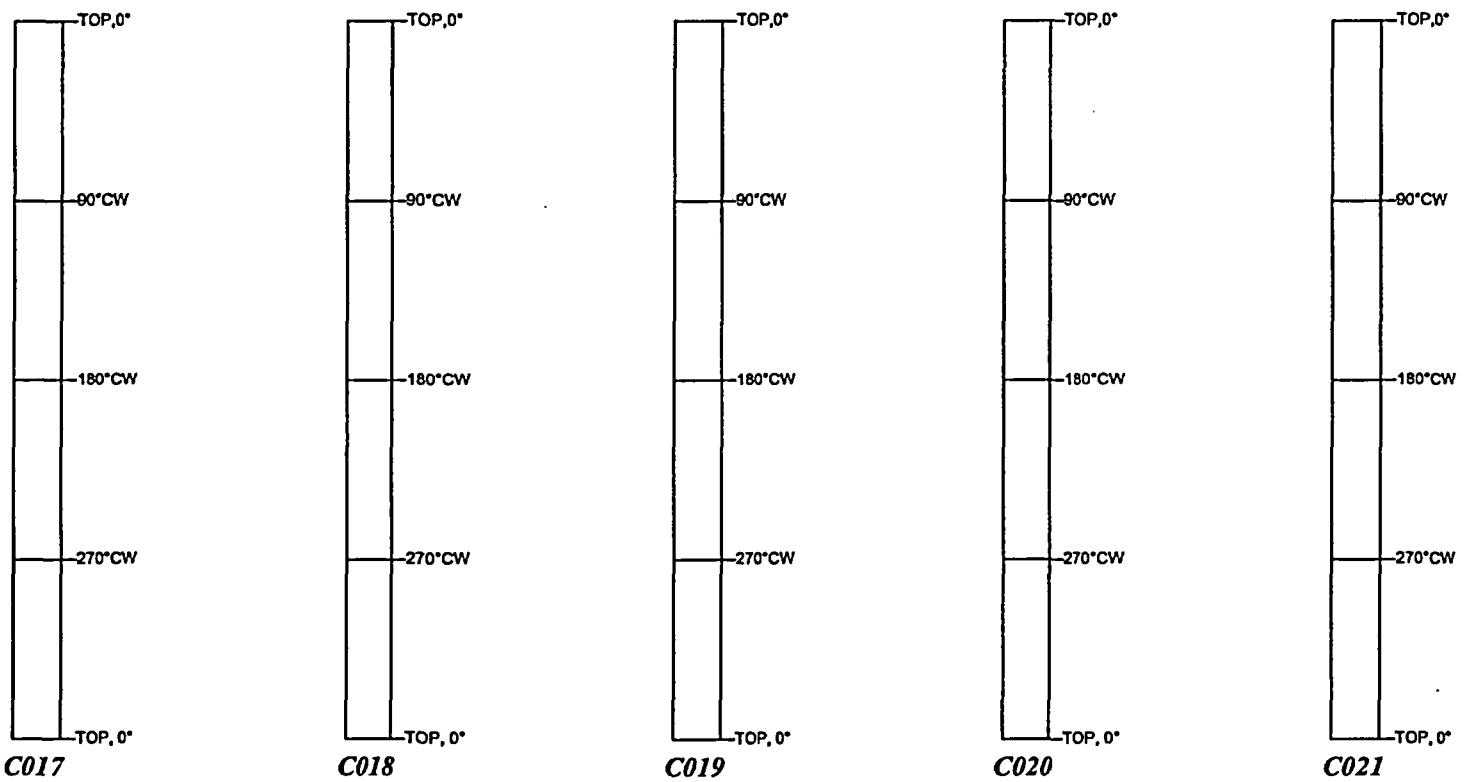
Outfall 9 Storm Drain Leg
Total Interior Surface Area = 201 sq-m

Outfall 10 Storm Drain Leg
Total Interior Surface Area = 215 sq-m

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FD 3500-2a Revised : 1/26/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Outfall 9	

