

**Rancho Seco**  
**Final Status Survey Summary Report**  
**March 19, 2008**  
**Plant Effluent Water Course (SU1)**  
**Survey Unit F1000001**

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## FINAL STATUS SURVEY SUMMARY REPORT

### Survey Unit:

F1000001, Plant Effluent Water Course (SU1)

### Survey Unit Description:

Operating History: This area was the release point for liquid effluents released from the plant. The area was impacted by both planned and unplanned liquid releases. Effluents were monitored under the operating RETS/REMP program. Operating records and the HSA document the release of radioactivity in this survey area. The HSA recorded multiple unplanned release events.

Site Characterization: Soil and sediment samples were collected and analyzed for the presence of plant-derived radionuclides. Cs-137 was the predominant nuclide with a mean activity level of 9.2 pCi/g and a maximum value of 48.2 pCi/g. The Characterization data were found to be conservative when compared to the historical information found in the reports referenced in the PDP. Based on the classification procedure (DSIP-0020), the area was determined to be a Class 2 land area.

HSA Events: ODR-740017, 740052, 750046, 760079, 810192, 810193, 810209, 83008, 830023, 830248, 840117, 840118, 840225, 840223, 850299, 850112, 860555, 870764, 870905.

### 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. Direct measurement locations were determined using a random-start, fixed grid pattern and 4,580 m<sup>2</sup> were scanned for approximately 55% coverage. Soil samples were collected at each direct measurement location and analyzed by HPGe detector. The instrumentation used for the survey along with the MDC values are listed in Tables 2-1 and 2-2 in Attachment 2.

**Table 1. Survey Unit Design Parameters**

<b>Survey Design Parameter</b>	<b>Value</b>	<b>Comment</b>
<b>Survey Area:</b>	F100	Plant Effluent Water Course (SU1)
<b>Survey Unit:</b>	0001	Open Land Area
<b>Class:</b>	2	LTP Table 5-4
<b>SU Area (m<sup>2</sup>):</b>	8,339	
<b>Evaluator:</b>	D. Anderson	
<b>DCGL for Cs-137 surrogate (pCi/g):</b>	52.6	
<b>DCGL for Co-60 (pCi/g):</b>	12.6	
<b>Area Factor:</b>	N/A	Class 2
<b>Design DCGL<sub>emc</sub> (pCi/g):</b>	N/A	Class 2
<b>LBGR (pCi/g):</b>	27.8	Adjusted
<b>Design Sigma (pCi/g):</b>	14.7	DTBD-06-001, Table 5-4A or B
<b>Type I Error:</b>	0.05	
<b>Type II Error:</b>	0.05	
<b>Sample Area (m<sup>2</sup>):</b>	490.5	Class 2
<b>Total Area Scanned (m<sup>2</sup>):</b>	4,580	
<b>Scan Coverage (%):</b>	54.9%	Class 2
<b>Z<sub>1-α</sub>:</b>	1.645	
<b>Z<sub>1-β</sub>:</b>	1.645	
<b>Sign P:</b>	0.945201	
<b>Calculated Relative Shift:</b>	1.6	
<b>Relative Shift Used:</b>	1.6	Uses 3.0 if Rel Shift >3
<b>N-Value:</b>	14	
<b>Design N-Value + 20%:</b>	17	NUREG-1575 Table 5-5
<b>Grid Spacing L:</b>	22.1	Class 2

**Survey Results:**

A total of 19 direct measurements were made in F1000001. The results are shown in Table 2-1. Statistical data including the mean, median, and standard deviation are shown in Table 2-2. All of the direct measurements were less than Unity. Soil samples were counted to the MDCs shown in Table 2-1 of Attachment 2.

Four adjoining ISOCS measurements indicated one area where the average activity exceeded the investigation level for a Class 2 soil survey. An investigation was performed and soil activity exceeding the DCGL of 52.6 pCi/g Cs-137 was identified. The 11-meter by 18-meter area was subsequently remediated, reclassified as a Class 1 land area and surveyed under F1000004.

**Table 2-1. Direct Measurement Results**

(all activity values in pCi/g)

