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Completion Report
Task I
PCB Remedial Action Plan
Florida Steel Corporation
Indiantown Mill
Indiantown, Florida

Ardaman & Associates, Inc.

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October 2, 1986
File Number 83-119

Consultants in Soils, Hydrogeology, Foundations and Materials Testing

Florida Department of Environmental Regulation
Bureau of Operations
2600 Blair Stone Road
Tallahassee, Florida 32301

Attention: Dr. Marvin Collins, Project Manager

Subject: Completion Report, Task I, PCB Remedial Action Plan, Florida Steel Corporation, Indiantown Mill, Indiantown, Florida

Gentlemen:

Enclosed please find the Completion Report for Task I of the PCB Remedial Action Plan for the Florida Steel Corporation Indiantown Mill, Indiantown, Florida. Should you have any questions regarding this report, please do not hesitate to call us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Mike Tannous

Mike Tannous
Assistant Project Engineer

John E. Garlanger

John E. Garlanger, Ph.D., P.E.
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JEG/MT:ed

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2 4 0090

EXECUTIVE SUMMARY

Between February 15, 1986 and May 8, 1986, approximately 11,200 cubic yards of soil and sediment with PCB contamination were excavated from the site of Florida Steel Corporation's Indiantown Mill and temporarily placed in a secure on-site storage facility. The excavations were then backfilled with clean fill material. The construction of the on-site storage facility, the excavation of the contaminated soil and sediment, and the placement of the contaminated soil and sediment in the on-site storage facility were all accomplished in accordance with the plans and specifications contained within the PCB Remedial Action Plan.

All potentially contaminated water from active excavation areas and the water removed from the existing borrow pit/detention pond prior to excavation of sediment contained therein was subjected to activated carbon filtration and disposed of through spray irrigation on an upgradient area of the property. Potentially contaminated water collected as a result of gravity drainage of the soil and sediment contained in the on-site storage facility is presently being temporarily stored in a 300,000 gallon tank for future treatment.

To verify that the remaining soil contains less than 50 ppm of PCB's, 122 post-cleanup verification samples were systematically retrieved from all excavated areas. All of the verification samples had PCB contamination well below 50 ppm. The average PCB concentration detected in the verification samples was less than 3.3 ppm and 75 percent of the samples had a PCB concentration below the limit of detection (1.0 ppm).

2 4 0091

A feasibility study for identifying the most cost effective and environmentally sound remedial action with respect to final disposition of the PCB-contaminated soil and sediment contained in the on-site storage facility (Task II) is underway and will be completed by October 15, 1986. A feasibility study plan has previously been submitted to FDER in accordance with the consent order.

INTRODUCTION

This report summarizes the on-site observations and the results of sampling and testing performed during implementation of Task I of the PCB Remedial Action Plan at the Florida Steel Corporation (FSC) Indiantown Mill. One or more engineers from Ardaman & Associates, Inc. was present at the site throughout the duration of the work associated with Task I.

The plan for excavating soil and sediment having PCB concentrations of 50 ppm or greater and temporarily storing these materials in an on-site secure storage facility is described in a report entitled "PCB Remedial Action Plan - Florida Steel Corporation Indiantown Mill" prepared by Ardaman & Associates, Inc. and dated August 26, 1985. The implementation of the Remedial Action plan is in accordance with the consent agreement between FSC and the Florida Department of Environmental Regulation (FDER) dated September 4, 1985.

2 4 0092

SITE LOCATION

The Florida Steel Mill is located approximately 2.5 miles northwest of Indiantown, Florida on Route 710. The site occupies most of the north ½ and a portion of the southeast ¼ of Section 35, Township 39 South, Range 38 East, Martin County, Florida. A site location map is shown in Figure 1.

REMEDIAL INVESTIGATION

A comprehensive soil sampling and testing program was conducted at the site between October, 1983 and May, 1984 to determine the extent of PCB contamination. The program consisted of drilling boreholes, retrieving soil samples and collecting sediment samples from the ditches and detention facilities existing on site. All retrieved samples were sent to a chemical lab for analysis. The results of the sample testing are graphically summarized on an isopach map showing areas and depth of soil with PCB concentrations greater than 50 ppm. This map is presented in Figure 2. The logs of all borings and soil cores drilled at the site and a listing of results of the sample analysis are included in the report submitted by Florida Steel Corporation on July 2, 1984 titled "Results of the PCB Sampling and Analysis Program at the Florida Steel Corporation, Indiantown Mill".

ON-SITE STORAGE FACILITY

A secure storage area was constructed on site to temporarily store the excavated soil and sediment. The storage area is located south of the Rolling Mill Building and west of the Melt Shop. The outside walls of the storage area were constructed of slag fill obtained on site.

A thin layer of fine slag was placed on the base and bottom 8 feet of the inner sides of the vault. Filter cloth was then placed over the fine slag to provide a protective "cushion" for the synthetic liner. The upper 8 to 9 feet of the side slopes were raked to remove coarser slag material and a two-fold layer of filter cloth was placed on the inner slopes for extra protection. The entire length of all field seams in the 60-mil high density polyethylene liner were tested for continuity by applying a vacuum to the joint and observing for loss of suction. The on-site engineer was present during the testing of all seams. No leaks were detected in any of the seams.

A gravity flow drainage system was installed at the base of the storage area for the collection of potentially contaminated water draining from the soil and sediment placed in the area. The collection system consists of eight 4-inch diameter, corrugated, perforated PVC collector pipes installed within a 12-inch thick sand blanket. The perforated pipes are connected to an 8-inch header pipe which drains through a 90 degree elbow into a discharge pipe that extends through the south dike into a collection sump. Gravity drainage of interstitial water contained within the soil and sediment stored in the facility is pumped from the collection sump to a 300,000 gallon tank for future treatment and disposal.

The on-site storage facility, as completed, is approximately 17 to 18 feet high and has surface dimensions of approximately 180x160 feet. The average slope is 2.0 horizontal (H) to 1.0 vertical (V) for the bottom 8 feet and 2.2H:1.0V for the remaining 9 to 10 feet. A schematic diagram of the vault, as constructed, is presented in Figure 3.

After placement of the contaminated soil and sediment in the storage area, the area was capped with a 30-mil high density polyethylene liner. The top liner was joined to the bottom liner along the periphery of the storage area and was covered with used tires to assist in holding the liner in place.

WATER TREATMENT SYSTEM

All potentially contaminated water collected throughout the duration of the job was temporarily stored in the oil tank containment area prior to being treated. The water treatment system consisted of a 50,000-gallon settling basin, two 12,000-gallon detention basins, two sand filters and initially two, and subsequently three, carbon filters connected in series. Potentially contaminated water from the existing borrow pit/detention pond was pumped into the 50,000-gallon settling basin where a flocculating agent was added to expedite the sediment settling process. The water was then pumped from the settling basin through the two sand filters to remove fine suspended solids. The sediment remaining in the bottom of the settling basin was collected and transported to the vault. Effluent from the sand filters was collected in a 12,000-gallon pool prior to being pumped through

the three carbon filters and into the second 12,000-gallon pool. The treated water from the second 12,000-gallon pool was disposed of through a spray irrigation.

Water samples were continually collected throughout the water treatment program. The duration of pumping between samples averaged approximately 35 hours. To allow for the prompt detection of carbon exhaustion in the first stages of carbon filtration, the water samples were collected prior to the final carbon filter.

Table 1 is a summary of the analytical results of water samples collected at the site during operation of the spray irrigation system. Included in the table are the PCB, lead and cadmium concentrations detected in each sample. The table also gives a brief description of corrective actions taken in cases where the PCB concentration prior to final carbon filtering was above .001 mg/L. All effluent was subjected to further carbon filtration beyond the sampling point.

IN-PLANT WATER RECIRCULATION FACILITIES

All in-plant water recirculation facilities that contained deposits of oily sediment were dewatered, scraped and steam cleaned. After cleaning, the trenches and the deep sump located in the mill building were backfilled with clean sand.

PCB CONTAMINATED SOIL REMOVAL

Excavation of PCB-contaminated soil and sediment began on Feburary 15, 1986 and was completed on May 8, 1986. All of the excavated material was placed in the on-site secure storage facility. Prior to completion of excavation in the contaminated areas, additional exploratory samples were obtained to better define the required depth of excavation. The location of these samples and a summary of the analytical results for these samples are provided in Appendix A.

POST-CLEANUP VERIFICATION SAMPLING

To document that complete removal of the soil and sediment designated on the isopach map had been achieved (Figure 2), a survey was conducted by a registered professional land surveyor. Surface elevations were measured before and after excavation and are shown on the cross sections included on the attached drawings (Sheets 1 through 13). As shown, most of the excavations were deeper and, in some cases, covered a larger area than indicated on the isopach map.

To document that the remaining soil contained less than 50 ppm of PCB's, verification samples were systematically retrieved from all excavated areas once the desired depth of excavation was reached. Verification sampling locations were selected using a random number generator. All areas shown on the isopach map (Figure 2) were divided into grids to allow for this random selection. Soil sampling was performed at a frequency of one sample per 16 grids in all areas except in the stormwater detention pond area, where sampling was done at a

frequency of one sample per 8 grids. Grid dimensions were 25x25 feet in the borrow pit/detention pond and 10x10 feet in all other areas.

To provide a margin of safety, a verification sample indicating a PCB concentration of 40 ppm or higher resulted in additional excavation and resampling of that area until a PCB concentration less than 40 ppm was obtained. A summary of all collected verification samples is presented in Table 2. The location of each sample is shown in Figure 4. As shown in Table 2, the verification samples all had PCB concentrations well below 50 ppm. The average PCB concentration detected in the 122 verification samples was less than 3.3 ppm and 75 percent of the samples had a PCB concentration below the limit of detection (1.0 ppm).

As a means of confirming the accuracy of the laboratory analytical procedures, the fourth and tenth verification samples collected and every tenth verification sample collected thereafter, were split with the Department of Environmental Regulation's (DER) laboratory. In addition, several samples were split with the Environmental Protection Agency's (EPA) laboratory. A summary of the results of the analysis of the split samples is presented in Table 3. Note that the PCB concentrations of samples 50a, 50b, 50c, 51a, 51b, 52a, 52b and 52c are greater than 50 ppm. These samples were not verification samples and, therefore, do not represent PCB concentrations in the remaining soil. The samples were taken solely for the split with the EPA laboratory. Additional excavation was performed in the area where these samples were retrieved. The actual verification sample from this area is 83a.

Once a section had been excavated and verified through sampling to meet the PCB limits specified in the RAP, the open excavation was backfilled with clean sand obtained from an on-site borrow area. A survey of the backfill material placed in excavated areas was conducted by the surveyor and is included on the attached drawings (Sheets 1 through 13).

Table 1

RESULTS OF WATER SAMPLING PRIOR TO AND DURING DEWATERING OF THE BORROW PIT/DETENTION POND
(February 8 - May 1, 1986)

Water Sample Number	Date of Sampling	PCB Concentration (mg/l)	Lead Concentration (mg/l)	Cadmium Concentration (mg/l)	Remarks
19735	2/08/86	0.0018	*	*	Sample retrieved from pond prior to the start of the dewatering process, 1 foot below surface.
19736	2/08/86	0.0016	*	*	Sample retrieved from pond prior to the start of the dewatering process, 3 foot below surface.
19789	2/12/86	0.0004	*	*	Effluent from the second sand filter prior to the installation of the carbon filters.
19816	2/15/86	0.0008	*	*	Effluent from the second sand filter prior to the installation of the carbon filters.
19817	2/15/86	0.0007	*	*	Effluent from the second sand filter prior to the installation of the carbon filters.
W1	2/20/86	0.0026	0.020	0.001	Effluent from the second sand filter prior to the installation of the carbon filters. Added two carbon filters to the water treatment system.
W2	2/25/86	0.0020	*	*	Effluent from the first carbon filter. Backflushed the sand filters.
W3	2/26/86	0.0048	0.034	0.002	Effluent from the first carbon filter.
W4	3/01/86	0.0009	0.032	0.003	Effluent from the second carbon filter. Added the third carbon filter in series. Backflushed the sand filters.
W5	3/07/86	0.0095	0.052	0.004	Effluent from the second carbon filter. Replaced carbon in one cell and changed upper portion of carbon in another cell.
W6	3/18/86	0.0014	*	*	Effluent from the second carbon filter.
W7	3/21/86	-	-	-	Sample was inadvertently delivered to lab after subsequent sample. Therefore not analyzed.
W8	3/23/86	0.0025	0.046	0.005	Effluent from the second carbon filter. Backflushed the sand filters. Decreased the rate of pumping.
W9	3/28/86	0.0011	0.079	0.004	Effluent from the second carbon filter. Decreased the rate of pumping.
W10	4/01/86	-	0.077	0.004	Effluent from the second [illegible] filter. Extract for PCB analysis lost.
W11	4/04/86	0.0003	0.127	0.007	Effluent from the second carbon filter.
W12	4/04/86	0.0006	0.042	0.004	Sample collected from the center of the south side of the polishing pond.
W13	4/04/86	0.0008	0.019	0.003	Sample collected from the southwest corner of the polishing pond.
W14	4/04/86	0.0002	0.029	0.005	Sample collected from the outflow ditch of the spray irrigation field.
W15	4/08/86	0.0003	0.036	0.006	Effluent from the second carbon filter.
W16	4/12/86	0.0011	0.06	0.008	Effluent from the second carbon filter. Backflushed the sand and carbon filters. Replaced top portion of the carbon in filter No. 1.
W17	4/23/86	0.0015	0.069	0.013	Effluent from the second carbon filter.
W18	4/26/86	0.0020	0.070	0.011	Effluent from the second carbon filter. Backflushed the carbon filters. Replaced the carbon in filter No. 2.
W19	4/29/86	.0006	0.102	0.013	Effluent from the second carbon filter.
W21	5/01/86	.0001	0.075	0.012	Effluent from the second carbon filter.

*Sample analyzed for PCB's only

Table 2

SUMMARY OF VERIFICATION SAMPLES

Sample* Number	Section**	Grid Number	PCB Concentration (mg/l)	Remarks
1a	F	54	<1	
2a	F	34-48	<1	
3a	F	72	1.9	
4a	F	46	**22.4**	
5a	D	342	<1	
6a	F	7	<1	
12a	D	153	<1	
13a	D	163	**34.2**	
15a	D	224	1.3	
E1a	D	330	<1	
19a	D	69	1.8	
25a	D	40	5.8	
27a	D	76	<1	
28b	C	52	<1	Sample retrieved from a depth of 6-12 inches.
29a	C	58	1.5	
31a	C	91	**36.5**	
32a	TTT	23	<1	
34a	C	97	<1	
35a	B	3	15.9	
36a	TTT	13	<1	

Table 2

SUMMARY OF VERIFICATION SAMPLES
(continued)

Sample* Number	Section**	Grid Number	PCB Concentration (mg/l)	Remarks
37a	A"	42-43 44-45	< 1	
38a	C	41	3.6	
39a	C	53	9.1	
40a	C	51	< 1	
41a	C	64	< 1	
42a	C	37	< 1	
43a	C	20	<1	
44a	C	7	<1	
45a	CRR	see Fig. 4	<1	
46a	CRR	see Fig. 4	< 1	
47a	CRR	see Fig. 4	< 1	
48a	CRR	see Fig. 4	<1	
49a	CRR	see Fig. 4	<1	
51a	A	10	<1	
52c	A"	24	< 1	Sample retrieved from a depth of 12-18 inches.
J30	by CRR	see Fig. 4	< 1	

Table 2

SUMMARY OF VERIFICATION SAMPLES
(continued)

Sample* Number	Section**	Grid Number	PCB Concentration (mg/l)	Remarks
J29	by CRR	see Fig. 4	< 1	
53a	A"	13	21.2	
H23i	A"	9	< 1	
54a	A	33	1	
55a	A	52	2.0	
56a	A	55	< 1	
E44a	D	104	< 1	
L36g	A	56-57	< 1	
58a	A"	22	< 1	
59a	D	318	< 1	
60a	D	305	< 1	
61a	D	272	< 1	
62a	D	267	< 1	
N37	D	256	< 1	
63a	D	201	< 1	
64a	D	204	< 1	
65a	D	159	< 1	
66a	D	129	< 1	
P30g	D	30	< 1	

Table 2

SUMMARY OF VERIFICATION SAMPLES
(continued)

Sample* Number	Section**	Grid Number	PCB Concentration (mg/l)	Remarks
Q30h	D	46	< 1	
P30d	D	19	3.7	
67a	D	53	< 1	
68a	B	22	< 1	Sample retrieved from a depth of 0 to 3 inches.
69a	D	101	< 1	
70a	D	72	< 1	
71a	A'	11	< 1	
72b	A	9	6.5	Sample retrieved from a depth of 6-12 inches.
74a	Swale***	-	< 1	North third of swale. Sample retrieved from center of swale.
75a	Swale***	-	5.7	North third of swale. Sample retrieved from east edge of cut.
76b	Swale***	-	<1	North third of swale. Sample retrieved from west edge of cut. (6-12 inches)
77a	Swale***	-	<1	Middle third of swale. Sample retrieved from center of swale.
78a	Swale***	-	10.8	Middle third of swale. Sample retrieved from east edge of cut.
79c	Swale***	-	<1	Middle third of swale. Sample retrieved from west edge of cut. (12-18 inches)
80a	Swale***	-	<1	South third of swale. Sample retrieved from center of swale.

Table 2

SUMMARY OF VERIFICATION SAMPLES
(continued)

Sample* Number	Section**	Grid Number	PCB Concentration (mg/l)	Remarks
81a	Swale***	-	13.3	South third of swale. Sample retrieved from east edge of cut.
82a	Swale***	-	3.9	South third of swale. Sample retrieved from west edge of cut.
P27 (Retest)	B	21	<1	
P30i (Retest)	D	21-32	9.1	
83a	A	23	< 1	
84a	Swale***	-	< 1	North third of swale. Samples retrieved from west edge of cut.
85a	Swale***	-	< 1	
86a	Swale***	-	< 1	
87a	Borrow Pit	66	5.3	
88a	Borrow Pit	30	< 1	
89a	Borrow Pit	45	<1	
90a	Borrow Pit	11	<1	
91a	Borrow Pit	62	<1	
92a	Borrow Pit	104	< 1	
93a	Borrow Pit	23	< 1	
94a	Borrow Pit	100	< 1	
95a	Borrow Pit	69	11.3	
96a	Borrow Pit	53	1.3	

Table 2

SUMMARY OF VERIFICATION SAMPLES
(continued)

Sample* Number	Section**	Grid Number	PCB Concentration (mg/l)	Remarks
97a	Borrow Pit	56	< 1	
98a	Borrow Pit	94	< 1	
100a	Borrow Pit	58	< 1	
101a	Borrow Pit	3	< 1	
102a	Borrow Pit	127	<1	
103a	Borrow Pit	110	< 1	
104a	Borrow Pit	72	< 1	
E71a	Borrow Pit	17	24.7	
105a	Swale***	-	< 1	
106a	Swale***	-	< 1	
107a	Swale***	-	< 1	
108a	Borrow Pit	135	< 1	
109a	E	21	< 1	
110a	E	67	< 1	
111a	E	53	< 1	
112a	E	40	5.2	
113a	E	91	< 1	
114a	E	116	< 1	
115b	E	96	< 1	Sample retrieved from a depth of 4 to 10 inches

Table 2

SUMMARY OF VERIFICATION SAMPLES
(continued)

Sample* Number	Section**	Grid Number	PCB Concentration (mg/l)	Remarks
116a	E	45	<1	
H24i (Retest)	A"	20	1.6	
J24d (Retest)	A'	1	8.2	
F25 (Retest)	A"	37	< 1	
E77a	E	see Fig. 4	< 1	
E78a	E	see Fig. 4	<1	
E79a	E	see Fig. 4	< 1	
E80a	E	see Fig. 4	<1	
117a	E	see Fig. 4	< 1	
118a	E	73	< 1	
119a	E	25	36.7	
120a	E	58	< 1	
121a	E	81	<1	
122a	E	95	2.3	
123a	E	108	6.2	

* Unless otherwise noted in the remarks column, samples were retrieved from a depth of 0 to 6 inches below the bottom of the excavation.
** See Figure 4 for section location.
*** See cross sectional map of swale section for sampling location.

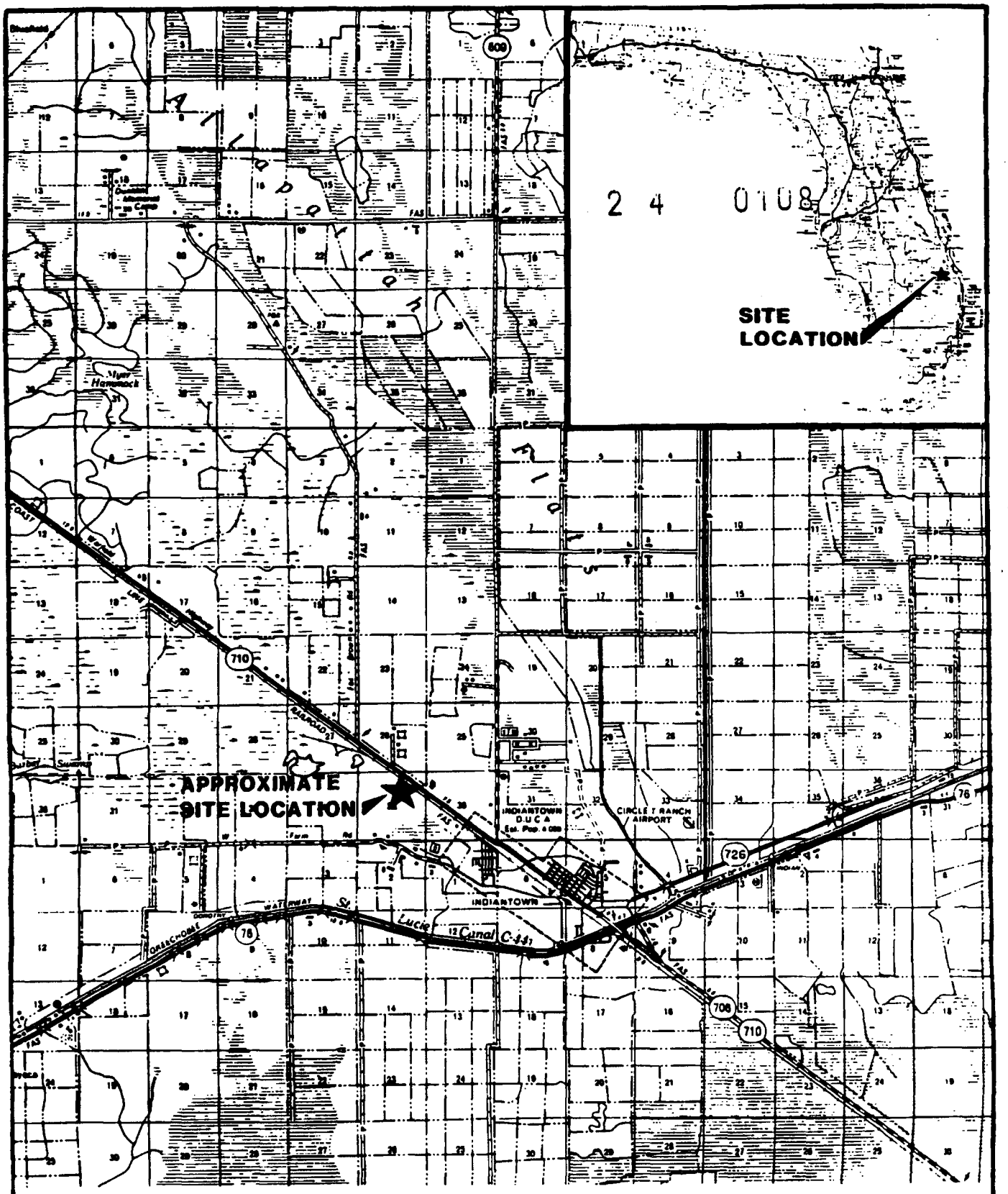
Table 3

SUMMARY OF SAMPLES SPLIT WITH THE FDER AND EPA

2 4 0107

Split Samples	Sampling Depth*** (inches)	Section****	Grid Number	PCB Concentration (ppm) Geotec Lab	DER Lab	EPA Lab
4a	0-6	F	46	22.4	14.6	-
4b	6-12	F	46	NA	0.3	-
4c	12-18	F	46	NA	<0.1	-
61a*	0-6	D	272	<1	<0.1	-
E44a*	0-6	D	104	<1	<0.1	-
34a*	0-6	C	97	<1	<0.1	-
40a	0-6	C	51	<1	<0.1	-
40b	6-12	C	51	<1	<0.1	-
50a****	0-6	A	19	249	236	360
50b	6-12	A	19	49	57	
50c	12-18	A	19	74.8	-	
83a	0-6	A	23	<1	<0.1	-
51a****	0-6	A	10	<1	<0.1	1.0
51b	6-12	A	10	17.9	<0.1	
52a****	0-6	A"	24	71.1	763**	90
52b	6-12	A"	24	724	39**	
52c	12-18	A"	24	<1	-	
60a	0-6	D	305	<1	<0.1	-
70a	0-6	D	72	<1	<0.1	-
80a	0-6	Swale	-	<1	<0.1	-
90a	0-6	Borrow Pit	11	<1	<0.1	-
100a	0-6	Borrow Pit	58	<1	<0.1	-
110a	0-6	E	67	<1	<0.1	-
120a	0-6	E	58	<1	0.7	-

NA Not analyzed.
* Replacement of Sample Numbers 10a, 20a and 30a, respectively.
** Apparent labelling error.
*** See Figure 4 for section location.
**** Split sample, not a verification sample.



SITE LOCATION MAP

SOURCE: U.S. HIGHWAY MAP
MARTIN COUNTY

0 1 2
SCALE —— MILES

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

EC DUST DISPOSAL AREA
FLORIDA STEEL CORPORATION
INDIANTOWN MILL
INDIANTOWN, FLORIDA

DRAWN BY: H.A.D.	CHECKED BY:	DATE: 9/10/85
FILE NO. 83-119	APPROVED BY:	

84758

K&E 19-1353

FIGURE 1

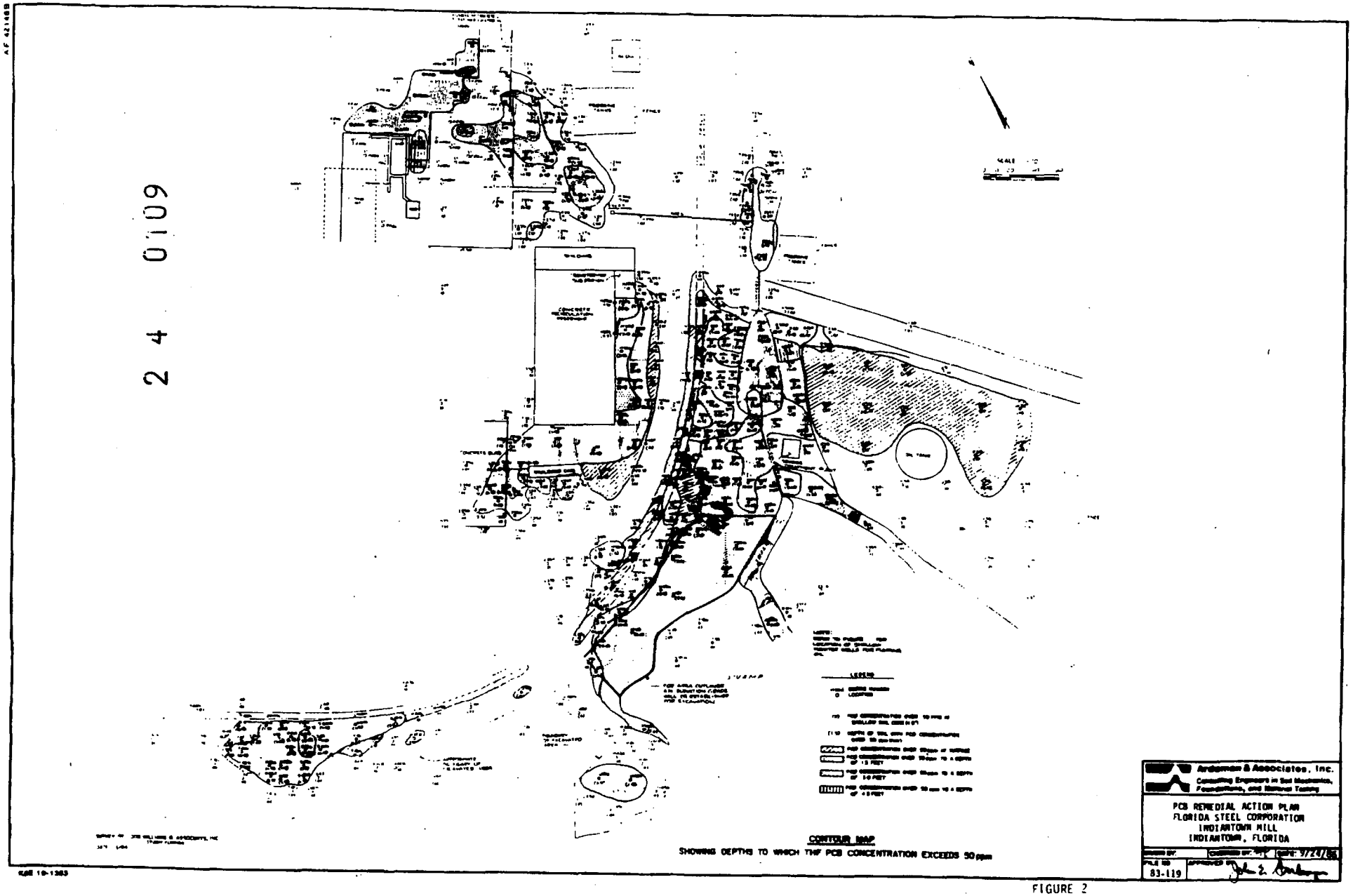


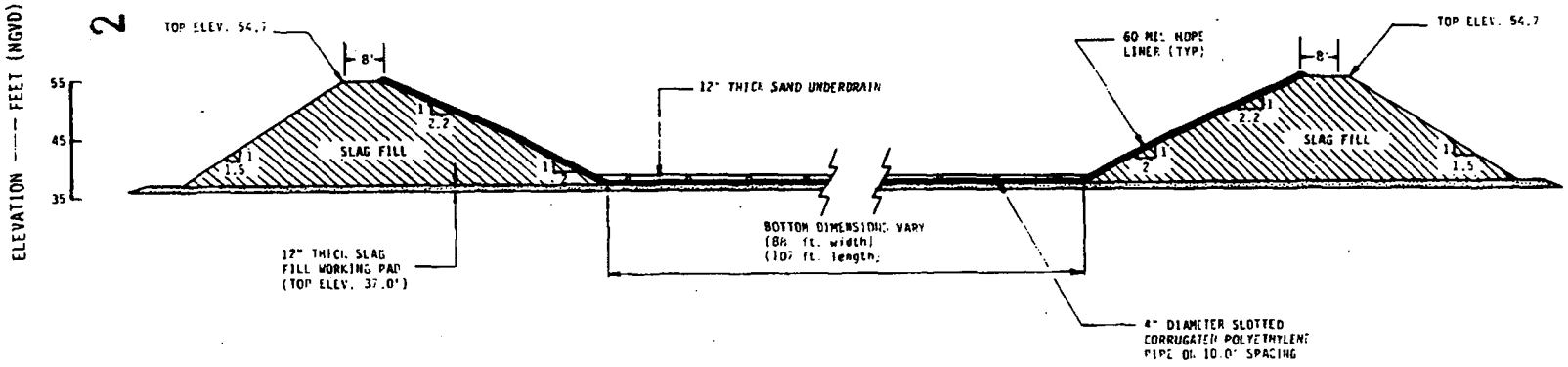
FIGURE 2

2 4 0109

24 0110

ON-SITE STORAGE FACILITY

SCALE 1"=20'-0"



Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Material Testing

PCB REMEDIAL ACTION PLAN
FLORIDA STEEL CORPORATION
INDIANTOWN MILL
INDIANTOWN, FLORIDA

DRAWN BY S.E.F. CHECKED BY [illegible] DATE 9/15/86
FILE NO. 83-119 APPROVED BY [illegible]

FIGURE 3

Appendix A

SUMMARY OF TEST RESULTS AND SAMPLING LOCATION OF THE EXPLORATORY SAMPLES

SUMMARY OF EXPLORATORY SAMPLES

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
EP1	Borrow Pit (Pond)	34	0-6	126	Samples retrieved with a piston sampler. (Pond)
EP2	Borrow Pit (Pond)	71	0-6	605	
EP3a	Borrow Pit (Pond)	111	0-6	396	
EP3b			6-12	521	
EP4	Borrow Pit (Pond)	69	0-6	75	
EP5	Borrow Pit (Pond)	109	0-6	430	
EP6	Borrow Pit (Pond)	32	0-6	31	
EP7	Borrow Pit	10	0-6	190	
EP8	Borrow Pit (Pond)	43	0-6	331	
EP9	Borrow Pit (Pond)	102	0-6	47	
EP10	Borrow Pit (Pond)	100	0-6	553	
EP11	Borrow Pit (Pond)	41	0-6	247	
EP12a	Borrow Pit (Pond)	8	0-6	777	
EP12b			6-12	581	
7a	D	327	0-6	43.9	
8a	D	312	0-6	68.0	Additional excavations were conducted in Area D following the results of the exploration samples from that area.
8b			6-12	1200	
9a	D	280	0-6	23.9	

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
10a	D	272	0-6	175	
10b			6-12	196	
10c			12-18	185	
11a	D	202	0-6	170	
11b			6-12	89	
14a	D	193	0-6	602	
14b			6-12	642	
16a	D	241	0-6	<1	
17a	D	147	0-6	0.8	
18a	D	129	0-6	134	
18b			6-12	9.2	
20b	D	104	6-12	381	
20c			12-18	35.9	
21a	D	23	0-6	272	
21b			6-12	2.0	
28a	C	52	0-6	160	
30a	C	97	0-6	29.6	
33a	A	8	0-6	633	
50a	A	19	0-6	249	
50b			6-12	49.0	
50c			12-18	74.8	
52a	A"	24	0-6	71.1	
52b			6-12	724	
57a	B	22	0-6	78	
57b			6-12	67	
72a	A	9	0-6	113	

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
73a	A	30	0-6	74.6	
73b			6-12	63.3	
76a	Swale*	-	0-6	334	
79a	Swale*	-	0-6	55.6	
99a	Borrow Pit	91	0-6	49.9	
115a	E	96	0-6	220	
E2a	D	309	0-6	204	
E2b			6-12	255	
E2c			12-18	259	
E3a	D	294	0-6	140	
E3b			6-12	189	
E3c			12-18	133	
E4a	D	256	0-6	163	
E4b			6-12	61.8	
E4c			12-18	9.4	
E5a	D	245	0-6	581	
E5b			6-12	273	
E5c			12-18	523	
E6a	D	191	0-6	616	
E6b			6-12	3.1	
E7a	D	119	0-6	197	
E7b			6-12	18.1	
E8a	D	121	0-6	376	
E8b			6-12	1337	
E8c			12-18	6.2	
E9a	D	143	0-6	<1	
E10a	D	142	0-6	5.0	

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
E11a	D	30	0-6	296	
E11c			6-12	229	
E12a	D	19	0-6	4.3	
E17a	D	307	0-6	NA	
E18a	D	303	0-6	NA	
E19b	D	293	6-12	485	
E20b	D	255	6-12	120	
E21a	D	242	0-6	6.1	
E22b	D	230	6-12	315	
E23b	D	221	6-12	390	
E24a	D	201	0-6	344	
E25a	D	188	0-6	13.5	
E26a	D	176	0-6	94.5	
E27c	D	273	12-18	575	
E28a	D	118	0-6	<1	
E29a	D	113	0-6	NA	
E30a	D	122	0-6	351	
E31a	D	111	0-6	<1	

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
E32d	D	293-294 304-305		<1	Test hole was bored to the depth of in situ sand where sample was retrieved (approximately 5 feet below original grade).
E33	C	2		<1	Samples were retrieved just east of the transformer located at the northeast corner of the CRR. Samples E33 and E34 were retrieved at depths of approximately 6 to 7 feet and 7 to 7.5 feet, below original grade, respectively.
E34	C	2		<1	
E35b	D	11-20		<1	Samples retrieved around the perimeter of a deeper hole excavated in this area.
E36b	D	29		<1	
E37b	D	31-43		<1	
E38a	B	22	0-6	68	
E38b			6-12	121	
E38c			12-18	6.8	
E39	outflow ditch from pond	-	0-6	1352	For sample location, see map in Appendix A. All sediment overlying in situ sand was removed from this area.
E40	outflow ditch from pond	-	0-6	9.0	
E41	outflow ditch from pond	--	0-6	8.3	

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
E42	outflow ditch from pond	-	0-6	310	
E43	outflow ditch from pond	-	0-6	33.6	
E44	See map in Appendix	-		<1	Sample retrieved below the culvert that connects Area D to Ditch B. Sample retrieved from a depth of approximately 5 to 5.5 feet below original grade.
E45	B	21	0-6	9.3	
E46	B	23	0-6	61	
E47b	A"	37		<1	Samples were retrieved along a line approximately 10 feet north of the hydraulic room. E47 was retrieved directly north of F25 at a depth of 0.5 to 1.0 feet below existing grade at date of sampling. E48 was retrieved approximately 16 feet east of E47 at a depth of 0.5 to 1.0. E49 was retrieved approximately 16 feet west of E47 at a depth of 1.0 to 1.5 feet below existing grade.
E48b	A"	38-39		<1	
E49c	A"	35-36		<1	
E50	B	23		<1	Grab sample retrieved with a glass jar.

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
E51c	D	32		4.5	Sample was retrieved from a depth of approximately 4 to 4.5 feet below existing grade at date of sampling which corresponds to a depth of approximately 7.5 to 8.0 feet below original grade.
E52a	outflow ditch from pond	-	0-6	64.5	Sediment overlying in situ sand was removed from this area.
E53	polishing pond	-	0-6	<1	Sample retrieved from the southeast corner of polishing pond.
E54	polishing pond	-	0-6	<1	Sample retrieved from the center of south side.
E55	polishing pond	-	0-6	6.6	Sample retrieved from southwest corner.
E56a	outflow ditch from pond	-	0-6	<1	See map in Appendix A for sample location.
E57a	outflow ditch from pond	-		6.7	
E57	A	36-44		47.2	Composite samples retrieved around the perimeter of a hole excavated in front of the reheat furnace. Additional excavations were conducted at the location of sample numbers E57 and E60.
E58	A	25-31		14.4	
E59	A	15		<1	
E60	A	6-7		173	

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
E61	A'	-		<1	Sample retrieved at a depth of approximately 3.5 to 4.0 feet below the slab of the reheat furnace.
E62	A'	-		<1	Sample retrieved at a depth of approximately 1.5 to 2.0 feet.
E63	A'	-		<1	Sample retrieved at a depth of approximately 2.0 to 2.5 feet.
E64	A'	-		<1	Sample retrieved at a depth of approximately 2.5 to 3.0 feet.
E65	A'	-		<1	Sample retrieved at a depth of approximately 3.5 to 4.0 feet.
E66	A'	-		<1	Sample retrieved at a depth of approximately 3.5 to 4.0 feet.
E67	A'	-		7.1	Sample retrieved at a depth of approximately 3.5 to 4.0 feet.
E68	A"	-		<1	Sample retrieved from below the hydraulic room, 7 feet east of F25 and at a depth of approximately 4 to 5 feet.
E69	A"	-		<1	Sample retrieved from below the hydraulic room, 5 feet south of F25 and at a depth of approximately 5 to 6 feet.

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
E70	A"	-		44.7	Sample retrieved from below the hydraulic room, 7 feet west of F25 and at a depth of approximately 5 to 6 feet.
E72	A	7	0-6	291	Composite sample.
E73	E	23	0-3	1.5	Samples of the in situ sand. Samples retrieved prior to the start of excavation in that area.
E74	E	68	0-3	2.3	
E75	A	7	0-6	3.1	
E76	E	See Fig. 4	0-6	87	
E81	Pond	-		<1	Grab sample of the sand excavated from the pond while digging out the sump area.
E82	-	-		<1	Grab sample of sand removed from the sludge tanks.
E83	-	-		<1	Grab sample retrieved from around the leachate collection sump.
E84	A	1-2		467	Composite sample retrieved from south edge of cut below concrete slab of reheat furnace, in the area of J24d, at a depth of 2 to 3 feet below original grade.