Final Status Survey
FD3500 Survey Unit 2: Outfall 9
Survey Scans C017 - C021

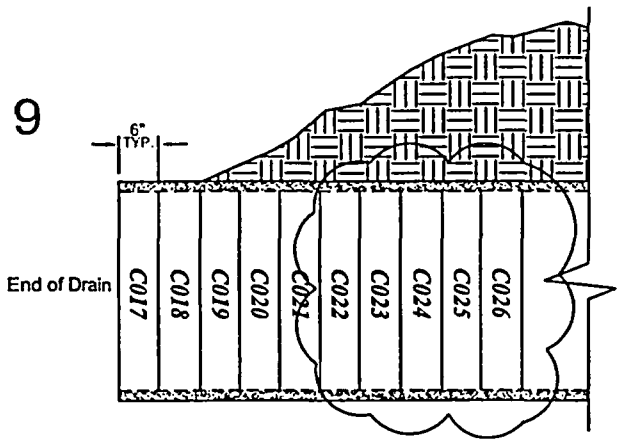


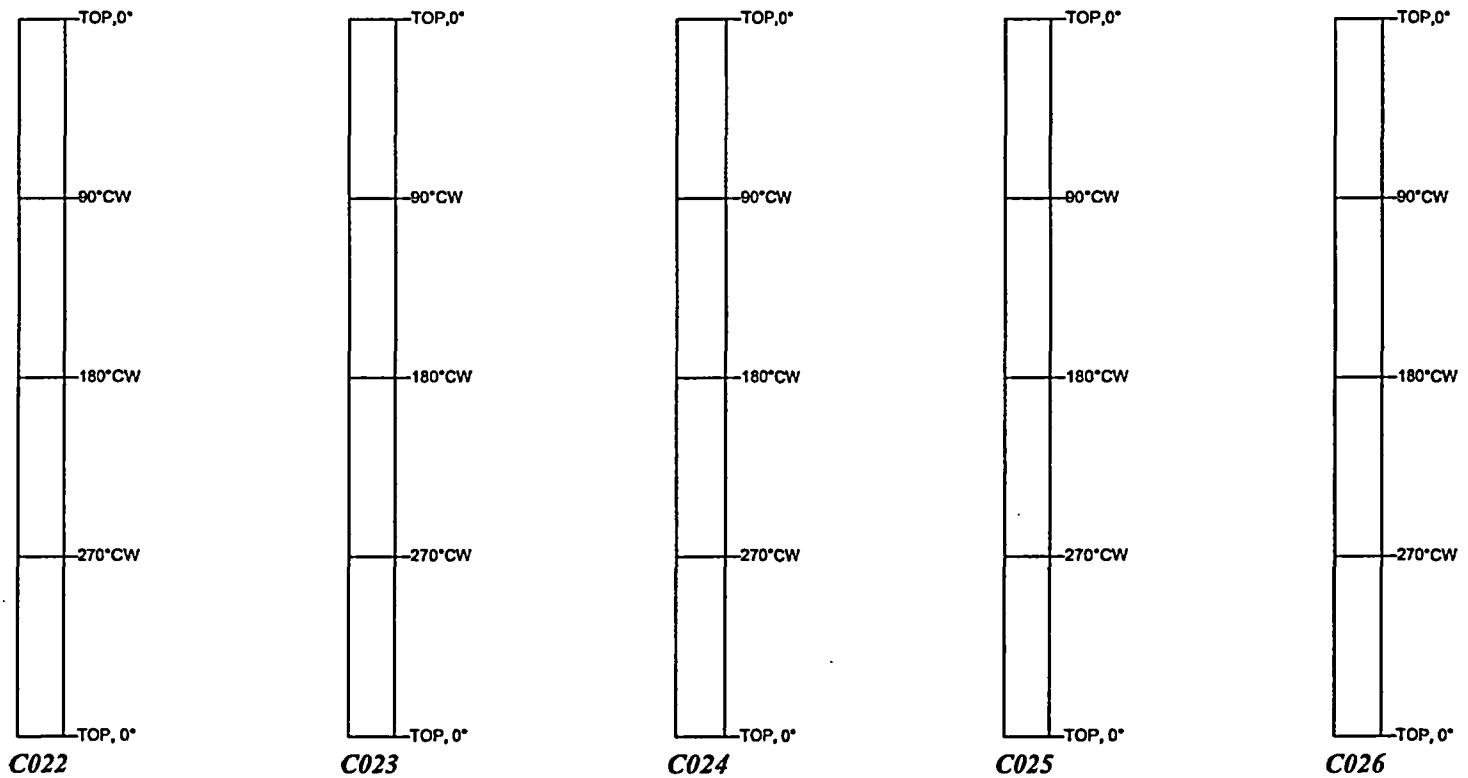


Total Surface Scan Area for Outfall 9= 2.9 sq-m

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FD 3500-2b Revised : 1/26/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Outfall 9	