Sample ID	Cs137				Co60				Unity Total
	MDA	Activity	Uncertainty	Unity Value	MDA	Activity	Uncertainty	Unity Value	
F1000001S0001SS	5.61E-02	3.64E-01	7.36E-02	0.0069	4.81E-02	<4.81E-02		0.0038	0.0107
F1000001S0002SS	7.64E-02	3.65E-01	7.61E-02	0.0069	5.88E-02	<5.88E-02		0.0047	0.0116
F1000001S0003SS	4.98E-02	<4.98E-02		0.0009	6.37E-02	<6.37E-02		0.0051	0.006
F1000001S0004SS	7.50E-02	4.38E-01	7.97E-02	0.0083	4.32E-02	<4.32E-02		0.0034	0.0118
F1000001S0005SS	5.98E-02	2.66E-01	6.13E-02	0.005	4.65E-02	<4.65E-02		0.0037	0.0087
F1000001S0006SS	5.53E-02	2.37E-01	6.36E-02	0.0045	4.73E-02	<4.73E-02		0.0038	0.0083
F1000001S0007SS	6.12E-02	2.57E-01	6.89E-02	0.0049	5.87E-02	<5.87E-02		0.0047	0.0095
F1000001S0008SS	4.94E-02	<4.94E-02		0.0009	5.31E-02	<5.31E-02		0.0042	0.0052
F1000001S0009SS	5.84E-02	2.57E-01	6.51E-02	0.0049	5.89E-02	<5.89E-02		0.0047	0.0096
F1000001S0010SS	7.62E-02	7.38E-01	1.20E-01	0.014	6.57E-02	<6.57E-02		0.0052	0.0192
F1000001S0011SS	1.08E-01	2.00E01	1.40E00	0.381	9.58E-02	2.29E-01	7.03E-02	0.0182	0.3992
F1000001S0012SS	7.21E-02	4.30E-01	7.98E-02	0.0082	6.00E-02	<6.00E-02		0.0048	0.0129
F1000001S0013SS	6.15E-02	5.27E-01	1.03E-01	0.01	4.92E-02	<4.92E-02		0.0039	0.0139
F1000001S0014SS	6.99E-02	1.70E00	1.41E-01	0.0322	8.70E-02	<8.70E-02		0.0069	0.0391
F1000001S0015SS	6.57E-02	<6.57E-02		0.0012	6.18E-02	<6.18E-02		0.0049	0.0062
F1000001S0016SS	7.19E-02	<7.19E-02		0.0014	6.05E-02	<6.05E-02		0.0048	0.0062
F1000001S0017SS	7.54E-02	1.31E01	9.40E-01	0.2498	6.57E-02	1.30E-01	7.06E-02	0.0103	0.2601
F1000001S0018SS	6.50E-02	1.18E00	1.19E-01	0.0225	5.76E-02	<5.76E-02		0.0046	0.0271
F1000001S0019SS	7.20E-02	1.26E00	1.54E-01	0.0239	7.33E-02	<7.33E-02		0.0058	0.0297

**Table 2-2. Direct Measurements Results Summary**

	<b>Cs137 Activity</b> (pCi/g)	<b>Co60 Activity</b> (pCi/g)	<b>Cs137 Unity</b>	<b>Co60 Unity</b>	<b>Unity Total</b>
<b>DCGLw</b>	52.6	12.6			
<b>Mean</b>	2.18E00	7.12E-02	0.0415	0.0056	0.0471
<b>Median</b>	3.65E-01	5.89E-02	0.0069	0.0047	0.0116
<b>Standard Deviation</b>	5.23E00	4.28E-02	0.0993	0.0034	0.1026
<b>Cs137 Activity Range</b> (pCi/g)	4.94E-02 to 2.00E01				
<b>Co60 Activity Range</b> (pCi/g)	4.32E-02 to 2.29E-01				
<b>Cs137 Unity Range</b>	0.0009 to 0.381				
<b>Co60 Unity Range</b>	0.0034 to 0.0182				
<b>Total Unity Range</b>	0.0052 to 0.3992				
<b>Sample Count</b>	19				

**Survey Unit Data Assessment:**

The survey design required 19 direct measurements for the Sign Test. The critical value and the results of the Sign Test are presented in Table 3. The sample mean and median values were less than the DCGL. The sample standard deviation was less than the design standard deviation so no additional samples were required.

**Table 3. Data Assessment Results**

<b>Survey Results Parameter</b>	<b>Value</b>	<b>Comment</b>
<b>Actual Direct Measurements (N):</b>	19	
<b>Median (Unity):</b>	0.012	
<b>Mean (Unity):</b>	0.047	
<b>Direct Measurement Std Deviation (Unity):</b>	0.103	
<b>Maximum (Unity):</b>	0.399	
<b>Sign Test Final N Value:</b>	19	
<b>S+ Value:</b>	19	
<b>Critical Value:</b>	13	
<b>Sufficient Samples Collected:</b>	Yes	
<b>Maximum Value &lt; Unitized DCGL:</b>	Yes	
<b>Median Value &lt; Unitized DCGL:</b>	Yes	
<b>Mean Value &lt; Unitized DCGL:</b>	Yes	
<b>Maximum Value &lt; DCGL<sub>mc</sub> (Unity):</b>	N/A	Class 2
<b>Standard Deviation &lt;= Sigma:</b>	Yes	
<b>Pass the Sign Test?</b>	Yes	
<b>Reject the Null Hypothesis?</b>	Yes	
<b>Does the Survey Unit Pass All Criteria?</b>	Yes	

### **Survey Unit Investigations and Results:**

One investigation (scan grids 128, 129, 130 and 166) was required for the scan measurements and the results are reported in Attachment 3. As a result of the investigation, soil activity exceeding the DCGL of 52.6 pCi/g Cs-137 was identified. The 11-meter by 18-meter area was subsequently remediated, reclassified as a Class 1 and surveyed under F1000004.

### **ALARA Statement:**

As stated in Chapter 4 of the LTP, as long as the residual activity within the survey unit is less than the DCGL (i.e. the survey unit average activity is less than the DCGL and the EMC criterion has been met), the ALARA criterion has been met.

### **Changes in Initial Survey Unit Assumptions:**

The survey unit was designed as a Class 2 land 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. One potential area of elevated activity was detected and evaluated as shown in Attachment 3. The area of investigation was remediated, reclassified and surveyed under F1000004.

### **Conclusion:**

The FSS of this survey unit was properly designed as a Class 2 survey based on Table 5-4 of the LTP. 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 direct measurements were less than Unity. One investigation was required. The 11-meter by 18-meter area was subsequently remediated, reclassified as a Class 1 and surveyed under F1000004.

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.

It is concluded that survey unit F1000001 meets the release criteria of 10CFR20.1402.