SUMMARY OF EXPLORATORY SAMPLES
(continued)

Sample Number	Section (see Appendix A)	Grid Number	Sampling Depth (inches)	PCB Concentration (mg/l)	Remarks
E85	A"	38		NA	Composite sample retrieved from below concrete slab of hydraulic room. See Figure 3 for sample location.
E86	A"	-		<1	Samples collected from the hydraulic room. See map in Appendix A for sample locations.
E87	A"	-		<1	
E88	A"	-		<1	
E89	A"	-		<1	
E90	A"	-		<1	
E91	A'	6-11		<1	Sample retrieved from below reheat furnace.
E92	A'	7-12		<1	

NA - Not analyzed.
*See cross sectional map of swale section for sampling location.

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Human Health and Environmental Risk Assessment of the Florida Steel Corporation Indiantown Mill Site Martin County, Florida

August, 1990
Revised January, 1991

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1.0 INTRODUCTION

Envirologic Data, Inc. (ELD) has prepared this Human Health Risk Assessment and Environmental Evaluation of the chemical residuals at the Florida Steel Corporation (FSC) Indiantown Mill Site in partial fulfillment of a Remedial Investigation (RI) as stipulated in FSC's Consent Order (CO) with the Florida Department of Environmental Regulation (FDER) which is the lead agency for this CERCLA site. The risk assessment is consistent with CERCLA/SARA, the National Contingency Plan, EPA Remedial Investigation/ Feasibility Study (RI/FS) guidance documents and EPA Risk Assessment guidance for the evaluation of human health and environmental risks.

1.1 Objectives

The objectives of the risk assessment include:

- Analysis of the "no-action" remedial alternative assessment.
- Determination of the necessity of any additional response action based on the threat of injury or harm to human health or the environment from the contaminated residuals at the site.
- Development or modification of preliminary remediation goals.

1.2 Scope of Assessment

Prior to and during the RI, FSC has sponsored extensive investigative work designed to characterize the nature and extent of any environmental impacts that the prior industrial activities might have had on the soil, sediment, surface water and ground water at the site. Assessment of potential human health impact from chemicals in soil (and corresponding risk

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derived remediation target levels) is addressed in this document and will be based on direct contact with soil. The potential impact of contaminated soil on groundwater quality (and corresponding environmental-fate-derived remediation target levels) is not addressed in this document but will be addressed in the Feasibility Study (FS) report.

Two phases of RI activities have been conducted by Ardaman & Associates, Inc. in association with Mark Schultz Associates and Carlos Stern Associates, Inc., and in coordination with both the FDER and Region IV EPA. The 19 studies and reports coordinated and submitted prior to the RI are listed in Section 1.3 of the Phase II RI report.

During Phase I, soil, sediment, groundwater, and surface water samples were collected from those areas of the site with the highest potential for contamination and analyzed for the full EPA Contract Laboratory Program/Hazardous Substance List (CLP/HSL) parameters. The Phase II remedial investigation further defined the horizontal and vertical extent of contamination in areas not previously addressed.

Soil sampling was designed to determine the nature and extent of contamination in each area of the site. Surface water and sediment sampling locations were chosen to determine the extent of transport of contaminants through fluvial processes, and whether contaminants were being transported towards the St. Lucie Canal. Groundwater monitoring wells were placed to delineate the extent of the contaminant plume. Other testing, such as aquifer characterization, was conducted to provide information related to the mobility of contaminants. Extraction Procedure Toxicity (EP Tox) Testing was conducted to determine the waste classification of materials, to provide general information on leachability, as well as to provide information for evaluation of remedial alternatives in the Feasibility Study (FS). An on-site flora and fauna survey and an off-site literature review were conducted as part of the environmental evaluation.

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1.3 Site Background

The Indiantown Mill Site is located in the Eastern Flatlands of Martin County, Florida, on Highway 710 approximately 2 miles northwest of Indiantown, Florida (Figure 1) a community of about 5,000 persons. Between 1970 and 1982, FSC used an electric arc furnace (EAF) to recycle scrap steel into new products. FSC owns approximately 150 acres of land bounded on the north by the Seaboard Coast Line (CSX) railroad and State Highway 710. The area beyond the highway for several miles to the north is undeveloped and includes a number of wetland areas. The Caulkins citrus processing plant is located to the northwest (upgradient) of the mill. On all other sides of the property there is undeveloped land and wetlands. All of the surrounding land is zoned industrial: beyond that it is zoned agricultural (Ardaman & Assoc., 1989). FSC's property was undeveloped prior to their operation of the EAF steel mill.

The Indiantown mill was closed for economic reasons in early 1982 and FSC has no plans to operate a steel mill at this property in the future.

Sources of contamination related to the now discontinuted FSC operations included emission control dust (EC dust), a byproduct of steel production, hydraulic fluid containing PCBs, and brine discharge from a water softening process. Slag, another byproduct of steel, may also be a potential source of contamination. The EC dust, and to a lesser extent slag, contained metals, including lead, cadmium, and zinc. The EC dust was disposed of on-site until November, 1980. During 1985, the greater part of the EC dust was removed and shipped to a metal recycling facility for zinc recovery.

Prior to 1975, hydraulic fluids containing PCBs were used in a shear to cut the steel billets. During that period, some hydraulic fluid entered the closed loop cooling water system and became incorporated into the mill scale sediments in that system. These sediments, which were not then known to contain PCBs, were disposed of on-site. In 1986 and 1987 all

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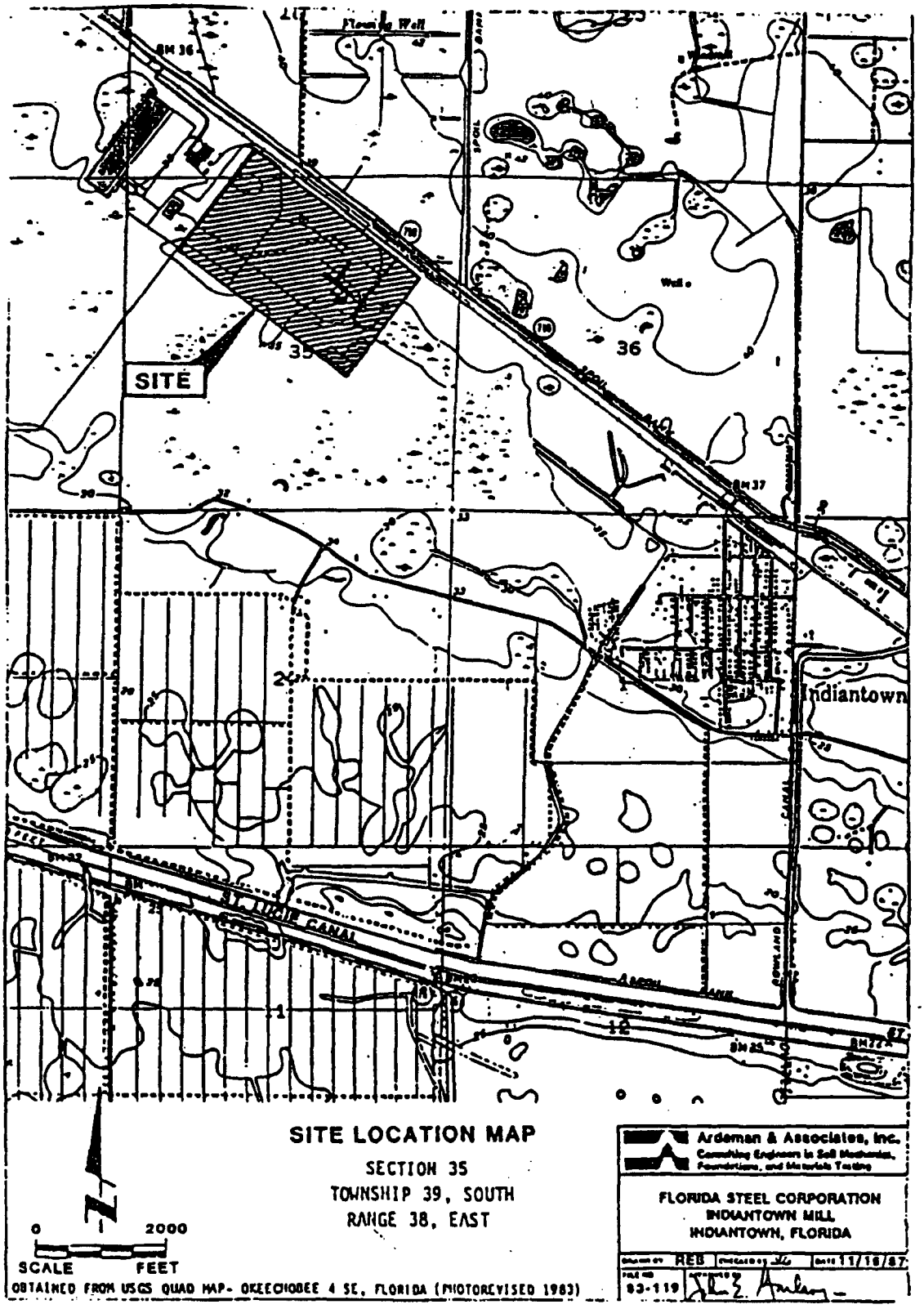
FIGURE 1

SITE LOCATION MAP
FLORIDA STEEL CORP., INDIANTOWN, FL



materials exhibiting PCB concentrations of 50 ppm and above were remediated under Consent Order.

During the time that the mill operated, groundwater used in the non-contact cooling system was softened to prevent scaling in the cooling water lines. The water was softened by passing it through a cation exchanger. During regeneration of the cation exchange medium, sodium chloride solution was flushed through the exchanger and the resulting brine was discharged onto the ground surface in the vicinity of the softener.

1.3.1 General Physiographic Setting

The FSC site is located in the North 1/2 of Section 35, Township 39 South, Range 38 East, Martin County, Florida. It is located approximately two miles northeast of the St. Lucie Canal and eight miles from the northeastern shore of Lake Okeechobee. The site is within the St. Lucie Canal Drainage Basin as designated by the South Florida Water Management District (SFWMD) (Cooper and Santee, 1988). Regional surface water and groundwater drainage is generally to the south-southeast.

The site is located in the region of Martin County known as the "Allapattah Flats." Topography in the area is nearly level, with slopes generally less than five percent. The elevation of the site is between 35 and 40 feet above mean sea level. Soils at the site are primarily of the Myakka-Immokalee-Basinger association, consisting of poorly drained sands in the surficial horizons with weakly cemented, poorly drained sandy subsoils (USDA, 1978; FL Dept. Admin., 1974). Surface water flow at the site is intermittent, occurring principally during the rainy season. The water table in the area is shallow, occurring, on average, less than four feet below grade.

The climatological conditions in the area include an annual average of 60 inches of rainfall and an annual average temperature of 75.2 degrees Fahrenheit. Sixty-four percent of the annual precipitation occurs between June and October (Ardaman, 1988), with the lowest

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average rainfall occurring during January. Fluctuations in the water table of two to five feet are associated with seasonal rainfall cycles.

1.3.2 Ecological Characteristics of the Site and Adjacent Areas

General vegetational communities in the area include palmetto and slash pine scrub interspersed with seasonally and permanently flooded wetland areas with emergent herbaceous species and deciduous and evergreen shrubs. There are several areas of standing open water greater than three feet in depth on the site. These areas (referred to as the "polishing pond" and "borrow pits"), are the result of excavation to obtain clean fill. Aquatic and emergent floral species including duckweed, arrowhead, hyacinth, water lily, cattail and giant reed occur in abundance in these areas.

Presence of Ecologically Sensitive Areas

As noted above, the site lies within the St. Lucie Canal Drainage Basin, and the regional surface water system consists of a series of man-made drainage ditches that ultimately discharge into the St. Lucie Canal, a water body that is essentially the channelized South Branch of the Indian River which terminates in an estuarine system at the Indian River Lagoon, approximately 25 miles downstream from Indiantown. The coastal ecology for this area has been extensively inventoried and characterized by several individuals and Agencies (Steward & Van Arman, 1987). The estuarine waters in the St. Lucie Inlet have been designated Class II (Shellfish Propagation and Harvesting). The barrier islands adjacent to the Inlet are designated as "Habitats of Species of Special Concern," and the waters of St. Lucie Inlet State Park are designated "Special Waters" by the state (FAC Ch. 17-3). The Indian River Lagoon watershed has been designated a "priority water body" by the state (SFWMD, 1987).

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Presence of Threatened or Endangered Species

There is currently no information to suggest that the site, or areas in the immediate vicinity of the site, provide critical habitat for threatened or endangered species (USFWS, 1980). During reconnaissance of the area, there was no evidence of permanent or sustained use of the area by threatened or endangered species (e.g., no bald eagle or everglades kite nest sites, etc. were observed). Previous environmental investigations conducted in the Indiantown area in the vicinity of the St. Lucie Canal also indicated that the area is not appreciably utilized by threatened or endangered species (Blythe, 1989).

An uncertainty regarding the presence of threatened or endangered species, or species of special concern may involve the temporary or transient presence of species known to be endemic to Lake Okeechobee or Everglades National Park. The general characteristics of the wetland habitat on and in the immediate vicinity of the site appear to be of naturally low quality relative to other south Florida wetland systems. It is therefore unlikely that sensitive species would select a low quality wetland system when more highly productive and less disturbed areas are available.

General Structure of Local Floral and Faunal Communities

Plant communities typical of south-central Florida have been described for several locations. For example, in the Kissimmee River floodplain the plant communities were grouped into several major categories and sub-categories, each with a unique species composition (Milleson, et al., 1980). Terrestrial forested, wetland forested, marsh/aquatic, and spoil and barren communities are in the vicinity of the FSC site. Flora typical of each of these habitat types are listed for reference purposes in Appendix A.

In another study, baseline information on native wetland habitat characteristics and species diversity in the Bartow, Florida area was collected to determine the feasibility of re-

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establishing wetlands communities on disturbed lands (Gilbert, et al., 1981). Information regarding the occurrence of both flora and fauna as determined by this study is also provided in Appendix A.

1.3.3 Physical and Chemical Processes Characteristic of the Site Environment

Numerous physical, chemical and biological processes such as dissolution, volatilization, sorption to sediments, photolysis, hydrolysis, and biodegradation act upon chemicals in the environment. The interaction of these factors determines the ultimate environmental fate of on- or off-site compounds as well as any risks which they pose. In order to assess the risk associated with a released chemical, it is necessary to understand how the compound will behave in a given environment.

The relative importance of various environmental transport processes at a given site are determined by both the physical-chemical properties (aqueous solubility, vapor pressure, chemical speciation, sorptive affinity and potential for biodegradation, etc.) of the contaminants present and site-specific environmental conditions. When information regarding some site-specific parameters (e.g., total organic carbon, grain size analysis of soils and sediments, redox potential, etc.) is limited, a general discussion of fate and transport of pollutants can be presented.

Volatilization from water to the atmosphere can be an important transport mechanism for chemicals exhibiting high equilibrium vapor pressure or extremely low aqueous solubility. The contaminants of concern at the FSC Indiantown site are primarily metal oxides which do not typically form volatile compounds in the environment. The strong sorptive affinity of PCBs for soil and sediment organic matter, and the previous removal of PCB contaminated material make volatilization an unlikely exposure pathway for PCBs at the site.

Sorption to soils and sediments is the controlling process for the environmental transport of chemicals which are strongly bound to natural organic matter and/or mineral

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surfaces. Such substances which exhibit a tendency to associate with particulate matter may be transported with suspended particles by surface runoff, surface water movement, or atmospheric transport of airborne particulates. At the Indiantown Mill site, sediment transport is currently a pathway of limited importance because the permeable soil and flat topographic relief of the site are not conducive to runoff. Ditches draining the site are heavily overgrown with vegetation and heavy vegetative growth in the ditches reduces the velocity of flow and favors sedimentation of suspended particles which further limits sediment migration. Contaminants associated with these particles may tend to be enriched in the bed sediments relative to the overlying water. Transport of contaminants via surface water flow is restricted primarily to dissolved species or those associated with colloidal material in the aqueous phase.

The heavy metals of concern at the FSC site are primarily associated with EC dust. PCBs present at the site are strongly bound to soils and sediments. Analytical data from the site indicate that these materials are present principally in soil and sediments.

Transportation of contaminants in groundwater is restricted to dissolved species. [A discussion of this topic is presented in the Phase II RI report.] Speciation of metals in the environment is affected by redox conditions (USEPA, 1979a). Hydrolysis and photolysis are not likely to be important processes affecting the chemicals associated with the site.

A number of compounds present at the FSC site demonstrate a potential for bioaccumulation or bioconcentration (Eisler, 1985; Klaussen, et al., 1986; Leland and Kuwabara, 1985). These compounds include PCBs, lead, cadmium, chromium and zinc.

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1.4 Description of Environmental Areas

In the RI, air photos were used to organize the site into Areas based on former use (and, consequently, the potential presence of different contaminants) during the time the steel mill was operational (see Phase II RI report). By these means the scope of the investigation in each area could be, and was, tailored to reflect the nature and level of activities in the particular area, i.e., the former industrial areas were more intensively investigated and the non-industrial less so. Although these boundaries are generally correct, they are not precise. Evidence of contamination along the fringe of a non-industrial area is, therefore, not evidence of migration but rather the result of an imprecise delineation of the boundary between industrial and non-industrial areas. This organization has been extended and expanded in the Risk Assessment. Areas A through G are outlined in Figure 2. Each area is discussed individually below.

Area A was formerly the active portion of the mill. This area is bounded on the east and the south by the railroad track and the northern boundary of the large EC dust disposal area and on the north and west by the road to the former scrap yard. This area includes the borrow pit/stormwater retention pond, hereafter referred to as the "borrow pit", the swale and ditches leading to and from the borrow pit and the containment area for the 300,000 gallon above ground storage tank. This area includes all locations where PCBs were detected (and from which they have since been removed) at concentrations of 50 ppm and above.

The dominant vegetation in Area A varies from one portion of the property to another. Along the ditches in the southwestern and southeastern portions, palmetto interspersed with broad-leaved evergreen species appear to predominate in the shrub layer, with numerous forbs, grasses, rushes, hedges and vines comprising a thick herb layer and ground cover. In most places in this portion of Area A, soils were saturated and covered with several inches of standing water. The margins of the 1.5-acre borrow pit/retention pond in the southeast corner of the site are overgrown with numerous species of aquatic and emergent

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vegetation. It is classified as a palustrine, open water, permanently flooded, excavated jurisdictional wetland, on the national wetlands inventory map (USFWS, 1985).

Area B, a subset of Area A, encompasses the two locations where EC dust was formerly disposed of on the plant site and an adjacent low area (cross-hatched in Figure 2) between the large disposal area and the borrow pit. These areas can be clearly identified from the 1983 high resolution color aerial photograph. Although most of the dust was removed in 1985, subsequent studies have confirmed that there are residual amounts present which range in thickness from a fraction of an inch to a foot or more. Wetland areas are found along the eastern and southern borders of the larger Area B.

The diversity and abundance of flora and fauna present in Area B differed markedly from that observed in adjacent areas which were not subject to EC dust disposal. Significant portions of the ground surface lack vegetation, and areas which are vegetated are dominated by a single species of pioneer grass. Other species common on disturbed sites are also present. Two species of birds (nighthawks and killdeer) were observed nesting in Area B (Schultz, 1989).

The boundary of Area C, also a subset of Area A, circumscribes the approximate limits of the area where slag was accumulated and processed for sale. Much of the slag remaining on site was used in the construction of the supporting walls of the secure on-site vault. Very little vegetation is present in Area C. Occasional individuals of pioneer grass or colonization species typical of disturbed sites can be found.

There were several shallow pools of standing water observed in various locations at the base of the slag pile throughout Area C due to the recent heavy rainfalls in the region that occurred just prior to site reconnaissance. A green colored layer of material was observed on the bottom of these pools. No vegetation or periphyton was observed in or near these pools.

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Area D is the location of the former scrap yard that was operated during the 12 year period the mill was active. The upper six inches to one foot of the soil profile in Area D consists of slag which was placed there in order to provide a firm base for the scrap processing operation. This area was also disturbed by construction of a railroad grade and access roads. Area D is being recolonized extensively by various plant species. The area was more heavily utilized by bird species than the other areas where extensive disturbance has occurred.

Adjacent to Area D, directly to the west of the terminus of the main access road, is a borrow pit that was created when clean fill was excavated for backfill for the areas excavated during the PCB cleanup. This pit is now permanently flooded, and supports a diverse community of aquatic and emergent vegetation along its banks. Extensive use of this pond by bird life was observed. Species observed utilizing the area included orioles (*Icterus spp.*), summer tanager (*Piranga rubra*), loggerhead shrike (*Lanius excubitor*), and several species of sparrow.

Area E is an electrical transformer substation partially covered with concrete and surrounded by fence, owned and operated by the Florida Power & Light Company.

Area F includes the open spaces on the northern (upgradient) portion of the property, that, for a brief period beginning in 1986, received spray irrigation of treated water from the borrow pit (pumped and treated during the PCB clean-up), and treated blowdown generated during the incineration of PCB-contaminated material contained in the vault.

All of the treated water was tested for lead, cadmium and PCBs prior to spray irrigation. The treatment of the discharged wastewater was effective and, as a result, no ecological impacts have been observed or documented due to this activity. No elevated concentrations of any contaminants of concern have been detected in the groundwater monitoring well located at the downgradient edge of this portion of the site. Portions of Area F are designated palustrine, forested (predominantly broad-leaved evergreen species), saturated (PF03B) according to wetlands inventory maps (USFWS, 1985).

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Area G includes all of the remaining portion of the FSC property. Based on the investigations conducted to date, and on close review of the 1983 aerial photograph, no industrial activities occurred within Area G. There is no evidence of any disposal of any kind having taken place within areas F and G. The abundance and diversity of vegetation observed in Areas F and G appeared much more extensive than that observed in other on-site locations.

Several different classifications of jurisdictional wetlands have been identified in Area G on the National Inventory Map. These include palustrine, emergent, persistent, seasonally flooded (PEM1C), and palustrine, scrub-shrub, evergreen, temporarily flooded (PSS7A) (USFWS, 1985).

Area H includes all ditches, ponds, and wetlands where surface water and sediment were evaluated in the RI. Within a short distance from the processing and disposal areas, drainage ditches were overgrown with emergent and riparian vegetation. Organic matter covers the ditch bottoms in most locations. Off-property, drainage ditches appear to have been improved by channelizing but currently are overgrown by vegetation in most areas. Sampling points in on-site ditches and ponds are shown on Figure 2. Sampling points in off-site ditches and wetlands are shown in Figure 13 of the Phase II RI.

Area I is the subsurface area occupied by the plume (Figure 3) containing elevated total dissolved solids (TDS) associated with the former water softening operation at the facility. The extent of the plume beneath the property has been delineated by geophysical methods and monitoring wells. It extends approximately 600 feet south of the property boundary. The plume is limited to the upper portion of the surficial aquifer (Ardaman Assoc., 1989).

The nature and extent of any contamination found in the various Environmental Areas is discussed in Section 3 below.

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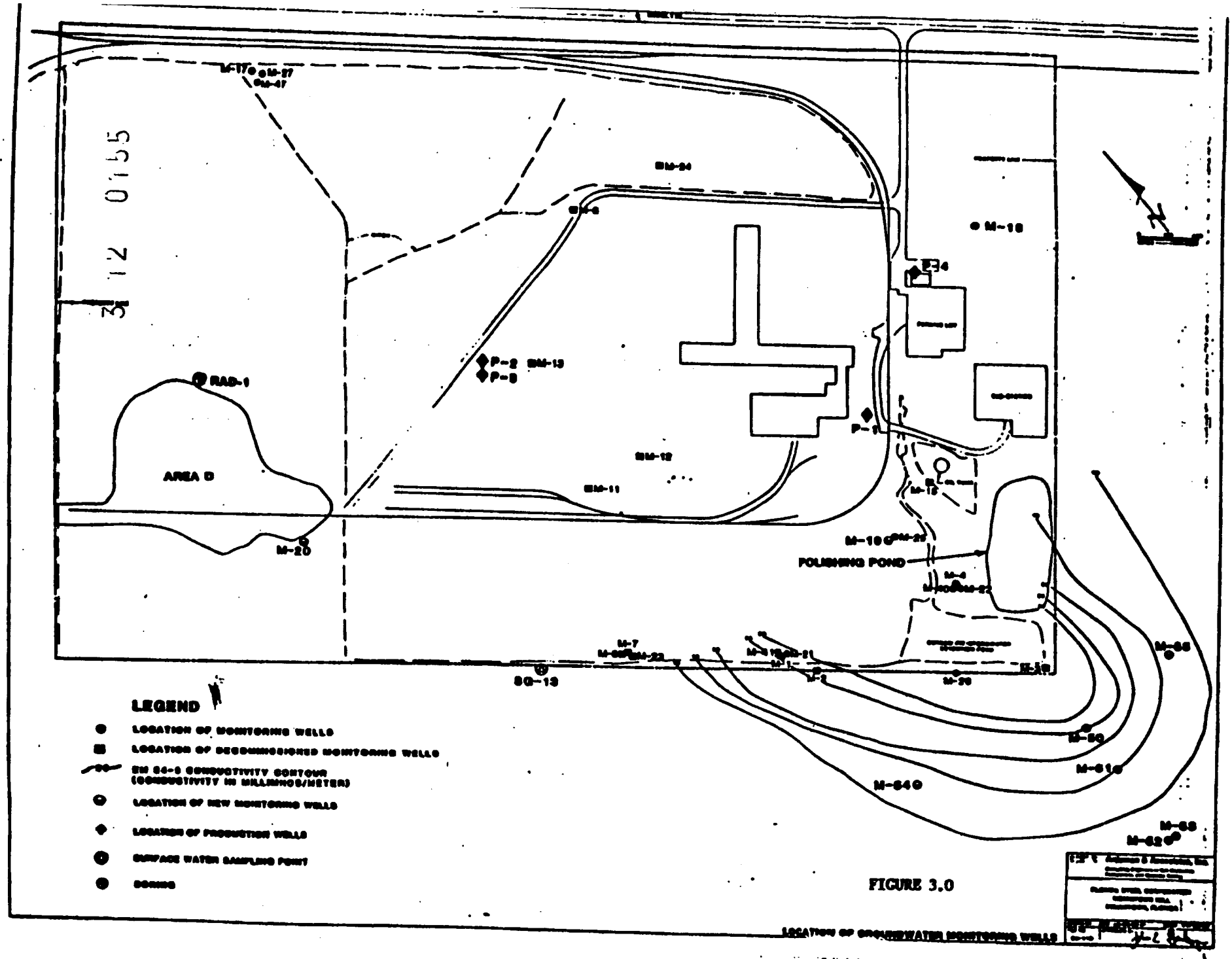

FIGURE 3.0

LOCATION OF GROUNDWATER MONITORING WELLS

3 12 0155

1.5 Organization of the Risk Assessment Report

3 12 0156

The report format follows the suggested table of contents in the Draft EPA guidance document Risk Assessment Guidance for Superfund (USEPA, 1989a and b). Each of the risk assessment steps identified in the Superfund Public Health Evaluation Manual (USEPA, 1986) are included. Some modifications have been made to incorporate the Environmental Evaluation.

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2.0 IDENTIFICATION OF CHEMICALS PRESENT ON-SITE AND SELECTION OF INDICATOR CHEMICALS

The selection of indicator chemicals is designed to identify the highest risk chemicals at the site. After reviewing the sampling methodologies and determining representative chemical concentrations for each environmental media, the chemical concentrations are compared with naturally occurring levels. If inorganic chemicals are present at the site at naturally occurring levels, they may be eliminated from the quantitative risk assessment (EPA, 1989). The resulting chemicals from this initial review are presented by media in a summary table.

For certain sites, the list of chemicals remaining after the initial review may be lengthy. Carrying a large number of chemicals through a quantitative assessment may yield excessive tables, text, and calculations--distracting resources away from relevant issues. Often if numerous chemicals are present on site, a comprehensive assessment will indicate from a public health as well as a statistical perspective that a limited number of chemicals will pose greater than 99% of the overall risk, while the remaining compounds will contribute a negligible relative impact .

In the final review, established methods will be used in this analysis to select from the initial list of chemicals (detected above background) those indicator chemicals which present the highest potential for risk. These methods include consideration of detection frequency, comparison to ARARs, use of toxicity-concentration screen, evaluation of essential nutrients, and assessment of mobility, persistence, and bioaccumulation.

In this risk assessment, the following steps are used to choose the indicator chemicals in each medium:

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1) Initial Review

3 12 0158

- Review of Site-Specific Data
- Determination of Representative Concentrations for Each Medium
- Comparison to Background Concentrations

2) Final Review

- Comparison to Potential ARARs and TBCs
- Assess Detection Frequency
- Toxicity-Concentration Screen
- Persistence-Mobility Screen

A summary of the potential chemical-specific applicable, relevant and appropriate requirements (ARARs) and policies or criteria to be considered (TBCs) for the FSC site are provided in Table 1. Executive Order 11990, Protection of Wetlands, and Executive Order 11988, Floodplain Management are potential location-specific ARARs.

2.1 General Site-Specific Data Considerations

Historical information, such as former locations of various processes and activities during the time the steel mill was active, was used in the design of sampling programs. Recent data, presented in the Phase I and Phase II RI, are considered representative of current conditions at the site and were utilized in analyses conducted in this Risk Assessment. Soil and groundwater samples were collected from background areas and analyzed for comparison.

Details on the sampling protocol, analytical parameters and methods are described in the Phase I and Phase II RI reports. In addition these reports contain the chain-of-custody forms and lab data sheets. The Phase I analyses were for the full list of HSL parameters on a limited number of composite and individual samples. On the other hand, Phase II analyses were for a larger number of samples and locations but were analyzed for fewer parameters.

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TABLE 1

SUMMARY OF CHEMICAL-SPECIFIC POTENTIAL ARAR's AND TBC CRITERIA FOR THE FSC SITE

	POTENTIAL ARARs			TBCs	
CONTAMINANT OF CONCERN	FLORIDA PRIMARY GROUND WATER STANDARDS (1)	FEDERAL DW MCL (2)	FLORIDA CLASS III SURFACE WATER QUALITY STANDARDS (3)	FEDERAL SOIL GUIDANCE	FEDERAL GROUNDWATER GUIDANCE
BARIUM	1.0 mg/l	1 mg/l (6)	NA		
CADMIUM	0.01 mg/l	0.01 mg/l (8)	0.0008 mg/l		
CHROMIUM	0.05 mg/l	0.05 mg/l (9)	0.05 mg/l		
COPPER	NA	1.0 (10)	0.03 mg/l		
GROSS ALPHA	15 pCi/l	15 pCi/l	15 pCi/l		
IRON	NA	0.3 (10)	1.0 mg/l		
LEAD	0.05 mg/l	0.05 mg/l (7)	0.03 mg/l	500 ppm to 1000 ppm (4)	15 µG/L (11)
PCBs	NA	NA (6)	0.000001 mg/l	25 ppm or 50 ppm (5)	
RADIUM (226 +228)	5 pCi/l	5 pCi/l	5 pCi/l		
SODIUM	160 mg/l	NA	NA		
ZINC	NA	5.0 (10)	0.03 mg/l		

(1) APPLICABLE TO GROUNDWATERS.

(2) GENERALLY CONSIDERED RELEVANT AND APPROPRIATE WHEN DETERMINING ACCEPTABLE EXPOSURE GROUNDWATER AND SURFACE WATER THAT IS CURRENT OR POTENTIAL SOURCE OF DRINKING WATER (PROPOSED NATIONAL CONTINGENCY PLAN,53 FED. REG 51505, DECEMBER 21, 1988).

(3) APPLICABLE TO AFFECTED SURFACE WATERS (APPROVED DURING CWA 303 TRIENNIAL REVIEW BY EPA REGION IV DURING 1988).

(4) OSWER GUIDANCE FOR INTERIM SOIL CLEANUP LEVEL FOR TOTAL LEAD IN RESIDENTIAL SETTINGS (OSWER DIRECTIVE #9355.4-02, SEPTEMBER 7, 1989). NO GUIDANCE ISSUED FOR INDUSTRIAL SETTINGS.

(5) TSCA GUIDANCE FOR PCB SPILLS IN INDUSTRIAL AREAS (52 FED. REG 10688 APRIL 2, 1987) 50 ppm APPLICABLE TO PCB SPILL AREAS DISCOVERED AND DETERMINED TO BE BELOW 50 PPM PRIOR TO THE PRE-MAY 4, 1987 PCB REMEDIATION UNDER THE CONSENT ORDER. 25 PPM APPLICABLE TO PCB SPILL AREAS NOT INVESTIGATED BEFORE MAY 4, 1987 (E.G., AREA D).

(6) PROPOSED DW MCL FOR BARIUM IS 5 MG/L AND FOR PCBs IS 0.0005 MG/L

(7) PROPOSED DW MCL FOR LEAD (FED REG AUGUST 18, 1988) IS 0.010 MG/L AT THE TAP AND 0.005 MG/L AT THE SOURCE; THE FINAL DW MCL IS EXPECTED TO BE ISSUED SOON.

(8) PROPOSED DW MCL FOR CADMIUM (FED REG MAY 22, 1989) IS 0.005 MG/L

(9) PROPOSED DW MCL FOR CHROMIUM (FED REG MAY 22, 1989) IS 0.1 MG/L

(10) SECONDARY DW MCL

(11) EPA's OFFICE OF EMERGENCY AND REMEDIAL RESPONSE HAS RECOMMENDED A CLEAN-UP GOAL OF 15 µG/L (June 21, 1990).

When available the Phase II data is used because of the inclusion of more data points and locations. However, for certain parameters not analyzed for in the Phase II study, it was necessary to rely on the Phase I data.

Soil samples were collected primarily from the upper portion of the soil horizon containing man-made materials. The thickness of fill material on the site is limited to a few feet. Samples from the soil immediately below the fill material were also collected to provide confirmation of the vertical extent of contaminants. Sediment samples were taken from the upper six inches of the sediment horizon. Two deeper sediment samples were collected to assess vertical distribution of the indicator parameters. Composite samples of EC dust and slag were collected at the site during February, 1990, for analysis for hexavalent and total chromium. The results of this analysis have been submitted to the EPA and DER in "Results of Sampling Program Conducted in February 1990" (Mark Schultz Associates, May 15, 1990).

Groundwater samples were collected from wells located throughout the property and off of the property to the south. Surface water grab samples were obtained from various locations along the drainage ditches. Air samples were collected from tripod-mounted, portable high-volume sampling equipment (see Phase II RI Report for full description).

All samples were collected according to the approved Quality Assurance Project Plans (QAPP). Detailed discussion of sample collection protocol is presented in the Phase I and Phase II RIs. Phase I soil samples were composites, while Phase II samples were discrete. All Phase I samples were analyzed according to the CLP protocols. For the Phase I CLP/-HSL analyses, all CLP and QA/QC deliverables were forwarded to EPA Region IV.

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2.1.1 Uncertainties

During Phase I, soil samples were composites in accordance with the QAPP and the instructions of an on-site environmental engineer from EPA Region IV's Environmental Services Division. Compositing was performed in a timely manner on chilled samples so that uncertainties associated with volatile organics analyses, and the possibility that some volatilization could have occurred, would be minimized. Pre-analytical volatilization is not considered to be of substantial concern because only two positives were detected in the composites samples, and it is unlikely that total volatilization of other organics would have occurred. Also, the fact that repeated sampling and analysis of groundwater has not detected volatile organics indicate that they are unlikely to be present in soils.

There is a degree of uncertainty inherent in the analyses of PCBs in soil and sediment, particularly when the concentrations are low. At the FSC site, there was a difference in analytical results between the EPA laboratory and the FSC contract laboratory, regarding the Phase II analyses of sediment samples which contained decomposing organic vegetation. Due to the discovery of PCBs in split sediment samples, the FSC samples were remixed and reanalyzed, and the PCB concentrations increased from less than 1.0 to between 3.0 and 5.0 ppm. The limited range of discrepancy, as exhibited by these analytical differences, does not suggest significant incremental hazard or risk to humans (see page 49 Phase II RI report).

An additional uncertainty exists for the chemical analysis of soils underlying the EC dust (Area B). These samples were collected from several inches of soil immediately under the EC dust in an area in which heavy equipment had operated. The presence of metals in soils under the EC dust may reflect disturbance of the overlying EC dust rather than mobility of metals.

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2.2 Results of CLP/HSL Sampling and Analysis by Media

During Phase I, soil, sediment, groundwater, and surface water samples were collected from those areas of the site with the highest potential for contamination and analyzed for the full list of CLP/HSL parameters. The analytical data were used to determine the list of chemicals identified at the site. In summarizing this data, a comparison is made to naturally existing background levels. If the identified compound is likely to be attributable to background sources rather than Florida Steel operations, the compound is eliminated from further quantitative evaluation. Chemicals analyzed for but not detected in any samples are not included in the summary tables.

2.2.1 Soil

For this portion of the analysis, only Phase I RI data was reviewed. Composite soil samples from Areas A, B, and D were analyzed for the full list of CLP/HLS organic and inorganic constituents. In choosing the indicator compounds this data source is preferred over the Phase II RI data since the Phase I RI data included the full list of CLP/HLS constituents but the Phase II RI focused only on the specific soil contaminants lead, barium, and PCBs.

Three composite samples, comprised of a total of fifteen individual samples, were collected from Area A from around the perimeter of the former PCB excavation area in accordance with the approved Phase I work plan. At each sampling location, the individual samples were collected from the most likely contaminated depth. The mean concentration, standard deviation and detected range of all analytes are given in Table 2.

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TABLE 2
DATA SUMMARY FOR AREA A SOILS

INORGANICS	MEAN	STD. DEV.	DETECTED RANGE	DISCRETE OR COMPOSITE	BACKGROUND CONCENTRATION
ALUMINUM	3578	2665	790-7500	C	<30,000 (1)
ANTIMONY	2	2	0.3-3.5	C	<0.3 (2)
ARSENIC	9	9	1-23	C	<0.3 (2)
BARIUM(3)	61	55	24-150	D	<5.3 (2)
BERYLLIUM	<1			C	<0.05 (2)
CADMIUM	10	4.5	6.9-18	C	<0.05 (2)
CALCIUM	29000	11510	24000-46000	C	18000-42000 (1)
CHROMIUM	154	121	16-300	C	<30 (1)
COBALT	10	9	4-21	C	<3 (2)
COPPER	254	202	49-490	C	<0.3 (2)
IRON	67340	6389	3700-150000	C	<150000 (1)
LEAD (3)	1067	2117	13-12200	D	1.28 (2)
MAGNESIUM	5092	5140	1560-13,000	C	<1500 (1)
MANGANESE	3658	3395	290-8900	C	<200 (1)
MERCURY	<1			C	<0.04 (2)
NICKEL	56	50	4-120	C	<7 (2)
POTASSIUM	68	64	110-160	C	11000-20000 (1)
SELENIUM	<1			C	<0.06 (2)
SILVER	1	0.3	1.1-1.5	C	<0.3 (2)
SODIUM	214	116	90-380	C	<3000 (1)
THALLIUM	<1			C	<0.3 (2)
VANADIUM	21	16	5-47	C	--
ZINC	3500	515	2700-4000	C	12.5 (2)
ORGANICS					
TOLUENE	0.009	0.009	0.009 - 0.021	C	
PCB 1248(3)	4.7	9	1 - 38	D	

1.) Shacklette and Boerngen, 1984
2.) From Table 2 of Phase I RI Report, Ardaman, 1988
3.) Phase II data, all other data on Table are Phase I data

All concentrations are in ppm.

3 12 0163

Three composite samples comprised of a total of fifteen individual samples were collected across Area B from the soil horizon composed of EC dust. The mean concentration levels, standard deviation and detected range of all analytes from the samples collected from Area B are given in Table 3.