Final Status Survey
FD3500 Survey Unit 2: Outfall 9
Survey Scans C022 - C026

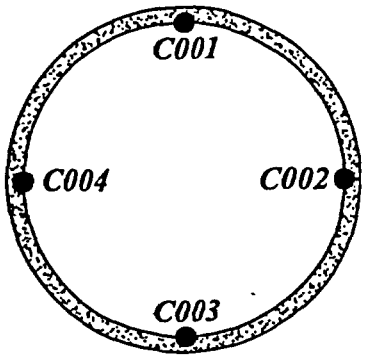




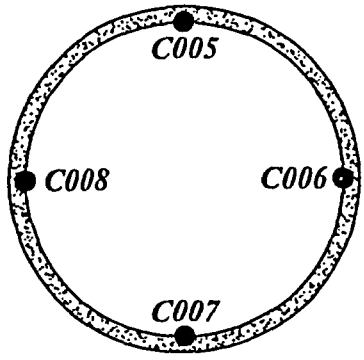
Total Surface Scan Area for Outfall 9= 2.9 sq-m

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FD 3500-2c Revised : 9/1/04
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Outfall 9	

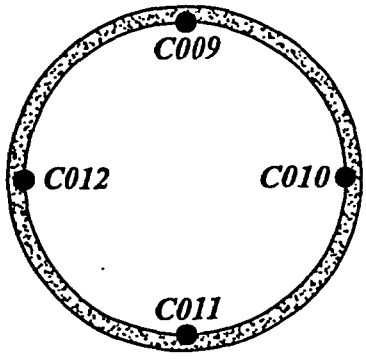
Final Status Survey
FD3500 Survey Unit 2: Outfall 9
Direct Points C001 - C016



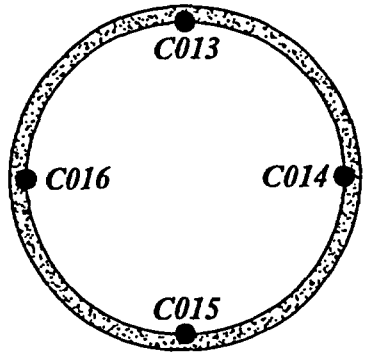
End of Drain



2' from End of Drain



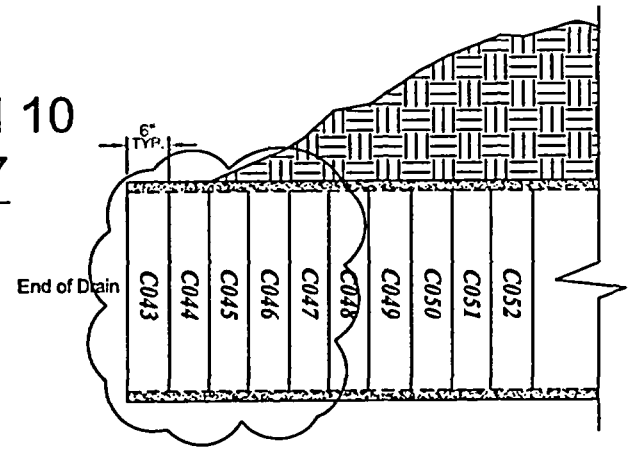
4' from End of Drain

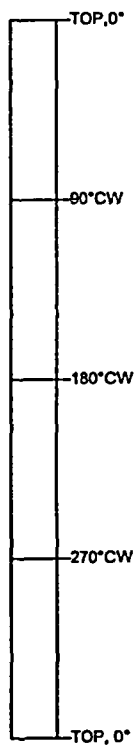


6' from End of Drain

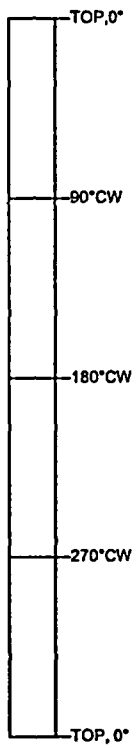
Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FD 3500-2d Revised : 1/26/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Outfall 10	