**Attachment 1**

**Maps**

**March 19, 2008**

**Survey Unit F1000001**

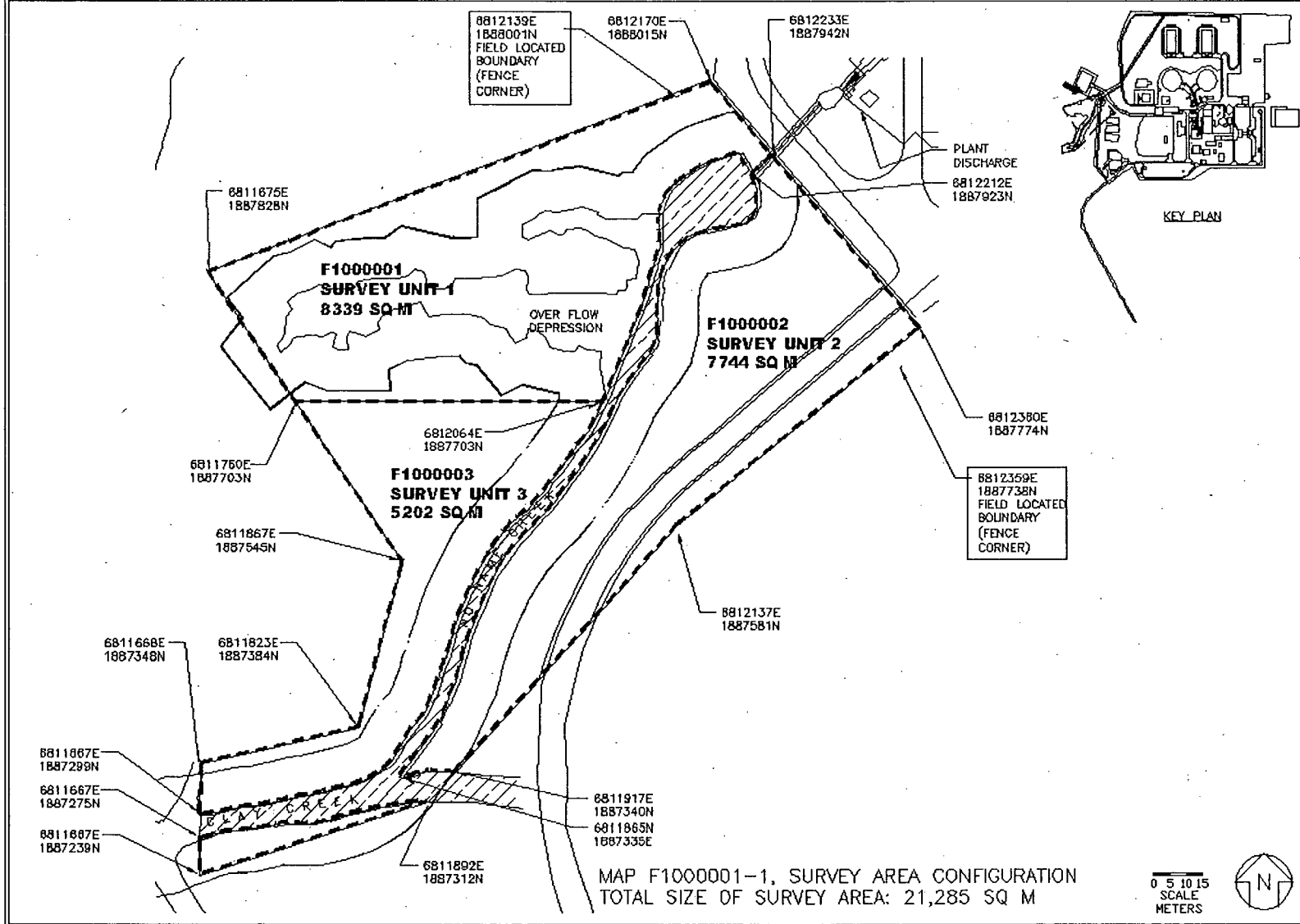


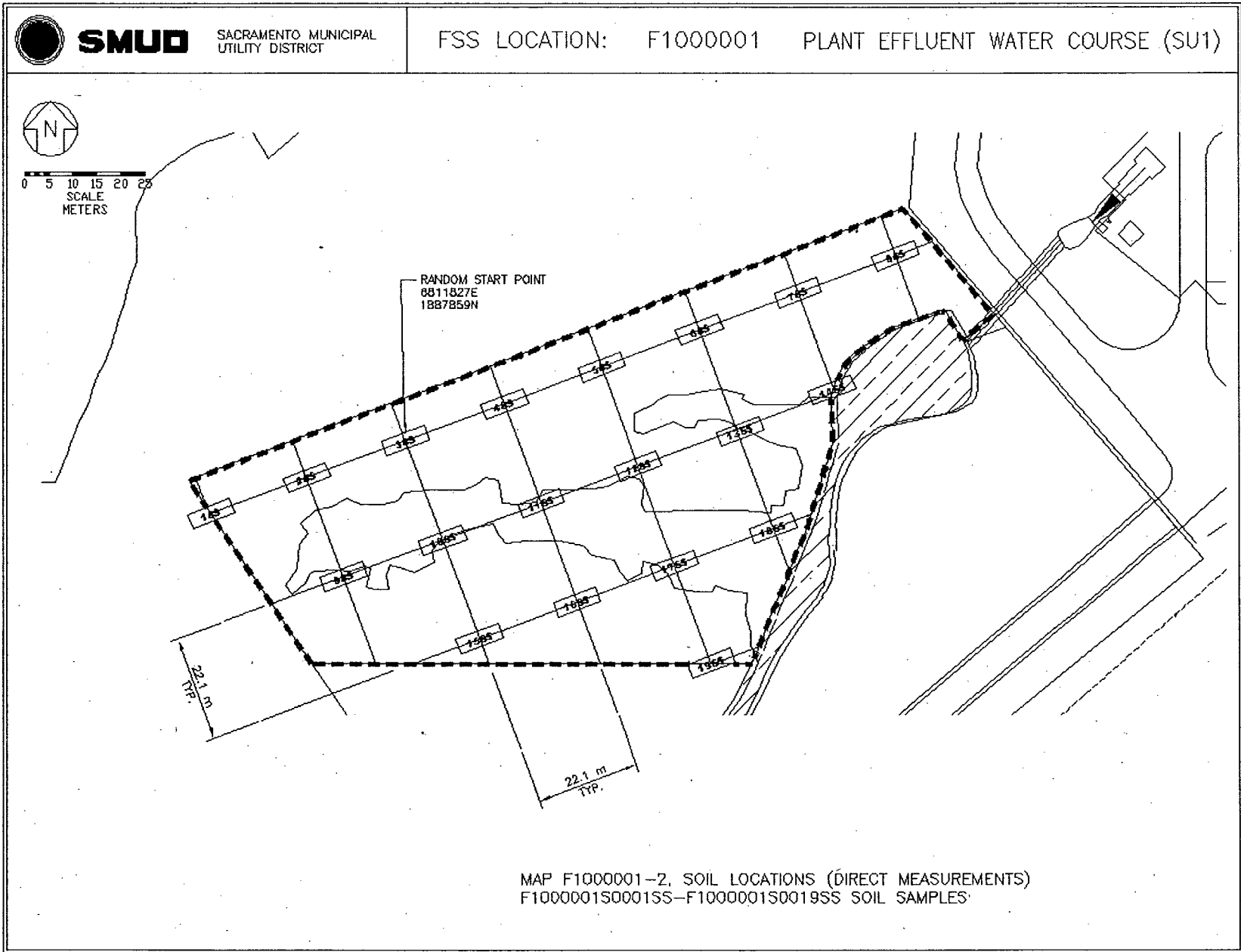