Three composite samples comprised of a total of eighteen individual samples were collected across Area D. The samples were collected from the upper 6 inches of the soil profile which consisted primarily of slag. The mean concentration levels, standard deviation and detected range are given in Table 4. Aldrin, gamma-BHC, 4-4'DDT and dieldrin, because of their low detection frequency (one composite sample) and low level of detection (< 0.5 ppm), were eliminated from further consideration in the risk assessment.

Aluminum, calcium, antimony, vanadium, beryllium, iron, mercury, potassium, selenium, sodium and thallium concentrations in soil are within the range of naturally occurring (background) concentrations for southeast Florida (USEPA, 1979a). In addition, arsenic, cobalt, and silver are within ten times background concentrations or the detection limit; they are not commonly found as primary contaminants of concern from electric arcfurnaces (USEPA, 1979b; Lehigh, 1982); and are immobile based on non-detection in groundwater or a concentration in groundwater below groundwater standards. These chemicals were eliminated from further consideration at this point in the risk assessment.

Sample P1COMP1 from Area A indicated the presence of 1,4-dichlorobenzene. However, after a portion of the area was removed due to PCBs, no 1,4-dichlorobenzene was detected in the post-excavation sample.

In summary, the chemicals in soil above background selected for further evaluation include barium, copper, manganese, cadmium, lead, nickel, chromium, magnesium, zinc, toluene, bis(ethylhexyl)phthalate and PCBs.

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T[illegible]

DATA SUMMARY FO[illegible]A B SOILS

INORGANICS	MEAN	STD. DEV.	DETECTED RANGE	DISCRETE OR COMPOSITE	BACKGROUND CONCENTRATION
ALUMINUM	9033	6255	3900-16000	C	<30000 (1)
ANTIMONY	<2			C	<0.3 (2)
ARSENIC	18	9	1-23	C	<0.3 (2)
BARIUM (3)	293	186	140-7293	C	<5.3 (2)
BERYLLIUM	<2			C	<0.06 (2)
CADMIUM	230	138	110-380	C	<0.05 (2)
CALCIUM	39233	37045	5700-79000	C	18000-42000 (1)
CHROMIUM	413	55	360-470	C	<30 (1)
COBALT	20	9	15-30	C	<3 (2)
COPPER	960	151	800-1100	C	<0.3 (2)
IRON	173333	75719	120000-260000	C	<150000 (2)
LEAD (3)	5483	6007	190-17000	C	1.28 (2)
MAGNESIUM	20667	9504	11000-30000	C	<1500 (1)
MANGANESE	19333	11372	10000-32000	C	<200 (1)
MERCURY	<2			C	<0.04 (2)
NICKEL	102	52	58-160	C	<7 (2)
POTASSIUM	163	40	110-160	C	11000-20000 (1)
SELENIUM	<2			C	<0.06 (2)
SILVER	11	5	7-16	C	<0.3 (2)
SODIUM	417	166	260-590	C	<3000 (1)
THALLIUM	<1			C	<0.3 (2)
VANADIUM	117	74	59-200	C	--
ZINC	77333	30730	49000-110000	C	12.5 (2)
ORGANICS					
TOLUENE	0.006	0.006	0.013	C	
bis(2-ETHYLHEXYL) PHTHALATE	NA	NA	1.7	C	
PCB 1248	NA	NA	2	D (1989)	
PCB 1248	4.6	6.3	0.79 - 12	C (1988)	
PCB 1254	0.5	NA	0.38 - 0.62	C (1988)	

1.) Shaklette and Boerngen, 1984.
2.) From Table 2 of Phase 1 RI Report, Ardaman, 1988.
3.) Phase II data, all other data from Phase I
NA - Not Applicable
All concentrations are in ppm.

3 12 0165

TABLE 4
DATA SUMMARY FOR AREA D SOILS

CHEMICAL	MEAN	STD. DEV.	DETECTED RANGE	DISCRETE OR COMPOSITE	BACKGROUND CONCENTRATION
ALUMINUM	1077	7600	2300-17000	C	
ANTIMONY	3	3	3 - 6	C	<0.3 (2)
ARSENIC	15	6	12-22	C	<0.3 (2)
BARIUM (1)	232	191	75-580	D	<5.3 (2)
BERYLLIUM	<2			C	<0.06 (2)
CADMIUM	5	2	3-7	C	<0.05 (2)
CALCIUM	77000	25534	49000-99000	C	18000-42000 (3)
CHROMIUM	367	106	270-480	C	<0.3 (2)
COBALT	14	5	10-19	C	<3 (3)
COPPER	247	51	190-290	C	<0.3 (2)
IRON	113333	41016	83000-160000	C	<150000 (3)
LEAD (1)	353	128	150-535	D	1.28 (2)
MAGNESIUM	35333	14572	19000-47000	C	<1500 (3)
MANGANESE	27000	11533	14000-36000	C	<200 (3)
MERCURY	<1			C	<0.04 (2)
NICKEL	41	11	34-54	C	<7 (2)
POTASSIUM	277	47	240-330	C	11000-200000 (3)
SELENIUM	<2			C	<0.06 (2)
SILVER	<2			C	<0.3 (2)
SODIUM	407	153	240-540	C	<3000 (3)
THALLIUM	<1			C	<0.3 (2)
VANADIUM	137	35	100-170	C	---
ZINC	2933	777	2300-3800	C	<12.5 (2)
bis (2-Ethlhexyl phthalate)	1.4	NA	1.8 and 2.3	C	
PCB 1248	NA	NA	8	D	
PCB 1248	2.8	4	0.2 - 7.5	C	
PCB 1254	1.4	2.1	0.1 - 3.9	C	

Concentrations in ppm

1. Phase II data, all other data are from Phase I
2. From Table 2 of Phase 1 RI Report, Ardaman, 1988
3. Shacklette and Boerngen, 1984

NA - Not Applicable

2.2.2 Groundwater

Groundwater monitoring wells are located in Area I, at the downgradient edge of Areas A, B, and D, and upgradient. During Phase I of the RI groundwater samples were obtained (5/88) from the center of Area I (MW-50), and from the well downgradient of Area D (MW-20) and were analyzed for the full range of CLP/HSL parameters. No volatile, acid or base neutral organic compounds were detected in any of the groundwater samples. Geophysical survey methods were utilized to aid in placement of additional wells to confirm the extent of contamination.

Twenty-two wells were sampled on three separate occasions (6/88, 12/88, 7/89) during the Phase II RI for the following compounds: lead, cadmium, sodium, barium, PCBs, gross alpha, iron, zinc, chloride, pH, and total dissolved solids. The locations of these wells are shown in Figure 3. Based on a review of the Phase I and Phase II data, the chemicals found at concentrations elevated above background and selected for further evaluation include sodium, lead, cadmium, barium, zinc, iron, chloride, gross alpha, and radium. Unfiltered and filtered data from the most recent round of sampling (7/89) of monitoring wells impacted by the plume are summarized in Tables 5 and 6.

2.2.3 Surface Water

During Phase I a surface water sample was collected at the point of offsite flow to the south and analyzed for the full list of CLP/HSL parameters. During the timeframe of the Phase II work, there was no offsite flow. In addition, during the time of the Phase II study the entire ditch along the south property line was dry as was the offsite drainage for one mile south of the site. Volatile, acid or base neutral extractable organics, pesticides and PCBs were not detected in the Phase I sample. However lead, cadmium, zinc, and iron were detected. Since the background levels of iron were elevated, this element was eliminated

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TABLE 5
Summary of Filtered Contaminant Concentrations in TDS Impacted Groundwater Plume

Chemical	(Wells 50,51,55,56,19,54,22,26)		Background (Wells 17, 27)	
	Mean	Max	Mean	Max
Sodium (mg/L)	858	1397	68	140
Lead (mg/L)	0.052	0.075	0.013	0.021
Cadmium (mg/L)	0.01	0.02	0.0015 (1)	0.002
Barium (mg/L)	0.7	1.63	BDL	NA
Zinc (mg/L)	NA (2)	NA	BDL	NA
Iron (mg/L)	22.0	38.0	0.57	1.79
TDS (mg/L)	2915	4655	410	818
Chloride (mg/L)	1244	2430	186	325
Radium 226 (pCi/L)	48.2	110.0	No Data Collected	NA
Radium 228 (pCi/L)	5.5	7.7	No Data Collected	NA

(1) Average of 2

(2) All below the detection limit except M-22 (0.26 ppm)

NA - Not Applicable

BDL - Below detection limit

TABLE 6
Summary of Unfiltered Contaminant Concentrations in TDS Impacted Groundwater Plume

Chemical	(Wells 50,51,55,56,19,54,22,26)		Background (Wells 17, 27)	
	Mean	Max	Mean	Max
Sodium (mg/L)	703	1397	94.4	141
Lead (mg/L)	0.049	0.122	0.028	0.035
Cadmium (mg/L)	0.011	0.02	0.0015 (1)	0.002
Barium (mg/L)	0.55	1.5	BDL	
Zinc (mg/L)	NA (2)	NA	BDL	
Iron (mg/L)	23.8	40.7	1.1	1.79
TDS (mg/L)	2740	4663	536	818
Chloride (mg/L)	1320	2430	260	436
Radium 226(4) (pCi/L)	24.6	80.4	0.6 (3)	NA
Radium 228(4) (pCi/L)	2.9	5.7	No Data Collected	NA

(1) Average of 2

(2) All below the detection limit except M-22 (0.26 ppm)

(3) One sample

(4) Well numbers M22, M26, M50, M51, M54, M55, and M56 (10/86-12/88)

NA - Not Applicable

BDL - Below detection limit

from further consideration. The reported concentrations of detected CLP/HSL parameters from Phase I; and lead, cadmium, iron, zinc, and PCBs from the Phase II study are summarized in Table 7. Although the identified contaminants will receive specific assessment under the environmental analysis, surface water is not evaluated quantitatively in respect to human receptors (see section 3.3.1, Selection of Pathways).

2.2.4 Sediment

One sediment sample was collected during Phase I. This sample was collected from the drainage ditch along the south property line near the point of offsite drainage to the south. This sample was analyzed for the complete CLP/HSL parameters. Two organic compounds were detected, PCBs and methylene chloride. None of the operations at the plant site involved the use of methylene chloride. Since methylene chloride was not detected elsewhere on the site and is considered to be a laboratory contaminant, it is not evaluated in the quantitative risk assessment. In addition, EPA Region IV has notified Florida Steel that in August 1990, it will be collecting twenty-eight downgradient offsite sediment samples and twenty-one surface water samples for analysis for metals and PCBs.

During RI Phase II, a total of 29 sediment samples were collected, sixteen on-site and thirteen offsite. As summarized in Tables 7 and 8, lead, cadmium, iron, zinc and PCBs were detected. Although the identified contaminants will receive specific assessment under the environmental analysis, sediments are not evaluated quantitatively in respect to human receptors (see section 3.3.1, Selection of Pathways).

The Phase II RI data are grouped into four relatively distinct locations; ditch east of FSC property, on the FSC property, downstream ditch near FSC property line, and downstream ditch over 5000 feet from the FSC site. Lead and zinc concentrations while elevated on and near the facility, decline substantially with distance from the FSC site. Cadmium

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TABLE 7
DATA SUMMARY FOR METALS AND PCB CONCENTRATIONS
IN CO-LOCATED SURFACE WATER AND SEDIMENT SAMPLES

LOCATION	APPROXIMATE DISTANCE FROM SOURCE AREA (ft)	LEAD		CADMIUM		IRON		ZINC		PCB	
		SW	SED	SW	SED	SW	SED	SW	SED	SW	SED
OLISHING POND	400	0.031	124/26 (a)	<0.001	4/2 (a)	0.158	1010/354	0.16	917/187	--	<1/<1 (a)
ORROW PIT (REMEDIATED)	500	0.016	34/70 (a)	<0.001	<2	0.255	599/1120	0.10	225/424	--	<1
OUTH PROPERTY BOUNDARY (1)	400	0.01	160/36(b)	<0.005	10/22(b)	3.5	2300/946 (b)	1.5	5000/410 (b)	<1	27/3 (b)
ALQUIN DITCH T WEST FARM ROAD (UPSTREAM)	5000	0.016	12	0.001	<2	0.215	4470	0.04	77	--	<1
ALQUIN GROVES DITCH T WEST FARM ROAD (DOWNSTREAM)	15000	0.019	5	0.001	<2	0.152	1760	0.02	30	--	<1
ALQUIN GROVES DITCH EAR COUNTY DITCH	16000	0.012	6	<0.001	<2	0.114	1490	0.013	<20	--	<1
OUNTY DITCH EAR ST. LUCIE CANAL	19000	0.008	<4	<0.001	<2	0.073	738	0.011	<20	--	<1

oncentrations in ppm

) Phase 1 Data

) Samples collected at opposite ends
) Sediment samples collected inside (on-property) / outside (off-property) brook in dike at property boundary.

3 12 0171

TABLE 8
SUMMARY OF METALS AND PCB CONCENTRATIONS IN SEDIMENTS ACROSS THE STUDY AREA

CHEMICAL	DITCHES EAST OF FSC PROPERTY	DITCHES ON FSC PROPERTY	DITCHES DOWNSTREAM NEAR FSC PROPERTY LINE	DITCHES DOWNSTREAM OVER 5000 FEET
LEAD				
MEAN	256	315	348	7
STD. DEV	282	441	237	4
RANGE	38 - 657	26-1410	36-621	<4 - 12
CADMIUM				
MEAN	12	11	12	<2
STD. DEV	9	14	10	NA
RANGE	2-17	2-46	<2 - 27	NA
IRON				
MEAN	3214	2543	3219	2115
STD. DEV.	2385	2424	2013	1629
RANGE	931-5690	122-7972	946-6120	738-4470
ZINC				
MEAN	3379	3026	3406	37
STD. DEV	2612	4308	2662	27
RANGE	398-5260	32-14800	410-6320	30-77
PCB1242				
MEAN	N.D.	2	N.D.	N.D.
STD. DEV	-	3	-	
RANGE	-	<1 - 8	-	
PCB1248				
MEAN	2	5	3	N.D.
STD. DEV	2	10	3	
RANGE	<1 - 5	<1 - 27	<1 - 7	

Concentrations in ppm

3 12 0112

seems elevated near the facility but to a lesser degree than lead and zinc. Iron concentrations are high throughout the area.

PCBs were detected in the sediment at the Phase I co-located water and sediment sampling point at 27 mg/kg, at 8 mg/kg in one of the six on-site Phase II sampling points, at 7 mg/kg and 3 mg/kg at two of five Phase II sampling points near the south FSC property boundary, and at 5 mg/kg at one of six Phase II sampling points east of the FSC property boundary. In summary PCBs were detected in 5 out of 22 sediment samples. Although not of concern from a human health perspective, the data is not sufficient to adequately address concerns regarding potential environmental effects. PCBs are not considered a contaminant of concern in surface water since they were not detected in any surface water samples.

Cadmium was not detected or was detected near the detection limit in all of the analyzed co-located surface/sediment samples. Concentrations at or near the site were higher than those found at the downstream sample locations included in Table 14. Cadmium contamination of sediments at or near the site has probably resulted from operation of the facility. Cadmium was not detected in either media at downstream (off-property), co-located surface water/sediment sampling locations, indicating that the contaminant has limited mobility at the FSC site. The cadmium in surface water was below the potential ARAR.

Lead and zinc were detected at elevated concentrations in surface water and sediment on and adjacent to the FSC property. Concentrations decreased substantially at downstream locations from the site.

Iron concentrations found in the surface water and sediment samples from the FSC property and surrounding areas were highly variable. No obvious patterns of contamination due to facility processes are indicated. The iron content of a surface water sample from the property boundary is substantially higher than other sampled locations and exceeds the federal

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and state ambient water quality criteria for protection of fresh water aquatic life. Conclusions regarding the high iron level at the property boundary cannot be drawn without additional sampling. Environmental impacts resulting from intermittently high iron levels in surface water are not expected to be significant given the low toxicity and high background concentrations of the element.

2.3 Summary of Chemicals Above Background

The preliminary list of chemicals of above background for each media is summarized in Table 9.

Table 9: Chemicals Elevated Above Background

Soil	Groundwater	Surface Water	Sediment
cadmium	cadmium	cadmium	cadmium
lead	lead	lead	lead
zinc	zinc	zinc	zinc
barium	barium		PCBs
PCBs	iron		iron
copper	sodium		
manganese	chloride		
chromium	radium		
toluene			
BEHP			
nickel			

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2.4 Selection of Indicator Chemicals

2.4.1 Groundwater

Of the chemicals identified in groundwater above background, chloride and zinc do not have primary drinking water standards. However chloride and sodium do have secondary standards that are based on prevention of aesthetic effects (such as taste or odor) rather than the potential for adverse health effects. Chloride and sodium are generally not considered chronic toxicants. Currently, the EPA does not have established acceptable intakes for sodium and chloride. In addition, sodium and chloride compounds are not amenable to the risk assessment process since the concentrations that might pose the potential for adverse health effects well exceed the concentrations that are tolerable from an aesthetic standpoint. Sodium and chloride will be compared to the drinking water standards in the Risk Characterization.

Zinc is eliminated from the groundwater scenarios because (1) it is an essential human nutrient, (2) present at low concentrations, (3) toxic only at higher levels, (4) has a low frequency of detection, and (4) is below the secondary drinking water standard. Zinc is considered a nutritionally essential metal, with an average U.S. daily intake in the range of 12-15 milligrams (Klaassen et al., 1986). Based on the most recent round of sampling (7/11-14/89) of the monitoring wells conservatively determined to be representative of exposure point concentration, zinc was detected in only one well. In comparing the reported concentration of 0.26 mg/l to the average daily intake of 12-15 milligrams, it is not expected that this level constitutes a potential health threat. In addition this concentration is well below the EPA secondary drinking water standard for zinc of 5 mg/l.

Iron is not assessed quantitatively. The EPA has concluded that the health data is considered inadequate for quantitative risk assessment (HEAST, 1989). Currently, the EPA

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does not have an established acceptable daily intake for iron. Iron is considered an essential human nutrient, toxic only at high doses, and was detected at low concentrations. Recommended daily dietary allowances for iron vary according to age and sex, ranging from 10-18 milligrams (EPA, 1984). It has been reported that daily intakes of 25 -75 milligrams of iron are levels well tolerated by adults (EPA, 1984). Based on a arithmetic mean concentration of 23.8 mg/l using unfiltered water from the monitoring wells conservatively chosen to represent exposure points, it is not expected that iron will pose a potential threat to human health. For these reasons, iron is not assessed quantitatively in the risk assessment.

Barium was not chosen as an indicator chemical because a recent EPA toxicological study (Wones et al., 1987) has disproved earlier reports of a relationship between ingestion of barium in drinking water and increased blood pressure. In the Wones study, humans drinking 1.5 liters of water containing 5 mg/l or 10 mg/l of barium daily did not experience any increases in cardiovascular risk factors such as hypertension. This toxicological study is cited by EPA as sufficient support for proposing to increase the MCL and MCLG for barium to 5.0 mg/l (Fed. Reg., 1989). Since the arithmetic mean concentration of barium at the conservatively chosen exposure points is 0.55 mg/l, barium is not considered a potential human health concern at the FSC site.

In summary the indicator compounds in groundwater selected for quantitative analysis include cadmium, lead, and radium. The quantitative assessment of radium is addressed in the radionuclide analysis (see Appendix E).

2.4.2 Soil

The indicator compounds for soil will be selected using a concentration-toxicity screen method. As suggested by the EPA (EPA, 1989), the objective of this method is to identify the chemicals in a particular medium that -- based on concentration and toxicity -- are most

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likely to contribute significantly to risks calculated for exposure scenarios involving that medium, so that the risk assessment is focused on the most significant risk.

In this procedure, a toxicity score for noncarcinogens is calculated for each chemical based on a concentration value divided by the reference dose. For carcinogens, the toxicity score is calculated by multiplying the chemical concentration by the cancer potency. Given constant exposure variables for a scenario, the two most important factors that determine relative contribution to overall risk from several chemicals is their toxicity and environmental concentration. For a chemical with a high concentration and high toxicity (low reference dose or high cancer potency), the resulting toxicity score is high. Inversely, for a chemical with a low concentration and low toxicity (high reference dose or low cancer potency), the resulting toxicity score is low. The risk scores are used only for potential reduction of the number of chemicals carried through the risk assessment and have no meaning outside the context of the screening procedure.

A toxicity score is initially calculated for each chemical. Next, the scores are summed to yield a total toxicity score. Each chemical specific toxicity score is then expressed as a ratio to the total toxicity score. The relative score provides a indication of the relative impact each chemical will contribute to the total risk for that pathway.

In calculating the scores, the health criteria used are specific for the pathway of interest (e.g., ingestion), when available. Consistent with EPA guidance (EPA, 1989), the concentration used in this screen is the upper limit of the detected range of reported concentrations. Phase I and Phase II data were reviewed to identify the maximum concentration.

The results of the concentration-toxicity screen are presented in Table 10. For the noncarcinogens, this screen illustrates that cadmium, lead, chromium, and zinc contributegreater than 98 percent of the total hazard index. Because of the insignificant

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TABLE 10. CALCULATION OF TOXICITY SCORES

CHEMICAL	HEALTH CRITERIA	SOIL CONC (ppm)	CHEMICAL SPECIFIC TOXICTY SCORE	RELATIVE TOX SCORE
NONCARCINOGENS	(RfD)			
CADMIUM	0.0005	380	7.60E+05	0.024
LEAD (1)	0.00057	17000	2.98E+07	0.937
CHROMIUM	0.005	1200	2.40E+05	0.008
ZINC	0.2	110000	5.50E+05	0.017 (sum > 98%)
BARIUM	0.05	7293	1.46E+05	0.005
COPPER	0.03	1100	3.67E+04	0.001
NICKEL	0.002	160	8.00E+04	0.003
TOLUENE	0.3	0.021	7.00E-02	0.000
MANGANESE	0.2	36000	1.80E+05	0.006
TOTAL			31817088.14	
CARCINOGENS	(cancer potency)			
PCB, 1248	7.7	38	292.6	0.907
PCB, 1254	7.7	3.9	30.03	0.093 (sum >98%)
BEHP	0.014	2.3	0.0322	0.000
TOTAL			322.6622	

TOXICITY SCORE(NONCARCINOGENCS)=SOIL CONCENTRATION/RfD
TOXICITY SCORE(CARCINOGENS)= SOIL CONCENTRATION*CANCER POTENCY
RELATIVE TOXICITY SCORE=CHEMICAL SPECIFIC/TOTAL
(1) Soil Concentration from Phase II RI, all other data from Phase I RI

contribution from barium, copper, nickel, toluene, and manganese, these compounds are not carried through the quantitative human health risk assessment. For the carcinogens, the screen illustrates that PCBs contribute greater than 99 percent of the total risk. Because of the insignificant contribution to the carcinogenic risk from bis-ethylhexyl phthalate, this compound is not carried through the quantitative risk assessment.

Magnesium was not included in the concentration-toxicity screen because there is currently no EPA reference dose or equivalent value. Magnesium is considered an essential human nutrient with a low potential for chronic toxicity. Given a maximum on-site soil concentration of 47,000 mg/kg, an individual would need to ingest greater than 8,000 mg of soil per day in order to reach the National Academy of Sciences Recommended Daily Allowance for magnesium. This scenario is highly unlikely; it is more unlikely that an individual would ingest enough soil to have an exceedance of the Recommended Daily Allowance large enough to be associated with an adverse health effect. For these reasons, magnesium is not assessed quantitatively.

In summary, the compounds retained for quantitative analysis of exposures to soils at the Florida Steel site include: cadmium, lead, chromium, zinc, and PCBs. These compounds represent the chemicals with the highest concentration and highest toxicity potential. The chemicals eliminated from quantitative analysis are justified based on evaluation of potential contribution to overall risk; which is characterized by toxicity, concentration, and consideration for persistence and bioaccumulation potential.

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3.0 EXPOSURE ASSESSMENT

After the indicator chemicals selection, exposure assessment is performed to determine the potential intensity, frequency, and duration of human and/or non-human exposures to a potentially toxic agent. The process includes measuring or estimating 1) the magnitude, duration, schedule, and route of exposure; 2) the size, nature and description of the human and/or non-human populations; and 3) the uncertainties in all estimates. Estimates of risk are based on reasonable maximum exposures expected to occur under both current and future land-use conditions for both sub-chronic and chronic exposures.

In the risk assessment, the information on sources and releases, fate and transport, and exposure point concentrations are discussed prior to selecting the exposure pathways of concern at the FSC site.

3.1 Description of Current and Future Land Uses

3.1.1 Current Land Uses

The FSC site is located in the eastern flatlands of Martin County, Florida. This 150-acre site was undeveloped prior to its acquisition by FSC in 1970. Subsequent to that date it has been used solely for industrial purposes. Until 1982 those industrial uses consisted of the operation of FSC's electric arc furnace and rolling mill to recycle scrap steel into new products.

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Currently, the northeast portion of the facility (Area F) is used for storage of metal cable spools by lease of FSC property. Employees are occasionally active on the site and are involved in maintenance, security, administrative, and remedial investigative activities.

A secure chain link fence surrounds the property and all gates are locked. The property is posted with no trespassing signs and hazard warning signs.

A main line rail track abuts and parallels the northerly boundary of the FSC site, as does Highway 710. A 230,000-volt electric transmission line parallels the southerly boundary of the FSC site at a distance of about 200 feet.

The FSC site and extensive areas to the east, south and west of the FSC site are zoned for industrial uses. The industrially zoned lands immediately west of the FSC site are in active use by industrial facilities. The industrially zoned lands to the south and east of the FSC site contain a number of wetlands. The uplands in those areas are currently undeveloped except for the 230,000-volt electric transmission line. The area north of the main line rail track and Highway 710 is zoned agricultural. This area includes a number of wetlands. The uplands in this area are currently used for agricultural purposes consistent with zoning regulations.

The FSC site has been substantially disturbed and has no appeal for those seeking recreational or wilderness areas. Its only water bodies are small man-made borrow pits and drainage ditches which are both unattractive and unsuitable for fishing. The sparse vegetation and great distances from wooded areas render it unattractive to game and hunters. In addition, access is prevented by the posted chain link fence surround the FSC site.

The FSC site becomes even less attractive for hunting, fishing and wilderness enthusiasts when one considers the fact that there are a number of high quality hunting,

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fishing and other recreational areas within a few miles of the FSC site such as Lake Ockochobee, 8 miles to the west; the beaches fronting the Atlantic Ocean, 25 miles to the east; the inland waterway and Atlantic Ocean, 25 miles to the east; and extensive parks, game preserves and wilderness areas in the adjacent counties.

The nearest large urban areas are West Palm Beach, about 40 miles southeast, and Stuart, about 25 miles northeast of the FSC site. The nearest town is Indiantown, Florida, a community of about 5,000 persons, located astride Highway 710 approximately 2 miles southeast of the FSC site. The nearest residence is located over 2,400 feet south of the FSC site.

3.1.2 Future Land Uses

Referring to the Indiantown planning area (which includes the vicinity of the FSC site) and three other areas, the "Comprehensive Growth Management Plan for Martin County" provides that ". . . most additional industrially designated land should be placed in these four planning areas" (Martin Co., 1989).

3.1.2.1 500-KV Electrical Transmission Line

By Order dated April 20, 1990, the Governor and Cabinet of Florida authorized Florida Power & Light Company ("FPL") to construct and operate a 500,000-volt electric transmission line within a south to north corridor which crosses the FSC site. A copy of the relevant portions of the Order is attached (Appendix G). A map showing the alignment of this corridor across the FSC site is attached (Figure 5). FPL has advised FSC that construction of the transmission line across the FSC site will begin about January, 1992, and will follow a north/south alignment near the center of the 150-acre FSC site.

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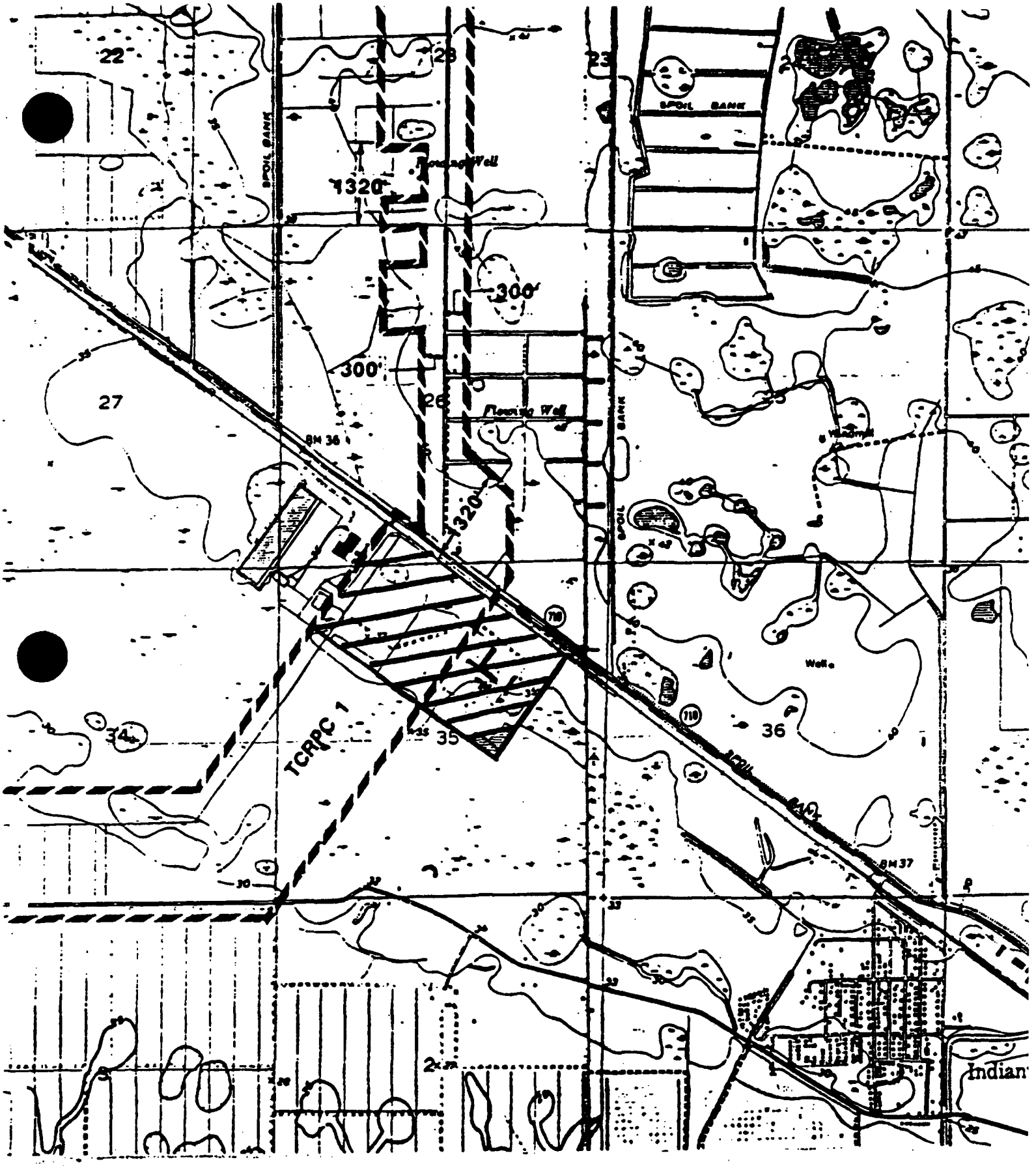

FIGURE 5.0 500 kV electrical transmission corridor boundaries. (crosshatching = Florida Steel property)

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3.1.2.2 300 MW Electrical Power Plant

Indiantown Cogeneration, L.P. ("ICL") has advised FSC that it has obtained an option to purchase industrially zoned lands lying south and southwest of the FSC site for construction and operation of a 300-million watt coal-fired electrical steam cogeneration power plant. In addition, ICL is seeking an option to acquire approximately 75 acres of the western half of the FSC site. ICL has further advised FSC that ICL plans to file its application for permission to construct and operate this power plant within six months, and anticipates approval and commencement of construction within three years or less.

3.1.2.3 Irrevocable Recorded Covenants Precluding Residential and Recreational Use

FSC has recorded in the land title records of Martin County, Florida, a declaration of restrictive covenants which will preclude residential and recreational uses on the FSC site (Appendix F). This recorded document will prohibit the following:

1) The Property shall not be used for residential purposes;

2) No daycare facilities, kindergartens, playgrounds, schools or other facilities catering to children under the age of sixteen years shall be operated on the Property;

3) The Property shall not be used for swimming, fishing, camping or hunting;

4) No structures or improvements intended for use for recreational purposes shall be constructed or operated on the Property; and

5) The Property shall not be used for the purpose of growing any crops to provide food for humans or animals.

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It specifically provides that it is enforceable by all interested parties including U.S. EPA and DER. Under applicable common law the document is irrevocable and may be modified only by court order.

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3.1.2.4 Other Adjacent Industrially Zoned Lands

FSC has been advised by the owners of the industrially zoned lands lying east and southeast of the site that those lands are currently being offered for sale for industrial uses.

3.1.2.5 Evaluation of Likely Future Land Uses

The FSC site is located in a rural area over 2,400 feet from the nearest residence, and over 5,000 feet from the nearest small residential development. It is 25 miles distant from the nearest large urban centers. It and adjacent lands are zoned for industrial uses; official land use planning documents project the area of the FSC site for further industrial designation; it is bounded on one side by a main line rail track and Highway 710, and on the opposite side by a 230,000-volt electric transmission line; within eighteen months a 500,000-volt electric transmission line will be constructed across the approximate center of the FSC site; within three years or less, a 300-million watt coal-fired electric cogeneration power plant will likely be constructed and operated on lands immediately south and southwest of the FSC site; the FSC site is unattractive for hunting, fishing or other recreational uses; and residential and recreational uses are being precluded by irrevocable covenants recorded in land title records under which only industrial, public utility and commercial uses are permissible. As stated on page 6-7 of EPA Risk Assessment Guidance for Superfund (EPA, 1989), "... an assumption of future residential land use may not be justifiable if the probability of the site will support residential use in the future is exceedingly small." A "common sense" evaluation suggested

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on page 6-6 of the above document, leads to the conclusion that the future use of the FSC site will neither be residential nor recreational but will continue to be solely industrial.

3.2 Sources of Contamination, Receiving Media, and Environmental Fate and Transport

The sources of contamination, receiving media, and the environmental fate and transport of indicator chemicals will be discussed in this section. First, each major source of contamination will be presented, and second each indicator chemical discussed.

3.2.1 Sources and Release Mechanisms

PCBs

Prior to 1975, the FSC mill used a system of hydraulic shears in the billet casting operations. The hydraulic fluid used in the hydraulic shears contained PCBs. The majority of leaked hydraulic fluid from the billet cutting shears entered the plant's recirculating contact cooling water system. This hydraulic fluid then became mixed with lube oil, mill scale, and other sediments, which accumulated in the former concrete recirculating reservoir (CRR). These sediments, which were not then known to contain PCBs, were periodically removed from the CRR and allowed to drain into the adjacent soil. These sediments were disposed of on-site, primarily in the low area immediately east of the CRR (Ardaman & Assoc., 1989).

The remediation conducted in 1986 removed PCBs present in soils and sediment at concentrations of 50 ppm and above. The area remediated was located in the eastern portion of Area A. The data from the Phase II RI indicate that the average PCB concentration in soil is less than 5 ppm in the most highly contaminated areas. The results of the remediation program are fully documented (Ardaman & Assoc., 1986).

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Emission Control (EC) Dust

Emission control dust is the fine particulate material generated as the high temperatures (i.e., greater than 3,000 degrees Fahrenheit) in an EAF drive off and oxidize some of the iron and most of the volatile metals contained in the scrap. Typically at the Indiantown site, the major constituents of the EC dust are iron oxide (approximately 55 percent by weight), and zinc oxide (about 30 percent by weight). Lead oxide concentrations are typically in the range of two to four percent.

As discussed in the Phase II RI Report, EC dust has some unique physical properties that distinguish it from the native soils on the site. The EC dust is composed of distinctive silt-sized particles. When dry, EC dust develops a hard crust, while when it is wet has a thick sludge consistency. Most of the EC dust remaining at the site is within Environmental Area B.

A significant air release mechanism is not probable from Area B because the material is either hardened or wet. Under a potential future industrial use scenario of truck traffic across Area B, dust generation could be a concern.

Probably the most significant potential release mechanisms from Area B are leaching to groundwater and runoff to surface water. EC dust probably had a significant potential for mobility during operation of the facility as evidenced by the relatively high concentrations of indicator chemicals in sediments adjacent to Area B (see Table 4). The indicator chemicals associated with EC dust are discussed separately in greater detail in Section 3.2.2.

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Slag

Slag is formed on top of the EAF during the melting process. It is formed from lime which is introduced as a flux into the furnace to remove impurities such as soil and sand from the molten steel. Lead, chromium, and zinc are the indicator chemicals found in the highest concentrations in the slag. Given the mineralogical nature of the slag matrix (i.e., a complex calcium alumino-silicate), slag is not expected to be a major source of leachate. Although Extraction Procedure (EP) toxicity testing was not designed to assess the site-specific potential for leaching, the results can be used qualitatively to assess the slag's inherent leaching propensity and the results of EP toxicity testing during the Phase II R.I. concur with the expected low leachability of slag.

The primary potential release mechanism for slag is generation of fugitive dust. The precise magnitude of any potential release is uncertain. This release pathway is qualitatively assessed later in this risk assessment.

Water Softening Brine

During the time that the mill operated, groundwater used in the non-contact cooling system was softened to prevent scaling in the cooling water lines. The water was softened by passing it through a cation exchanger. During regeneration of the cation exchange medium, sodium chloride solution was flushed through the exchanger and the resulting brine was discharged onto the ground surface in the vicinity of the softener.

A groundwater plume associated with the elevated TDS concentrations comprises Environmental Area I. The indicator chemicals associated with the elevated TDS plume are lead, cadmium, radium-226, and radium-228. There is no indication that the source of the

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radium measured in the plume is associated with the by-products of steel making. Analyses of slag, EC dust and lime at the site showed similar radium concentrations to those of native soil.

Several uncertainties exist with regard to the radium detected in Environmental Area I. Radium-228 was measured in concentrations substantially less than the radium-226. However, its source is uncertain given its short half-life. Another uncertainty is the mechanism that resulted in the elevated radium-226 concentrations in groundwater.

Two related theories may explain the occurrence of elevated radium levels and subsequently high gross alpha levels (see Phase II RI Report). First, leaching tests with a sodium chloride solution performed on native soil, EC dust, lime and slag indicate that the presence of dissolved radium in the ground water plume could be a result of the dissolved sodium chloride causing naturally occurring radium to leach from the soil. Secondly, that naturally occurring radium in the groundwater withdrawn by the former production well was concentrated by cation exchange with the column resin.

Lead and cadmium levels are elevated throughout the contaminant plume. While the source is not known, it is likely that a combination of leaching from contaminated soils in various areas and the same cation exchange process discussed above took place with naturally occurring lead and cadmium.

3.2.2 Environmental Fate and Transport of Indicator Chemicals

PCBs

A general discussion of PCB environmental fate and transport is included in Appendix B. The primary PCB Aroclor identified at the site is 1248. This Aroclor contains a

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mixture of some of the highest chlorinated PCBs as well as some of the least chlorinated PCBs. Subsequently, the long-term environmental fate of the low level residuals remaining at the site will be a combination of biodegradation and slow volatilization of low to moderately chlorinated congeners, and long term adsorption of more highly chlorinated PCBs to organic materials in soils and sediment.

In addition to PCBs being released to air at a slow rate, transport of PCBs at the site could occur via sediment transport. However, sediment transport is not now a major transport mechanism at the site due firstly to the 1986 remediation and, secondly, to the vegetation which fills drainage ditches (low erosion potential).

Cadmium

Cadmium was detected at elevated concentrations in the soils of Environmental Areas A, B, C, D, sediments in Area H, and groundwater in Area I. A discussion of cadmium's environmental fate and transport is included in Appendix B.