Final Status Survey
FD3500 Survey Unit 2: Outfall 10
Survey Scans C043 - C047

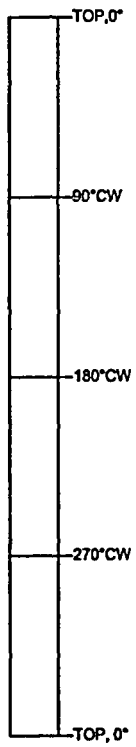




C043



C044



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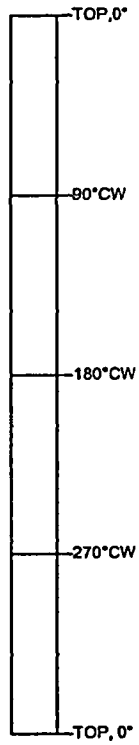
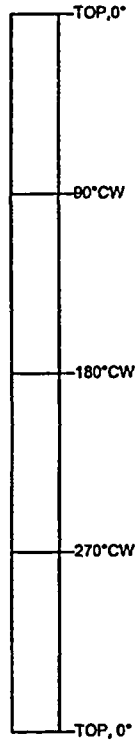


C046

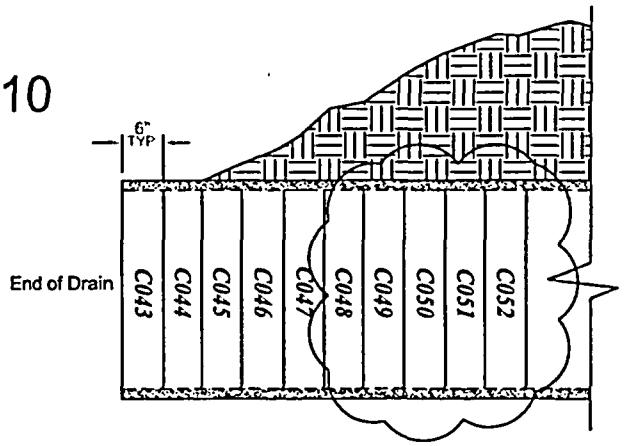


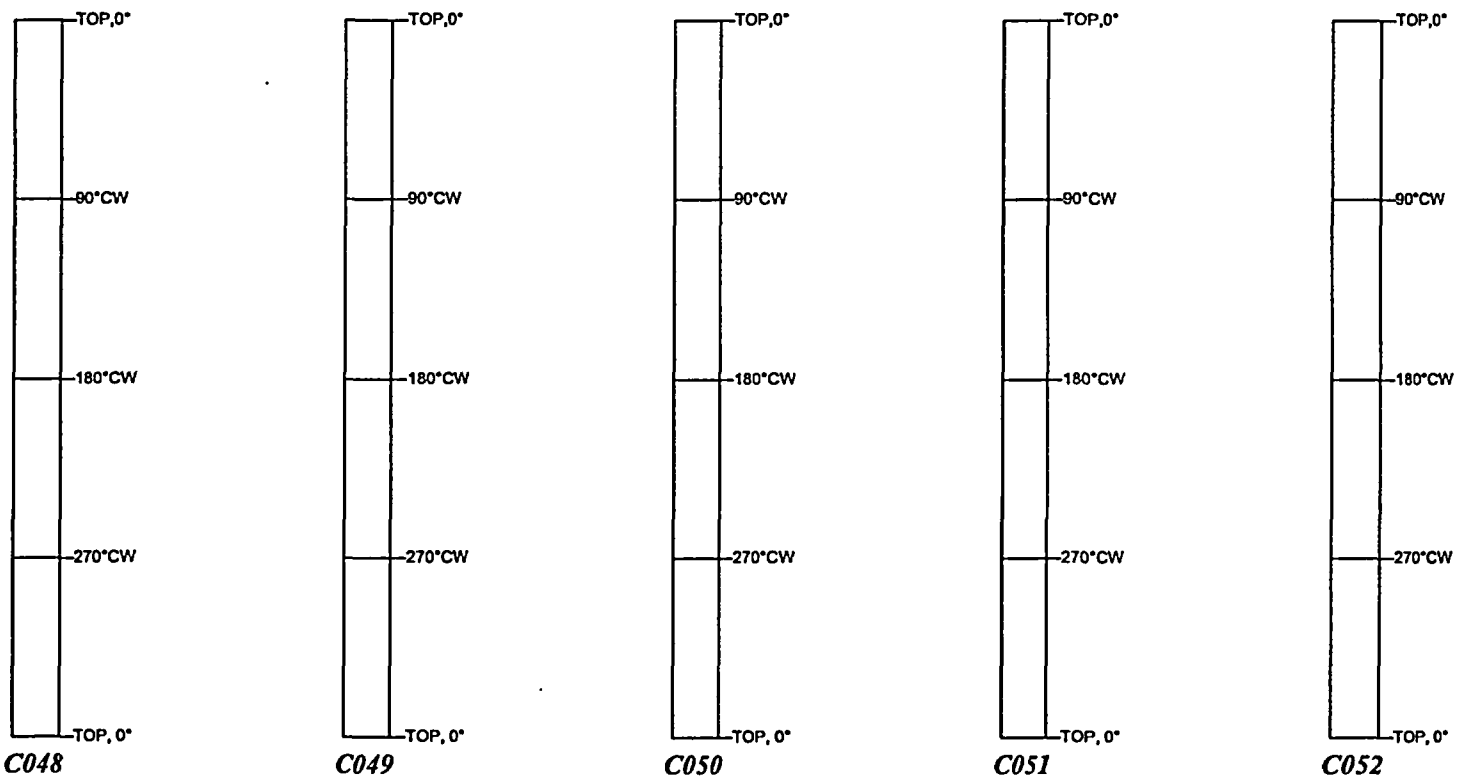
C047

Total Surface Scan Area for Outfall 10 = 1.8 sq-m