**SMUD**

SACRAMENTO MUNICIPAL  
UTILITY DISTRICT

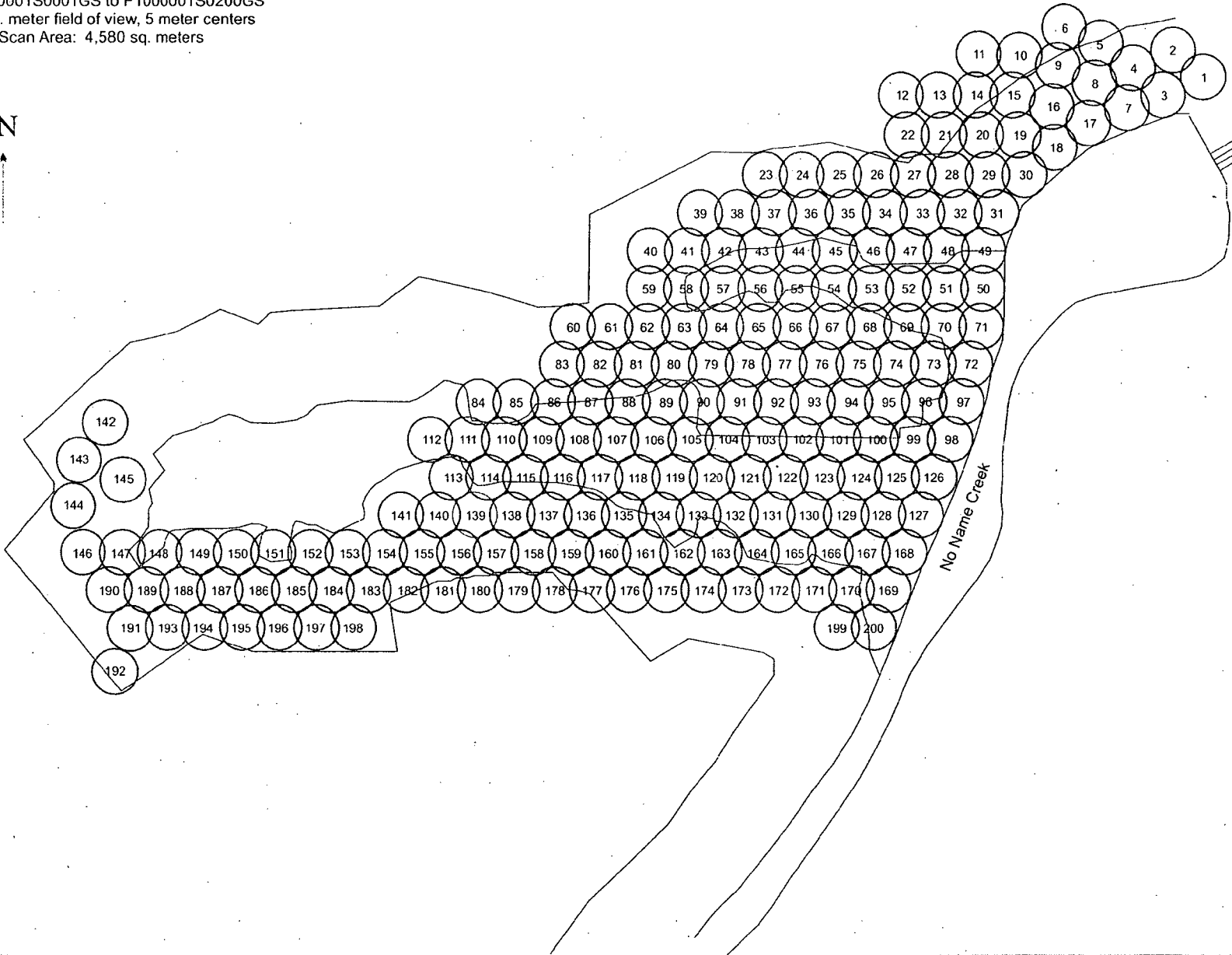
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PLANT EFFLUENT WATER COURSE