Cadmium is generally mobile in acidic water. At the FSC site, surface waters have a pH close to neutral. Shallow groundwater has a pH in the range of 4 to 5. Deeper groundwater (below 40 feet) has a pH over 6. In surface water, cadmium would likely accumulate in areas with high organic content and possibly be taken up by plants in those areas. Volatilization is not a major process in cadmium dispersion in the environment. Bioaccumulation may occur in fresh water systems where cadmium is present in elevated concentrations.

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Chromium

Chromium was detected at elevated concentrations in the soils of Areas A, B, C, D. No chromium has been detected in the surface water or groundwater. A detailed discussion of chromium environmental fate and transport is included in Appendix B.

Chromium appears to be immobile at the FSC site. Chromium was not detected in any of the permanent monitoring wells during three successive rounds of sampling with a detection limit of 0.005 mg/l. The other metals associated with EC dust, such as lead and cadmium, were an order of magnitude higher than their detection limits. With FL DER approval, chromium was dropped from the list of parameters for which groundwater is analyzed. A possible explanation is that any hexavalent chromium associated with EC dust has been oxidized to the trivalent form which is more stable, less mobile and less toxic than the hexavalent form. Also, CrVI is rapidly converted to the trivalent form in poorly drained soils exhibiting high organic content, as is the case in many areas of the FSC site.

Volatilization is not known to be a significant process for chromium dispersal in the environment. Bioaccumulation can be significant under certain conditions but levels in biota are usually lower than levels in the sediments. The presence or absence of uptake by terrestrial plants at the FSC site has not been studied.

Lead

Lead is the most common contaminant found at the FSC site. A detailed review of the environmental fate and transport of lead is presented in Appendix B.

The generally acidic pH of the shallow groundwater at the site and abundance of naturally occurring organic matter are the factors which most strongly influence lead mobility

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at the FSC site. Lead in sediments can be remobilized by biomethylation. Bioaccumulation and bioconcentration is highly variable depending on the species (e.g., filter feeders are capable of bioaccumulating high levels of lead). Experimental results indicate that conditions occurring in most natural waters render the majority of lead present unavailable for accumulation by aquatic biota. Dissolved lead can be enriched in sediments near sources of significant releases. The fate of lead in groundwater is primarily determined by cation exchange processes.

Radium

Radium mobility may be affected by any one of several mechanisms. Chlorides of radium are soluble, whereas carbonates and sulfates have low solubilities. Primary dispersal limiting mechanisms are cocrystallization, coprecipitation, and adsorption. Radium is known to occupy structural sites within a crystal lattice, such as when it substitutes for barium in barite. Coprecipitation of radium may occur when iron and manganese oxides and hydroxides are precipitated. Adsorption of radium may also be affected by organic matter, iron and manganese oxides, and clay minerals (Levinson and Coetze, 1978).

At the FSC site the environmental fate of radium dissolved in the ground water is dependent upon any of the above-mentioned mechanisms and may be influenced by the chloride concentrations in the plume as well.

Zinc

Zinc is an indicator chemical found in Areas A, B, D and I. Concentrations of zinc in EC dust at the Indiantown site are typically in the 20 to 25 percent range while concentrations in slag are less than one percent. A review of the environmental fate and transport of zinc is included in Appendix B.

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Zinc is potentially one of the most mobile of the heavy metals. Adsorption of zinc to components of natural sediments appears to be the dominant fate of the metal in aerobic aquatic environments. Concentrations of zinc in sediments always exceed those found in overlying waters. These general characteristics are consistent with the distribution of zinc at the FSC site. Concentrations on and near the site are elevated but rapidly decline with distance from the site. Dissolved organic compounds and substrate particle size are also primary factors influencing the environmental fate of zinc.

Zinc is bioaccumulated by aquatic organisms. Bioconcentration by plants is dependent upon plant species and soil pH. Volatilization appears to be an unimportant mechanism for the dispersal of zinc in the environment.

3.3 Identification of Receptors and Exposure Pathways

Each exposure pathway consists of four elements: 1) a source and mechanism of chemical release to the environment, 2) an environmental transport media (e.g., air, ground water, surface water) for the release chemical, 3) a point of potential human contact with the contaminated medium (referred to as an exposure point), and 4) a human exposure route (e.g., drinking water). Each pathway therefore describes a particular route by which a population or individual may be exposed to contaminants originating from a site. Once the exposure pathways have been identified and adequately described, receptor populations can be identified, exposure point concentrations determined, doses and intakes can be calculated, and any uncertainties can be described. All potential exposure pathways considered for the FSC site under the no-action scenario for present and future land use are presented in Table 12.

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3.3.1 Selection of Pathways for Quantitative Evaluation by Media

Certain exposure pathways can be eliminated from quantitative evaluation in this assessment because present and future site and adjacent land use and conditions limit the location and characterization of potential receptors. Each pathway is discussed by media below.

Air (Environmental Areas A-H)

Inhalation of contaminants volatilizing from the surface soil, sediment in drainage ditches or other surface waters is not considered to be significant at the FSC site due to the lack of contaminants present at the surface which can volatilize.

Inhalation of contaminants associated with fugitive dust will be qualitatively assessed. Air monitoring data collected downwind of Area B indicate that fugitive dust emissions are of minimal concern under current site conditions. Although OSHA permissible exposure limits (PELs) have not been proposed as ARARs, they are useful for comparative purposes because future site use will be industrial. For lead, the concentration is three orders of magnitude below the PEL. For cadmium and chromium, the concentrations are five orders of magnitude lower than the PELs. Consideration of fugitive dust exposure is qualitatively addressed below.

Air sampling was conducted in the EC dust area on two consecutive days during the Phase I investigation. A tripod-mounted, portable, high volume air sampler (General Metal Works Model GT 2200) was used in combination with an 8" x 10" glass fiber filter (Model EPM 2000) to obtain the particulates. The sampler was placed immediately downwind of Area B. Wind speed varied from calm to very windy during the 9 hour collection period on

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May 26, 1989 and varied from calm to breezy during the 12-hour collection period on May 27, 1988. The samples were analyzed for lead, cadmium and chromium. All sampling was conducted as per the QAPP. The results of the analyses are presented below:

Test Results

Analyte	May 26, 1988	May 27, 1989	8 hr. Occupational Limits
Lead	0.290 ug/m^3	0.040 ug/m3	50 ug/m^3
Cadmium	0.011 ug/m^3	0.002 ug/m^3	200 ug/m^3
Chromium	0.008 ug/m^3	0.003 ug/m^3	1000 ug/m^3 (Cr metal)

OSHA permissible exposure limits are listed for comparison.

Surface Water and Sediments (Area H)

Exposure to the surface water and sediment located in the polishing pond, borrow pits and associated drainage areas, is not evaluated in this exposure assessment as these areas are not likely to be contacted by workers; and the areas are even less likely to be contacted by people passing by due to the restricted access to the site. Surface waters are not used as a source of potable water in the vicinity of Indiantown.

Environmental concerns (non-human health) will be evaluated by comparing surface water concentrations to water quality criteria and qualitatively assessing potential impacts from contaminated sediments in the Risk Characterization Section below.

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Soils (Areas A-G)

Contact (soil ingestion and dermal) by workers with the surface soils located on the FSC site will be assessed on an area by area basis. Currently, the FSC site is secured by a fence and access is limited to workers. For the reasons given in 3.1.2 above, common sense leads to the conclusion that access to the property will continue to be limited to industrial workers.

The current use scenario includes limited use of the property by workers. Potential future use includes unrestricted use by workers at an industrial facility.

Groundwater (Area I)

The nearest downgradient potable well is over 1,400 feet from the plume's boundary and is currently unimpacted by the contamination plume. Therefore, exposure to groundwater under current conditions is not quantitatively assessed. No potable or non-potable wells are currently in use on the site and consequently are not assessed under the current use scenario.

With respect to future use, the locations of water supply wells downgradient from the site are shown on Figure 4. Available information on well specifications is summarized in Table 11. The nearest well is more than 1,400 feet from the downgradient edge of Environmental Area I. Groundwater samples were collected from the two domestic wells nearest the site during the June 1987 sampling. One well is reported to be 104 feet deep and the other well is over 100 feet deep. Concentrations of cadmium, chloride, iron, lead, sodium, total dissolved solids, and gross alpha were at background levels in the two domestic wells (Appendix D). The Phase II Remedial Investigation Report contains data showing the rate at which the leading edge of the groundwater plume is moving to the south-southeast.

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FIGURE 4

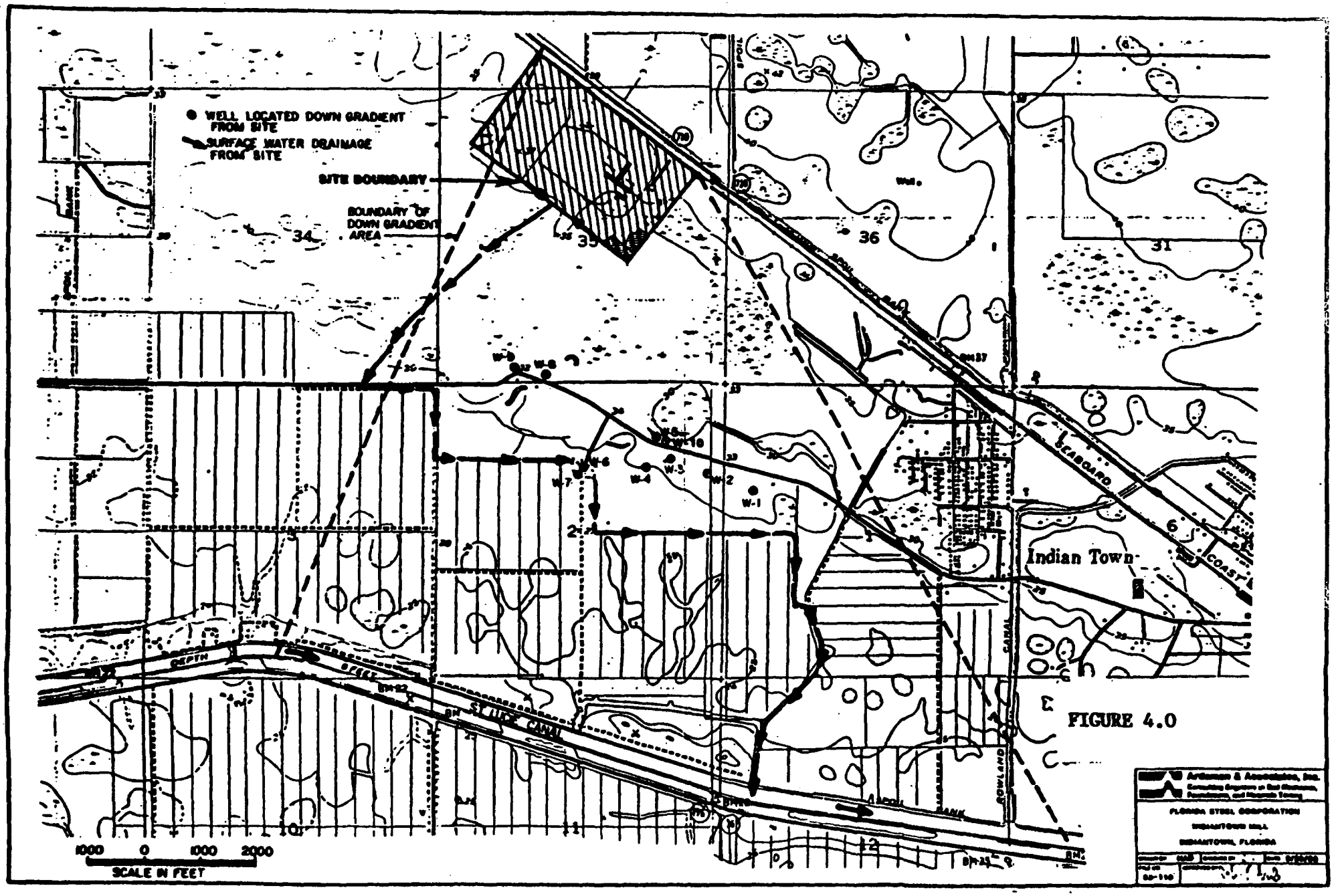

FIGURE 4.0

Anderson & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Magnetic Testing
FLORIDA STEEL CORPORATION
INDIANTOWN MILL
INDIANTOWN, FLORIDA

TABLE 11
Summary of Contaminant Concentrations
In Filtered Groundwater Downgradient of Area B

Chemical	(Wells 1 + 21) Mean	Max	Background (17 + 27) Mean	Max
Sodium (mg/L)	213	655	68	141
Lead (mg/L)	0.035	0.065	0.013	0.021
Cadmium (mg/L)	0.0052	0.01	0.0015 (1)	0.002
Barium (mg/L)	0.62	0.88	BDL	
Zinc (mg/L)	3.01	6.02 (2)	BDL	
Iron (mg/L)	13.2	40.4	0.57	1.79
TDS (mg/L)	1731	2702	410	818
Gross Alpha (pCi/L)	27	32	3.3	6
Radium 226 (pCi/L)	16.9 (3)	21.5	0.6 (4)	
Radium 228 (pCi/L)	12.1 (3)	23.7	no data collected	

(1) Average of 2

(2) Only one filtered sample above the detection limit, all M-21 were BDL

(3) Average of 2 filtered samples

(4) One sample

Based on those data, the forward edge of the groundwater plume would reach the nearest domestic water supply well in about 35 years if FSC is not authorized to begin removing and treating the contaminated groundwaters before that time. (FSC has advised DER and U.S. EPA that it will seek expedited approval to begin removing and treating contaminated groundwater at an early date so that they will never reach any water supply wells; See Appendix I). Based on these considerations, the pathways selected for quantitative evaluation include residential drinking water ingestion, residential bathing and showering, and on-site industrial non-potable uses (hand washing).

Summary of Exposure Pathways Evaluated

Dermal contact with soils and soil ingestion under an occupational setting are the pathways assessed quantitatively under current conditions. Under the future use scenario, on-site dermal contact with soils, on-site soil ingestion, and on-site non-potable groundwater use all by industrial workers will be assessed quantitatively. Also under the future use scenario, ingestion and dermal contact of off-site groundwater by residential users will be assessed quantitatively. The resulting exposure pathways are summarized in Tables 12 and 13.

3.4 Exposure Point Concentrations

The intent of this section is to estimate the reasonable exposure point concentrations which are conservatively within the range of possible exposures. Phase I and Phase II RI data were used to estimate exposure point concentrations in the various areas of the site. The data are summarized in the following sections of the report for each Environmental Area. The actual data points and calculation of the 95% upper confidence limits (95% UCL) are provided in Appendix J.

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TABLE 12
FLORIDA STEEL SITE
ANALYSIS OF POTENTIAL HUMAN EXPOSURE PATHWAYS
NO ACTION AND FUTURE USE SCENARIOS

Media	Release Pathway	Exposure Mechanism	Type of Exposure	Chosen for Quantitative Analysis
Air	From Contaminated Soil	Volatilization	Inhalation	No - volatiles not present in surface soils, air sampling indicates no significant contamination
		Fugitive Dust	Inhalation	No - soil amenable to wind erosion, pathway will be assessed qualitatively
Ground Water	Nearest Downgradient Residential Well - Currently	Bathing	Dermal Inhalation	No - nearest residence not affected No - nearest residence not affected, and no significant volatile contamination
		Drinking Water	Ingestion	No - nearest residence not affected
		Household Use	Inhalation	No - nearest residence not affected
	Future Potable Residential Well Off-Site (Groundwater Plume)	Bathing	Dermal Inhalation	Yes No, no significant volatile contamination
		Drinking Water	Ingestion	Yes
		Household Use	Inhalation	No, no significant volatile contamination
	Future Industrial Non-potable use	Bathing	Dermal Inhalation	No No, no significant volatile contamination
		Hand Washing	Dermal	Yes
		Drinking Water	Ingestion	No
		On Site Water Use	Inhalation	No, no significant volatile contamination
Surface Water	Borrow Pit	Casual Contact	Dermal	No, unlikely to be contacted by workers, restricted access to a passerby
	Borrow Pit (Drainage Area)	Casual Contact	Dermal	No, this area not covered with surface water
	Polishing Pond	Casual Contact	Dermal	No, unlikely to be contacted by workers, restricted access to a passerby
Soil/Sediments	Borrow Pit (Sediments)	Casual Contact (industrial)	Dermal Ingestion	No, unlikely to be contacted by workers, restricted access to a passerby
	Borrow Pit (Drainage Area) (Sediments)	Casual Contact (industrial)	Dermal Ingestion	No, unlikely to be contacted by workers, restricted access to a passerby
	Contaminated Soil in Area A	Casual Contact (industrial)	Dermal Ingestion	Yes
	Contaminated Soil in Area B (EC Dust)	Casual Contact (industrial)	Dermal Ingestion	Yes
	Contaminated Soil in Area C (Slag)	Casual Contact (industrial)	Dermal Ingestion	Yes

TABLE 12 - continued
FLORIDA STEEL SITE
ANALYSIS OF POTENTIAL EXPOSURE PATHWAYS
NO ACTION AND FUTURE USE SCENARIOS

Media	Release Pathway	Exposure Mechanism	Type of Exposure	Chosen for Analysis
	Contaminated Soil in Area D	Casual Contact (industrial)	Dermal Ingestion	Yes
	Contaminated Soil in Area E	Casual Contact (industrial)	Dermal Ingestion	Yes
	Contaminated Soil in Area F	Casual Contact (industrial)	Dermal Ingestion	Yes
	Contaminated Soil in Fringe of Area G*	Casual Contact (industrial)	Dermal Ingestion	Yes

*Concentrations not representative of Area G as a whole due to skewing from sampled locations near Area B (see section 3.4.7)

TABLE 13
FLORIDA STEEL SITE
ROUTES OF EXPOSURE USED TO CALCULATE INTAKES
NO ACTION AND FUTURE USE SCENARIOS

Exposure Scenario	Potentially Exposed Population	Routes of Exposure		
		Dermal	Ingestion	Inhalation
No Action Surface Soils	Adults (industrial)	Casual Contact with Surface Soil	Soil	None
Future Off-Site Potable Residential Well (groundwater plume)	Adults	Bathing	Drinking Water	None
	Children Ages 6 to 12	Bathing	Drinking Water	None
	Children Ages 2 to 6	Bathing	Drinking Water	None
Future Industrial Non-Potable Well On-Site	Adults	Hand Washing	None	None

3.4.1 Areas A, B and D

Phase II (barium, lead, PCBs) and Phase I (CLP/HSL) data are summarized in Tables 2,3 and 4 for Areas A, B and D respectively. These Tables present arithmetic mean concentrations, standard deviations, and detected ranges. The 95% UCL and upper range concentrations used as exposure point concentrations for the indicator chemicals are summarized in Table 17a and 17b.

3.4.2 Area C

All samples collected from Area C soils during the Phase II investigation were discrete samples collected at the soil/slag interface and from higher horizons if the appearance of the soil indicated the possible presence of EC dust. These samples were also collected on a 150 foot hexagonal grid. During Phase I three samples of slag were obtained from the slag used in construction of the vault (see Phase II RI Report).

The mean concentration levels, standard deviation and detected range of all analytes are given in Table 14. Background concentrations are also given for comparison. No organic compounds other than PCBs were analyzed for in the slag.

3.4.3 Area E

A composite of three soil samples was collected from Area E prior to the PCB clean-up and analyzed for PCBs. PCBs were below the detection limit of 1 ppm.

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TABLE 14
DATA SUMMARY FOR AREA C SOILS

CHEMICALS	MEAN	STD. DEV. FOR EC DUST	DETECTED RANGE	DISCRETE OR COMPOSITE	BACKGROUND CONCENTRATION (3)
ARSENIC	2	0.6	2-3	D	<0.3
BARIUM	613	30.6	580-640	D	<5.3
BARIUM (1)	187	154	80-484	D	<5.3
CADMIUM	6	1.4	3.9-6.4	D	<0.05
CHROMIUM	773	371	520-1200	D	<30
LEAD (1)	498	376	155-1330	D	<1.28
MERCURY	0.03	0.02	0.06	D	<0.04
SELENIUM	0.06	0.02	0.04-0.08	D	<0.06
SILVER	2.5	2	1-5	D	<0.3
PCB	<1	N.A.	N.D.	D	

(1). These results are Phase II Data, all othe data are Phase I.
(3). From Table 2 of Phase I RI Report, (Ardaman Association, 1988)

N.A. - Not Applicable
N.D. - Not Detected
Concentrations in ppm

3.4.4 Area F

Soil samples were collected from Area F and analyzed for barium, lead and PCBs. The mean and range of concentrations detected in soils are summarized on Table 15. Soil background concentrations are also given for comparison.

Lead, the only contaminant of concern reported in Area F, was detected in low concentrations. Given the dominance of lead as a contaminant at the site overall and the former use of Area F, the low lead concentration in Area F is assumed to be a reliable indication of no significant contamination. The lead concentration reported in Area F is quantitatively assessed to further demonstrate its lack of environmental significance. The mean and maximum values for lead in Area F are presented in Table 15.

3.4.5 Area G

Soil samples were collected from Area G and analyzed for barium, lead, and PCBs. The mean, standard deviation, and range of concentrations detected are summarized in Table 16. Background concentrations are also given for comparison.

3.4.6 Area I (Groundwater Plume)

The groundwater monitoring network currently consists of 19 monitoring wells; twelve on-property and seven off-property. There are several well clusters in which the wells are screened at different depths (see RI for description of screened intervals).

The July, 1989 round of unfiltered ground water data are summarized in Table 6. These data have been grouped to include those wells that have markedly elevated levels of

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TABLE 15 and 16

SUMMARY OF DATA FROM AREA F SOILS

CHEMICAL	MEAN	STD. DEV.	DETECTED RANGE	DISCRETE OR COMPOSITE
BARIUM	ND	ND	ND	D
LEAD	22	12	10 - 33	D

SUMMARY OF DATA FROM AREA G SOILS

CHEMICAL	MEAN	STD. DEV.	DETECTED RANGE	DISCRETE OR COMPOSITE
BARIUM	N.A.	N.A.	65 AND 110	D
LEAD	32.9	50.2	4-218	D

Concentrations in ppm
N.A. - Not applicable since only 2 of 25 samples detected Barium
ND - Not Detected

skewing from sampled locations near Area B (see section 3.4.7)

TDS and other contaminants (monitoring wells 50, 51, 55, 56, 19, 54, 22, 26). Geophysical survey methods were utilized to aid in placement of wells and confirm the extent of contamination. A cluster of background wells (monitoring wells 17 and 27) are provided for comparison. Deep wells were not included in the summary because they are not impacted by contamination (see Phase II RI). Monitoring wells 1 and 21 are discussed elsewhere in this report in relation to being downgradient of Area B.

A plume of ground water contamination extends approximately 600 feet beyond the southern property line. The chemicals found in the plume at concentrations elevated above background levels were sodium, lead, cadmium, barium, zinc, iron, chloride, gross alpha, and radium (226 and 228).

The groundwater concentrations used in calculations of chemical intakes are based on an average from the wells most strongly influenced by the high TDS plume. Flow from the current plume boundary to potential receptors has been assumed to follow a plug flow pattern with no attenuation or dilution. The timing of the arrival of the plume in the area of potential residential receptors is approximately 35 years assuming an average flow velocity of 40 feet/year and 1,400 feet to the nearest receptor. The exposure point concentrations used in the quantitative calculations are summarized in Table 17c. (FSC has advised DER and U.S. EPA that it will seek expedited approval to begin removing and treating contaminated groundwater at an early date so that plume will never reach any water supply wells.)

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TABLE 17a: EXPOSURE POINT CONCENTRATIONS
OCCUPATIONAL, CURRENT USE–FLORIDA STEEL SITE

PATHWAY (Media)	*AREA*	*CHEMICAL*	*MAXIMUM* (mg/kg)	*95% UCL* (mg/kg)
Soil Ingestion/Contact (Soil)	A	Cadmium	1.80E+01	1.52E+01
		Chromium	3.00E+02	2.94E+02
		Lead*	1.22E+04	1.52E+03
		Zinc	4.00E+03	4.09E+03
		PCB, 1248	3.80E+01	8.40E+00
	B	Cadmium	3.80E+02	4.82E+02
		Chromium	4.70E+02	5.14E+02
		Lead	1.70E+04	9.78E+03
		Zinc	1.10E+05	1.34E+05
		PCB, 1248	1.20E+01	1.64E+01
		PCB, 1254	6.20E-01	7.80E-01
	C	Cadmium	6.40E+00	8.22E+00
		Chromium	1.20E+03	1.46E+03
		Lead*	1.33E+03	6.99E+02
	D	Cadmium	7.00E+00	8.55E+00
		Chromium	4.80E+02	5.61E+02
		Lead*	5.35E+02	4.68E+02
		Zinc	3.80E+03	4.38E+03
		PCB, 1248	7.50E+00	1.03E+01
		PCB, 1254	3.90E+00	5.35E+00
	F	Lead*	3.30E+01	4.32E+01
	G	Lead*	2.18E+02	5.57E+01

*From Phase II RI Report (Ardaman, 1988). All other values from Phase I Report (Ardaman, 1988)

TABLE 17b: EXPOSURE POINT CONCENTRATIONS
OCCUPATIONAL, FUTURE USE–FLORIDA STEEL SITE

PATHWAY (Media)	*AREA*	*CHEMICAL*	*MAXIMUM* (mg/kg)	*95% UCL* (mg/kg)
Soil Ingestion/Contact (Soil)	A	Cadmium	1.80E+01	1.52E+01
		Chromium	3.00E+02	2.94E+02
		Lead*	1.22E+04	1.52E+03
		Zinc	4.00E+03	4.09E+03
		PCB, 1248	3.80E+01	8.40E+00
	B	Cadmium	3.80E+02	4.82E+02
		Chromium	4.70E+02	5.14E+02
		Lead	1.70E+04	9.76E+03
		Zinc	1.10E+05	1.34E+05
		PCB, 1248	1.20E+01	1.64E+01
		PCB, 1254	6.20E-01	7.80E-01
	C	Cadmium	6.40E+00	8.22E+00
		Chromium	1.20E+03	1.46E+03
		Lead*	1.33E+03	6.99E+02
	D	Cadmium	7.00E+00	8.55E+00
		Chromium	4.80E+02	5.61E+02
		Lead*	5.35E+02	4.68E+02
		Zinc	3.80E+03	4.36E+03
		PCB, 1248	7.50E+00	1.03E+01
		PCB, 1254	3.90E+00	5.35E+00
	F	Lead*	3.30E+01	4.32E+01
	G	Lead*	2.18E+02	5.57E+01
Hand Washing (Water)	On-site Monitor Wells	Cadmium	2.10E-02	2.00E-02
		Lead	1.22E-01	8.00E-02

*From Phase II RI Report (Ardaman, 1988). All other values from Phase II Report (Ardaman, 1988)

TABLE 17c: EXPOSURE POINT CONCENTRATIONS
RESIDENTIAL, FUTURE USE–FLORIDA STEEL SITE

PATHWAY (Media)	*AREA*	*CHEMICAL*	*MAXIMUM* (mg/kg)	*95% UCL* (mg/kg)
Ingestion of Groundwater (Groundwater)	On-Site Monitoring Wells	Cadmium	2.10E-02	2.00E-02
		Lead	1.22E-01	8.00E-02
Bathing (Groundwater)	On-Site Monitoring Wells	Cadmium	2.10E-02	2.00E-02
		Lead	1.22E-01	8.00E-02

3.5 Calculation of Intakes

The final step of the exposure assessment is the calculation of daily human intakes or daily human doses of each substance of concern. The intake, which is sometimes referred to as the administered dose, is the amount of a specific substance which comes into contact with the absorptive surfaces of the body and is therefore available for absorption. Dose, on the other hand, is considered by the EPA to constitute the absorbed fraction of the intake (USEPA, 1989a). Both intake and dose are expressed in terms of milligrams of a specific substance per unit body weight per day, generally in units of mg/kg/day.

A relative absorption factor is used to correct for differences in absorption between the hypothetical exposure scenario and the absorption for the experimental study upon which the health criterion (cancer potency or reference dose) is based. The factor accounts for absorption differences resulting from factors such as administered matrix (corn oil vs. soil), species differences, temporal considerations, and route of administration.

For this assessment, three scenarios are quantified separately: subchronic, chronic noncarcinogenic, and carcinogenic. For carcinogens, the dose is expressed as a lifetime average daily dose (LADD). For chronic (long-term) exposures to systemic toxicants, the dose is expressed as a chronic daily intake (CDI), in which the daily intake is averaged over the duration of the exposure. Both the CDI and LADD are based on 95% UCL exposure point concentrations.

In order to address potential short-term exposures to site concentrations above the average concentration, this assessment includes a subchronic scenario. Although EPA defines a subchronic exposure scenario duration as between 2 weeks and 7 years (USEPA, 1989a), the reasonable maximum exposure to the highest reported concentrations of the indicator

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chemicals is likely to be one week. Because this scenario is more accurately described as an acute scenario, the analysis is conservative in that the predicted exposure is evaluated using an Acceptable Intake for Subchronic durations (AIS). The exposure point concentration for this scenario is the maximum reported concentrations of the indicator chemicals.

Common intake parameters are described in Section 3.5.1, while the pathway specific parameters are described in Section 3.5.2 through 3.5.6. The intake calculation Tables and resulting intakes are summarized in Appendix C.

3.5.1 Common Intake Parameters

There are several parameters in the exposure models that are constant regardless of the pathway of interest. Since these parameters are used repetitively throughout the baseline risk assessment, these parameters are identified and the appropriate values are discussed here. Several of the parameters, such as body weights and averaging times, are well documented in the available literature and require no site-specific considerations. On the other hand, some parameters such as exposure frequency and exposure duration are site-specific and require professional judgment.

The value for body weight is the average body weight over the period of the exposure (USEPA, 1989d). For pathways where intake rate to body weight ratios are relatively constant over a lifetime, it is generally not necessary to provide body weights for specific age groups. However, for several pathways addressed in this report the ratio is not constant and therefore the exposure is calculated separately for different age groups. For the residential scenarios the two receptor groups are children aged 1 to 6 years and adults. For children aged 1 to 6 years the average body weight is 16 kilograms. This value represents the 50th percentile reported in "Development of Statistic.. Distribution of Ranges of Standard Factors Used in Exposure Assessment" (USEPA, 1985c). For an adult body weight value, the EPA

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Exposure Factors Handbook recommends an average (for men and women combined) of 70 kilograms (USEPA, 1989c).

The exposure frequency describes the incidence of the exposure events, in units of days per year. For the occupational carcinogenic and chronic noncarcinogenic evaluation, this assessment utilizes an exposure frequency of 120 days/year. This value equates to 2.5 days a week for 12 months, or 5 days a week for 6 months. For the chronic residential scenarios, an exposure frequency of 365 days per year is used. For the subchronic exposure frequency, a maximum reasonable estimate of 7 days per year for residential and 5 days per year for occupational is used. In addition, it is conservatively assumed that the days of subchronic exposure occur consecutively.

The averaging time selected for the exposure assessment depends on the type of toxic effect being assessed. For calculating potential carcinogenic risks, it is necessary to average the estimated cumulative dose over a lifetime (USEPA, 1989c; EPA, 1988b). This dose is often termed the Lifetime Average Daily Dose (LADD). Although 70 years has been widely used in the past and is used in this assessment, current data suggest that 75 years would be a more appropriate average value (USEPA, 1989c). This is based on life expectancy data published by the U.S. Department of Commerce, which reported an average life expectancy for the total U.S. population of 74.7 years. The use of a 70 year lifetime is a conservative assumption.

For noncarcinogenic chronic evaluations, the averaging time for occupational and residential scenarios is equivalent to the exposure duration, described below. For the subchronic evaluation the averaging time is one week, equal to the duration of the subchronic exposure. The subchronic exposure is assumed to occur once a year.

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The exposure duration describes how long the potential exposure extends. The value for this parameter is the same for several pathways. For residential exposures, the EPA recommends using the 95 percentile value if statistical site-specific data are available. Lacking site-specific data, national statistics are available that show that upper-bound (90th percentile) number of years spent by individuals at one residence is 30 years (USEPA, 1989a). The EPA Risk Assessment Guidance for Superfund, Human Health Evaluation Manual (1989a) states that the upper-bound value of 30 years can be used for exposure duration when calculating reasonable potential maximum residential exposures. Since the residential exposure models calculate age group specific doses, it is assumed that a child's potential exposure duration (ages 1 to 6 years) is for 5 years, followed by 30 years of exposure as an "adult", resulting in a total exposure duration of 35 years. For the occupational scenarios, the potential exposure duration is conservatively assumed to be an occupational lifetime of 40 years, roughly translating to the ages of 20 through 60 years of age. It is unlikely that an individual would be employed at the same location and same job description for that duration of time. This same document recommends a value of 30% for an absorption value for ingestion of soil.

For dermal absorption of inorganic compounds from soil, this assessment uses a value of 1.0%. This value is consistent with Agency recommendations. For PCBs, a relative dermal absorption of 5.0% is used consistent with the value used by the EPA in "Development of Advisory Levels for PCB Cleanup" (USEPA, 1986).

A relative absorption of 100% for ingestion of soil (inorganic and organic compounds) is used in this assessment as per EPA instruction. As suggested in the following discussion, the actual relative absorption is likely to be less.

The relative ingestion absorption value is used to account for differences in absorption between the matrix used in the reference dose study and the reduced absorption resulting from

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binding of the inorganic compounds to the soil matrix. Several studies have demonstrated that soil retards absorption relative to that from other matrices (corn oil, acetone, water, etc.) commonly used in laboratory studies (Poiger and Schlatter, 1979; Drill et al., 1979; Shu et al., 1988; Skowronski et al., 1988; and Yang et al., 1989). Several sources support a relative absorption of 50% or less:

- "The extent of gastrointestinal absorption of lead from non-food sources in children has been estimated from data in animals and chemical parameters to be about 30% from dirt and dust and 17% from paint chips. (ATSDR, Toxicity Profile for Lead,1988); and

- A factor of 30% for lead absorption from dusts and soils is not an unreasonable value."(EPA Air Quality Criteria for Lead, Vol III, 1986).

- Envirologic Data contacted the EPA, Toxics Integrations Branch, to determine EPA opinion regarding the pharmacokinetics of lead. EPA has developed a biokinetic uptake model for site specific use. One input variable in the model is gastrointestinal absorption rate of lead from soil. EPA advises that the absorption rate is approximately 30% for soil concentrations below 1200 ppm and 15% for those above 1200 ppm.(Griffin, 1990)

An additional important consideration is that the health criterion is based on studies with children, while the receptor population at the Florida Steel Corporation site is adult industrial workers. It is well documented that the kinetics and disposition of lead are significantly different in adults versus children. Specifically:

- "For dietary lead, absorption in children is about 50%, compared with 8% (Hammond, 1982) or 15% (Chamberlain et al, 1978) gastrointestinal lead absorption measured in adults." (ATSDR, Toxicity Profile for Lead, 1988); and

- "Also, similar to findings in humans, the extent of gastrointestinal absorption of lead in experimental animals is age dependent. The rat pup absorbs 40 to 50 times more lead via the diet than does the adult rat."(ATSDR, Toxicity Profile for Lead, 1988)

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Similar conclusions regarding age-specific absorption are drawn in EPA's Exposure and Risk Assessment for Lead, 1982 and EPA's Air Quality Criteria for Lead, Vol III, 1986. Based on the data, the relative gastrointestinal absorption of lead in adults versus children is approximately 10%/50%, or 0.2. Since the population of concern at the site is adults, and since the criteria is based on children, it is appropriate to apply a factor of 0.2 to correct for age-specific differences in lead absorption. Combined with the 30% absorption coefficient (to account for differences in absorption from non-food (soil) and food (water) sources), the final corrected absorption is 0.06 (0.3 x 0.2.)

In addition, a compound's distribution coefficient (Kd) provides an estimate of the compounds adsorption to soil. Specifically, the Kd is the ratio of the concentration of the compound in soil to that in water in a soil-water system at equilibrium. For lead the reported Kd is about 900 (Baes et al., 1984), meaning that at equilibrium mixture conditions the concentration in the water will be 1/900 of the concentration in soil. The high affinity of lead for soil particles is therefore expected to reduce the bioavailability from soil relative to other matrices.

As suggested by the above discussions, the relative absorption for ingestion of soil is likely to be less than 50%. However, as per EPA instruction, this risk assessment uses a conservative value of 100%.

In summary, the above values for average body weights, potential exposure durations, relative absorption and averaging times are common to all the exposure models. The appropriate values for the FSC baseline risk assessment have been identified here, precluding the need to discuss the parameters again in conjunction with specific exposure models. The chemical concentrations and contact rate are pathway-specific variables and are discussed below.

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3.5.2 Dermal Contact with Soil (Occupational)

The soil contact rate, or the adherence factor, is a measure of the average amount of soil which adheres to a given skin surface area for a given unit time. Typical units are milligrams of soil per square centimeter of skin per day. The amount of soil that may accumulate on the skin depends upon the body part in contact with the soil, the soil type and moisture, and the activity resulting in contact with the soil. Several different values have been either used by the EPA in risk assessment or recommended in risk assessment guidance documents:

- EPA, 1984, "Risk Analysis of TCDD Contaminated Soils": upper range estimate of 0.5 to 1.5 mg/cm^2/day.
- EPA, 1986b, "Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup": 1.0 mg/cm^2/day.
- EPA, 1988b, "Superfund Exposure Assessment Manual": Commercial potting soil = 1.45 mg/cm2/day; clay mineral kaolin = 2.77 mg/cm2.
- EPA, 1989c, "Exposure Factors Handbook": not available, factor to be developed

The basis of reported soil adherence factors will be reviewed in order to select a value which, when combined with the other exposure values, results in a reasonable maximum estimate (RME) of exposure for regulatory purposes.

Lepow et al. (1975) reported a soil contact rate of 0.5 mg/cm^2/day. Lepow et al. (1975) measured soil accumulation on the hands of 22 children ages 2-6 that had been playing both outdoors and indoors. Soil from the hands of the children was collected by repeatedly pressing a preweighted adhesive strip to a sing[illegible] area of the palm of the hand and dividing the weight of the collected dirt by the surface area from which it was collected.

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Roels et al. (1980) calculated a range of 0.42 mg/cm^2/day to 1.78 mg/cm^2/day as the soil accumulation rate on the palms of the dominant hands of 11 year old children that had previously been playing in a school yard. A dilute nitric acid solution was used to rinse the hand. The total amount of lead in the rinsate was determined and compared to the concentration of lead in the soil from the play ground in order to calculate the total amount of soil rinsed from the hand. As with Lepow et al. (1975), the total amount of soil was divided by the surface area of the rinsed hand to derive the range of contact rates. The average soil adherence rate was 0.9 mg/cm^2/day (Sedman, 1989).

Que Hee et al. (1985) quantified the amount of soil that adheres to the palm of the hand of an adult for different soil particle sizes. The hand of an adult was applied to a petri dish containing a preweighted amount of dust. The hand was removed from the petri dish and nonadhering dust remaining in the dish was weighed to calculate the amount of dust that adhered to the hand. The average adherence rate was 31.0 mg per hand. For an assumed hand surface area of 160 cm^2, the corresponding soil adherence rate is 0.2 mg/cm^2.

In summary, three soil accumulation rates based on empirical data are reported in the published literature: 0.5 mg/cm^2/day (Lepow et al., 1975); 0.9 mg/cm^2/day (Roels et al., 1980); and 0.2 mg/cm^2/day (Qee Hee et al., 1985). Based on the empirical data and best professional judgement, a reasonable maximum estimate of the soil contact rate for high contact surface areas (such as hands and feet) is 1.0 mg/cm^2/day.

The above three estimates are based on the amount of soil accumulation on the palms of hands. Other skin surfaces are not likely to be in contact with soil to the same extent as the palms of the hands. These contact rates represent reasonable maximum estimates. It is conservative to assume that soil will accumulate at these rates for every exposure event resulting in potential contact with outdoor soil. Outdoor activity on vegetated or paved areas will result in reduced accumulation rates of surface soil.