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FD 3500-2e Revised : 1/26/05
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Outfall 10	

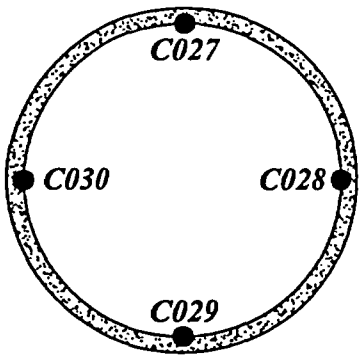
Final Status Survey
FD3500 Survey Unit 2: Outfall 10
Survey Scans C048 - C052



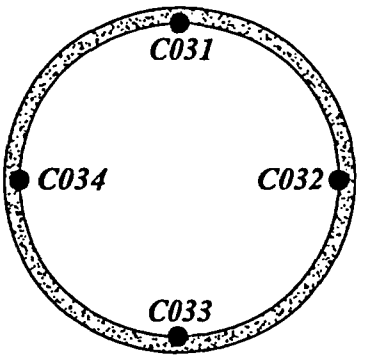


Total Surface Scan Area for Outfall 10 = 1.8 sq-m

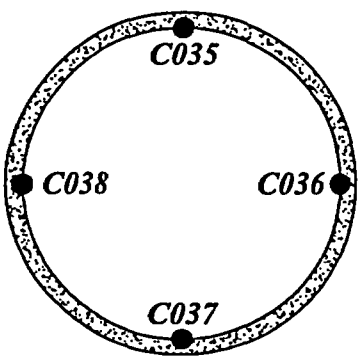
Final Status Survey
FD3500 Survey Unit 2: Outfall 10
Direct Points C027 - C042