Map F1000001-3, Plant Effluent Water Course (SU1)  
ISOCS Gamma Scan Measurements  
F1000001S0001GS to F1000001S0200GS  
28 sq. meter field of view, 5 meter centers  
Total Scan Area: 4,580 sq. meters





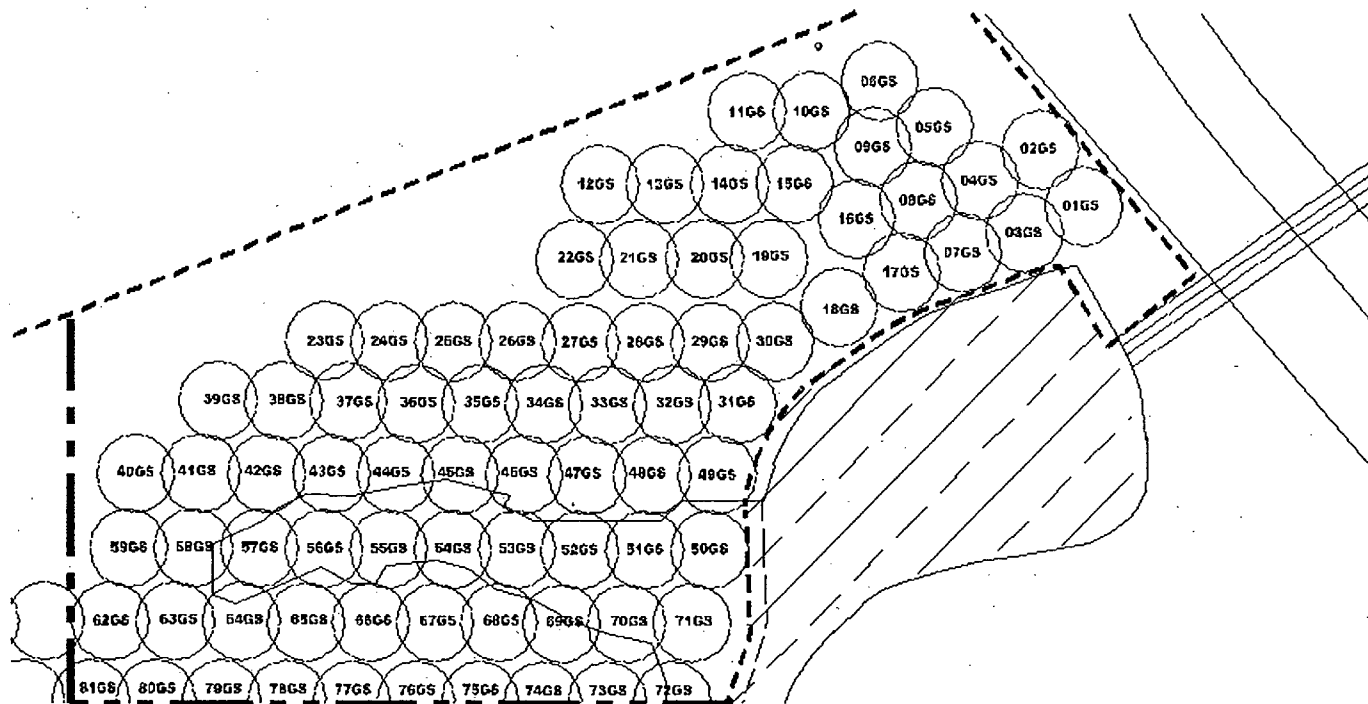
**SMUD**

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FSS LOCATION: F1000001 PLANT EFFLUENT WATER COURSE (SU1)