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In estimating exposures to surface soil, it is necessary to combine the soil accumulation rate with the surface area of the skin in contact with the soil. For occupational adults, the exposed surface area is assumed to be 1700 cm^2, which approximates the surface area of the hands and forearms.

3.5.3 Soil Ingestion (Occupational)

For purposes of regulatory risk assessments, EPA guidance suggests that risk assessments use a soil ingestion rate for adults of 50 mg/day. This value is used in this risk assessment to calculate intakes via soil ingestion.

3.5.4 Handwashing (Occupational)

Dermal contact with groundwater while handwashing is a potential exposure pathway under the future occupational scenario. Two parameters utilized in the mathematical model to estimate the amount of chemical intake are the permeability rate and dermal surface area in contact with water. For chemicals which do not have permeability constants, the chemicals are assumed to be absorbed through the skin as a solute in water and, therefore, the permeation rate of the chemical across the skin boundary is assumed to be equal to the permeation rate of water (USEPA, 1988b). The permeability rate for water is reported to be 5.0×10^{-4} cm/hr (USEPA, 1988b) and was used as the permeability rate for the chemicals in the groundwater.

The dermal contact surface area is assumed to consist of the hands and most of the forearms. Hawley (1985) estimated the surface area of the hands and most of the forearms to be 1700 cm^2. This value is used in the exposure scenario and is a reasonable maximum estimate of the occupational dermal contact area.

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3.5.5 Ingestion of Groundwater (Residential)

The EPA (1989a) has reviewed the reported literature (NAS, 1977; Cantor et al., 1987; Gillies and Paulin, 1983; Pennington, 1983; EPA, 1984; cited in EPA, 1989) to estimate the average volume of water consumed per day. For adults, the EPA presently uses 2.0 liters per day based on an historical figure set by the U.S. Army as well as other values reported in the literature. Based on these studies, the average adult drinking water consumption rate was reported at 1.4 liters per day and the reasonable worst case value was reported at 2.0 liters per day (USEPA, 1989a). The EPA (1989a) considers 2.0 liters per day to be an overestimate for most people and should be used to represent a long-term average consumption rate. In addition, the 2.0 liter value includes drinking water as well as water consumed in the form of juices and other beverages containing tap water. Although this value is likely to overestimate the actual amount of water consumed by an adult in the home per day, it is used in this exposure scenario.

For children (individuals of 10 kg body mass or less), the EPA (1989a) suggests 1 liter per day; the basis for this value was not provided. However, several studies reported by the EPA (1989a) may be used to estimate an average value.

STUDY	AGE (yrs)	DIET	VOLUME/DAY (liters)
Pennington, 1983	2	water, water based drinks	.499
USEPA, 1984	1-4	tap water	.434
	5-9	tap water	.521
ICRP, 1981	5-14	water based drinks	.540 - .790

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The average of these reported values using the upper value of the ICRP (1981) study is .561 liters per day. However, the EPA recommended value of 1.0 liter per day is utilized in this exposure scenario.

3.5.6 Bathing (Residential)

Bathing in water drawn from a residential well represents a potential exposure pathway to the indicator chemicals. Two parameters utilized in the mathematical model to estimate the amount of chemical intake are dermal surface area in contact with water and the chemical permeability rate. The dermal surface area of the adult is estimated by the EPA (1985) at 18,150 cm^2. Because adults are likely to shower, 100% of the dermal surface area in assumed to be covered with water during this activity.

For the child, the bathing activity is likely to be a bath. Assuming the head represents approximately 20% of the total dermal surface area and the head is not immersed in water for the total duration of the bath, the dermal surface area in contact with water is assumed to be 80% of the total (7,280 cm^2) or 5,760 cm^2.

As discussed in Section 3.5.4, the permeability rate for the indicator chemicals is equal to the permeation rate of water (5.0×10^{-4} cm/hr.). This value is used in this exposure scenario.

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4.0 TOXICITY EVALUATION

4.1 Introduction

The toxicity evaluation is conducted as part of a risk assessment to quantitatively and qualitatively assess the potential for adverse human health effects from exposure to the indicator compounds at the Florida Steel site. The quantitative portion of the evaluation entails identifying the relevant indices of toxicity against which exposure point intakes can be compared in the risk characterization of the site.

These toxicity indices are presented in Table 18. Several of the indicator compounds lacked EPA verified subchronic reference doses. For these compounds, this screening level analysis uses a derived subchronic reference dose which is a factor of ten higher than the chronic reference dose. This approach is reasonable in that the chronic RfD is based on a lifetime of exposure, whereas the subchronic scenario for this analysis is based on a five day per year exposure duration.

In a previous draft of the RA (11/89) it was assumed that 1/10 of the monitored chromium was hexavalent, with the remaining fraction being trivalent. Therefore, the health criteria used in the draft RA for total chromium was 1/10 the reference dose for hexavalent chromium. More recent data is available which supports using the health criteria for trivalent chromium. As reported in "Results of Sampling Program conducted in February 1990" (Mark Schultz Associates, 5/15/90) composite samples of EC dust and slag were analyzed for total and hexavalent chromium. This analysis indicated that less than 0.15% of the total chromium was hexavalent. Based on these results it is appropriate to use the reference dose of trivalent chromium for the risk assessment.

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As per EPA review (10/10/90), Florida Steel Corporation is conducting additional analysis of hexavalent vs. trivalent chromium. Screening level calculations have been performed assuming that the chromium is 100% hexavalent and are shown in the table below.

AREA	Total Hazard Index* (trivalent)**	Total Hazard Index* (hexavalent)***
A	5.9×10^{-1}	6.0×10^{-1}
B	3.2×10^{0}	3.2×10^{0}
C	2.2×10^{-1}	2.6×10^{-1}
D	2.0×10^{-1}	2.2×10^{-1}

* all pathways and chemicals combined
** from Table 19, August, 1990 Risk Assessment
*** all exposure parameters remain constant; Chromium RfD changes from 1.0 mg/kg/day to 5.0×10^{-3} mg/kg/day.

These calculations indicate that even under worst-case assumptions (100% Cr VI), the contribution from chromium is negligible relative to the contribution from lead. Therefore, the use of Cr VI or Cr III RfD does not significantly alter the calculated hazard indices. Due to the minimal impact, the present calculations assume the chromium is trivalent, pending receipt of additional analysis. When those data are received, the calculations can be revised if appropriate. Based on the knowledge of the composition of the raw materials used in the electric arc furnace steel making process as well as the operating conditions inside the EAF, substantially all chromium present is expected to be in the trivalent form.

The qualitative aspect of the evaluation includes a summary of the pertinent toxicology data for each compound as well as the EPA and International Agency for Research onCancer (IARC) weight-of-evidence classification which describes each compound's potential for human carcinogenicity. A general discussion of the EPA and IARC weight of evidence classification system and attendant uncertainties will be presented later in this

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TABLE 18: TOXICITY VALUES: POTENTIAL NONCARCINOGENIC EFFECTS

CHEMICAL	CHRONIC RfD (mg/kg/day)	CONFIDENCE LEVEL	CRITICAL EFFECT	UNCERTAINTY AND MODIFYING FACTOR	SUBCHRONIC RfD (mg/kg/day)	COMMENT
ORAL ROUTE						
Cadmium (water)	5.00E-04	HIGH	Proteinuria	UF = 10 for H MF = 1	5.00E-03	a,d
Cadmium (food)	1.00E-03	HIGH	Proteinuria	UF = 10 for H MF = 1	1.00E-02	a,d
Chromium VI	5.00E-03	LOW	Not Defined	UF = 500 for H, A, S MF = 1	2.00E-02	a,b
Chromium III	1.00E+00	LOW	Hepatotoxicity	UF = 100 for H, A MF = 10	1.00E+01	a,d
Lead	4.28E-04	NA	CNS Effects	NA	4.28E-03	c, d
Zinc	2.00E-01	NA	Anemia	UF = 10	2.00E+00	b,d
PCBs	ND	NA	NA	NA	NA	NA
INHALATION ROUTE: NOT POTENTIAL EXPOSURE ROUTE						

a: IRIS, 1989
b: HEAST, 1989
c: Derived from proposed MCL
d: subchronic assumed to be 10 times chronic RfD
Uncertainty adjustments: H=variation in human sensitivity; A=animal to human extrapolation; S= less than lifetime adjustment; L=LOAEL to NOAEL

ND = No Data
NA = Not Applicable

TABLE 18, continued: TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS

CHEMICAL	EPA WEIGHT-OF-EVIDENCE	TYPE OF CANCER	CANCER POTENCY ORAL [1/(mg/kg/day)]	CANCER POTENCY INHALATION [1/(mg/kg/day)]
Cadmium	Inhalation: B1 Ingestion: Inadequate Evidence	Lung NA	NA	6.1
Chromium VI	Inhalation: A Ingestion: Inadequate Evidence	Lung NA	NA	41
Chromium III	Inhalation: D Ingestion: D	NA NA	NA	NA
Lead	Inhalation: B2 Ingestion: B2	Renal Renal	ND	ND
Zinc	Inhalation: ND Ingestion: ND	NA NA	NA	NA
PCBs	Inhalation: B2 Ingestion: B2	ND liver carcinoma	7.7	7.7

toxicity assessment. The weight-of-evidence carcinogenicity classification followed by a brief summary of the adverse health effects associated with each indicator compound are presented below. A detailed and referenced toxicology profile for each indicator compound is included in Appendix B.

4.2 Weight of Evidence for Carcinogenicity Classification

Lead has been classified by EPA as Group B2, a probable human carcinogen, and is classified by IARC as a Class 2B, a probable human carcinogen.

Cadmium has been classified as Group B1, a probable human carcinogen by the inhalation route by EPA, and by IARC as Class 2A, a probable human carcinogen by the inhalation route.

Chromium (in the hexavalent form) is classified by EPA as Group A, a known human carcinogen by the inhalation route, and by IARC as Class 1, a human carcinogen by the inhalation route. Neither EPA nor IARC have classified Chromium (trivalent) or chromium metal as carcinogens. Because information is unavailable as to the concentration of chromium present in each valence state, for this toxicity assessment it is conservatively assumed that 10 percent of the chromium present is in the hexavalent form.

PCB's are classified by EPA as Group B2, possible human carcinogens and by IARC as Class 2A, probable human carcinogens. The carcinogenic assessment for PCB's by both of these groups is based upon animal studies and epidemiological studies of exposure to PCB mixtures that are more highly chlorinated than the PCB's detected on the FSC site. In general, chronic toxicological studies of various Aroclor mixtures have indicated that these mixtures have different degrees of carcinogenic potential proportional to the degree of

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chlorination. However, EPA usually evaluates all PCBs as if all these compounds are of the same carcinogenic potency as that demonstrated during chronic studies of animals exposed to Aroclor 1260 mixture. This is a very conservative assumption for mixtures of PCBs such as the less chlorinated Aroclors 1242 and 1248.

Both radium 226 and 228 are considered by EPA as Group A, known human carcinogens, and have not yet been formally classified by IARC.

Zinc has not been classified as to carcinogenicity by either EPA or IARC.

4.3 Summaries of Adverse Health Effects for Indicator Chemicals

4.3.1 Lead

Lead and lead compounds have been placed in the EPA carcinogen classification Group B2 (probable human carcinogen) and are considered as having a low potency and low hazard ranking compared to other carcinogens. This classification is based on numerous long-term toxicology studies utilizing several different routes of exposure, lead compounds and species of animals. Epidemiological studies have not provided any definitive support for lead's ability to cause cancer in humans. EPA has not prepared a quantitative estimate of lead's carcinogenic potency. A recent draft EPA document cites the lack of cross-species pharmacokinetics models, and that only relatively high doses of lead have caused cancer in animals as two of the reasons that the linearized multistage model has not been used to calculate a carcinogenic potency factor. Additionally, many other factors such as the age and nutritional status of the animals used in the experimental studies affect lead's ability to cause cancer. When the above points are addressed and clarified EPA may derive a quantitative estimate of lead's carcinogenic potency. Until such time as this occurs, lead and lead compounds can only be assessed quantitatively as non-carcinogens in a risk assessment.

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Lead is absorbed through the lungs, gastrointestinal tract, and, to a lesser extent, the skin. It is absorbed more readily in children than adults because they ingest more lead through more mouthing activity, absorb more of the lead that they ingest, and are more sensitive to its effects. It is absorbed more readily in children than adults and can cross the placenta resulting in fetal exposure. Lead may decrease the growth and intelligence quotient (IQ) of the fetus and young children. Mean blood levels of 50-70 µg/dL have been shown to decrease the intelligence quotient in children by an average of 5 points (ATSDR, 1988). Lead may decrease the growth and intelligence quotient (IQ) of the fetus and young children (blood levels 15-22 µg/dL) and adults (blood levels 60-80 µg/dL (ATSDR, 1988).

4.3.2 PCBs

Polychlorinated biphenyls (PCBs) are typically a mixture of many different isomers. They can be absorbed through the skin, gastrointestinal tract, and the lungs. The acute toxicity of PCBs is low. Chronic exposure can cause chloracne, liver damage, immunologic effects, reproductive disorders, and neurologic disease. Quantitative exposure data associated with these effects in humans were not located in the literature. Toxicological studies indicate that PCB mixtures containing the more highly chlorinated Aroclors 1254 and 1260 are carcinogenic in rats and mice.

4.3.3 Cadmium

Cadmium and cadmium compounds demonstrate moderate acute toxicity by ingestion or inhalation. For acute inhalation exposure, cadmium concentrations of 0.2 to 0.5 mg/m^3 have been associated with symptoms similar to metal fume fever. Oral exposure to soluble cadmium compounds at doses of 0.05 mg/kg have been reported to cause stomach irritation. The primary target organs associated with chronic exposure to cadmium are the kidney and lungs. The kidney is considered to be the most sensitive tissue to chronic cadmium exposure,

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with a toxic threshold concentration of 200 μg/g cadmium in the renal cortex. Chronic inhalation exposure to cadmium at levels of 0.1 mg/m^3 is reported to increase risk of emphysema. Lung tumors have been induced in rodents by exposure to cadmium via the respiratory route, and there is epidemiological evidence for induction of lung cancer in workers heavily exposed to cadmium fume.

4.3.4 Chromium

Long-term inhalation exposure of workers to low levels of chromium (unknown valance state) has been associated with an increase incidence of lung cancer. Lifetime exposure to $1 \mu g/m^3$ is expected to produce an additional 120 lung cancer cases per 10,000 persons exposed (ATSDR, 1988). Other respiratory tract effects reported in workers exposed to varying levels of chromium include irritation of nasal mucosa and transient decrease in lung function. There is no evidence that Chromium (VI) is carcinogenic by the oral route.

Chronic ingestion exposures to chromium may cause adverse effects in the kidney and liver. Oral ingestion of approximately 2 grams of chromate produced tubular renal necrosis and diffuse liver necrosis which contributed to the cause of death in fatal cases (ATSDR, 1988). Limited studies indicate that Chromium (III) is not carcinogenic via ingestion or inhalation.

4.3.5 Radium 226 and 228

Radium is a metabolic analog of calcium and is deposited in the skeleton. It has been observed at high intake rates that radium induces an increased incidence of bone tumors. In general, the lower the body burden of radium, the less frequent the appearance of a malignant tumor. It has been suggested that there is a threshold dose below which the required tumor

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appearance time generally exceeds the human life-span, and hence radiation-induced tumors appear with negligible frequency.

4.3.6 Zinc

Zinc is an essential trace element that is involved in enzyme functions, protein synthesis, and carbohydrate metabolism. Short-term inhalation exposure to zinc at levels of 180 ppm (10 minute exposure duration) is reported to cause metal fume fever, characterized by flu-like symptoms and difficulty in breathing. The health effects of long-term inhalation exposure of humans to zinc is not known.

The major toxic effects from ingestion of zinc are anemia and intestinal problems. Long-term exposure to levels of 153 ppm in food (6 week exposure duration) in humans have been shown to cause anemia. Decreased levels of high density lipoprotein (HDL)-cholesterol in blood have been reported for chronic exposure in humans to 170 mg per day. Reduced immune response has also been associated with this exposure level. Decreased HDL-cholesterol levels have been implicated as a risk factor in the development of heart disease.

Two epidemiological studies involving occupational inhalation exposure to zinc failed to demonstrate a relationship to cancer in humans; no carcinogenic studies are available for animals exposed to zinc by the inhalation route. The carcinogenicity of zinc in animals for oral exposure was investigated in one study which was determined to be inadequate due to experimental limitations.

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4.4 Discussion of Carcinogenicity Assessment

Evaluations of carcinogenicity within the context of a human health risk assessment involve two steps: 1) the identification of potential carcinogens among the contaminants present at the site; and, 2) the quantitative determination of their carcinogenic potency.

Evidence of possible carcinogenicity in humans comes primarily from long-term animal tests and epidemiological investigations. Results from these studies are supplemented with information from short-term tests, pharmacokinetic studies, comparative metabolism studies, structure-activity relationships, and other relevant information sources or areas of study.

For judging the qualitative evidence of carcinogenicity, EPA and the IARC employ a policy of "weight-of-evidence," meaning that the quality and adequacy of all relevant data on responses induced by a possible carcinogen using different procedures will be considered. There are three major steps in determining the weight-of-evidence for carcinogenicity:

1) Characterization of the evidence from human studies and from animal studies;

2) Combination of the two types of studies into a final indication of overall weight-of-evidence for human carcinogenicity; and,

3) Evaluation of all supportive information to determine whether the overall weight-of-evidence should be modified.

The second phase in carcinogen assessment involves the quantification of risk. Experimental studies of carcinogenic effects that utilize the low exposure levels usually encountered in the environment generally are not feasible. Therefore, various mathematical

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models have to be used for extrapolation from high doses used in animal bioassay to low doses resulting from exposure to ambient environmental concentrations.

Since the resolution power of animal studies, for example, is not adequate for precise elaboration of the dose-response curve, extrapolating from a high dose to a low dose introduces a level of uncertainty which may amount to orders of magnitude. Given the recognized differences in carcinogenic response between species, and between strains of the same species, it is clear that additional uncertainties will be introduced when quantitative extrapolations, as from rodents to humans, are made. Of the various proposed models for quantitative extrapolations, US EPA recommends a linearized multistage model: "In the absence of adequate information to the contrary, the linearized multistage model will be employed" (Federal Register, Guidelines for Carcinogen Risk Assessment, 24 September 1986). The linearized multistage model assumes linearity at low doses. Alternative models do not assume a linear relationship and in general are much more appropriate and much less conservative. When applied to the same data, the various models can produce a wide range of risk estimates; the model recommended by US EPA usually produces the highest estimates of risk. Moreover, this model does not provide a best estimate of risk, but rather an upper-bound probability that the risk will be less than the risk estimate 95 percent of the time.

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5.0 RISK CHARACTERIZATION

Risk characterization is the final step of the risk assessment process. A comparison is made between calculated doses or intakes and the appropriate reference dose for noncarcinogens and between calculated risks and target risks for potential carcinogens. In the section below, the risks to the potentially exposed population from exposure and subsequent intake of the indicator compounds are calculated for noncarcinogenic and carcinogenic effects (EPA, 1985).

5.1 Noncarcinogenic Hazard Index

The Hazard Index method is used to assess the overall potential for noncarcinogenic effects posed by multiple compounds. The Hazard Index calculates a safety margin, a factor by which the acceptable dose exceeds the estimated exposure level. This approach assumes that multiple subthreshold exposures could result in an adverse effect and that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures to acceptable exposures. This relationship can be expressed as:

$$\text{Hazard Index} = E_1/AL_2 + E_2/AL_2 + \ldots = E_i/AL_i$$

where,

E_i = Exposure level (or intake) for the contaminant.

AL_i = Acceptable level (or intake) for the contaminant.

For a single contaminant, there may be a potential adverse health effect when the hazard index exceeds unity or one. However, because the "acceptable level" itself incorporates a large margin of safety (safety factor), it is possible that no toxic effects may occur

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even if the "acceptable level" is exceeded. For multiple chemical exposures, hazard indices, if summed, may result in an overall Hazard Index that exceeds one even if no single chemical exceeds its acceptable level.

A Hazard Index is calculated for each separate area of the site. The Hazard Index is generally used as a screening tool to determine adverse noncarcinogenic effects from chemicals found on the site. In addition, the calculation of the Hazard Index for each area allows the risk assessor to determine which areas of the site hold the most potential to exceed acceptable exposure levels and hence identify the areas for which remediation efforts should be targeted.

USEPA has developed toxicity information regarding different exposure durations. For short term durations, the value is termed subchronic reference dose (RfDs) or acceptable intake subchronic (AISs). For long term exposure durations, the value is termed chronic reference dose (RfD) or acceptable intake chronic (AIC). These values are obtained from the EPA's on-line Integrated Risk Information System (IRIS), the most up-to-date source for quantitative and qualitative toxicity information for use in risk assessment. If toxicity values are not available on IRIS, other EPA publications such as Health Effects Assessment documents are consulted. See Table 18 for specific Reference Doses and Acceptable Intake (Subchronic and Chronic).

5.2 Carcinogenic Risk

For potential carcinogens, risks are estimated as probabilities. The carcinogenic potency factor is the upper 95 percent confidence limit of the probability of a carcinogenic response per unit intake over a lifetime of exposure. This is not the only methodology to calculate risks, but it is likely to be an upper bound. The use of the linearized multistage

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model methodology assumes that the shape of the dose-response curve is linear in the low dose region. The low-dose carcinogenic risk equation is:

Risk = Lifetime Average Daily Dose * Carcinogenic potency factor

5.3 General Trends

In general, the following trends are apparent in the site-specific calculated hazard indices and risks. Of the various site areas, Area B has the highest potential total hazard index, exceeding 1.0 for both the chronic and subchronic occupational scenarios. With the exception of the total subchronic and chronic hazard index for Area A, the remaining total hazard indices are below 1.0. Lead has the greatest contribution to the calculated hazard index values. In addition, the occupational scenario pathway with the greatest contribution to the total hazard index is soil ingestion, followed by dermal contact with soil and a negligible contribution from dermal contact with water. Separate calculations were made for each area, (i.e., Area A did not include Area B or C). The calculated hypothetical carcinogenic risk is similar for Areas A, B and D, about 3.8 in 100,000.

For the residential scenarios the contribution from bathing is negligible. However, the ingestion of groundwater results in an exceedence of a hazard index of 1.0, with the majority contributed by lead. In evaluating the significance of these numbers it is important to consider the uncertainties and conservatism outlined in Section 5.7.

5.4 Current Land-Use Conditions

In general, the assumptions made in the current-use, no-action scenario overestimate the magnitude of risk, primarily due to the very limited activity on the property at this time.

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Impacted ground water is currently not utilized and consequently not assessed under current use.

5.4.1 Noncarcinogenic Hazard Indices

Tables 19 and 20 present calculated noncarcinogenic Chronic and Subchronic Hazard Indices for substances of concern for current land-use conditions.

Area A
For chronic exposures in Area A, none of the calculated Hazard Indices exceed unity. Chronic Hazard Indices range from 2.3×10^{-5} to 8.3×10^{1}. The total chronic Hazard Index for Area A is 1.1×10^{0}. The subchronic Hazard Indices range from 5.2×10^{-6} to 1.5×10^{0}. The total subchronic Hazard Index is 2.0×10^{0}.

Area B
For Area B, the chronic Hazard Indices range from 2.8×10^{-5} to 5.4×10^{0} and the subchronic Hazard Indices range from 8.2×10^{-6} to 2.0×10^{0}. The total chronic Hazard Index for Area B is 7.5×10^{0}; the total subchronic Hazard Index is 2.8×10^{0}.

Area C
For Area C, the chronic Hazard Indices range from 1.2×10^{-4} to 3.8×10^{-1}. The subchronic Hazard Indices range from 2.1×10^{-5} to 1.6×10^{-1}. The total chronic Hazard Index for Area C is 5.2×10^{-1}; the total subchronic Hazard Index is 2.1×10^{-1}.

Area D
For Area D, the chronic Hazard Indices range from 4.5×10^{-5} to 2.6×10^{-1}. The subchronic Hazard Indices range from 8.3×10^{-6} to 6.4×10^{-2}. The total chronic Hazard Index for Area D is 3.5×10^{-1}; the total subchronic Hazard Index is 8.6×10^{-2}.

Area F
For Area F, total chronic and subchronic Hazard Indices for lead are less than one (3.2×10^{-2} for chronic exposure and 5.3×10^{-3} for subchronic exposure).

Area G
For Area G, the total chronic Hazard Index for lead is less than one (4.1×10^{-2}). The subchronic Hazard Index is 3.5×10^{-2}.

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SUMMARY TABLE 19
OCCUPATIONAL, CURRENT USE--CHRONIC HAZARD INDEX

AREA	CHEMICAL	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Soil Ingestion				
A	Cadmium	3.6E-03		
	Chromium	6.9E-05		
	Lead	8.3E-01		
	Zinc	4.8E-03	8.4E-01	
B	Cadmium	1.1E-01		
	Chromium	1.2E-04		
	Lead	5.4E+00		
	Zinc	1.6E-01	5.6E+00	
C	Cadmium	1.9E-03		
	Chromium	3.4E-04		
	Lead	3.8E-01	3.9E-01	
D	Cadmium	2.0E-03		
	Chromium	1.3E-04		
	Lead	2.6E-01	2.6E-01	
F	Lead	2.4E-02	2.4E-02	
G	Lead	3.1E-02	3.1E-02	
Pathway: Dermal Contact with Soil				
A	Cadmium	1.2E-03		
	Chromium	2.3E-05		
	Lead	2.8E-01		
	Zinc	1.6E-03	2.9E-01	
B	Cadmium	3.9E-02		
	Chromium	4.1E-05		
	Lead	1.8E+00		
	Zinc	5.3E-02	1.9E+00	
C	Cadmium	6.6E-04		
	Chromium	1.2E-04		
	Lead	1.3E-01	1.3E-01	
D	Cadmium	6.8E-04		
	Chromium	4.5E-05		
	Lead	8.7E-02	8.8E-02	
F	Lead	8.1E-03	8.1E-03	
G	Lead	1.0E-02	1.0E-02	
Composite of all Pathways				

AREA	
A	1.1E+00
B	7.5E+00
C	5.2E-01
D	3.5E-01
F	3.2E-02
G	4.1E-02

SUMMARY TABLE 20
OCCUPATIONAL, CURRENT USE–SUBCHRONIC HAZARD INDEX

AREA	CHEMICAL	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Soil Ingestion				
A	Cadmium	9.2E-04		
	Chromium	1.5E-05		
	Lead	1.5E+00		
	Zinc	1.0E-03	1.5E+00	
B	Cadmium	1.9E-02		
	Chromium	2.4E-05		
	Lead	2.0E+00		
	Zinc	2.8E-02	2.1E+00	
C	Cadmium	3.3E-04		
	Chromium	6.1E-05		
	Lead	1.6E-01	1.6E-01	
D	Cadmium	3.6E-04		
	Chromium	2.4E-05		
	Lead	6.4E-02	6.4E-02	
F	Lead	3.9E-03	3.9E-03	
G	Lead	2.6E-02	2.6E-02	
Pathway: Dermal Contact with Soil				
A	Cadmium	3.1E-04		
	Chromium	5.2E-06		
	Lead	4.9E-01		
	Zinc	3.5E-04	5.0E-01	
B	Cadmium	6.6E-03		
	Chromium	8.2E-06		
	Lead	6.9E-01		
	Zinc	9.5E-03	7.1E-01	
C	Cadmium	1.1E-04		
	Chromium	2.1E-05		
	Lead	5.4E-02	5.4E-02	
D	Cadmium	1.2E-04		
	Chromium	8.3E-06		
	Lead	2.2E-02	2.2E-02	
F	Lead	1.3E-03	1.3E-03	
G	Lead	8.8E-03	8.8E-03	
Composite of all Pathways				

AREA	
A	2.0E+00
B	2.8E+00
C	2.1E-01
D	8.6E-02
F	5.3E-03
G	8.8E-02

5.4.2 Calculation of Carcinogenic Risk

PCBs and radium were the only potential carcinogens evaluated quantitatively in this assessment. The total carcinogenic risk for PCBs in Area A is 2.3×10^{-5}; in Area B is 4.8×10^{-5}; and in Area D is 4.4×10^{-5}. These risk estimates represent the upper bound 95% confidence limits, indicating that there is only a 5% probability that actual carcinogenic risks could exceed the estimated values and the actual risk may be as low as 0. These calculated carcinogenic risks are well within EPA's generally acceptable risk range of 10^{-4} to 10^{-6}. Table 21 presents calculated carcinogenic risk values. Quantitative evaluation of radionuclides is given in Appendix E.

5.5 Future Land Use

The future use industrial scenario calculations are similar to the current industrial scenario. For the occupational scenarios the primary difference between current use and future use is the contribution from the hand washing pathways. The results are summarized in Tables 22, 23 and 24 for the on-site occupational scenarios; and Tables 25 and 26 for the off-site residential scenarios.

5.5.1 Residential Potable Water Exposure

Noncarcinogenic Hazard Indices for dermal contact with groundwater (bathing) were evaluated. For adults, the chronic Hazard Indices range from 1.7×10^{-3} to 8.0×10^{-3}; the subchronic Hazard Indices range from 1.8×10^{-4} to 1.2×10^{-3}. The pathway chronic Hazard Index for this exposure in adults is 9.7×10^{-3}; the pathway subchronic Hazard Index is 1.4×10^{-3}.

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SUMMARY TABLE 21
OCCUPATIONAL, CURRENT USE--CARCINOGENIC RISK

AREA	CHEMICAL	CHEMICAL SPECIFIC RISK	TOTAL PATHWAY RISK	TOTAL EXPOSURE RISK
Pathway: Dermal Contact with Soil				
A	PCB, 1248	1.5E-05	1.5E-05	
B	PCB, 1248	2.9E-05		
	PCB, 1254	1.4E-06	3.0E-05	
D	PCB, 1248	1.8E-05		
	PCB, 1254	9.4E-06	2.7E-05	
Pathway: Ingestion of Soil				
A	PCB, 1248	8.7E-06	8.7E-06	
B	PCB, 1248	1.7E-05		
	PCB, 1254	8.1E-07	1.8E-05	
D	PCB, 1248	1.1E-05		
	PCB, 1254	5.5E-06	1.6E-05	
Composite of all Pathways				

AREA	
A	2.3E-05
B	4.8E-05
D	4.4E-05

SUMMARY TABLE 22
OCCUPATIONAL, FUTURE USE--CHRONIC HAZARD INDEX

AREA	CHEMICAL	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Soil Ingestion				
A	Cadmium	3.6E-03		
	Chromium	6.9E-05		
	Lead	8.3E-01		
	Zinc	4.8E-03	8.4E-01	
B	Cadmium	1.1E-01		
	Chromium	1.2E-04		
	Lead	5.4E+00		
	Zinc	1.6E-01	5.6E+00	
C	Cadmium	1.9E-03		
	Chromium	3.4E-04		
	Lead	3.8E-01	3.9E-01	
D	Cadmium	2.0E-03		
	Chromium	1.3E-04		
	Lead	2.6E-01	2.6E-01	
F	Lead	2.4E-02	2.4E-02	
G	Lead	3.1E-02	3.1E-02	
Pathway: Dermal Contact with Soil				
A	Cadmium	1.2E-03		
	Chromium	2.3E-05		
	Lead	2.8E-01		
	Zinc	1.6E-03	2.9E-01	
B	Cadmium	3.9E-02		
	Chromium	4.1E-05		
	Lead	1.8E+00		
	Zinc	5.3E-02	1.9E+00	
C	Cadmium	6.6E-04		
	Chromium	1.2E-04		
	Lead	1.3E-01	1.3E-01	
D	Cadmium	6.8E-04		
	Chromium	4.5E-05		
	Lead	8.7E-02	8.8E-02	
F	Lead	8.1E-03	8.1E-03	
G	Lead	1.0E-02	1.0E-02	
Dermal Contact, hand washing				
On-site	Cadmium	5.6E-05		
	Lead	2.6E-04	3.2E-04	

Composite of all Pathways	AREA	
	A	1.1E+00
	B	7.5E+00
	C	5.2E-01
	D	3.5E-01
	F	3.2E-02
	G	4.1E-02

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SUMMARY TABLE 23
OCCUPATIONAL, FUTURE USE--SUBCHRONIC HAZARD INDEX

AREA	CHEMICAL	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Soil Ingestion				
A	Cadmium	9.2E-04		
	Chromium	1.5E-05		
	Lead	1.5E+00		
	Zinc	1.0E-03	1.5E+00	
B	Cadmium	1.9E-02		
	Chromium	2.4E-05		
	Lead	2.0E+00		
	Zinc	2.8E-02	2.1E+00	
C	Cadmium	3.3E-04		
	Chromium	6.1E-05		
	Lead	1.6E-01	1.6E-01	
D	Cadmium	3.6E-04		
	Chromium	2.4E-05		
	Lead	6.4E-02	6.4E-02	
F	Lead	3.9E-03	3.9E-03	
G	Lead	2.6E-02	2.6E-02	
Pathway: Dermal Contact with Soil				
A	Cadmium	3.1E-04		
	Chromium	5.2E-06		
	Lead	4.9E-01		
	Zinc	3.5E-04	5.0E-01	
B	Cadmium	6.6E-03		
	Chromium	8.2E-06		
	Lead	6.9E-01		
	Zinc	9.5E-03	7.1E-01	
C	Cadmium	1.1E-04		
	Chromium	2.1E-05		
	Lead	5.4E-02	5.4E-02	
D	Cadmium	1.2E-04		
	Chromium	8.3E-06		
	Lead	2.2E-02	2.2E-02	
F	Lead	1.3E-03	1.3E-03	
G	Lead	8.8E-03	8.8E-03	
Dermal Contact, hand washing				
On-site	Cadmium	6.1E-06		
	Lead	4.1E-05	4.7E-05	

Composite of all Pathways	AREA	
	A	2.0E+00
	B	2.9E+00
	C	2.1E-01
	D	8.6E-02
	F	5.9E-03
	G	3.5E-02

SUMMARY TABLE 24
OCCUPATIONAL, FUTURE USE–CARCINOGENIC RISK

AREA	CHEMICAL	CHEMICAL SPECIFIC RISK	TOTAL PATHWAY RISK	TOTAL EXPOSURE RISK
Pathway: Dermal Contact with Soil				
A	PCB, 1248	1.5E-05	1.5E-05	
B	PCB, 1248	2.9E-05		
	PCB, 1254	1.4E-06	3.0E-05	
D	PCB, 1248	1.8E-05		
	PCB, 1254	9.4E-06	2.7E-05	
Pathway: Ingestion of Soil				
A	PCB, 1248	8.7E-06	8.7E-06	
B	PCB, 1248	1.7E-05		
	PCB, 1254	8.1E-07	1.8E-05	
D	PCB, 1248	1.1E-05		
	PCB, 1254	5.5E-06	1.6E-05	
Composite of all Pathways				

AREA	
A	2.9E-05
B	4.8E-05
D	4.4E-05

SUMMARY TABLE 25
RESIDENTIAL, FUTURE USE--CHRONIC HAZARD INDEX

CHEMICAL	RECEPTOR	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Bathing				
Cadmium	Child	2.2E-03		
Lead	Child	1.0E-02	1.3E-02	
Cadmium	Adult	1.7E-03		
Lead	Adult	8.0E-03	9.7E-03	
Pathway: Ingestion of Groundwater				
Cadmium	Child	2.4E+00		
Lead	Child	1.1E+01	1.3E+01	
Cadmium	Adult	1.1E+00		
Lead	Adult	5.3E+00	6.5E+00	
Pathway: Composite				
	Child			1.3E+01
	Adult			6.5E+00

SUMMARY TABLE 26
RESIDENTIAL, FUTURE USE–SUBCHRONIC HAZARD INDEX

CHEMICAL	RECEPTOR	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Bathing				
Cadmium	Child	2.3E-04		
Lead	Child	1.6E-03	1.8E-03	
Cadmium	Adult	1.8E-04		
Lead	Adult	1.2E-03	1.4E-03	
Pathway: Ingestion of Groundwater				
Cadmium	Child	2.5E-01		
Lead	Child	1.7E+00	1.9E+00	
Cadmium	Adult	1.2E-01		
Lead	Adult	8.1E-01	9.3E-01	
Pathway: Composite				
	Child			1.9E+00
	Adult			9.4E-01

For dermal contact with groundwater (bathing), the chronic Hazard Indices for children range from 2.2×10^{-3} to 1.0×10^{-2}; the subchronic Hazard Indices range from 2.3×10^{-4} to 1.6×10^{-3}. The total chronic Hazard Index for this exposure in children is 1.3×10^{-2}; the total subchronic Hazard Index is 1.8×10^{-3}.

Noncarcinogenic Hazard Indices for ingestion of groundwater were evaluated. For adults, the chronic Hazard Indices range from 1.1×10^{0} to 5.3×10^{0}; the subchronic Hazard Indices range from 1.2×10^{-1} to 8.1×10^{-1}. The pathway chronic Hazard Index for this exposure in adults is 6.5×10^{0}; the pathway subchronic Hazard Index is 9.3×10^{-1}.

For ingestion of groundwater, the chronic Hazard Indices for children range from 2.4×10^{0} to 1.1×10^{1}; the subchronic Hazard Indices range from 2.5×10^{-1} to 1.7×10^{0}. The pathway chronic Hazard Index for this exposure in children is 1.3×10^{1}; the total subchronic Hazard Index is 1.9×10^{0}.

5.5.2 Occupational

The occupational future scenarios involving exposures to soils are identical to the current scenario and therefore are not repeated here.

Noncarcinogenic Hazard Indices for dermal contact of ground water during hand washing are summarized. For adults, the chronic Hazard Indices range from 5.6×10^{-5} to 2.6×10^{-4}; the subchronic Hazard Indices range from 6.1×10^{-6} to 4.1×10^{-5}. The pathway chronic Hazard Index for this exposure in adults is 3.2×10^{-4}; the total subchronic Hazard Index is 4.7×10^{-5}. As illustrated in Tables 22 and 23, the contribution of the handwashing pathway to the overall hazard index is minimal.

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5.6 Environmental Evaluation

Definitive conclusions on the degree of current impacts and potential future impacts under the no-action scenario cannot be made with the existing data. A discussion of the available information and data gaps is presented below.

5.6.1 Surface Water

Concentrations of contaminants in surface water are used to assess a migration pathway and the potential for injury to aquatic life. Flow data will be required to understand any contaminant dispersion and any related risks from surface water routes of exposure. Comparison of the contaminant concentrations to surface water standards indicates that lead, iron and zinc exceed Florida surface water standards on or near the site boundary.

5.6.2 Sediment

Sediment sampling is used to determine the extent of migration by the surface water migration route and the potential impacts to aquatic ecosystems. Unlike surface water, no sediment standards or criteria exist at this time.

Data from the RI indicate the presence of PCBs, lead, cadmium, and zinc in sediments on, and downstream from the site. The concentrations of these parameters in sediment decrease rapidly downstream from the FSC property boundary. Iron concentrations are elevated on and near the site and also in one upstream sample. On-site lead and zinc concentrations are several times background concentrations based on analysis from samples collected furthest downstream. Potential impacts from bioaccumulation/bioconcentration of lead, zinc, cadmium, or PCBs cannot be assessed without additional site characterization data.

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5.6.3 Sensitive Species and Habitat Survey

Wetland areas have been preliminarily identified on and adjacent to the site. The potential impact to wetlands cannot be assessed without additional surface water and sediment data and a wetlands delineation.

The limited survey of flora and fauna at the site indicates a diversity of habitats and species. No endangered or threatened species, or habitats of exceptional quality were identified on or near the site. The wetland areas are regarded to be low to moderate quality habitat relative to the everglades and wetland areas associated with Lake Okeechobee. In general, there is currently no evidence to suggest that past or potential releases from the FSC site have or will significantly alter ambient water conditions in the St. Lucie Canal and its associated estuary.

5.7 Site-Specific Health Based Soil Remediation Target Levels

Using intake and exposure assumptions detailed in Sections 4.0 and 5.0, and as per EPA OSWER directive regarding adult ingestion rate, health based soil remediation target levels for an adult for the industrial use scenario are calculated as shown in Table 27. This level is based on worker contact with soil via skin and ingestion exposures.