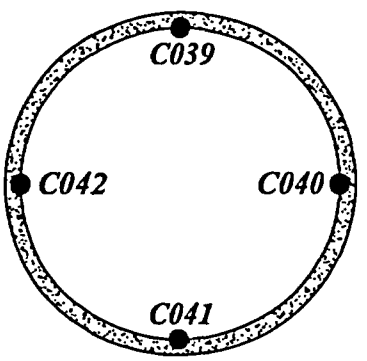
End of Drain



2' from End of Drain

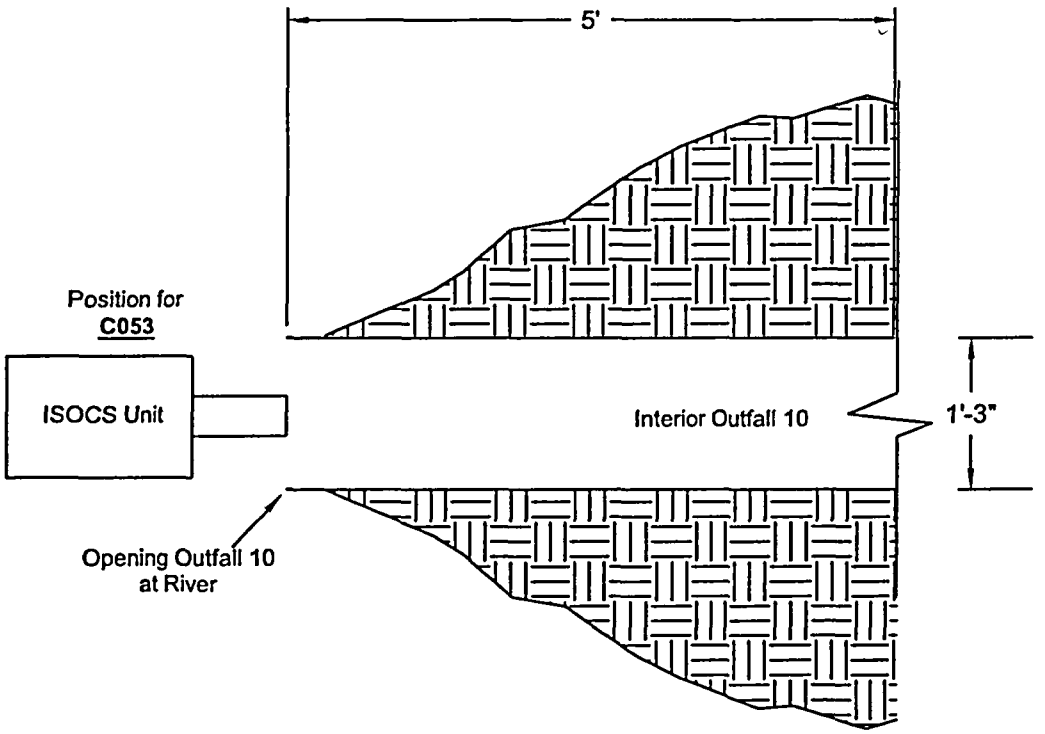


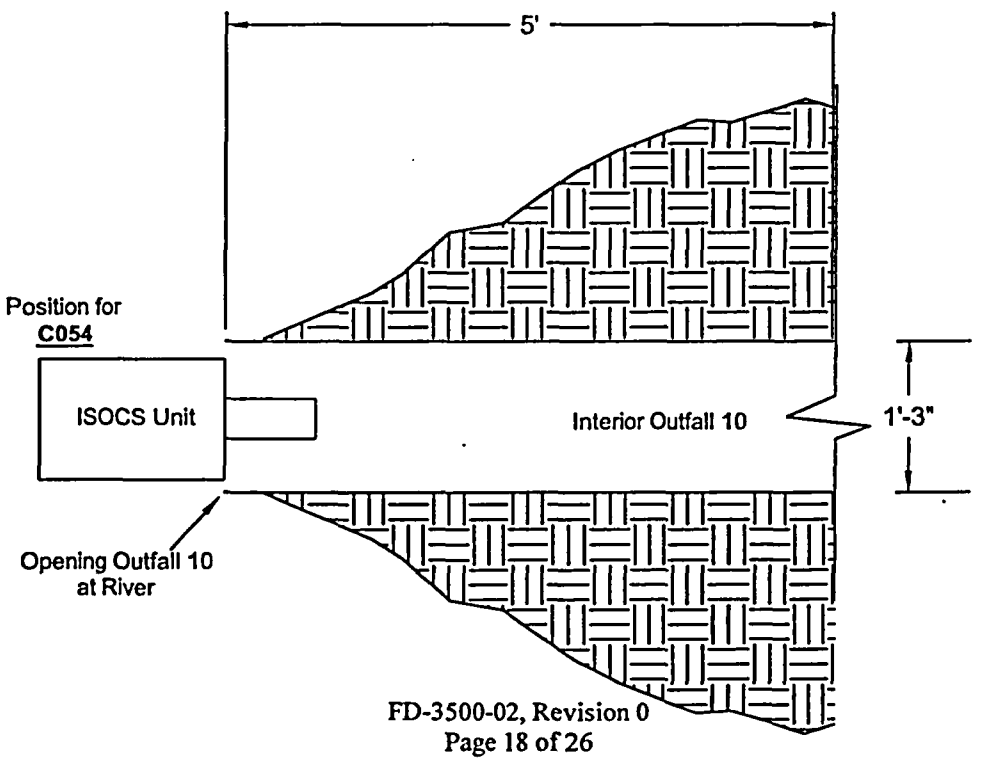
4' from End of Drain



6' from End of Drain

Final Status Survey
FD3500 Survey Unit 2: Outfall 10
ISOCS Scan - Locations C053 & C054





Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

E-600 S/N	Probe S/N (type)
1648	177991 (43-68/5)
1928	177991 (43-68/5)

HPGe Detectors (Laboratory Analysis)

Detector Number	MDC
FSS1	0.05 to 0.08 pCi/g

ISOCS Detectors (Field Measurements)

Detector Number	MDC
ISOCS-7605	1.14 to 2.68 E4 dpm/m^2

TABLE 2-2

INSTRUMENT SCAN MDC, DCGL, AND INVESTIGATION LEVEL

Detector	43-68 (Outfall 9) 24"diameter damp surfaces	43-68 (Outfall 10) 15" diameter Pipe dry surfaces	43-68 (Outfall 9) 24" diameter dry surfaces
Scan MDC (dpm/100 cm^2)	4,841 (Note 1)	2,290 (Note 1)	1,832
DCGL (dpm/100 cm^2)	9,800	9,800	9,800
Investigation Level (Alarm setpoint) (dpm/100 cm^2)	19,841 (~ DCGL plus background) (Note 2)	14,545 (~ DCGL plus background)	13,596 (~ DCGL plus background)

NOTES:
1. Separate scan MDC developed for the 43-68 by adjusting the LTP Table 5-6 value for the change in efficiency due to geometry or moisture.
2. The survey was designed for dry pipe conditions. Land vapor condensed on the upper portions of the piping at the time of the survey, and is accounted for in the table.