0 1 2 3 4 5  
SCALE  
METERS



MATCH LINE  
F1000001-5

ISDCS FIELD OF VIEW, 28 m<sup>2</sup>  
ON 5 METER CENTERS

MAP F1000001-4, GAMMA SCANS  
F1000001S0001GS-F1000001S0057GS  
TOTAL SCAN AREA: 1229 SQ METERS



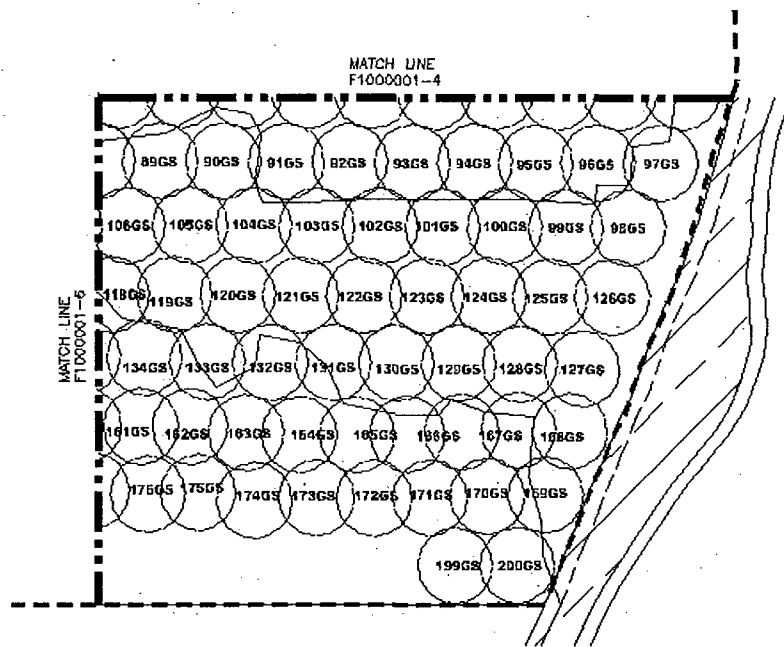
**SMUD**

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FSS LOCATION: F1000001 PLANT EFFLUENT WATER COURSE (SU1)



0 1 2 3 4 5  
SCALE  
METERS



ISDCS FIELD OF VIEW, 28 m<sup>2</sup>  
ON 5 METER CENTERS

MAP F1000001-5, GAMMA SCANS  
F1000001S0058GS-F1000001S0119GS  
TOTAL SCAN AREA: 1295 SQ METERS



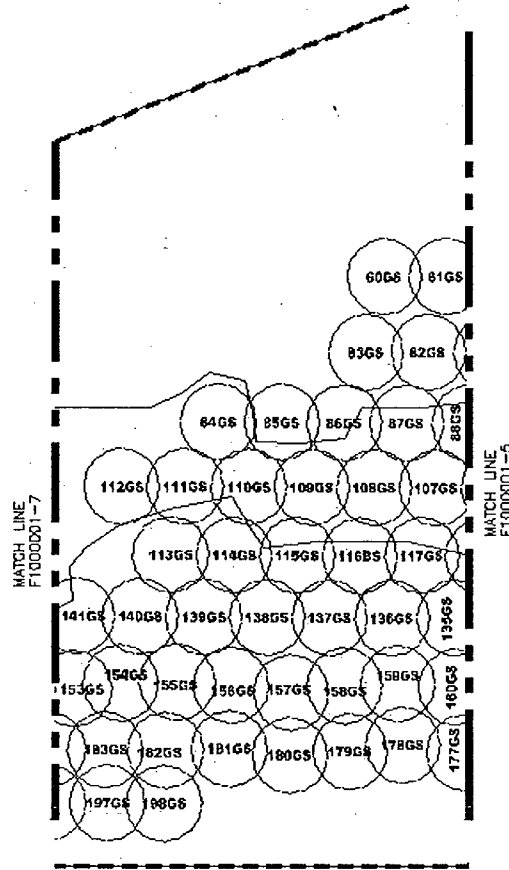
**SMUD**

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FSS LOCATION: F1000001 PLANT EFFLUENT WATER COURSE (SU1)



0 1 2 3 4 5  
SCALE  
METERS



ISDCS FIELD OF VIEW, 28 m<sup>2</sup>  
ON 5 METER CENTERS

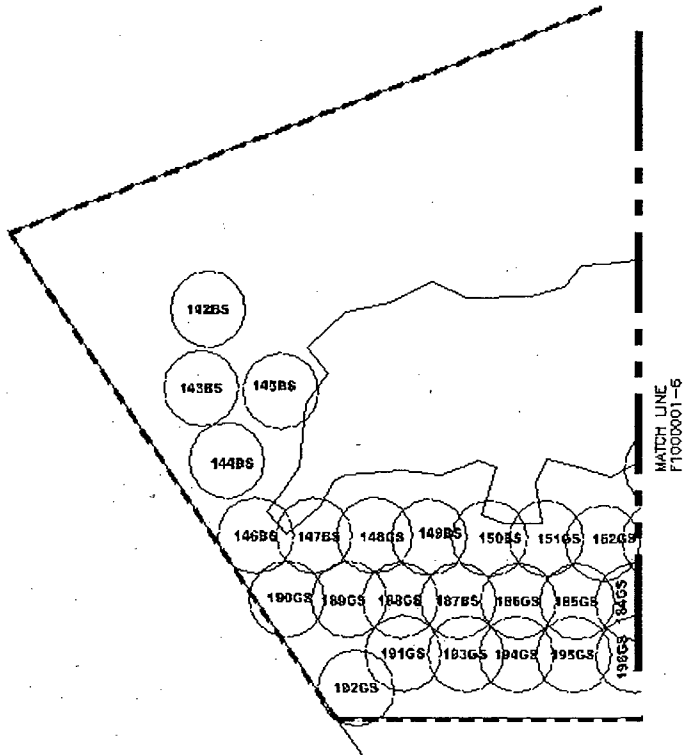
MAP F1000001-6, GAMMA SCANS  
F1000001S0120GS-F1000001S0168GS  
TOTAL SCAN AREA: 1035 SQ METERS



**SMUD**

SACRAMENTO MUNICIPAL  
UTILITY DISTRICT

FSS LOCATION: F1000001 PLANT EFFLUENT WATER COURSE (SU1)