The HI and Potential Cancer Risk values are presented as summations of the risks for multiple compounds by pathway and by area in order to evaluate the total potential hazard in a conservative manner. However, in the development of "Health Based Soil Remediation Target Levels", the target concentrations are established on the basis of exposure to only a single contaminant at a time.

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TABLE 27
CALCULATION OF ALLOWABLE SOIL CONCENTRATION
OCCUPATIONAL, NONCARCINOGENIC CHRONIC

Occupational - Dermal, Soil Ingestion, and Combined

EQUATIONS

[1] ASC(dermal) = RFD/(ES * CR * CF * ABD * EF * ED * 1/AT * 1/BW)
[2] ASC(ingestion) = RFD/(SR * CF * ABI * EF * ED * 1/AT * 1/BW)
[3] ASC(combined) = RFD/[(ES * CR * CF * ABD * EF * ED * 1/AT * 1/BW) + (SR * CF * ABI * EF * ED * 1/AT * 1/BW)]

SYMBOLS AND DESCRIPTIONS	UNITS	VALUES
ASC = Allowable Soil Concentration	mg/kg	EQ[1] - [3]
ES = Exposed Skin Area(hands, forearms)	cm2/day	1700
CR = Average Soil Contact Rate	mg/cm2	1
CF = Conversion Factor	kg/mg	1.00E-06
ABD = Relative Absorption, Dermal	unitless	0.01
BW = Body Weight	kg	70
RFD = Acceptable Daily Dose	mg/kg-day	See Below
EF = Exposure Frequency	days	120
ED = Exposure Duration	years	40
AT = Averaging Time	days	14600
SR = Soil Ingestion Rate(value per Region IV directive)	mg/day	50
ABI = Relative Absorption, Ingestion	unitless	1

RESULTS

CHEMICAL	*RFD*	*ASC(dermal)*	*ASC(ingestion)*	*ASC(combined)*
Cadmium	1.00E-03	1.25E+04	4.26E+03	3.18E+03
Chromium(tri)	1.00E+00	1.25E+07	4.26E+06	3.18E+06
Lead	4.28E-04	5.36E+03	1.82E+03	1.36E+03
Zinc	2.00E-01	2.50E+06	8.52E+05	6.36E+05

If two chemicals are present, there are infinite combinations of chemical specific concentrations that correspond to a total Hazard Index of 1.0 as shown below.

Chemical Specific Chemical A	Hazard Index Chemical B	Total Hazard Index
0.5	0.5	1.0
0.99	0.01	1.0
0.01	0.99	1.0

No guidance has been found suggesting appropriate apportionment of the Hazard Index.

Of greater importance, is consideration of the relative contribution of each chemical to the total hazard index. For this site the only chemical with a hazard index greater than 1.0 is lead in Areas A and B. The concentration of the metals in the soil is a major factor in calculating the hazard index. The relative concentrations of lead, cadmium and chromium are consistent throughout all areas of the Site; and the concentration of lead consistently exceeds by one and one-half orders of magnitude or more the concentrations of cadmium and chromium. The concentrations of these metals in the materials present in Area B are substantially greater than in other areas of the site. For Area B, more than 95% of the total hazard index is contributed by lead. The hazard indices contributed by cadmium, chromium and zinc are negligible. The same relative contribution by cadmium, chromium and zinc to the hazard indices for other areas would be similar.

Furthermore, an additional consideration is that removal of lead to the remediation goal would result in the simultaneous removal of Cd, Cr, and Zn concentrations. However, this consideration is secondary, in that remediation of lead alone to a hazard index of 1.0, results in a total hazard index of about 1.0 due to the significant contribution from lead, and

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the negligible contribution of the remaining chemicals. Because of these factors, the methods used to calculate the remediation levels are protective, appropriate, and reflect possible contributions from multiple chemicals.

For lead, the EPA OSWER has issued interim guidance (OSWER Directive #9355.4-02) setting forth a soil cleanup level of 500 - 1000 ppm based on direct contact (not groundwater protection) for residential settings. As outlined in the interim guidance, "site-specific conditions may warrant the use of soil cleanup levels below the 500 ppm level or somewhat above the 1000 ppm level." Envirologic Data's risk assessment, based on site-specific conditions, derived a health protective soil concentration for lead of 1360 ppm based on cumulative soil ingestion (a soil ingestion rate of 50 mg/day and a gastrointestinal absorption coefficient for lead of 100%) and dermal contact. This level for lead was based on current and future industrial site uses (see Section 3.1). Note, however, that the potential impact of contaminated soil on groundwater quality (and corresponding environmental fate derived soil remediation target levels) are not addressed herein, but will be addressed in the Feasibility Study.

Surface water and ground water cleanup objectives will be set to meet the ARARs or ACLS. Lead, radium (226 and 228) and gross alpha are the health based standards that exceed acceptable levels throughout most of the ground water plume. The Florida groundwater standards, which represent potential ARARs for the site, are currently exceeded for sodium, lead, and radium in downgradient wells.

5.8 Uncertainties and Conservatism in the Analysis

The National Academy of Sciences (1989) suggests that risk assessments should include a discussion of the strengths and weaknesses of each assessment by describinguncertainties and stating assumptions and limitations. Uncertainties arise in part

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from the fact that the exposure models are restricted by the limitations in both existing knowledge of site-specific exposure conditions and the scientific database regarding the toxicological properties, physiological effects, and environmental fate of chemicals (see NAS for more detailed listing and discussion). Although uncertainties occur at several points in the risk assessment process (see below), conservative (i.e., health-protective) assumptions made in response to data and process limitations result in overstatement of potential risks. For example, in the event that site-specific exposure data may be uncertain, assumptions can be made which overestimate true risk by exaggerating exposure conditions.

5.8.1 Uncertainties

Site-specific uncertainties in the risk assessment approach presented in this report include the following factors:

- Data limitations exist, including: limited air sampling data, limited surface water transport data, and limited knowledge of the mechanism of radium mobilization in ground water, etc;
- The concentrations of PCBs in sediments are uncertain since duplicate samples yielded results that varied between less than 1 and 5 mg/kg;
- Limited information on health effects may represent a source of uncertainty in the final risk estimate;
- There are general toxicological parameter limitations; for example, the estimations of cancer potency factors and reference doses for the substances of concern are associated with uncertainties due to variations in the toxicological database and dose-response assessments in laboratory bioassays;
- Exposure scenarios chosen to represent those most likely to be of interest represent best judgments; changes in governmental policies or marked societal changes could alter these scenarios; and

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- Exposure models include estimated values. Where site-specific exposure parameters are unknown, parameters are estimated based on average reported values.

5.8.2 Conservatism

Where uncertainty is present in the risk assessment, Envirologic Data believes that the approach taken is scientifically valid and conservative, such that the potential risks associated with the indicator compounds are overstated. Some of the conservative assumptions which were adopted for this specific assessment include the following:

- Exclusion of data reported as "not detected" in the calculation of arithmetic means. Incorporating only data where detectable quantities were reported serves to bias the mean toward the elevated concentrations which results in a conservative mean value.

- The concentration of PCBs in sediments is assumed to equal the highest concentration reported in the sample analyses.

- The substances selected as indicator compounds at the FSC site were chosen based on their toxicity, environmental mobility and persistence, and concentrations on site. These criteria comprise a scientifically valid procedure for the selection of indicator compounds. The substances selected represent the most toxic, mobile, and/or persistent chemicals at the site, as well as those in the largest concentrations.

- The use of EPA-derived dose-response criteria (reference doses and cancer potency factors) results in conservative risk estimates. In the development of cancer potency factors, the EPA selects the slope factor which represents the 95% upper bound confidence limit; in other words, the value at which it is believed that there is only a 5% probability that actual cancer risk could be greater than estimated cancer risk. In addition, the methodology for the derivation of these agency slope factors employs the assumption that the dose-response curve is linear in the low dose region. This assumption may or may not be reflective of actual dose-response information.

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- For the derivation of reference doses, uncertainty or "safety" factors are applied to the No-Observed-Adverse-Effect-Level (NOAEL) or NOEL to account for variability in response to a substance between different species or among individuals within a species. The use of these procedures in the development of dose-response values results in the generation of conservative estimates of cancer potency or reference doses.

- Hypothetical exposure routes. Exposure routes identified for the site include hypothetical future use scenarios. Actual exposures in these scenarios may never occur, or they may occur at significantly lower intensities than modeled in this assessment.

- The occupational soil ingestion rate (50 mg/day) used to calculate intakes. There are studies available which may support a lower value than (50 mg/day) for the adult soil ingestion rate. See Appendix H which describes more recent studies that support a lower value of 25 mg/day.

- The concentrations of the substances of concern are assumed to remain constant over time. Environmental fate and transport mechanisms, which result in attenuation or dilution of the concentrations, are not considered.

Envirologic Data adopted these and other conservative assumptions to predict the reasonable worst possible adverse human health or environmental effects that could potentially result from the presence of the contaminants at the FSC site. These assumptions were selected to develop reasonable upper-bound, worst-case estimates of potential risks.

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6.0 SUMMARY

A baseline human health and environmental Risk Assessment has been conducted for Florida Steel Corporation (FSC) Indiantown Mill site in conjunction with ongoing Remedial Investigation activities. The Risk Assessment has been prepared in accordance with "Superfund Public Health Evaluation Manual" guidance and protocol, with appropriate modifications to incorporate facts such as the Environmental Evaluation.

The FSC Indiantown Mill site is located approximately three miles northwest of the community of Indiantown in Martin County, Florida. FSC operated an electric arc furnace (EAF) at the Indiantown site between 1970 and 1982 for recycling scrap steel into new products. The fine particulate dust generated by the EAF contained oxides of several metals, including cadmium, iron, lead, and zinc. The dust was collected by baghouses and, prior to November 17, 1980, the emission control (EC) dust was deposited in two on-site disposal areas.

During 1985, FSC removed approximately 8,000 tons of the EC dust from on-site disposal areas and shipped it, under manifest, to a metal recycling facility for zinc recovery. However, identifiable quantities of EC dust remain in the former disposal areas. The final disposal of the remaining EC dust is one of the topics of the Phase II Remedial Investigation/Feasibility Study (RI/FS).

Since the inclusion of the Indiantown Mill site on the original National Priority List (NPL) in December 1982, FSC has commissioned extensive assessment and remediation work at the site. This work has been planned and conducted in coordination with both the Florida

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Department of Environmental Regulation (FDER) and Region IV of the United States Environmental Protection Agency.

During the early stages of the aforementioned investigations it was discovered that some soils in the vicinity of the mill and a portion of the area containing EC dust were contaminated with PCBs. Following site assessment activities in 1983 and 1984, and in compliance with a Consent Agreement between FSC and FDER, approximately 11,200 cubic yards (18,800 tons) of soil, sediment and EC dust containing PCBs, at a concentration of 50 ppm and above, were excavated from the site during early 1986 and temporarily placed in a secure on-site storage vault.

In compliance with an Administrative Order on Consent between FSC and EPA (dated September 21, 1987), the material in the vault was incinerated during late 1987 and early 1988, thereby destroying the PCBs. Because of the presence of heavy metals, ash from the incineration process was consolidated and placed within a building on the site pending final disposition. The final disposition of this material is one of the subjects addressed in the current RI/FS.

Two by-products of EAF steel production, slag and EC dust were produced at the Indiantown Mill site. Brine was also generated from the water softening process.

Slag is formed from lime, which is introduced as a flux into the furnace to remove metallurgical impurities such as soil and sand from the molten steel.

Emission control dust is the fine particulate material generated as the high temperatures in the EAF drive off and oxidize some of the iron and other volatile metals contained in the scrap. Approximately 25 to 30 lbs. of EC dust were generated for every ton of steel produced. The major constituents in EC dust are iron oxide (approximately 55 percent by

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weight) and zinc oxide (approximately 30 percent by weight). Lead oxide concentrations in EC dust typically range from two to four percent. Since November 18, 1980, EC dust has been regulated as a hazardous waste.

Brine was released intermitently from the water softening unit, which was used to treat groundwater that was added as makeup water to the process water system. The brine contained sodium chloride and high concentrations of total dissolved solids (TDS), including substances that are naturally present in the lower surficial aquifer at the site. Among the solids naturally present in the aquifer or adsorbed onto subsurface soil particles and potentially released with or by the brine are radium-226, radium-228, lead and cadmium.

In order to organize the RI Report, the 150 acre property has been divided into nine discrete areas. The areas have been defined in terms of their former use and the type of contamination determined to be present.

Area A was formerly the active portion of the mill. This area includes all locations where PCBs were detected (and from which they have since been removed at concentrations of 50 ppm and above).

Area B encompasses the two locations where EC dust was formerly disposed of on the plant site. Although most of the dust was removed in 1985, subsequent studies have confirmed that there are residual amounts present, ranging in thickness from a fraction of an inch to a foot or more. Both parcels of Area B are included in Area A.

The boundary of **Area C** circumscribes the known limits of the area where slag was accumulated and processed for sale. Most of the slag remaining on the site was used in the construction of the supporting walls of the secure on-site vault. Area C is included within Area A.

Area D is the location of the former scrap processing yard.

Area E is a Florida Power and Light electrical substation.

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Area F encompasses the open space in the northern portion of the property. During 1986, these areas served as spray fields where water removed from the borrow pit was disposed of following treatment.

Area G covers all of the remaining aboveground portions of the FSC property. As indicated in the Phase II RI report, no industrial activities occurred within Area G, nor is there any evidence of disposal having taken place in this portion of the site,

Area H refers to all surface waters in the study area, including drainage ditches, ponds, borrow pits and other locations with standing water and potentially containing water-borne sediments.

Area I describes the location of the groundwater contaminant plume associated with the brine discharge. It extends beneath the site and approximately 600 feet downgradient beyond the southern property line. The plume extends through a fine sand, surficial aquifer to a depth of 15 to 30 feet below grade. Groundwater quality in the plume is characterized by elevated concentrations of lead, cadmium, zinc, and radium. There is no evidence of impact on the deeper groundwater.

Site assessment activities under the RI were conducted in two phases. Phase I was based primarily on knowledge of the nature and location of prior industrial and disposal activities. The objective in both Phase I and Phase II was to identify and define the nature and extent of chemical constituents that may be present in soils, sediments, groundwater, and surface waters at the site. Sampling was conducted in all areas and more intensively in areas of the site having the highest potential for contamination. Media were analyzed for the full range of Contract Laboratory Program/Hazardous Substance List (CLP/HSL) constituents. Phase II involved additional sampling to further define the nature and extent of contamination associated with the EC dust, and to determine if PCBs were present outside those areas previously addressed.

In the risk assessment, chemicals of concern were identified by reviewing toxicity, relative concentrations, and environmental mobility. The indicator chemicals selected for quantitative analysis are summarized below by media:

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- Soils: cadmium, chromium, lead, PCBs, and zinc;
- Groundwater: cadmium, lead

Cadmium, chromium, lead, and zinc were evaluated for noncarcinogenic endpoints of concern. For the exposure routes considered, radium is classified as a Class A carcinogen (known human carcinogen), PCBs as a Class B2 carcinogen (possible human carcinogen), and lead as a Class B2 carcinogen.

For noncarcinogens, the potential to induce adverse health effects is quantified by calculating the ratio of the predicted dose to the allowable dose. This ratio is termed the hazard index. If the hazard index is less than one, the contaminant is considered unlikely to be associated with any adverse health effects, and therefore unlikely to be of regulatory concern. As the frequency and/or magnitude of the exposures exceeding the allowable health criteria increases, the probability of adverse effects in a human population increases. When the Hazard Index exceeds one, the risk manager will need to look carefully at the data set, the margin of safety incorporated into the health criteria, and the likelihood and conservatism of the exposure assessment (Barnes and Dourson, 1989). For carcinogenic compounds, agency policy is that target goals for lifetime incremental upperbound cancer risk be in the range of 1 in 10,000 to 1 in 1,000,000.

The carcinogenic effects of lead were not quantified because: (1) the bioassay database for lead carcinogenicity is weak and consequently the EPA Carcinogenicity Assessment Group has not calculated a lead cancer potency; (2) the noncarcinogenic effects of lead are better quantified; and (3) protection from the sensitive noncarcinogenic effects is likely to be protective of the carcinogenic effects as well. Although radium was selected as an indicator compound in groundwater, it was not assessed quantitatively because: (1) the methodology for calculating health risks resulting from exposures to radium is (a) not typical

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of standard risk assessment protocol and (b) currently under significant review and revision; (2) ARARs are available for the media and exposure pathway of concern.

The future use of the site will be industrial rather than residential or recreational. This conclusion is based on the following: the site and contiguous lands are zoned industrial; its current use is industrial; official land use planning documents project further industrial zoning for this area; it is bounded on one side by a main line rail track and highway, and on the other side by a 230,000 volt electrical transmission line; a 500,000 volt electrical transmission line will cross near its center within 1 1/2 years; a 300 mega-watt coal-fired electrical power plant will likely be constructed on its southerly boundary (with an easement across the FSC site) within three years; and residential and recreational uses are being precluded by irrevocable covenants recorded in land title records. It is located in a rural area over 2,400 feet from the nearest residence, and over 5,000 feet from the nearest small residential development. For these reasons, the hypothetical receptor exposed to on-site soils is limited to an on-site adult worker. As a reasonable worst case scenario, the receptor is assumed to be engaged in industrial related construction type activity resulting in exposures to contaminated soil through incidental ingestion of soil and dermal contact with soil. The calculation assumes an occupational exposure duration of 40 years, with the frequency of exposure events occurring 5 days/week for 6 months per year.

The chemicals identified in the surface soil and selected for quantitative analysis included one or more of the following: cadmium, chromium, zinc, and PCBs. For the noncarcinogenic compounds, the calculated hazard indices ranged from 5.2×10^{-6} for chromium (Area A) to 5.4×10^{0} for lead (Area B). A health based soil remediation target level of 1360 ppm was derived for lead based on soil ingestion (a soil ingestion rate of 50 mg/day and a gastrointestinal absorption rate of 100%) and dermal contact. Note, however, that the potential impact of contaminated soil on groundwater quality (and corresponding environmental fate derived soil remediation target levels) are not addressed herein, but will be

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addressed in the Feasibility Study. PCBs is the only indicator compound assessed for carcinogenic endpoints of concern. The calculated upperbound lifetime incremental cancer risk ranged from 2.3 in 1,000,000 (Area D) to 4.8 in 100,000 (Area B).

The occupants of residences located hydraulically downgradient from the FSC site (which are all beyond the industrially zoned land and all over 1,400 feet from the leading edge of the plume) are potential future receptors of chemicals in the groundwater plume unless it is contained or remediated or unless the results of dispersion, degradation, and attenuation reduce the concentrations within the plume to levels consistent with applicable ARARs. Accordingly, the potential receptors of contaminants in groundwater include residential adults and children living in downgradient residences as well as on-site adults. The scenarios address hypothetical exposures to both potable and nonpotable groundwater. The exposure pathways quantified are dermal contact via bathing with potable water (residential adults and children), ingestion of potable water (residential adults and children), and dermal contact via hand washing with nonpotable water (occupational adults). The chemicals identified in the groundwater and selected for quantitative analysis were cadmium and lead. The chronic hazard indices for the noncarcinogenic compounds ranged from 5.6×10^{-5} for cadmium (occupational adult--hand washing with nonpotable water) to 1.1×10^{1} for lead (child--ingestion of potable water). FSC has asked DER and U.S. EPA to authorize FSC (Appendix I) to begin treating and removing contaminated groundwater at an early date so that the plume will never reach any water supply wells.

This risk assessment has used methodologies and model parameters that are conservative and therefore protective of human health. The actual risks posed by this site to human and environmental receptors are not likely to be higher than the estimated risks, and are likely to be lower.

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8.0 APPENDICES

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Appendix A - Flora and Fauna List
(pages 129-133)

TABLE A-1

PLANT SPECIES TYPICAL OF CENTRAL FLORIDA WETLANDS AND TRANSITIONAL AREAS ON NATURAL AND DISTURBED SITES

Scientific Name	Common Name
Acer rubrum	Red maple
Alternanthera philoxeroides	Alligatorweed
Andropogon virginicus	Beard grass
Aristida spp.	Three-awn grass
Aster subulatus	Aster
Azolla caroliniana	Mosquito fern
Baccharis halimifolia	Salt bush
Bacopa caroliniana	Water hysop
Centella asiatica	Coinwort
Cephalanthus occidentalis	Buttonbush
Cyperus distinctus	Sedge
Cyperus globulosus	Sedge
Cyperus haspan	Sedge
Cyperus iria	Sedge
Cyperus retorsus	Sedge
Cyperus surinamensis	Sedge
Echinochloa walteri	Barnyard grass
Eclipta alba	
Eichornia crassipes	Water hyacinth
Eleocharis cellulosa	Spike rush
Eupatorium spp.	Dogfennel
Fimbristylis autumnalis	
Hydrocotyl umbellata	Water pennywort
Hypericum fasciculatum	St. John's wort
Juncus effusus	Softrush
Lemna minor	Duckweed
Ludwigia decurrents	
Ludwigia octovalis	
Ludwigia palustris	False loosestrife
Ludwigia peruviana	Primrose willow
Ludwigia repens	
Najas guadalupensis	Naiad
Oenothera laciniata	Evening primrose
Panicum dichotomiflorum	Panic grass
Panicum hemitomon	Maidencane
Palspalum repens	Torpedo grass
Phragmites communis	Giant reed
Pinus elliotti	Slash pine
Pistia stratiotes	Water lettuce
Pluchea purpurascens	Marsh fleabane
Polygonum punctatum	Smartweed

TABLE A-1 (Continued)

Scientific Name	Common Name
Pontederia lanceolata	Pickerelweed
Rhynchelytrum repens	Natal grass
Sacciolepsis striata	
Saggitaria lancifolia	Arrowhead
Salix caroliniana	Southern willow
Salvinia rotundifolia	Water fern
Scirpus validus	Bulrush
Scirpus cubensis	Bulrush
Serenoa repens	Palmetto
Setaria geniculata	Foxtail grass
Spartina bakerii	Switchgrass
Stillingia sylvatica	Queen's delight
Thalia geniculata	Arrowroot
Typha latifolia	Cattail
Wolffiella floridana	
Xyris spp.	Yellow-eyed grass

Sources: Gilbert, et al., 1981; Milleson, et al., 1980.

TABLE A-2

ANIMAL SPECIES TYPICAL OF CENTRAL FLORIDA WETLANDS AND TRANSITIONAL AREAS ON NATURAL AND DISTURBED SITES

FISH

Florida gar
Threadfin shad
Golden shiner
Brown bullhead
Seminole killfish
Golden topminnow
Mosquitofish
Least killfish
Largemouth bass
Warmouth
Bluegill
Redear sunfish
Blue talapia

REPTILES AND AMPHIBIANS

American alligator
Mud turtle
Florida softshell turtle
Florida red-bellied turtle
Banded water snake
Garter snake
Black racer
Rat snake
Cottonmouth
Eastern diamondback
Southern toad
Oak toad
Southern cricket frog
Pig frog
Southern leopard frog
Bullfrog

BIRDS

Pied-billed grebe
Double-crested cormorant
Anhinga*
Florida duck

BIRDS (Continued)

Blue-winged teal
Shoveler
Wood duck
Hooded merganser
Turkey vulture*
Black vulture*
Marsh hawk
Red-tailed hawk
Red-shouldered hawk
American kestrel*
Ospery
Bobwhite
Snowy egret
Cattle egret
Great blue heron*
Green heron
Black crowned night heron
Glossy ibis
American coot
Black-necked stilt
Killdeer*
Greater yellowlegs
Lesser yellowlegs
Least sandpiper
Common snipe
Ring-billed gull
Mourning dove*
Rock dove*
Barn owl*
Ruby-throated hummingbird
Belted kingfisher
Eastern phoebe
Barn swallow
Blue jay*
Fish crow*
Carolina wren*
Mockingbird*
Robin*
Blue-gray gnatcatcher
Loggerhead shrike*
Myrtle warbler

TABLE A-2 (Continued)

BIRDS (Continued)

Palm warbler
Yellow-throated warbler
Prairie warbler
Yellowthroat*
Red-winged blackbird*
Boat-tailed grackle*
Brown-headed cowbird
Cardinal*
American goldfinch*
Savanah sparrow
Vesper sparrow
Field sparrow
Swamp sparrow
Song sparrow*

MAMMALS

Oppossum
Shorttail shrew
Raccoon
Striped skunk
Red fox
Rice rat
Cotton rat
House mouse
Eastern cottontail
Marsh rabbit
Armadillo

Source: Gilbert, et al., 1981.
* - Observed at Florida Steel, Indiantown site.

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Appendix B - Toxicity Profiles
(pages 134-194)

CADMIUM

This document presents background information on the physical and chemical properties of cadmium, environmental fate and its health effects in potentially exposed human populations. This document is not intended to represent a complete analysis of the available scientific research literature, but rather an abbreviated overview of the toxicity of this metal.

Physical and Chemical Properties

Elemental cadmium occurring in nature is found in two valence states: elemental cadmium having a 0 value state, and cadmium compounds having a +2 valence. Cadmium has the potential to form ionic and covalent compounds with anions, and can also complex with ammonia, cyanide, halides, and thiocyanate. Physical and chemical properties are summarized in Table 1.

Environment Fate

Direct releases of cadmium into the atmosphere are largely due to the combustion of fossil fuels and the smelting of nonferrous materials. The cadmium associated with these emission sources are typically bound to particulate matter. Although the atmosphere provides an important route for environmental cadmium transfer, photochemical reactions do not play a significant role in its fate. In an aqueous environment, the dominant fate of cadmium is sorption onto clays and organic substances which results in precipitation, an important mechanism for reducing the aquatic load of cadmium. Soils receive a significant amount of cadmium from phosphate fertilizers and landspread sewage sludge. In soil, cadmium is strongly sorbed by soils, with the sorption increasing as the organic content of the soil increases (ATSDR, 1988).

Table 1: Chemical and Physical Properties of Cadmium

Property	Value	Reference
Molecular weight	112.40 g/mol	IARC, 1976
Appearance	Greyish-white powder	CCD, 1987
Melting point	320.9°C	CCD, 1987
Boiling point	765°C	IARC, 1976

Toxicokinetics

Ingested cadmium is poorly absorbed from the gastrointestinal tract (1-6%). Once absorbed, cadmium induces the production of metallothionein, a low molecular weightprotein whose endogenous role is to regulate zinc and copper metabolism. Metallothionein readily sequesters the free cadmium, and this complex is preferentially deposited in the kidney. Because excretion of cadmium is slow, the corresponding half-life of cadmium in the body has been estimated to range from 17 to 38 years (ATSDR, 1988).

Acute and Chronic Animal Toxicity

Cadmium is most acutely toxic when inhaled. Cats exposed by inhalation to cadmium oxide fumes exhibited fatal pulmonary irritation (EPA, 1984).

Rats exposed via oral route to chronic levels of cadmium exhibited anemia, kidney damage, decreased weight gain, and increased mortality. Rats exposed to cadmium salts developed kidney damage, as well as systolic hypertension and arteriosclerosis. Similar kidney effects have been observed in mice (EPA, 1984).

Rats exposed via inhalation to chronic levels of cadmium have developed lung tumors. Cadmium has been found to be carcinogenic when administered by injection, but not by the oral route (EPA, 1984).

Reproductive effects including decreased fertility, runting and early pup death have been demonstrated in rats and other rodents. Reproductive data are apparently unavailable for the inhalation route; the observed effects have been associated with intravenous, intraperitoneal, and subcutaneous administrations (EPA, 1984).

Acute and Chronic Human Toxicity

For acute inhalation exposure, cadmium concentrations of 0.2 to 0.5 mg/m^3 have been associated with symptoms similar to metal fume fever (ATSDR, 1988). Increased risk of lung disease, including emphysema have been reported following chronic exposure to levels of 0.1 mg/m^3. These exposure levels have also been associated with systemic injury to the kidney for inhalation exposure (ATSDR, 1988).

Effects from oral exposure to cadmium are dependent on the solubility of cadmium compounds. For soluble cadmium compounds, a dose of 0.05 mg/kg has been associated with stomach irritation (ATSDR, 1988).

Because of the preferential accumulation of cadmium in the kidney, this tissue is generally recognized to be the most sensitive to chronic cadmium exposure. A substantial body of data exists which suggests that renal injury exhibits a threshold dose-response curve, with effects generally manifesting at a renal cortex cadmium concentration in excess of 200 ug/g (ATSDR, 1988).

An oral reference dose for cadmium has been proposed and is currently under review by an EPA work group. The reference dose is based on work by Friberg et al. (1974) which suggested that ingestion of 0.35 mg/day by an adult would not exceed a critical renal concentration of 200 μg/g even after a 50 year exposure duration (ATSDR, 1988). This value (0.35 mg/day) was converted into a dose of 0.005 mg/kg-day assuming a 70 kg adult body weight. This dose was used as a human No-Observable-Adverse-Effect-Level (NOAEL), to which an uncertainty factor of 10 was applied to derive the proposed reference dose of 0.0005 (5×10^{-4}) mg/kg-day (ATSDR, 1988).

No reference dose for exposure to cadmium via inhalation has been developed (ATSDR, 1988).

Cadmium has been classified in Group B1 as a probable human carcinogen by inhalation exposures (IRIS, 1989). The dose-response assessment for the carcinogenic effects of inhaled cadmium is based on the work of Thun et al. (1985). In this study, 602 white male cadmium smelter workers who had been employed in production for a minimum of 6 months (between 1940 and 1969) were tracked through the end of 1978. A two-fold excess risk of lung cancer was observed in this cohort. Data on concentrations of cadmium in the urine of workers employed after 1960 indicated that the population might be highly exposed. The authors of the study took into account some factors which may have confounded the results of the study, including concurrent exposure to arsenic, and smoking among exposed individuals. Although an EPA Carcinogen Assessment Group evaluation took issue with the methods used by the authors to discount these factors, the study was considered to be adequate for the purposes of deriving a cancer potency factor. The study by Thun et al. resulted in the calculation of an inhalation cancer potency factor of 6.1 $(mg/kg\text{-}day)^{-1}$.

Summary of Cadmium Criteria and Guidelines

EPA Carcinogen Classification	Group B1
IARC Classification	
animal	sufficient
human	limited
EPA Cancer Potency	
oral	-
inhalation	6.1 $(mg/kg\text{-}day)^{-1}$
proposed RFD (oral)	5×10^{-4} mg/kg-day
ACGIH TLV	0.05 mg/m^3
MCL	0.01 mg/l
MCLG	10 ng/l

Aquatic Toxicity

Freshwater acute values for cadmium range from 1.0 µg/l for rainbow trout to 28,000 µg/l for a mayfly (EPA, 1986). Chronic tests have been conducted using freshwater fish and invertebrate species. Chronic values range from 0.15 µg/l for *Daphnia magna* to 156 µg/l for the Atlantic salmon (EPA, 1986). Acute-chronic ratios range from 0.9021 for the chinook salmon to 433.8 for the flagfish (EPA, 1986).

Freshwater aquatic plants are affected by cadmium at concentrations ranging from 2 to 7,400 µg/l. These values fall in the same range as the acute toxicity values for fish and invertebrate species and are above the chronic values. Bioconcentration factors for cadmium in freshwater range from 164 to 4,190 for invertebrates and from 3 to 2,213 for fishes (EPA, 1986).

Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic organisms for acute and chronic effects are dependent on water hardness. Freshwater organisms should not be affected if the 4-day average concentration of cadmium does not exceed the value given by $e^{(0.7852[\ln(\text{hardness})]-3.490)}$ more than once every 3 years and if the one-hour average concentration does not exceed the value given by $e^{(1.128[\ln(\text{hardness})]-3.828)}$ more than once every 3 years (EPA,1986). For example, at hardnesses of 50, 100, and 200 mg/l as $CaCO^3$, the freshwater acute toxicity values (1-hour concentrations) are 1.8, 3.9, and 8.6 µg/l, respectively. Examples of freshwater chronic toxicity values (4-day concentrations) using similar hardness values are 0.66, 1.1, and 2.0 µg/l (EPA, 1986). If brook trout, brown trout, and striped bass are as sensitive as some data indicate, they might not be protected by this criterion (EPA, 1986).

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CHROMIUM

This document presents background information on the physical and chemical properties of chromium and its health effects in potentially exposed human populations. This document is not intended to represent a complete analysis of the available scientific research literature, but rather an abbreviated overview of the toxicity of this metallic element.

Physical and Chemical Properties

Chromium is a metallic element which occurs in nature primarily as the mineral chromite; elemental chromium does not occur naturally. Chromium compounds are used in the metallurgical industry, and in the chemical industry for metal finishing, manufacture of pigments, leather tanning, wood treatment, and water treatment. The mining processes emit more chromium to the environment than natural processes. Cumbustion of fossil fuels also liberates substantial amounts of chromium into the environment. Chromium has also been identified in cigarette smoke (ATSDR, 1987).

Chromium exists in four oxidation states, but only two, Cr (III) and Cr (VI), are important because of their predominance and stability in the ambient environment (EPA, 1984).

Hexavalent chromium (Cr (VI)) is the second most stable state (compared to Cr (III)); however, it is the most important form toxicologically. Therefore, for the purposes of this document, hexavalent chromium is the focus, and more specifically, the compound of interest is chromium trioxide (CrO_3).

Physical and chemical properties of Cr and CrO_3 are summarized in Tables 1 and 2, respectively.

Table 1: Chemical and Physical Properties of Chromium (Cr)

Property	Value	Reference
Molecular/atomic weight	51.99 g/mol	ATSDR, 1987
Appearance	Steel gray	ATSDR, 1987
Melting point	1157 ± 20°C	Clayton & Clayton, 1981
Boiling point	2672°C	Clayton & Clayton, 1981
Specific gravity	7.20 g/cm^3 (28°C)	Clayton & Clayton, 1981
Solubility	Insoluble in water; insoluble in organic solvents	ATSDR, 1987
Vapor Pressure	1 mm Hg at 1616°C	ATSDR, 1987

Table 2: Chemical and Physical Properties of the Hexavalent Compound, CrO_3

Property	Value	Reference
Molecular weight	100.1	Merck, 1983
Appearance	Dark red delinquescent crystals, flakes or granular powder	Merck, 1983
Melting point	197°C	Merck, 1983
Boiling point	Decomposes	ATSDR, 1987
Specific gravity	2.7 g/cm^3 (25°C)	ATSDR, 1987
Solubility	Soluble in water; soluble in H_2SO_4; soluble in ethanol and ether	Merck, 1983 ATSDR, 1987
Vapor pressure	Unknown	ATSDR, 1987

Environmental Fate

Industrial activities and soil-derived aerosols contribute low concentrations of chromium to the atmosphere. Under normal conditions, i.e., away from industrial sources, Cr (III) and Cr (0) are relatively unreactive in the atmosphere. Cr (VI) may react with particulate matter or gaseous pollutants to form Cr (III). However, such reactions have not been thoroughly studied (EPA, 1984).

Chromium is primarily removed from the atmosphere by fallout and precipitation. Particles of chromium with an aerodynamic diameter smaller than 20 um may remain airborne for long periods and be transported significant distances. Approximately 50% of the total chromium in iron/chrome smelter dust may be bioavailable. Of this fraction, 20% of the bioavailable portion will exist in the Cr (VI) state (ATSDR, 1987).

Cr (VI) exists in several pH dependent forms - hydrochromate, chromate, and dichromate ionic species. The oxidizing ability of Cr (VI) in aqueous solution is pH dependent; the oxidation potential increases at lower pHs (EPA, 1984).

Of the two oxidation states, Cr (III) and Cr (VI), Cr (VI) compounds are the primary soluble forms, and therefore are mobile in the environment. However, in water, organic matter reduces Cr (VI) to Cr (III).

Sources of Cr in surface waters include surface runoff, deposition from air, and industrial and municipal wastewater release. Cr may be transported in the following forms: in solution and organic complexes; adsorbed; precipitated and co-precipitated; in organic solids; and in sediments (EPA, 1984).

In soil, Cr is in mineral, absorbed or precipitated form. The organic matter in soil is expected to reduce any soluble chromate to insoluble chromic oxide (Cr_2O_3). Atmospheric transport of Cr from soil occurs via aerosol formation. It also may be transported from soil through runoff and leaching of water. Flooding and subsequent anaerobic decomposition of

plant matter may increase dissolution of Cr (III) oxides in the soil (EPA, 1984). Because of the natural degradation of Cr (VI) to Cr (III), Cr (III) compounds are expected to be more abundant in soil (ATSDR, 1987). The EPA has estimated that the half-life of chromium in soils may be several years. Bioaccumulation is not a significant source of exposure due to the low levels of Cr in plants and foods and insignificant accumulation in mammalian systems (EPA, 1984)

Pharmacokinetics

The effects of both Cr (III) and Cr (VI) have been studied in man and animals. The relative chemical inactivity of Cr (III) compared to Cr (VI) correlates with various animal acute toxicity studies in chromium salts (EPA, 1984). From the studies, it is evident that high levels of Cr (III) were required to cause the deaths. This is due to the relative insolubility and poor intestinal absorption of most Cr (III) compounds (ATSDR, 1987).

Cr (VI) compounds, however, penetrate cell membranes very effectively and are more readily absorbed through the gut or skin (EPA, 1984). Skin may reduce Cr (VI) to Cr (III) which then may bind to proteins (IARC, 1973).

In the respiratory and GI tracts, soluble Cr (VI) is taken up by epithelial cells through the plasma membrane. Reduction of Cr (VI) occurs from enzymatically mobilized electrons; reduction is limited, so that Cr (III) and Cr (VI) exist simultaneously in the cytoplasm. Cr (VI) is released by diffusion into the bloodstream (EPA, 1984; HSDB, 1988).

Chromium concentrations in tissues decrease with age. However, lung concentrations have been shown to increase with age. This may be due to deposition and retention of chromium-containing particulates or tobacco smoke (EPA, 1984).

Acute and Chronic Animal Toxicity

Chromium metal is biologically inert and has a low order of toxicity when administered orally. The oral LD_{50} for the mouse ranges from 135 mg/kg of body weight to 11,260 mg/kg. Symptoms of chromium poisoning include diarrhea, cyanosis, tail necrosis, and gastric ulcer. Cr (VI) is more acutely toxic than Cr (III), and can cause kidney failure or gastric corrosion. Kidney effects are the primary result of acute exposures to chromium by various routes (EPA, 1984). The LD_{50s} in rats orally administered Cr (VI) compounds ranged from 6.7 to 22.5 mg/kg (ATSDR, 1987).

Cr (VI) administered to rats in drinking water for one year was apparently nontoxic (EPA, 1984). In reproductive studies, both Cr (VI) and Cr (III) have been found to cross the placental barrier in hamsters and mice and enter the fetus during gestation. Fetal uptake is greater with the Cr (VI) form than with the Cr (III) form. Developmental effects included external abnormalities such as cleft palate, skeletal defects, and neural tube defects. A number of mutagenicity studies, primarily of Cr (VI) compounds, demonstrated genotoxic effects. Carcinogenicity studies in animals via the inhalation and oral exposure routes have not induced significantly increased incidences of tumors (EPA, 1984; IRIS, 1988).

There is evidence, however, that chromium (VI) compounds are carcinogenic in rats by other routes of administration. Calcium chromate produces tumors at the sites of administration; lead chromate, sintered calcium chromate, zinc chromate, strontium chromate, sintered chromium trioxide, lead chromate oxide and cobalt-chromium alloy produce sarcomas at the sites of subcutaneous, intramuscular and/or intrapleural administration in rats. Lead chromate also produces renal carcinomas following intramuscular administration in rats.

Data are inadequate to evaluate the carcinogenicity of many chromium compounds in mice, hamsters, guinea pigs and rabbits (IARC, 1973).