Attachment 3

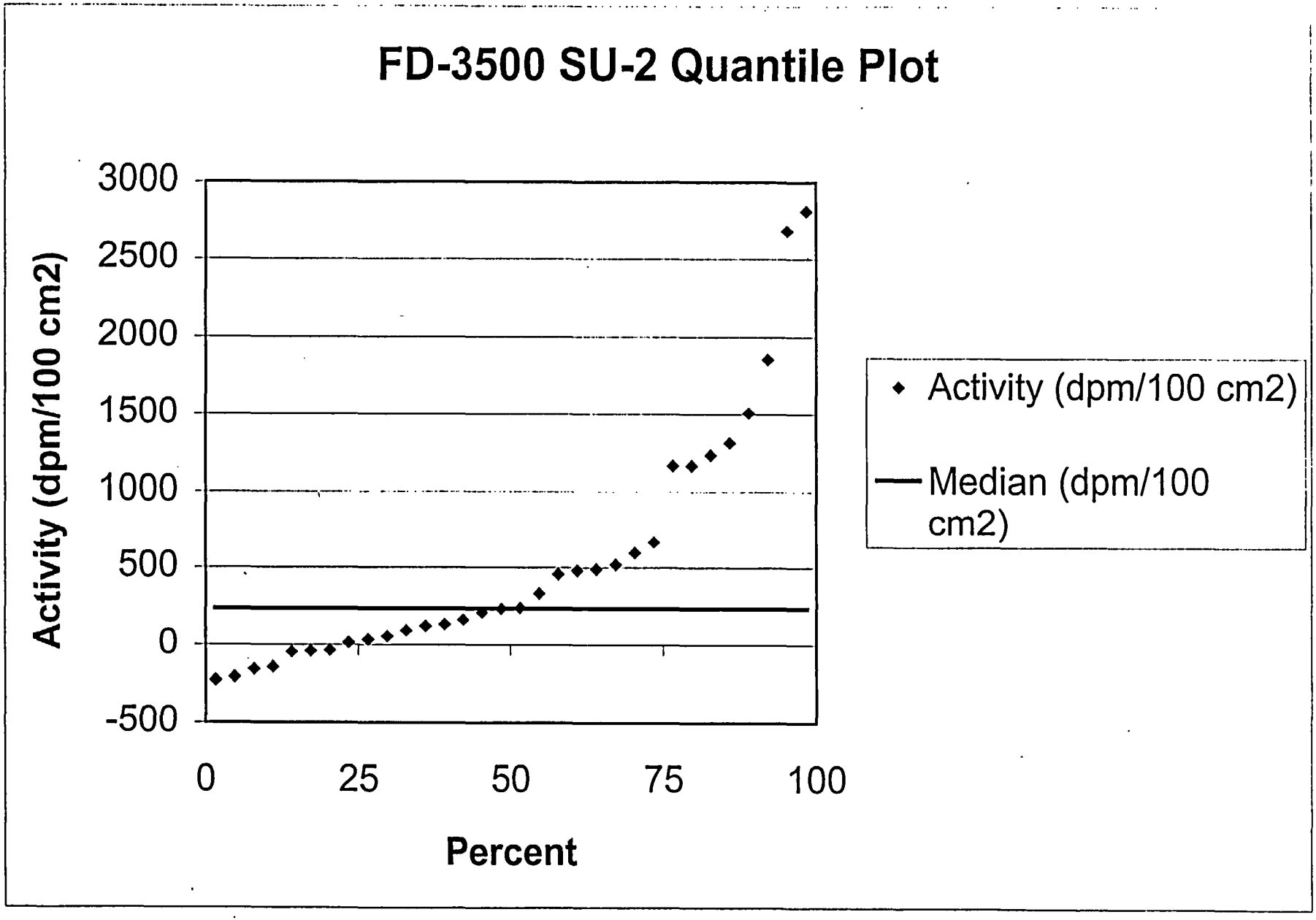
Investigation Table
(No Investigations Required)

Attachment 4

Statistical Data

Survey Package FD3500 Unit 2 Surface Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FD3500	Outfalls 9 &10
Survey Unit:	02	Storm Drain piping
Evaluator:	DR	
$DCGL_w$:	9,800	
$DCGL_{emc}$:	9,800	N/A Class 3 SU
LBGR:	4,900	
Sigma:	727	
Type I error:	0.05	
Type II error:	0.05	
Total Instrument Efficiency:	13.0%	data adjusted for various effs.
Detector Area (cm^2):	126	
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:	6.7	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	
Static Data Values		**Comments**
Number of Samples:	32	
Median:	240	
Mean:	553	
Net Static Data Standard Deviation:	788	
Total Standard Deviation:	788	SRSS
Maximum:	2,820	
Sign Test Results		**Comments**
Adjusted N Value:	32	
S+ Value:	32	
Critical Value:	21	
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	N/A Class 3 SU
Total Standard Deviation <=Sigma:	Investigate	SU passes, See Section F
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Investigate	SU passes


FD-3500 SU-2 Quantile Plot
Activity (dpm/100 cm2)
3000
2500
2000
1500
1000
500
0
-500
0
25
50
75
100
Percent
Activity (dpm/100 cm2)
Median (dpm/100 cm2)

One-Sample T-Test Report

Page/Date/Time	2 3/8/05 2:28:17 PM
Database	C:\Program Files\NCSS97\FD3500 SU-2.S0
Variable	C2

Plots Section

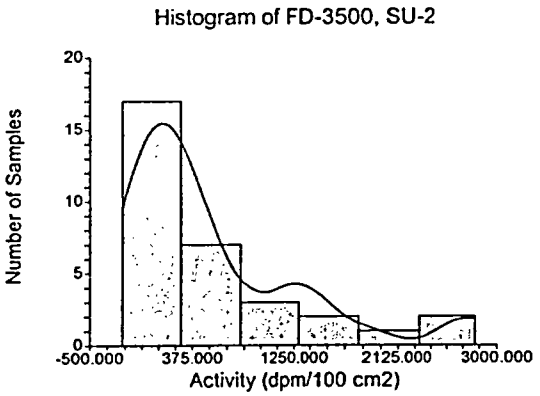


Chart Section