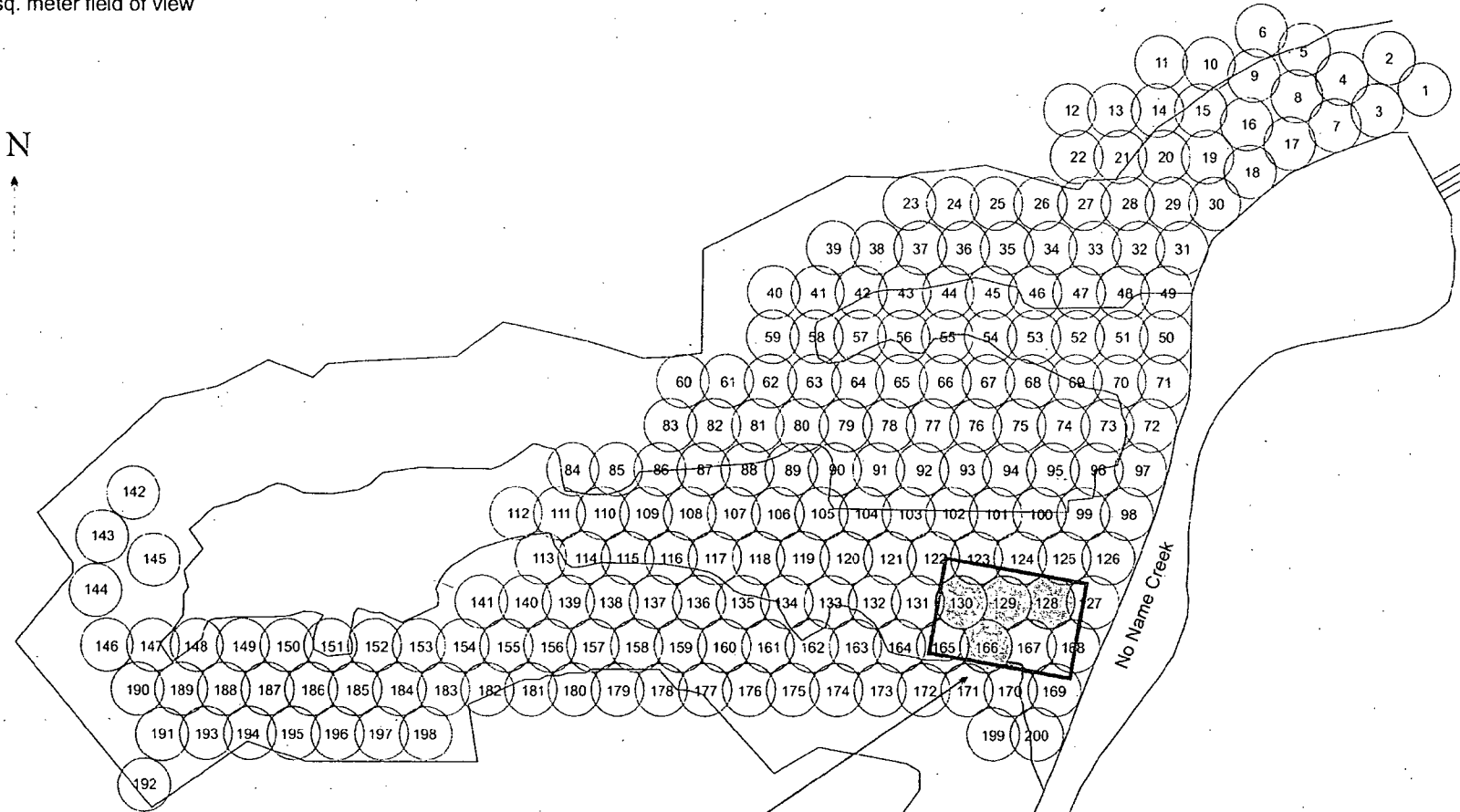


ISDCS FIELD OF VIEW, 28 m<sup>2</sup>  
ON 5 METER CENTERS

MAP F1000001-7, GAMMA SCANS  
F1000001S0169GS-F1000001S0216GS  
TOTAL SCAN AREA: 1021 SQ METERS

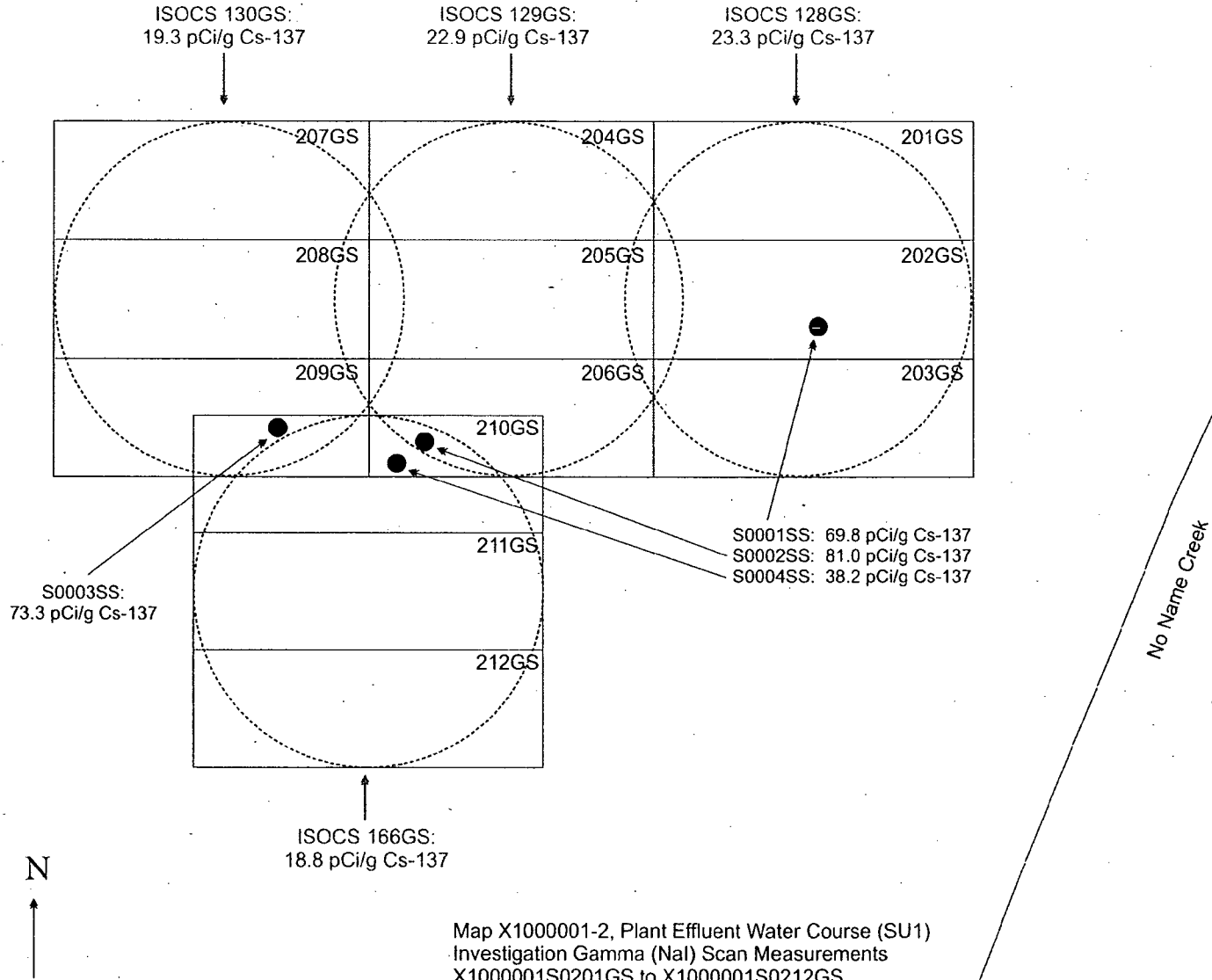


Map X1000001-1, Plant Effluent Water Course (SU1)  
Elevated ISOCS Gamma Scan Measurements  
28 sq. meter field of view



11 m by 18 m area  
removed from  
survey unit.  
Area surveyed as  
F1000004 (Class 1)

ISOCS scans are 28 sq. meter field of view,  
6 meters in diameter



Map X1000001-2, Plant Effluent Water Course (SU1)  
Investigation Gamma (NaI) Scan Measurements  
X1000001S0201GS to X1000001S0212GS  
Investigation Soil Samples  
X1000001S0001SS to X1000001S0004SS

**Attachment 2**  
**Instrumentation**  
**March 19, 2008**  
**Survey Unit F1000001**

**Table 2-1. Survey Unit Instrumentation**

<b>Instrument</b>	<b>Detector Model No.</b>	<b>Detector Serial No.</b>	<b>MDC</b>
HPGe	N/A	9987008	Soil – 1.08E-01 pCi/g Cs-137 Soil – 9.58E-02 pCi/g Co-60
HPGe	N/A	05047773	Soil – 7.64E-02 pCi/g Cs-137 Soil – 8.70E-02 pCi/g Co-60
ISOCS	N/A	2983947	Soil – 3.67E-01 pCi/g Cs-137 Soil – 2.91E-01 pCi/g Co-60

**Table 2-2. Investigation Criteria and DCGL**

<b>Instrument</b>	<b>Parameter</b>	<b>Value</b>
ISOCS	Investigation Criteria - Scan	Soil – 20 pCi/g Cs-137 <sup>1</sup>