Acute and Chronic Toxicity in Humans

Chromium (VI) compounds are responsible for the majority of health problems in humans associated with all chromium compounds. They are irritating and corrosive, and may be absorbed by inhalation, cutaneously, or by ingestion. Dermal effects include ulcerations of the hand and allergic contact dermatitis. Respiratory problems include ulceration of the nasal septum with subsequent perforation, and chronic rhinitis and pharyngitis (EPA, 1984). Workers exposed to CrO_3 or Cr (VI) concentrations of 0.06 - 0.72 mg/m^3 have reported many cases of nasal mucosa injury. However, the length of exposure was variable (ATSDR, 1987). DNA damage was detected in human leukocytes at a concentration of 50 umol/L chromium (RTECS, 1987).

Many epidemiological studies of workers involved in chromate production have established an association between exposure to chromium compounds and lung cancer, particularly squamous cell carcinomas and anaplastic tumors (EPA, 1984).

The available epidemiological evidence does not clearly implicate specific compounds or the valence state of chromium associated with respiratory cancer. However, based on the animal studies, exposure to certain chromium (VI) compounds would provide the greatest risk to humans (ATSDR, 1987; IARC, 1973).

IARC (1973) concluded that there is sufficient evidence of respiratory carcinogenicity in individuals occupationally exposed during chromate production. There are insufficient data on lung cancer risks in other chromium-associated occupations and for cancer at other sites. The Carcinogen Assessment Group placed chromium (VI) compounds into group A, indicating that there is decisive evidence for the carcinogenicity of those compounds in humans (ATSDR, 1987).

Summary of Chromium (VI) Criteria and Guidelines

EPA Carcinogen Classification Cr (VI)	A: human carcinogen by inhalation route
IARC Classification	Group 1
animal	sufficient evidence
human	sufficient evidence
EPA Cancer Potency	
oral	*
inhalation	41.0 $(mg/kg\text{-}day)^{-1}$**
EPA RfD (oral)	0.005 (mg/kg-day)****
ACGIH TLV - Cr (VI)	0.05 (mg/m^3)
MCL - Cr (VI)	0.05 (mg/l)
MCLG - Cr (VI)	0.12 (mg/l)
Ambient Water Quality Criteria (carcinogenicity) - Cr (VI)	0.05 (mg/l)***
OSHA TLV	0.5 mg/m^3 soluble salts

* Epidemiological and laboratory studies are negative to date.

** Based upon human studies.

*** Recommended level for protection of human health, assuming consumption of fish as well as drinking water.

**** Based on NOAEL of 25 mg/l of chromium as K_2CrO_4 (uncertainty factor of 500), using Sprague-Dawley rats exposed to Cr (VI) in drinking water for one year (IRIS, 1988).

Aquatic Toxicity

Acute toxicity values for chromium (VI) for freshwater animal species range from 23 µg/l for a cladoceran to 1.87×10^6 µg/l for a stonefly (EPA, 1986). Species of daphnids have been shown to be especially sensitive. Available data indicate that the acute toxicity of chromium (VI) decreases as water hardness and pH increase.

Chronic toxicity values for daphnids range from < 2.5 to 40 µg/l. For rainbow trout and brook trout, the chronic toxicity value is 265 µg/l; the value for the fathead minnow is 1,987 µg/l (EPA, 1986). For trout species and the minnow, a temporary reduction in growth were observed following exposure at low concentrations during chronic toxicity testing; growth of chinook salmon was reduced at a concentration of 16 µg/l. Except for the fathead minnow, all chronic toxicity tests were conducted in soft water. The bioconcentration factor for rainbow trout is less than 3. Green algae are reported to be sensitive to chromium (VI) (EPA, 1986).

Ambient water quality criteria (AWQC) acute and chronic toxicity values for freshwater aquatic species are 16 and 11 µg/l, respectively. Acute effects are not expected to occur if the average 1-hour acute criteria concentration is not exceeded more than once every three years. Chronic effects are not expected to occur if the 4-day average chronic criteria is not exceeded more than once every three years (EPA, 1986).

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LEAD

Physical and Chemical Properties

Lead, a gray-white metal, is the heaviest metal in Group IVB of the periodic table. Over 95% of the environmental occurrences of lead are found as lead salts (Bushnell and Jaegar, 1986). Since the majority of lead forms released into the environment are oxidized into lead salts, this review will focus on inorganic lead. Because of its soft, malleable, and non-corrosive properties, lead has been used extensively since 2,000 B.C. Present and past uses of lead include: piping, roofing, cooking and storage utensils, solder, storage batteries, ammunition, gasoline additives, paint pigments, and for production of brass and bronze. Inorganic lead salts are relatively high melting point solids and exhibit low vapor pressures at room temperatures (EPA, 1986).

Additional chemical and physical properties of three forms of lead are summarized in Tables 1a, 1b, and 1c.

Environmental Fate

In the atmosphere, the predominant form of lead is particulate bound. The transport and fate of particle bound lead is related to particle size, characteristics of the release source, and atmospheric conditions (EPA, 1986). Inorganic lead salts are unlikely to undergo any significant chemical changes in the atmosphere. In addition, the primary removal mechanism from the atmosphere is wet and dry deposition (EPA, 1986).

The behavior of lead in soils is dependent upon the chemical species of lead, the soil pH, the soil organic content, and the soil ion exchange capacity (ATSDR, 1988). In general, lead is immobile and readily retained by the soil, resulting in a limited potential for leaching into ground or surface water (EPA, 1986).

Table 1a: Chemical and Physical Properties of Metallic Lead

Property	Value	Source
Atomic Weight	207.2	ATSDR, 1988
Appearance	Bluish-gray	ATSDR, 1988
Melting Point	327.4°C	ATSDR, 1988
Boiling Point	1770°C	ATSDR, 1988
Density (g/cm^3)	11.35 at 20°C	ATSDR, 1988
Vapor Pressure (mm of Hg)	1.0 at 980°C	ATSDR, 1988
Solubility	water: insoluble organic solvents: insoluble	ATSDR, 1988

Table 1b: Chemical and Physical Properties of Lead Oxide (PbO)

Property	Value	Source
Atomic Weight	223.20	ATSDR, 1988
Appearance	Yellow	ATSDR, 1988
Melting Point	886°C	ATSDR, 1988
Boiling Point	Decomposes at 1472°C	ATSDR, 1988
Density (g/cm^3)	8.0-9.53	ATSDR, 1988
Vapor Pressure (mm of Hg)	NA	ATSDR, 1988
Solubility	Water: 17 mg/l at 20°C Organic solvents: NA	ATSDR, 1988

Table 1c: Chemical and Physical Properties of Lead Chloride ($PbCl_2$)

Property	Value	Source
Atomic Weight	278.11	ATSDR, 1988
Appearance	white	ATSDR, 1988
Melting Point	501°C	ATSDR, 1988
Boiling Point	950°C	ATSDR, 1988
Density (g/cm^3)	5.85	ATSDR, 1988
Vapor Pressure (mm of Hg)	1 at 547°C	ATSDR, 1988
Solubility	water: 0.99g/100 mL organic solvent: insoluble in ethanol	ATSDR, 1988

Because lead can form numerous salts in an aqueous solution, its fate is complex and variable (ATSDR, 1988). In general, lead forms compounds of low solubility, typically in the range of 30 ug/l to 500 ug/l for water with pH greater than 5.4. As a result of its low solubility and high affinity for soil particles, a significant portion of lead present in river water is likely to be in an undissolved form, such as large particles of the lead salt, or incorporated into particulate matter from surface runoff (ATSDR, 1988). The ratio of lead in suspended solids to lead in the dissolved form varies from 4:1 in rural streams to 27:1 in urban streams.

Toxicokinetics

Depending upon the particle size of airborne lead and individual breathing patterns, a certain percentage of airborne lead is deposited in the lower respiratory tract (EPA, 1986). Once deposited in the lower respiratory tract, lead is almost completely absorbed (ATSDR, 1988). For ingestion of lead, gastrointestinal absorption in children is approximately 50% , while in adults absorption ranges from about 8 to 15% (Chamberlain et al., 1978; Hammond, 1982; as cited in ATSDR, 1988). Dermal absorption of inorganic lead compounds is considered insignificant (EPA, 1979; ATSDR, 1988, Moore et al., 1980).

Once absorbed, lead is distributed throughout the body in a uniform manner, regardless of the route of absorption (Hammond, 1982; as cited in ATSDR, 1988). In the body, lead is preferentially dispersed among several physiologically distinct compartments. In human adults, 95% of the total body burden of lead is found in the bones (Barry, 1975, 1981; as cited in ATSDR, 1988). A portion of the lead associated with bones is considered inert, while another portion is considered labile and responsible for maintenance of an equilibrium of lead between bone and other tissues (Rabinowicz et al. 1976, 1977; as cited in ATSDR, 1988).

Of the lead distributed in the blood compartment, 99% is associated with the erythrocytes and about 1% is associated with plasma and is available for transport to soft tissues. Lead accumulation in most soft tissues such as kidney, liver, and brain, with perhaps

the exception of the renal cortex and aorta, is of a much smaller proportion than accumulation in the bones (ATSDR, 1988).

On a subcellular level, lead is taken up by mitochondria and subsequently interferes with oxidative phosphorylation and ion transport. This inhibition of cellular respiration can result in central nervous system (CNS) effects. Elevated concentrations of blood lead can interfere with heme synthesis. Since heme is utilized by hemoglobin for the transport of oxygen, and also as a structural component of other tissues, this interference can affect multiple tissues (Bushnell and Jaegar, 1986).

Human Toxicity

Acute Effects

The health effects of lead are generally measured by relating blood lead levels to the resulting health effects (EPA, 1986). Generally, experimental studies with animals provide support for observations in human studies, with regard to both the types of effects and the dose-effect relationships (ATSDR, 1988). For that reason, this discussion will focus on human health effects. Due to the pharmacokinetics of lead, in particular the partitioning between different body compartments and resulting half lives, the primary health effects of concern are those associated with chronic exposures.

At high exposure levels, lead produces encephalopathy, gastrointestinal effects, anemia, nephropathy, and electrocardiographic abnormalities in humans. Symptoms include dullness, irritability, poor attention span, headache, muscular tremor, loss of memory, and hallucinations. Lead blood levels associated with the neurobehavioral effects noted above are 120 µg/dL (ATSDR, 1988). Because acute health effects are not considered common manifestations of exposure to inorganic lead compounds, there are limited data available concerning acute health effects (Clayton & Clayton, 1981). The LD_{LO}'s (lowest dose of a substance reported to have caused death) for inorganic lead in laboratory animals range from 300 mg/kg to 30,000 mg/kg (ATSDR, 1988). Although no inhalation lethality data has been

reported for inorganic lead compounds in experimental animals, LC_{50}'s (concentration of a chemical in the air which is lethal to 50% of the animals in an experimental study) reported for organic lead compounds range from 850 mg/m^3 to 8870 mg/m^3 (Cremer and Callaway, 1961; as cited in ATSDR, 1988). No lethality values were reported for human populations.

Chronic Effects

One physiological function particularly sensitive to the effects of lead is heme biosynthesis, characterized by inhibited erythrocyte ALA-D activity and corresponding elevation of its substrate ALA (EPA, 1986). Coulson et al. (1973) exposed male adult volunteers via inhalation for 23 hours per day for three to four months to 3.2 or 10.9 µg/m3 particulate lead. After five weeks of exposure, erythrocyte levels of ALA-D decreased to 85% (3.2 µg/m^3) or 56% (10.9 µg/m^3) of pre-exposure levels. The health effects (i.e. potential neurotoxicity) of lead inhibited ALA-D activity and accumulation of ALA at lower lead exposure levels remains controversial (EPA, 1986). Anemia is a manifestation of chronic lead intoxication resulting from direct erythrocyte cell damage, as well as reduced hemoglobin production. Lead blood levels in workers have shown that 5%, 14%, and 36% of the workers with a corresponding lead blood level of 40-59 µg/dL, 60-79 µg/dL and greater than 80 µg/dL developed anemia (ATSDR, 1988).

At sublethal lead exposures various overt neurological signs and symptoms have been detected. Changes in slow wave electroencephalogram (EEG) patterns and nerve conduction velocities have been correlated with lead exposure corresponding to a lead blood level of 40-60 µg/dL (ATSDR, 1988). Studies have also linked childhood blood lead levels to delays in early cognitive and physical development (Davis and Svendsgaard, 1987; Bellinger et al., 1984, 1987; Dietrich et al., 1987; Baghurst et al., 1987; Wolf et al., 1985; as cited in 40 CFR, 1988). Recent reports have shown a significant association between blood lead levels and IQ deficits in black children of uniformly low socio-economic status (Fulton et al., 1987; Hatzakis et al., 1987; as cited in 40 CFR, 1988). Mean blood levels of 50-70 µg/dL have been shown to decrease the intelligence quotient of children by an average of 5 points (ATSDR, 1988).

Chronic exposure to lead can cause irreversible kidney dysfunction, characterized by vascular sclerosis, tubular cell atrophy, interstitial fibrosis, and glomerular sclerosis (Klaassen et al., 1986). Although several studies have reported correlations between blood lead levels and blood pressure, other studies have reported no association (Gartside, 1988).

Reproductive Effects

Relative to reproductive effects, high blood lead levels in males can decrease fertility, while in females severe occupational exposure to lead has been associated with an increased incidence of spontaneous abortion (ATSDR, 1988).

Carcinogenicity

Epidemiologic studies of lead-exposed workers have investigated the relationship between lead exposure and cancer mortality. The EPA (1986) determined that these studies are inconclusive and therefore inadequate to evaluate the carcinogenicity of lead in humans. Because some lead compounds induce renal tumors in experimental animals, lead is classified as a probable human carcinogen (Group B2). However, the EPA has recommended that quantitative estimates of carcinogenic potency not be used for the purpose of risk assessment (40 CFR, 1988). The EPA has stated that lead induces tumors only at relatively high concentrations of lead, and at lower exposure levels the non-cancer effects of lead are of greatest concern (40 CFR, 1988).

Aquatic Toxicity

The acute toxicity of lead to several species of freshwater animals has been shown to decrease as the hardness of water increases. At a hardness of 50 mg/l the acute sensitivities of 10 species range from 142.5 µg/l for an amphipod to 235,900 µg/l for a midge (EPA, 1986). Data on the chronic effects of lead on freshwater animals are available for two fish and two invertebrate species. The chronic toxicity of lead also decreases as hardness increases and the lowest and highest available chronic values (12.26 and 128.1 µg/l) are both

for a cladoceran, but in soft and hard water, respectively (EPA, 1986). Acute-chronic ratios are available for three species and range from 18 to 62. Freshwater algae are affected by concentrations of lead above 500 µg/l, based on data for four species. Bioconcentration factors are available for four invertebrate and two fish species and range from 42 to 1,700 (EPA, 1986).

Ambient Water Quality Criteria (AWQC) acute and chronic toxicity values for freshwater species are a function of water hardness. The chronic criteria value is given by $e^{(1.273[\ln(hardness)]-4.705)}$ in µg/l (EPA, 1986). Except for very sensitive species, chronic effects are not expected to occur if the 4-day average concentration is not exceeded more than once every three years. Similarly, the acute toxicity criteria value is given by $e^{(1.273[\ln(hardness)]-1.1460}$ in µg/l (EPA, 1986). Unacceptable acute effects are not expected if the 1-hour average concentration is not exceeded more than once every three years.

Summary of Criteria and Guidelines for Lead

EPA	Allowable Intake Chronic (inhalation Allowable Intake Chronic (oral)	none listed none listed
EPA	Maximum Contaminant Level	0.05 mg/l
ACGIH (dusts and fumes)	TLV-TWA	0.15 mg/m^3

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POLYCHLORINATED BIPHENYLS (PCBs)

In this section, the potential adverse health effects associated with exposure to PCBs are presented, as well as background information on the physical and chemical properties and environmental fate. The information in the following profile is accurate and complete within the limits of the searches and evaluations conducted by Envirologic Data. This document is not intended to represent a complete analysis of the available scientific research literature, but rather an overview of the toxicity of this class of chlorinated hydrocarbons.

Physical and Chemical Properties

Polychlorinated biphenyls (PCBs) are a class of man-made chemicals consisting of 209 individual compounds that contain a variable number of substituted chlorine atoms on the aromatic rings. Because of their heat-resistant and insulating properties, they have been used extensively as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacturing of PCBs in the U.S. stopped in 1977 when it was discovered that PCBs persisted in the environment and could accumulate in the food chain. Many transformers and capacitors filled with fluids containing PCBs are still in use, however. Commercial PCB mixtures were marketed under various trade names, e.g. Aroclor (Monsanto, USA), Clophen (Bayer, West Germany) and Kanechlor (Kangafuchi, Japan). In the United States, PCBs (also referred to as Aroclor in this text) were characterized by a four-digit code. The first two digits, 12, indicate that the parent molecule is a biphenyl and the last two digits indicate the chlorine content as a percentage of the total weight of the product. For example, Aroclor 1254 is a biphenyl containing 54% chlorine by weight.

The physical and chemical properties and the chemical formulations of PCBs vary considerably, depending on the amount and position of chlorine substitution on the aromatic rings. PCBs are characteristically non-flammable and non-reactive and exhibit low water solubility. Physical and chemical properties for two PCB isomers, Aroclor 1254 and 1260, are summarized in Table 1.

Table 1: Physical and Chemical Properties of PCBs

Property	Value: Aroclor 1254	Value: Aroclor 1260	Reference
Molecular formula	$C_{12}H_{10-n}Cl_n$, n = 1-10		Kimbrough, 1987
Molecular weight	328.4	375.7	Hutzinger et al., 1974; cited in ATSDR, 1987
Appearance	Light yellow viscous liquid	Light yellow sticky resin	Monsanto, 1974; cited in ATSDR, 1987
Melting point	Unknown	Unknown	
Boiling point	365-390	385-420	Monsanto, 1974; cited in ATSDR, 1987
Solubility	0.012	0.0027	Monsanto, 1974; cited in ATSDR, 1987
water mg/l	0.057 (24°C)		Paris et al., 1978; cited in ATSDR, 1987
organic solvents	Very soluble	Very soluble	EPA, 1985a; cited in ATSDR, 1987
Density, g/cm^2 at 25°C	1.50	1.58	Monsanto, 1974; cited in ATSDR, 1987
Partition Coefficients (log)			
octanol-water (K_{ow})	6.5	6.8	ATSDR, 1987
soil sorption (K_{oc})	4.81	5.54	Waid, 1986
Vapor pressure mm Hg at 25°C	7.71×10^{-5}	4.05×10^{-5}	Monsanto, 1974; cited in ATSDR, 1987
Henry's law constant, atm-m^3/mol at 25°C	2.0×10^{-3}	4.6×10^{-3}	ATSDR, 1987

Environmental Fate

The current sources of PCB releases to the environment include leaching from landfills containing PCB wastes, incineration of PCB-containing materials, and disposal of PCBs to open areas (Weant and McCormick, 1984; Murphy et al., 1985, cited in ATSDR, 1987). Existing evidence indicates that an environmental cycling process involving volatilization of PCBs from water or soil into the atmosphere accounts for the major release of PCBs to the environment (Swackhamer and Armstrong, 1986; Larsson, 1985; Murphy et al., 1985, cited in ATSDR, 1987). The cycle is repeated once PCBs are returned to earth via wet or dry deposition. The environmental persistence of PCBs varies according to the degree of chlorination. PCBs that are highly chlorinated are resistant to biodegradation and are slow to break down in the environment.

The behavior of PCBs in soil depends on both the chlorine content of the specific compound and on the characteristics of the soil (EPA, 1984). In general, significant leaching is not expected to occur in soil due to the low water solubility, high octanol-water partition coefficients and strong adsorption of PCBs to soils. As the degree of chlorination of the PCB molecule increases, the soil adsorption is increased, thus decreasing the rate of leaching. The half-life of PCBs in soil also varies according to the chlorine content of the specific congener. Half-lives range from several days for PCBs containing one or two chlorine atoms up to an infinite period of time for PCBs containing five or more chlorine atoms (Pal et al., 1980, cited in EPA, 1984). PCBs in soil have not been shown to degrade by processes other than biodegradation (ATSDR, 1987).

PCBs may be physically removed from the atmosphere by both dry and wet deposition (Eisenrich et al., 1981; cited in ATSDR, 1987). Dry deposition occurs only for PCBs in the particulate phase. The vapor pressures of the Aroclors indicate that they will exist primarily in the atmosphere in the vapor phase, thus utilizing wet deposition as the primary route of transport to ground surfaces (ATSDR, 1987). According to Eisenreich et al. (1981; cited in ATSDR, 1987), 87% to 100% of PCBs in air are operationally in the vapor phase. The half-lives in the atmosphere of the vapor phase reaction between PCBs and hydroxyl radicals

(photochemically formed by sunlight) range from 12.9 days to 1.31 years for various isomers (ATSDR, 1987).

PCBs in water tend to sorb to sediment and suspended matter rather than remaining in the water column. Aroclors with a low chlorine content will sorb less strongly than the more highly chlorinated Aroclors. PCBs containing less than three chlorine atoms may be degraded in water (Pal et al., 1980; Callahan et al., 1979; cited in ATSDR, 1987), while PCBs containing four chlorines may be partially degradable, and those containing five or more chlorines are resistant to degradation. No estimate of half-lives in natural bodies of water is available (EPA, 1984). Dissolved PCBs present in natural water may be removed by volatilization (Lyman et al., 1982, cited in ATSDR, 1987). PCBs containing a higher chlorine content have a decreased rate of volatilization relative to the lower chlorinated PCBs because of adsorption to sediments. Photolysis is the major chemical degradation process in water (Leifer et al., 1983, cited in ATSDR, 1987).

Pharmacokinetics

PCBs consist of mixtures of different congeners and impurities with varying characteristics, which complicates the understanding of the toxicokinetics associated with PCB products. The pharmacokinetic studies cited below have commonly used both mixtures of PCB congeners and specific congeners to study fate. Exposure to PCBs by the general population occurs mainly through the oral route, particularly the consumption of fish (ATSDR, 1987). Occupational exposure, however, occurs primarily through the inhalation and dermal routes.

Oral absorption of PCBs administered to rats and monkeys was reported in two studies to be greater than 90% for all dosage levels, indicating that PCBs are easily absorbed (Albro and Fishbein, 1972; Allen et al., 1974, cited in EPA, 1984). One study, however, reported that as much as 87% of a single oral dose passed unabsorbed through the intestine of monkeys (Norbach et al., 1978; cited in EPA, 1984). Humans who consumed PCB-contaminated fish exhibited elevated PCB blood levels, indicating gastrointestinal absorption, but the extent of

absorption was not quantified (Humphrey, 1976; cited in ATSDR, 1987). Rats exposed by inhalation readily absorbed PCBs, as indicated by the concentration present in the liver 15 minutes post exposure, which was greater than 50% of the concentration present after two hours (Benthe et al., 1972; cited in ATSDR, 1987). One occupational study of a capacitor manufacturing facility found a reduced forced vital capacity (FVC) of the lungs in 14% of the workers, but the exposure route was not specified (Warshaw et al., 1979). Evidence of dermal absorption of PCBs has been reported to occur in guinea pigs, rabbits, and rats (Miller, 1944; Nishizumi, 1976; cited in ATSDR, 1987). Dermal absorption was reported to be the major route of uptake in an occupational study of electrical workers exposed to PCBs (Maroni et al., 1981; cited in ATSDR, 1987).

PCBs are distributed in the body in a biphasic manner, exhibiting rapid clearance from the blood and subsequent accumulation in the liver and muscle (Drill et al., 1981, cited in ATSDR, 1987). PCBs may be translocated from the liver to adipose tissue for storage. Several studies reviewed by EPA (1987) and reported in ATSDR (1987) have shown that PCBs concentrate in human breast milk. Wolff (1983; cited in ATSDR, 1987) reported breast milk concentrations of PCBs to be 4 to 10 times higher than in maternal blood.

Jacobson et al. (1984; cited in ATSDR, 1987) corroborated Wolff's results, and also reported the detection of PCBs in amniotic fluid, umbilical tissues, and baby's blood, based on a case study of a woman occupationally exposed in a capacitor factory. PCB levels in these tissues were lower than in the maternal blood. Studies of women exposed to PCBs through fish consumption also reported higher maternal PCB serum concentrations than umbilical cord serum concentrations (Jacobson et al., 1984; Bush et al., 1984, cited in ATSDR, 1987). Studies of mice, monkeys, and ferrets have shown that PCBs cross the placental barrier and accumulate in fetuses (EPA, 1987; cited in ATSDR, 1987). One study of monkeys fed PCBs during gestation reported that PCB concentrations detected in the skin of offspring were similar to the concentrations detected in subcutaneous maternal fat, but that at weaning the mesenteric fat PCB concentration in offspring was 4 to 7 times greater than maternal subcutaneous fat (Barsotti and Van Miller, 1984; cited in ATSDR, 1987).

Human Toxicity

Data on human health effects comes primarily from occupational studies and from the Yusho and Yucheng poisoning incidents that occurred in Japan and Taiwan in 1968 and 1979, respectively. Several studies of workers exposed to PCBs reported effects that included chloracne, pruritis, rashes, hyperpigmentation, thickening and discoloration of fingernails, respiratory complaints, and eye irritation (Kimbrough, 1987). Although exposure to PCBs can result in alterations of liver enzymes (e.g., SGOT, GGTP), these changes have not been correlated with clinically detectable liver disease (ATSDR, 1987). One study investigated pregnancy outcome and birth weight among capacitor workers exposed to PCBs, and reported that the gestation period was reduced by one week and that infants weighed slightly less than controls (Taylor et al., 1984; cited in Kimbrough, 1987). Data on smoking and alcohol consumption (factors known to affect birth weight) were not reported; therefore, the results should be viewed with caution. Several studies have reported a reduced gestation period and behavioral changes related to either higher fish intake or higher intake of PCBs (Schwartz et al., 1983; Jacobson et al., 1983, 1984; Fein et al., 1984; cited in Kimbrough, 1987).

Health effects due to the Yusho poisoning incident in Japan, in which people consumed rice oil contaminated with PCBs, were similar to those reported in occupational settings, but more severe. Palmar sweating and muscular weakness were also observed. Infants born to Yusho mothers exhibited reduced birth weight and height, hyperpigmentation of skin and mucous membranes, precocious dental eruption, and decreased calcification of the cranium (EPA, 1984). The poisoning incident that occurred in Taiwan over ten years later was also the result of the consumption of PCB-contaminated rice oil. In both Japan and Taiwan, the disease was first recognized due to the development of chloracne in the affected patients (Kimbrough, 1987). The rice oil was found to contain not only PCBs, but 2,3,7,8-tetrachlorodibenzofuran (TCDF), 2,3,4,7,8-pentachlorodibenzofuran (PCDF) and polychlorinated quaterphenyls (PCQs) (Buser et al., 1978; cited in Kimbrough, 1987). PCDFs are thought to be several times more toxic than PCBs (EPA, 1984).

One study found a positive correlation between serum PCB levels and blood pressure in residents who were exposed to fish containing both PCBs and DDT (Kreiss et al., 1981). Rates of borderline and definite hypertension were 30% higher than expected based on national rates. The significance of this correlation is unknown, since exposure to more than one chemical was involved.

The effect of PCBs on the immune system is not yet well understood. Drill et al. (1981; cited in ATSDR, 1987) postulated that immunesuppression may occur only at high dosages, and as an effect secondary to malnutrition. These conclusions are based on splenic and lymphoid system histological alterations observed in PCB-treated animals. The immunotoxicity of PCBs appears to be dependent on the ability of PCBs to both bind to and cause the expression of the aromatic hydrocarbon receptor (EPA, 1987).

There is limited data on the carcinogenic effects of PCBs in humans. Eleven out of thirty-three deaths among Yusho patients were from malignancies (EPA, 1984). In an occupational study, three cases of melanoma were observed, whereas 0.04 cases would have been expected (Bahn et al., 1976; cited in EPA, 1984). IARC has stated that this is suggestive evidence that PCBs are human carcinogens (IARC, 1982). Two other occupational studies of capacitor workers reported increased incidence rates of cancer, but both studies suffered from methodological problems. Brown and Jones (1981; cited in Kimbrough, 1987) reported excess deaths from both liver cancer and rectal cancer. The increase was not statistically significant for either site or for both sites combined. Bertazzi et al. (1981; cited in Kimbrough, 1987) reported a statistically significant increase in the number of deaths from all neoplasms in males, and an elevated number of deaths from all causes in females. The numbers in the study, however, were small.

Summary of PCB Criteria and Guidelines

EPA (1987) Carcinogen Classification	Group B2
IARC Classification (1982)	
Animal	Sufficient evidence
Human	Inadequate evidence
EPA (1987) Cancer Potency	
Oral	7.7 mg/kg-day
TLV-TWA (ACGIH, 1986)	0.5 mg/m^3 (Aroclor 1254)
Ambient Water Quality Criteria (carcinogenicity) (EPA, 1980)	0.79 - 0.0079 ng/l at 10^{-5} to 10^{-7} risk levels
Drinking Water Criteria (carcinogenicity) (EPA, 1987)	0.5 - 0.005 ug/l at 10^{-4} to 10^{-6} risk levels

Aquatic Toxicity

The acute toxicity of polychlorinated biphenyls (PCBs) to freshwater animals has been measured with three invertebrate and four fish species, and the species mean acute values range from 2.0 to 283 µg/l. The data from flow-through tests with measured concentrations are similar for fish and invertebrate species, and probably accurately reflect the toxicity of the compounds. The data from static tests are more variable, and many may not reflect actual toxicity, due to volatility, solubility, bioconcentration, and adsorption characteristics of the

various PCB compounds. Eleven life-cycle or partial life-cycle tests were completed with three invertebrate and two fish species; the chronic values range from 0.2 to 15 µg/l. The freshwater residue data show that PCBs accumulate to relatively high levels in fish and invertebrate tissues, and that for most species PCBs are not rapidly depurated when exposure is discontinued. Bioconcentration factors for invertebrate species range from 2,700 to 108,000. Bioconcentration factors for PCB exposures of fish species range from 3,000 to 274,000 (EPA, 1980).

For polychlorinated biphenyls the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.014 µg/l as a 24-hour average. The concentration of 0.014 µg/l is probably too high because it is based on bioconcentration factors measured in laboratory studies, but field studies apparently produce factors at least 10 times higher for fishes. The available data indicate that acute toxicity to freshwater aquatic life probably will only occur at concentrations above 2.0 µg/l and that the 24-hour average, should provide adequate protection against acute toxicity (EPA, 1986).

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In a review of the metabolic process of PCBs, EPA (1987) determined that the rate of metabolism decreases as the degree of chlorination on both phenyl rings increases. Specific PCB congeners metabolized by different species may exhibit considerable variation in metabolite distribution. Although the major PCB metabolites are phenolic products, other metabolites that have been identified are trans-dihydrodiols, polyhydroxylated PCBs and methyl ether derivatives (ATSDR, 1987). The presence of trans-dihydrodiol metabolites indicates that PCB metabolism occurs through formation of arene oxide intermediates that are potential electrophiles, having been implicated in cellular necrosis, mutagenicity, and carcinogenicity (EPA, 1987).

PCB excretion is largely dependent on the metabolism of PCBs to more polar compounds (EPA, 1987). PCB elimination from tissues is dependent on structure-dependent metabolism rates of individual PCB congeners at equilibrium. Metabolite elimination of the more highly chlorinated congeners occurs primarily through the feces (Goto et al., 1974; cited in EPA, 1987).

Animal Toxicity

The acute toxicity of PCBs to various laboratory animals is similar (with the exception of the guinea pig) regardless of route of administration, species, or age of the animal. The single dose oral LD_{50} values in rats, rabbits, mice, and mink range from 0.5 to 20 g/kg body weight (EPA, 1986). The oral LD_{50} of guinea pigs is reported to be 0.5 mg/kg (McConnell, 1980; cited in EPA, 1984).

A number of studies have been conducted to assess the subchronic and chronic toxicity of PCBs to laboratory animals. When the PCB congeners Aroclor 1254 and Aroclor 1260 were orally administered to rats, the following health effects were observed: an increase in relative liver weight, porphyria, lipid accumulation and extensive foci of adenofibrosis in the liver, an increase in serum cholesterol, SGOT, and beta globulin levels, a decrease in serum gamma globulin, and skin lesions on the ears (EPA, 1984). Health effects observed in mice included skin lesions on the ears, hepatic lesions, and moderate hepatomegaly. In PCB-treated

monkeys, the skin lesions, liver pathologies, and serum chemistries were similar to the effects observed in rats (EPA, 1984).

Several studies have been conducted on the reproductive and teratogenic effects of PCBs in laboratory animals. There is evidence that PCBs can cross the placenta. Fetotoxicity was observed in rats, mice, and monkeys (EPA, 1984). Abortions and fetal mortality have been observed in rats, rabbits, and mice, and reduced litter size has been observed in rats (EPA, 1984). Monkeys are the most sensitive species to the reproductive effects of PCBs. Studies have reported that mothers orally exposed to PCBs (congeners other than Aroclor 1254 and Aroclor 1260) produced infants that exhibited reduced body weight and hyperpigmentation (Allen and Barsotti, 1976; Allen et al., 1979; Barsotti, 1981; cited in EPA, 1984). Nursing resulted in loss of facial hair, edema of eyelids, gastric hyperplasia and vomiting, and liver degeneration in the offspring. One study conducted in mice found teratogenic effects (Marks et al., 1981; cited in EPA, 1984). An increased incidence of cleft palate and hydronephrosis was observed.

Mutagenicity data is conflicting. Both negative and positive responses were observed in a number of short-term tests. The variable data observed with PCBs is consistent with the poor response and lack of correlation with animal carcinogenicity data reported for many highly chlorinated compounds in short-term assays (EPA, 1986).

Several animal bioassays have been conducted to assess the carcinogenic potential of PCBs. Early studies, however, were considered inadequate as a result of small group size or periods of exposure extending for less than one year (EPA, 1984). A later study using a larger group size and a longer exposure period reported an increased incidence of hepatocellular carcinomas in female rats (Kimbrough, 1975; cited in EPA, 1984). A recent study by Norback and Weltman (1985; cited in EPA, 1984) reported incidences of trabecular carcinomas, adenocarcinomas, and neoplastic nodules in rats exposed orally to Aroclor 1260 for over two years. This study served as a basis for the most recent cancer potency developed by EPA (1987).

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RADIUM

This document presents background information on the physical and chemical properties of radium, environmental fate and its health effects in potentially exposed human populations. This document is not intended to represent a complete analysis of the available scientific research literature, but rather an abbreviated overview of the toxicity of this radionuclide. The scientific database with respect to chronic low-level human and animal toxic effects is limited, as reflected in the numerous data gaps.

Physical and Chemical Properties

Radium is a naturally-occurring silvery white radioactive metal which exists in several isotopic forms. Radium has been found to be naturally occurring in the environment in very low concentrations in soil, rocks, coal, plants, and food (ATSDR, 1989). Physical and chemical properties are summarized in Table 1.

Environmental Fate

The principal transport mechanism for radium in air is adsorption to particulate matter, such as coal fly ash. In water, radium exists primarily as a divalent ion (Ra^{2+}). The dissolved concentration of radium in water is typically controlled by adsorption-desorption mechanisms at the solid-liquid interfaces, as well as by the solubility of the substrate containing the radium (ATSDR, 1989). In water, radium degrades by radioactive emission processes (i.e. decay) only. The rate of decay is specific for each decay progeny (also called daughter particle) (ATSDR,1989).

The chemical properties of dissolved radium are similar to barium, calcium, and strontium. An increase in pH results in an increase in the solubility of radium salts. Radium has a tendency to coprecipitate with barite and sparingly soluble barium sulfate to produce $(BaRa)SO_4$. Therefore, in environmental settings where barite and barium sulfate are present, migration of radium is expected to be insignificant. Overall, limited field data

Table 1. Chemical and Physical Properties of Radium (Ra)

Property	Value	Reference
Molecular weight	226.03 g/mg	ATSDR, 1989
Appearance	Silver-white solid	ATSDR, 1989
Melting point	700°C	ATSDR, 1989
Boiling point	< 1140°C	ATSDR, 1989
Solubility		
Water at 20°C	Decomposes	
Other solvents	Decomposes in acids	ATSDR, 1989

support the generalization that radium is not mobile in groundwater systems (ATSDR, 1989).

Radium is not typically mobile when in contact with solid materials such as soil. However, if ionic conditions are favorable as described above, desorption off the solid will occur, rendering the ion available for plant uptake and incorporation into the animal food chain. Radium has been reported to bioaccumulate in plants and bioconcentrate in the animal food chain, where it moves from lower trophic levels up to humans (ATSDR, 1989).

Toxicokinetics

During a laboratory experiment, several capsules containing radium sulfate ruptured, exposing several laboratory workers. Laboratory tests indicated that some of the radium had been absorbed by the lungs of these workers and had entered the circulatory system, ultimately having been deposited in the bones. Some of the radium may have been coughed up and subsequently swallowed to have been absorbed from the stomach (ATSDR, 1989).

Studies of a group of elderly subjects who ingested a solution of radium indicated that about 80% was promptly excreted in the feces during the first 10 days, while the remaining 20% was retained and distributed systemically. In an injection study of similar subjects administered radium-224, a feces to urine excretion ratio was reported to be 30:1 (ATSDR, 1989).

Oral administration of radium in rats resulted in a low rate of absorption. At 400 to 500 days after administration, the rats retained 1 to 7% of the ingested dose, primarily in the skeleton. When injected intradermally, the rats retained 77% of the radium dose 140 to 300 days after the injection (ATSDR, 1989).

Acute and Chronic Animal Toxicity

Data is limited regarding acute and chronic animal responses to ingested or inhaled radium. Evans et al. (1944) reported that rats administered radium by dropper for 20 days manifested osteogenic sarcomas in 3 and possibly all 5 rats. The lowest dose to induce a malignancy was 73 microcurie per kilogram (μCi/kg). A very early study (Proescher and Almquest, 1914) with mice reported that injection of radium (most likely Ra-226) at 2,000 to 4,000 μCi/kg was fatal in 7 to 10 days. Humphreys et al. (1985) reported that 12-week-old mice showed no evidence of a decrease in life span up to the 60 μCi/kg dose level. Schoeters and Vanderborght (1981) reported that the number of hemopoietic stem cells in the bone marrow of mice injected with Ra-226 at a dose level of 17,820 μCi/kg was depressed at least 100 days after the injection, but returned to normal by 300 days. Mice injected with 22,320 μCi/kg of the chloride salt of Ra-226 expressed a marked depression in the number of peripheral white blood cells 400 days after injection; 530 days post-injection, these levels improved (Schoeters et al., 1983).

Acute and Chronic Human Toxicity

Data regarding the acute toxicity of radium in humans is lacking. The database for human responses to chronic radium exposures is well defined for high doses. In general, it is believed that the adverse effects of radium are the direct result of radiation emitted from the element as well as the daughter products (ATSDR, 1989).

Humans at greatest risk from exposure to radium include those exposed during early childhood or adolescence; the endpoints of toxicity as a result of such exposures have included tooth breakage, reduction in bone growth, bone sarcomas, and breast cancer in females who were exposed to total doses greater than 12 μCi/kg (ATSDR, 1989). In exposed humans in general, liver and kidney cancers are suspected of being induced by Ra-224 (Spiess et al., 1989). Both Ra-226 and Ra-228 have been reported to cause bone sarcomas; Ra-226 alone is thought to incur carcinomas of the bones enclosing the mastoid air cells and paranasal sinuses. It has been estimated that Ra-228 is about 2.5 as potent (per μCi) with

respect to the induction of bone sarcomas as Ra-226 (Rowland et al., 1978). Radon, a gaseous daughter particle, is believed to cause carcinomas of the mastoid and paranasal sinuses, by migrating from the location in the body where the daughter product is formed to a location where it becomes trapped. Once trapped, radon particles irradiate adjacent cell tissue, potentially causing malignancies (Rowland et al., 1989; Stebbings et al., 1984). It is noteworthy that leukemia, which is often induced in humans by irradiation of marrow cells, has not been observed in the exposed populations (Baverstock and Papworth, 1985; Spiers et al., 1983; Spiess et al., 1989).