All	DCGL <sub>w</sub>	52.6 Cs-137 12.6 Co-60
All	DCGL <sub>EMC</sub>	N/A

<sup>1</sup>Based on detecting a 1 m<sup>2</sup> hot spot within the 28 m<sup>2</sup> detector field of view

**Attachment 3**  
**Investigation**  
**March 19, 2008**  
**Survey Unit F1000001**

**Table 3-1 Survey Unit Investigation**

<i>Grid</i>	<i>Investigation Level (Cs-137 pCi/g)</i>	<i>Initial Value (Cs-137 pCi/g)</i>	<i>Investigation Result (pCi/g)</i>	<i>Elevated Area (m<sup>2</sup>)</i>	<i>Area Factor</i>	<i>DCGL<sub>emc</sub></i>	<i>Investigation Result (pCi/g)</i>	<i>DCGL<sub>emc</sub> Unity Fraction</i>
128,	20	23.3	69.8	11 m by 18 m	N/A	N/A	11 m by 18 m area remediated, reclassified as Class 1 and surveyed under F1000004	
129	20	22.9	81		N/A	N/A		
130	20	19.3	73.3		N/A	N/A		
166	20	18.8	38.2		N/A	N/A		
Survey Unit Remainder						DCGL = 52.6	SU Mean =	N/A
EMC Unity Sum								N/A

NOTE: ISOCS instrumentation measures average activity within the detector field of view. The Investigation Level for the 28 sq. meter field of view used within this survey unit is based on detecting a 1 m<sup>2</sup> area of elevated activity at the edge of the field of view. NaI scans and soil sampling were used to locate the elevated activity and determine the extent of the area requiring remediation.

**Attachment 4**  
**Data Assessment**  
**March 19, 2008**  
**Survey Unit F1000001**