The largest database with documented chronic effects is that of the female radium dial painters, who tipped their RA-226 and Ra-228 contaminated paint brushes with their lips or tongues in the process of applying luminating paint to instrument panels. Chronic adverse effects among these workers included anemia, regenerative anemia, generative anemia, pernicious anemia, as well as bone sarcomas, carcinomas of the perinasal sinuses and mastoid cells, and deterioration of skeletal tissue. It has been estimated that the lowest total intake of radium associated with a malignancy was 1.03 μCi/kg based on a female body weight of 58 kilograms (ATSDR, 1989).

Another significant source of data in humans exposed to radium were German adults and children who were injected with Ra-224 for treatment of tuberculosis, ankylosing spondylitis, and other diseases. The average total Ra-224 activity was 4.8μCi/kg (Wick and Gossner, 1989). Out of 2,000 individuals who received this treatment, 899 cases are currently being followed (Spiess et al., 1978).

In a second study of persons injected with Ra-224 in Germany from 1948 to 1975, and included 1,473 ankylosing spondylitis patients who received intravenous injections but at lower levels than the first group. Wick and Gossner (1989) reported that the average total activity was 4.8 μCi/kg, and that 10 cases of bone marrow failure were observed in these patients, compared to 7 in the controls. The significance of the excess cases was not addressed (Wick and Gossner, 1989).

Summary of Radium Criteria and Guidelines

EPA Carcinogen Classification:	Group A - human carcinogen
MCL	
Radium-226, radium-228	5 pCi/L
Gross alpha particle activity (excluding radon and uranium)	15 pCi/L

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ZINC

This document presents background information on the physical and chemical properties of zinc and its health effects in potentially exposed human populations. This document is not intended to represent a complete analysis of the available scientific research literature, but rather an abbreviated overview of the toxicity of this metallic element.

Physical and Chemical Properties

Zinc is a silvery metal of low to intermediate hardness. It is attacked by moist air, CO_2, SO_2, acid gases, and acids. Dangerous fire and explosion risks exist for zinc.

Zinc (Zn) is characterized as:

- melting point: 419.6°C (CCD, 1987)
- appearance: shining white metal with bluish-grey luster (CCD, 1987)
- specific gravity: 7.14 (CCD, 1987)
- vapor pressure: 100 mm Hg @ 736°C (OSHA, 1978).

Acute and Chronic Animal Toxicity

Zinc is poorly absorbed, and its compounds are relatively non-toxic orally. LD_{50}'s for the rat range from 1190-2460 mg/kg.

Chronic levels of zinc produced few effects in dogs, cats and rats. Dogs exhibited some glycosuria, and some degeneration of the pancreas in cats was found at autopsy. The levels of zinc oxide used in the dog and cat studies were 175-1,000 mg/day for 3-53 weeks.

Animal studies indicate that zinc produces the following effects:

- Toxicity:

  rat oral LD_{50}: 1190-2460 for zinc and its various compounds (Clayton and Clayton, 1981).

Acute and Chronic Toxicity in Humans

Zinc is an essential trace element that is involved in enzyme functions, protein synthesis, and carbohydrate metabolism. The recommended daily dietary allowances for zinc are as follows: adults, 15 mg/day; children over a year old, 10 mg/day; and additional supplements during pregnancy and lactation (NRC, 1977).

Short-term inhalation exposure to zinc at levels of 180 ppm (10 minute exposure duration) is reported to cause metal fume fever, characterized by flu-like symptoms and difficulty in breathing. The health effects of long-term inhalation exposure of humans to zinc is not known.

The major toxic effects from ingestion of zinc are anemia and intestinal problems. Long-term exposure to levels of 153 ppm in food (6 week exposure duration) in humans has been shown to cause anemia. Decreased levels of high density lipoprotein (HDL)-cholesterol in blood have been reported for chronic exposure in humans to 170 mg per day. Reduced immune response has also been associated with this exposure level. Decreased HDL-cholesterol levels have been implicated as a risk factor in the development of heart disease.

Two epidemiological studies involving occupational inhalation exposure to zinc failed to demonstrate a relationship to cancer in humans; no carcinogenic studies are available for animals exposed to zinc by the inhalation route. The carcinogenicity of zinc in animals for oral exposure was investigated in one study which was determined to be inadequate due to experimental limitations.

Aquatic Toxicity

Freshwater toxicity values for zinc indicate that the acute toxicity decreases as water hardness increases. When adjusted to a hardness of 50 mg/l, sensitivities range from 50.70 µg/l for *Ceriodaphnia reticulata* to 88,960 µg/l for a damselfly (EPA,1986). Additional data indicate that toxicity increases as temperature increases. Chronic toxicity values for two invertebrates range from 46.73 µg/l for *Daphnia magna* to > 5,243 µg/l for the caddisfly, *Clistoronia magnificia* (EPA,1986). Chronic toxicity values for seven fish species range from 36.41 µg/l for the flagfish, *Jordanella floridae*, to 854.7 µg/l for the brook trout, *Salvelinus fontinalis* (EPA,1986). Acute-chronic ratios range from 0.2614 to 41.20, but the ratios for the sensitive species are all less than 7.3 (EPA, 1986).

The sensitivity range of freshwater plants to zinc is greater than that for animals. Growth of the alga, *Selenastrum capriocornutum*, was inhibited by 30 µg/l; however, the 4-day EC_{50} values for several other species of green algae exceeded 200,000 µg/l (EPA, 1986). Zinc was found to bioaccumulate in freshwater animal tissues from 51 to 1,130 times the concentration present in the water.

Ambient Water Quality Criteria (AWQC) for zinc is dependent on water hardness. Freshwater aquatic organisms should not be affected if the four-day average concentration of zinc does not exceed the value given by $e^{(0.8473[\ln(\text{hardness})]+0.7614}$ more than once every three years and if the one-hour average concentration does not exceed the value given by $e^{(0.8473[\ln(\text{hardness})]+0.8604}$ more than once every three years (EPA,1986). For example, at hardnesses of 50, 100, and 200 mg/l as $CaCO_3$, the freshwater acute toxicity values (1-hour concentrations) are 65, 120, and 210 µg/l, respectively. Examples of freshwater chronic toxicity values (4-day concentrations) using similar hardness values are 59, 110, and 190 µg/l (EPA, 1986). If the striped bass is as sensitive as some data indicate, it will not be protected by this criterion (EPA,1986).

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Appendix C - Intake Models
(pages 195-222)

CALCULATION TABLE 1.0
OCCUPATIONAL, CURRENT USE–NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Soil Ingestion

EQUATIONS

[1] CDI = CS * IR * RA * CF * FI * EF * ED * 1/BW * 1/AT

[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table17a
IR = Ingestion Rate	mg/day	50
RA = Relative Absorption	unitless	1.0
CF = Conversion Factor	kg/mg	0.000001
FI = Fraction Ingestion from Cont. Source	unitless	1
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	14600
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*CDI*	*HI*
A	Cadmium	3.6E-06	3.6E-03
	Chromium	6.9E-05	6.9E-05
	Lead	3.6E-04	8.3E-01
	Zinc	9.6E-04	4.8E-03
B	Cadmium	1.1E-04	1.1E-01
	Chromium	1.2E-04	1.2E-04
	Lead	2.3E-03	5.4E+00
	Zinc	3.1E-02	1.6E-01
C	Cadmium	1.9E-06	1.9E-03
	Chromium	3.4E-04	3.4E-04
	Lead	1.6E-04	3.8E-01
D	Cadmium	2.0E-06	2.0E-03
	Chromium	1.3E-04	1.3E-04
	Lead	1.1E-04	2.6E-01
F	Lead	1.0E-05	2.4E-02
G	Lead	1.3E-05	3.1E-02

CALCULATION TABLE 2.0
OCCUPATIONAL, CURRENT USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Soil Ingestion

EQUATIONS

[1] SDI = CS * IR * RA * CF * FI * EF * ED * 1/BW * 1/AT

[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table17a
IR = Ingestion Rate	mg/day	50
RA = Relative Absorption	unitless	1.0
CF = Conversion Factor	kg/mg	0.000001
FI = Fraction Ingestion from Cont. Source	unitless	1
EF = Exposure Frequency	days/year	5
ED = Exposure Duration	years	1
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
sHI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*SDI*	*sHI*
A	Cadmium	9.2E-06	9.2E-04
	Chromium	1.5E-04	1.5E-05
	Lead	6.2E-03	1.5E+00
	Zinc	2.0E-03	1.0E-03
B	Cadmium	1.9E-04	1.9E-02
	Chromium	2.4E-04	2.4E-05
	Lead	8.7E-03	2.0E+00
	Zinc	5.6E-02	2.8E-02
C	Cadmium	3.3E-06	3.3E-04
	Chromium	6.1E-04	6.1E-05
	Lead	6.8E-04	1.8E-01
D	Cadmium	3.6E-06	3.6E-04
	Chromium	2.4E-04	2.4E-05
	Lead	2.7E-04	6.4E-02
F	Lead	1.7E-05	3.9E-03
G	Lead	1.1E-04	2.6E-02

CALCULATION TABLE 4.0
OCCUPATIONAL, CURRENT USE--NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Soil Dermal Contact

EQUATIONS

[1] CDI = CS * AF * RA * SA * CF * EF * ED * 1/BW * 1/AT
[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17a
AF = Adherence Factor	mg/cm2	1
RA = Relative Absorption	unitless	0.01
CF = Conversion Factor	kg/mg	0.000001
SA = Skin Surface Area	cm2	1700
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	14600
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*CDI*	*HI*
A	Cadmium	1.2E-06	1.2E-03
	Chromium	2.3E-05	2.3E-05
	Lead	1.2E-04	2.8E-01
	Zinc	3.3E-04	1.6E-03
B	Cadmium	3.9E-05	3.9E-02
	Chromium	4.1E-05	4.1E-05
	Lead	7.8E-04	1.8E+00
	Zinc	1.1E-02	5.3E-02
C	Cadmium	6.6E-07	6.6E-04
	Chromium	1.2E-04	1.2E-04
	Lead	5.6E-05	1.3E-01
D	Cadmium	6.8E-07	6.8E-04
	Chromium	4.5E-05	4.5E-05
	Lead	3.7E-05	8.7E-02
F	Lead	3.4E-06	8.1E-03
G	Lead	4.4E-06	1.0E-02

CALCULATION TABLE 5.0
OCCUPATIONAL, CURRENT USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Soil Dermal Contact

EQUATIONS

[1] SDI = CS * AF * RA * SA * CF * EF * ED * 1/BW * 1/AT

[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17a
AF = Adherence Factor	mg/cm2	1
RA = Relative Absorption	unitless	0.01
CF = Conversion Factor	kg/mg	0.000001
SA = Skin Surface Area	unitless	1700
EF = Exposure Frequency	days/year	5
ED = Exposure Duration	years	1
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
sHI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*SDI*	*sHI*
A	Cadmium	3.1E-06	3.1E-04
	Chromium	5.2E-05	5.2E-06
	Lead	2.1E-03	4.9E-01
	Zinc	6.9E-04	3.5E-04
B	Cadmium	6.6E-05	6.6E-03
	Chromium	8.2E-05	8.2E-06
	Lead	2.9E-03	6.9E-01
	Zinc	1.9E-02	9.5E-03
C	Cadmium	1.1E-06	1.1E-04
	Chromium	2.1E-04	2.1E-05
	Lead	2.3E-04	5.4E-02
D	Cadmium	1.2E-06	1.2E-04
	Chromium	8.3E-05	8.3E-06
	Lead	9.3E-05	2.2E-02
F	Lead	5.7E-06	1.3E-03
G	Lead	3.8E-05	8.8E-03

CALCULATION TABLE 2.0
OCCUPATIONAL, CURRENT USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Soil Ingestion

EQUATIONS

[1] SDI = CS * IR * RA * CF * FI * EF * ED * 1/BW * 1/AT
[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table17a
IR = Ingestion Rate	mg/day	50
RA = Relative Absorption	unitless	1.0
CF = Conversion Factor	kg/mg	0.000001
FI = Fraction Ingestion from Cont. Source	unitless	1
EF = Exposure Frequency	days/year	5
ED = Exposure Duration	years	1
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
sHI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*SDI*	*sHI*
A	Cadmium	9.2E-06	9.2E-04
	Chromium	1.5E-04	1.5E-05
	Lead	6.2E-03	1.5E+00
	Zinc	2.0E-03	1.0E-03
B	Cadmium	1.9E-04	1.9E-02
	Chromium	2.4E-04	2.4E-05
	Lead	8.7E-03	2.0E+00
	Zinc	5.6E-02	2.8E-02
C	Cadmium	3.3E-06	3.3E-04
	Chromium	6.1E-04	6.1E-05
	Lead	6.8E-04	1.6E-01
D	Cadmium	3.6E-06	3.6E-04
	Chromium	2.4E-04	2.4E-05
	Lead	2.7E-04	6.4E-02
F	Lead	1.7E-05	3.9E-03
G	Lead	1.1E-04	2.6E-02

CALCULATION TABLE 3.0
OCCUPATIONAL, CURRENT USE--CARCINOGENIC

Calculation of Intake and Risk Associated with Soil Ingestion

EQUATIONS

[1] LADD = CS * IR * RA * CF * FI * EF * ED * 1/BW * 1/AT

[2] RISK = LADD * CP

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17a
IR = Ingestion Rate	mg/day	50
RA = Relative Absorption	unitless	1.0
CF = Conversion Factor	kg/mg	0.000001
FI = Fraction Ingestion from Cont. Source	unitless	1
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	25550
CP = Cancer Potency	1/(mg/kg/day)	Table 18
LADD = Lifetime Average Daily Dose	mg/kg/day	EQ[1]
RISK = Lifetime Incremental Cancer Risk	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*LADD*	*RISK*
A	PCB 1248	1.1E-06	8.7E-06
B	PCB 1248	2.2E-06	1.7E-05
	PCB 1254	1.0E-07	8.1E-07
D	PCB 1248	1.4E-06	1.1E-05
	PCB 1254	7.2E-07	5.5E-06

CALCULATION TABLE 6.0
OCCUPATIONAL, CURRENT USE--CARCINOGENIC

Calculation of Intake and Risk Associated with Soil Dermal Contact

EQUATIONS

[1] LADD = CS * AF * RA * CF * SA * EF * ED * 1/BW * 1/AT
[2] RISK = LADD * CP

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17a
AF = Adherence Factor	mg/cm2	1
RA = Relative Absorption	unitless	0.05
CF = Conversion Factor	kg/mg	0.000001
SA = Skin Surface Area	cm2	1700
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	25550
CP = Cancer Potency	1/(mg/kg/day)	Table 18
LADD = Lifetime Average Daily Dose	mg/kg/day	EQ[1]
RISK = Lifetime Incremental Cancer Risk	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*LADD*	*RISK*
A	PCB 1248	1.9E-06	1.5E-05
B	PCB 1248	3.7E-06	2.9E-05
	PCB 1254	1.8E-07	1.4E-06
D	PCB 1248	2.3E-06	1.8E-05
	PCB 1254	1.2E-06	9.4E-06

CALCULATION TABLE 7.0
OCCUPATIONAL, FUTURE USE--NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Soil Ingestion

EQUATIONS

[1] CDI = CS *IR * RA * CF * FI * EF * ED * 1/BW * 1/AT

[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17b
IR = Ingestion Rate	mg/day	50
RA = Relative Absorption	unitless	1.0
CF = Conversion Factor	kg/mg	0.000001
FI = Fraction Ingestion from Cont. Source	unitless	1
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	14600
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*CDI*	*HI*
A	Cadmium	3.6E-06	3.6E-03
	Chromium	6.9E-05	6.9E-05
	Lead	3.0E-04	8.3E-01
	Zinc	9.6E-04	4.8E-03
B	Cadmium	1.1E-04	1.1E-01
	Chromium	1.2E-04	1.2E-04
	Lead	2.3E-03	5.4E+00
	Zinc	3.1E-02	1.6E-01
C	Cadmium	1.9E-06	1.9E-03
	Chromium	3.4E-04	3.4E-04
	Lead	1.6E-04	3.8E-01
D	Cadmium	2.0E-06	2.0E-03
	Chromium	1.3E-04	1.3E-04
	Lead	1.1E-04	2.6E-01
F	Lead	1.0E-05	2.4E-02
G	Lead	1.3E-05	3.1E-02

CALCULATION TABLE 8.0
OCCUPATIONAL, FUTURE USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Soil Ingestion

EQUATIONS

[1] SDI = CS * IR * RA * CF * FI * EF * ED * 1/BW * 1/AT

[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17b
IR = Ingestion Rate	mg/day	50
RA = Relative Absorption	unitless	1.0
CF = Conversion Factor	kg/mg	0.000001
FI = Fraction Ingestion from Cont. Source	unitless	1
EF = Exposure Frequency	days/year	5
ED = Exposure Duration	years	1
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
sHI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*SDI*	*sHI*
A	Cadmium	9.2E-06	9.2E-04
	Chromium	1.5E-04	1.5E-05
	Lead	6.2E-03	1.5E+00
	Zinc	2.0E-03	1.0E-03
B	Cadmium	1.9E-04	1.9E-02
	Chromium	2.4E-04	2.4E-05
	Lead	8.7E-03	2.8E+00
	Zinc	5.6E-02	2.8E-02
C	Cadmium	3.3E-06	3.3E-04
	Chromium	6.1E-04	6.1E-05
	Lead	6.8E-04	1.6E-01
D	Cadmium	3.8E-06	3.8E-04
	Chromium	2.4E-04	2.4E-05
	Lead	2.7E-04	8.4E-02
F	Lead	1.7E-05	3.9E-03
G	Lead	1.1E-04	2.6E-02

CALCULATION TABLE 9.0
OCCUPATIONAL, FUTURE USE–CARCINOGENIC

Calculation of Intake and Risk Associated with Soil Ingestion

EQUATIONS

[1] LADD = CS * IR * RA * CF * FI * EF * ED * 1/BW * 1/AT

[2] RISK = LADD * CP

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17b
IR = Ingestion Rate	mg/day	50
RA = Relative Absorption	unitless	1.0
CF = Conversion Factor	kg/mg	0.000001
FI = Fraction Ingestion from Cont. Source	unitless	1
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	25550
CP = Cancer Potency	1/(mg/kg/day)	Table 18
LADD = Lifetime Average Daily Dose	mg/kg/day	EQ[1]
RISK = Lifetime Incremental Cancer Risk	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*LADD*	*RISK*
A	PCB 1248	1.1E-08	8.7E-08
B	PCB 1248	2.2E-06	1.7E-05
	PCB 1254	1.0E-07	8.1E-07
D	PCB 1248	1.4E-06	1.1E-05
	PCB 1254	7.2E-07	5.5E-06

CALCULATION TABLE 10.0
OCCUPATIONAL, FUTURE USE–NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Soil Dermal Contact

EQUATIONS

[1] CDI = CS * AF * RA * SA * CF * EF * ED * 1/BW * 1/AT
[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17b
AF = Adherence Factor	mg/cm2	1
RA = Relative Absorption	unitless	0.01
CF = Conversion Factor	kg/mg	0.000001
SA = Skin Surface Area	cm2	1700
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	14600
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*CDI*	*HI*
A	Cadmium	1.2E-06	1.2E-03
	Chromium	2.3E-05	2.3E-05
	Lead	1.2E-04	2.8E-01
	Zinc	3.3E-04	1.6E-03
B	Cadmium	3.9E-05	3.9E-02
	Chromium	4.1E-05	4.1E-05
	Lead	7.8E-04	1.8E+00
	Zinc	1.1E-02	5.3E-02
C	Cadmium	6.8E-07	6.8E-04
	Chromium	1.2E-04	1.2E-04
	Lead	5.6E-05	1.3E-01
D	Cadmium	6.8E-07	6.8E-04
	Chromium	4.5E-05	4.5E-05
	Lead	3.7E-05	8.7E-02
F	Lead	3.4E-06	8.1E-03
G	Lead	4.4E-06	1.0E-02

CALCULATION TABLE 11.0
OCCUPATIONAL, FUTURE USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Soil Dermal Contact

EQUATIONS

[1] SDI = CS * AF * RA * SA * CF * EF * ED * 1/BW * 1/AT

[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17b
AF = Adherence Factor	mg/cm2	1
RA = Relative Absorption	unitless	0.01
CF = Conversion Factor	kg/mg	0.000001
SA = Skin Surface Area	unitless	1700
EF = Exposure Frequency	days/year	5
ED = Exposure Duration	years	1
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
sHI = Hazard Index	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*SDI*	*sHI*
A	Cadmium	3.1E-06	3.1E-04
	Chromium	5.2E-05	5.2E-06
	Lead	2.1E-03	4.9E-01
	Zinc	6.9E-04	3.5E-04
B	Cadmium	6.6E-05	6.6E-03
	Chromium	8.2E-05	8.2E-06
	Lead	2.9E-03	6.9E-01
	Zinc	1.9E-02	9.5E-03
C	Cadmium	1.1E-06	1.1E-04
	Chromium	2.1E-04	2.1E-05
	Lead	2.3E-04	5.4E-02
D	Cadmium	1.2E-06	1.2E-04
	Chromium	8.3E-05	8.3E-06
	Lead	9.3E-05	2.2E-02
F	Lead	5.7E-06	1.3E-03
G	Lead	3.8E-05	8.8E-03

CALCULATION TABLE 12.0
OCCUPATIONAL, FUTURE USE--CARCINOGENIC

Calculation of Intake and Risk Associated with Soil Dermal Contact

EQUATIONS

[1] LADD = CS * AF * RA * CF * SA * EF * ED * 1/BW * 1/AT

[2] RISK = LADD * CP

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CS = Concentration in Soil	mg/kg	Table 17b
AF = Adherence Factor	mg/cm2	1
RA = Relative Absorption	cm2	0.05
CF = Conversion Factor	kg/mg	0.000001
SA = Skin Surface Area	unitless	1700
EF = Exposure Frequency	days/year	120
ED = Exposure Duration	years	40
BW = Body Weight	kg	70
AT = Averaging Time	days	25550
CP = Cancer Potency	1/(mg/kg/day)	Table 18
LADD = Lifetime Average Daily Dose	mg/kg/day	EQ[1]
RISK = Lifetime Incremental Cancer Risk	unitless	EQ[2]

RESULTS

AREA	*CHEMICAL*	*LADD*	*RISK*
A	PCB 1248	1.9E-06	1.5E-05
B	PCB 1248	3.7E-06	2.9E-05
	PCB 1254	1.8E-07	1.4E-06
D	PCB 1248	2.3E-06	1.8E-05
	PCB 1254	1.2E-06	9.4E-06

CALCULATION TABLE 13.0
OCCUPATIONAL, FUTURE USE--NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Hand Washing

EQUATIONS

[1] CDI = CW * SA * PC * ET * EF * ED * CF * 1/BW * 1/AT

[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in water	mg/l	Table 17b
SA = Skin Surface Area	cm2	1700
PC = Permeability Constant	cm/hr	0.0005
ET = Exposure Time	hours/day	0.167
EF = Exposure Frequency	days/year	250
ED = Exposure Duration	years	40
CF = Conversion Factor	liters/cm3	0.001
BW = Body Weight	kg	70
AT = Averaging Time	days	14600
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*CDI*	*HI*
Cadmium	2.8E-08	5.6E-05
Lead	1.1E-07	2.6E-04

CALCULATION TABLE 14.0
OCCUPATIONAL, FUTURE USE--NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Hand Washings

EQUATIONS

[1] SDI = CW * SA * PC * ET * EF * ED * CF * 1/BW * 1/AT

[2]s HI = CDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in water	mg/l	Table 17b
SA = Skin Surface Area	cm2	1700
PC = Permeability Constant	cm/hr	0.0005
ET = Exposure Time	hours/day	0.167
EF = Exposure Freguency	days/year	5
ED = Exposure Duration	years	1
CF = Conversion Factor	liters/cm3	0.001
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*SDI*	*sHI*
Cadmium	3.0E-08	6.1E-06
Lead	1.8E-07	4.1E-05

CALCULATION TABLE 15.0
RESIDENTIAL CHILD, FUTURE USE–NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Ingestion of Groundwater

EQUATIONS

[1] CDI = CW * IR * RA * EF * ED * 1/BW * 1/AT

[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in Water	mg/l	Table 17c
IR = Ingestion Rate	l/day	1.0
RA = Relative Absorption	unitless	1
EF = Exposure Frequency	days/year	365
ED = Exposure Duration	years	6
BW = Body Weight	kg	17
AT = Averaging Time	days	2190
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*CDI*	*HI*
Cadmium	1.2E-03	2.4E+00
Lead	4.7E-03	1.1E+01

CALCULATION TABLE 16.0
RESIDENTIAL ADULT, FUTURE USE--NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Ingestion of Groundwater

EQUATIONS

[1] CDI = CW * IR * RA * EF * DD * 1/BW * 1/AT

[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in Water	mg/l	Table 17c
IR = Ingestion Rate	l/day	2
RA = Relative Absorption	unitless	1
EF = Exposure Frequency	days/year	365
ED = Exposure Duration	years	30
BW = Body Weight	kg	70
AT = Averaging Time	days	10950
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*CDI*	*HI*
Cadmium	5.7E-04	1.1E+00
Lead	2.3E-03	5.3E+00

CALCULATION TABLE 17.0
RESIDENTIAL CHILD, FUTURE USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Ingestion of Groundwater

EQUATIONS

[1] SDI = CS * IR * AB * CF * FI * EF * ED * 1/BW * 1/AT
[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in Water	mg/l	Table 17c
IR = Ingestion Rate	l/day	1.0
RA = Relative Absorption	unitless	1
EF = Exposure Frequency	days/year	7
ED = Exposure Duration	years	1
BW = Body Weight	kg	17
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
sHI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*SDI*	*sHI*
Cadmium	1.2E-03	2.5E-01
Lead	7.2E-03	1.7E+00

CALCULATION TABLE 18.0
RESIDENTIAL ADULT, FUTURE USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Ingestion of Groundwater

EQUATIONS

[1] SDI = CW * IR * RA * CF * FI * EF * ED * 1/BW * 1/AT

[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in Water	mg/l	Table 17c
IR = Ingestion Rate	l/day	2
RA = Relative Absorption	unitless	1
EF = Exposure Frequency	days/year	7
ED = Exposure Duration	years	1
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
sHI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*SDI*	*sHI*
Cadmium	6.0E-04	1.2E-01
Lead	3.5E-03	6.1E-01

CALCULATION TABLE 19.0
RESIDENTAL CHILD, FUTURE USE–NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Bathing

EQUATIONS

[1] CDI = CW * SA * PC * ET * EF * ED * CF * 1/BW * 1/AT

[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in water	mg/l	Table 17c
SA = Skin Surface Area	cm2	5760
PC = Permeability Constant	cm/hr	0.0005
ET = Exposure Time	hours/day	0.33
EF = Exposure Frequency	days/year	365
ED = Exposure Duration	years	6
CF = Conversion Factor	liters/cm3	0.001
BW = Body Weight	kg	17
AT = Averaging Time	days	2190
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*CDI*	*HI*
Cadmium	1.12E-06	2.24E-03
Lead	4.47E-06	1.04E-02

CALCULATION TABLE 20.0
RESIDENTIAL ADULT, FUTURE USE--NONCARCINOGENIC CHRONIC

Calculation of Intake and Hazard Index Associated with Bathing

EQUATIONS

[1] CDI = CW * SA * PC * ET * EF * ED * CF * 1/BW * 1/AT
[2] HI = CDI / RfD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in water	mg/l	Table 17c
SA = Skin Surface Area	cm2	18150
PC = Permeability Constant	cm/hr	0.0005
ET = Exposure Time	hours/day	0.33
EF = Exposure Frequency	days/year	365
ED = Exposure Duration	years	30
CF = Conversion Factor	liters/cm3	0.001
BW = Body Weight	kg	70
AT = Averaging Time	days	10950
RfD = Reference Dose	mg/kg/day	Table 18
CDI = Chronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*CDI*	*HI*
Cadmium	8.6E-07	1.7E-03
Lead	3.4E-06	8.0E-03

CALCULATION TABLE 21.0
RESIDENTIAL CHILD, FUTURE USE–NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Bathing

EQUATIONS

[1] SDI = CS *AF * RA * SA * CF * EF * ED * 1/BW * 1/AT

[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in water	mg/l	Table 17c
SA = Skin Surface Area	cm2	5760
PC = Permeability Constant	cm/hr	0.0005
ET = Exposure Time	hours/day	0.33
EF = Exposure Frequency	days/year	7
ED = Exposure Duration	years	1
CF = Conversion Factor	liters/cm3	0.001
BW = Body Weight	kg	17
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*SDI*	*sHI*
Cadmium	1.17E-06	2.35E-04
Lead	6.82E-06	1.59E-03

CALCULATION TABLE 22.0
RESIDENTIAL ADULT, FUTURE USE--NONCARCINOGENIC SUBCHRONIC

Calculation of Intake and Hazard Index Associated with Bathing

EQUATIONS

[1] SDI = CS *AF * RA * SA * CF * EF * ED * 1/BW * 1/AT
[2] sHI = SDI / RsD

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUES*
CW = Concentration in water	mg/l	Table 17c
SA = Skin Surface Area	cm2	18150
PC = Permeability Constant	cm/hr	0.0005
ET = Exposure Time	hours/day	0.33
EF = Exposure Frequency	days/year	7
ED = Exposure Duration	years	1
CF = Conversion Factor	liters/cm3	0.001
BW = Body Weight	kg	70
AT = Averaging Time	days	7
RsD = Subchronic Reference Dose	mg/kg/day	Table 18
SDI = Subchronic Daily Intake	mg/kg/day	EQ[1]
HI = Hazard Index	unitless	EQ[2]

RESULTS

CHEMICAL	*SDI*	*sHI*
Cadmium	9.0E-07	1.8E-04
Lead	5.2E-06	1.2E-03

SUMMARY TABLE 23
OCCUPATIONAL, FUTURE USE–SUBCHRONIC HAZARD INDEX

AREA	CHEMICAL	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Soil Ingestion				
A	Cadmium	9.2E-04		
	Chromium	1.5E-05		
	Lead	1.5E+00		
	Zinc	1.0E-03	1.6E+00	
B	Cadmium	1.9E-02		
	Chromium	2.4E-05		
	Lead	2.0E+00		
	Zinc	2.8E-02	2.1E+00	
C	Cadmium	3.3E-04		
	Chromium	6.1E-05		
	Lead	1.6E-01	1.6E-01	
D	Cadmium	3.6E-04		
	Chromium	2.4E-05		
	Lead	6.4E-02	6.4E-02	
F	Lead	3.9E-03	3.9E-03	
G	Lead	2.6E-02	2.6E-02	
Pathway: Dermal Contact with Soil				
A	Cadmium	3.1E-04		
	Chromium	5.2E-06		
	Lead	4.9E-01		
	Zinc	3.5E-04	5.0E-01	
B	Cadmium	6.6E-03		
	Chromium	8.2E-06		
	Lead	6.9E-01		
	Zinc	9.5E-03	7.1E-01	
C	Cadmium	1.1E-04		
	Chromium	2.1E-05		
	Lead	5.4E-02	5.4E-02	
D	Cadmium	1.2E-04		
	Chromium	8.3E-06		
	Lead	2.2E-02	2.2E-02	
F	Lead	1.3E-03	1.3E-03	
G	Lead	8.8E-03	8.8E-03	
Dermal Contact, hand washing				
On-site	Cadmium	6.1E-06		
	Lead	4.1E-05	4.7E-05	

Composite of all Pathways	AREA	
	A	2.0E+00
	B	2.8E+00
	C	2.1E-01
	D	8.6E-02
	F	5.3E-03
	G	3.5E-02

SUMMARY TABLE 24
OCCUPATIONAL, FUTURE USE–CARCINOGENIC RISK

AREA	CHEMICAL	CHEMICAL SPECIFIC RISK	TOTAL PATHWAY RISK	TOTAL EXPOSURE RISK
Pathway: Dermal Contact with Soil				
A	PCB, 1248	1.5E-05	1.5E-05	
B	PCB, 1248	2.9E-05		
	PCB, 1254	1.4E-06	3.0E-05	
D	PCB, 1248	1.8E-05		
	PCB, 1254	9.4E-06	2.7E-05	
Pathway: Ingestion of Soil				
A	PCB, 1248	8.7E-06	8.7E-06	
B	PCB, 1248	1.7E-05		
	PCB, 1254	8.1E-07	1.8E-05	
D	PCB, 1248	1.1E-05		
	PCB, 1254	5.5E-06	1.6E-05	
Composite of all Pathways				

AREA	
A	2.2E-05
B	4.8E-05
D	4.4E-05

SUMMARY TABLE 25
RESIDENTIAL, FUTURE USE--CHRONIC HAZARD INDEX

CHEMICAL	RECEPTOR	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Bathing				
Cadmium	Child	2.2E-03		
Lead	Child	1.0E-02	1.3E-02	
Cadmium	Adult	1.7E-03		
Lead	Adult	8.0E-03	9.7E-03	
Pathway: Ingestion of Groundwater				
Cadmium	Child	2.4E+00		
Lead	Child	1.1E+01	1.3E+01	
Cadmium	Adult	1.1E+00		
Lead	Adult	5.3E+00	6.5E+00	
Pathway: Composite				
	Child			1.3E+01
	Adult			6.5E+00

SUMMARY TABLE 26
RESIDENTIAL, FUTURE USE--SUBCHRONIC HAZARD INDEX

CHEMICAL	RECEPTOR	HAZARD QUOTIENT	PATHWAY HAZARD INDEX	TOTAL EXPOSURE HAZARD INDEX
Pathway: Bathing				
Cadmium	Child	2.3E-04		
Lead	Child	1.6E-03	1.8E-03	
Cadmium	Adult	1.8E-04		
Lead	Adult	1.2E-03	1.4E-03	
Pathway: Ingestion of Groundwater				
Cadmium	Child	2.5E-01		
Lead	Child	1.7E+00	1.9E+00	
Cadmium	Adult	1.2E-01		
Lead	Adult	8.1E-01	9.3E-01	
Pathway: Composite				
	Child			1.9E+00
	Adult			9.4E-01

TABLE 27
CALCULATION OF ALLOWABLE SOIL CONCENTRATION
OCCUPATIONAL, NONCARCINOGENIC CHRONIC

Occupational - Dermal, Soil Ingestion, and Combined

EQUATIONS

[1] ASC(dermal) = RFD/(ES * CR * CF * ABD * EF * ED * 1/AT * 1/BW)
[2] ASC(ingestion) = RFD/(SR * CF * ABI * EF * ED * 1/AT * 1/BW)
[3] ASC(combined) = RFD/[(ES * CR * CF * ABD * EF * ED * 1/AT * 1/BW) + (SR * CF * ABI * EF * ED * 1/AT * 1/BW)]

SYMBOLS AND DESCRIPTIONS	UNITS	VALUES
ASC = Allowable Soil Concentration	mg/kg	EQ[1] - [3]
ES = Exposed Skin Area(hands, forearms)	cm2/day	1700
CR = Average Soil Contact Rate	mg/cm2	1
CF = Conversion Factor	kg/mg	1.00E-06
ABD = Relative Absorption, Dermal	unitless	0.01
BW = Body Weight	kg	70
RFD = Acceptable Daily Dose	mg/kg-day	See Below
EF = Exposure Frequency	days	120
ED = Exposure Duration	years	40
AT = Averaging Time	days	14600
SR = Soil Ingestion Rate(value per Region IV directive)	mg/day	50
ABI = Relative Absorption, Ingestion	unitless	1

RESULTS

CHEMICAL	*RFD*	*ASC(dermal)*	*ASC(ingestion)*	*ASC(combined)*
Cadmium	1.00E-03	1.25E+04	4.26E+03	3.18E+03
Chromium(tri)	1.00E+00	1.25E+07	4.26E+06	3.18E+06
Lead	4.28E-04	5.36E+03	1.82E+03	1.36E+03
Zinc	2.00E-01	2.50E+06	8.52E+05	6.36E+05

Appendix D - Domestic Well Data
(pages 223-224)

DOMESTIC WELL DATA

CHEMICAL	WELL #1	WELL #2
Gross alpha	< 2 pic/l	< 1.0 pic/l
Cadmium	<0.001 mg/l	<0.001 mg/l
Chloride	20 mg/l	20 mg/l
Iron	0.045 mg/l	0.055 mg/l
Lead	< 0.005 mg/l	< 0.005 mg/l
Sodium	11.6 mg/l	11.9 mg/l
TDS	306 mg/l	356 mg/l
PH	8	7

Florida Steel
12/28/90
Recalculating Exposure Point Concentrations Using 95% UCL
Area A

	Cadmium	Chromium	Zinc
P1Comp1	7.9	260	3900
P1Comp2	8.2	76	3400
P1Comp2D	9	120	4000
P1Comp3	18	16	3500
P1Comp11	6.9	300	2700

Cadmium	
n	5
Mean	10
St.Dev.	4.53
95%UCL	15.21

Chromium	
n	5
Mean	154
St.Dev.	121.28
95%UCL	293.79

Zinc	
n	5
Mean	3500
St.Dev.	514.78
95%UCL	4091.66

PCBs

0.5	26
0.5	13
0.5	38
0.5	1
2	3
2	0.5
13	4
0.5	0.5
0.5	0.5
0.5	0.5
3	0.5
10	0.5
2	
0.5	

(0.5 = 1.2 detection limit)

PCBs	
n	26
Mean	4.77
St.Dev.	8.98
95%UCL	8.40

Lead

23	840	352	475
26	365	899	616
59	1170	354	673
*2	228	5480	341
175	260	266	1620
13	121	106	571
*2	195 *2		632
545	879	272	1680
22	133	421	2840
229	897	591	1910
445	10200	624	2760
483	12200	491	3150
96	701	2270	4660
121	683	1950	7030
64	701	424	15
38	758	78	79
217	46	417	65
167	668	502	398
29	710	717	408
161 *2		5180	
283	274	100	
289	584	390	
207	429		

Lead	
n	83
Mean	1066.76
St.Dev.	2050.23
95%UCL	1516.84

*2 = non-detects, which were not used in average

Florida Steel
12/28/90
Recalculating Exposure Point Concentrations Using 95% UCL
Area B

	Cadmium	Chromium	Zinc
P1Comp4	110	410	49000
P1Comp5	380	360	110000
P1Comp6	200	470	73000

Cadmium	
n	3
Mean	230
St.Dev.	137.48
95%UCL	482.40

Chromium	
n	3
Mean	413
St.Dev.	55.08
95%UCL	514.45

Zinc	
n	3
Mean	77333.33
St.Dev.	30730.01
95%UCL	133752.82

	Lead
P1Comp4	7700
P1Comp5	17000
P1Comp6	11000
P2G6-1	5530
P2G13-1	190
P2G14-1	5030
P2G15-1	810
P2G16-1	503
P2B1-1	1580

Lead	
n	9
Mean	5482.556
St.Dev.	5679.87
95%UCL	9761.39

PCB-1248
1.1
12
0.79

PCB-1248	
n	3
Mean	4.63
St.Dev.	6.38
95%UCL	16.35

PCB-1254
0.62
0.21
0.38

PCB-1254	
n	3
Mean	0.40
St.Dev.	0.21
95%UCL	0.78

(.21 = 1/2 detection limit)

Florida Steel
12/28/90
Recalculating Exposure Point Concentrations Using 95% UPL
Area D

	Cadmium	Chromium	Zinc
P1Comp7	3.4	480	2300
P1Comp8	4.9	270	2700
P1Comp9	7.1	350	3800

Cadmium	
n	3
Mean	5.13
St.Dev.	1.86
95%UCL	8.55

Chromium	
n	3
Mean	367
St.Dev.	105.99
95%UCL	561.26

Zinc	
n	3
Mean	2933.33
St.Dev.	776.75
95%UCL	4359.42

PCB-1248
0.26
7.5
0.65

PCB-1248	
n	3
Mean	2.80
St.Dev.	4.07
95%UCL	10.28

PCB-1254
0.1
3.9
0.4

PCB-1254	
n	3
Mean	1.47
St.Dev.	2.11
95%UCL	5.35

Lead
272
535
372
480
314
150
348

Lead	
n	7
Mean	353.00
St.Dev.	128.41
95%UCL	467.54

Florida Steel
12/28/90
Recalculating Exposure Point Concentrations Using 95% UCL
Lead - Areas F & G

3 12 0568

Area F

10
33
23

Lead - Area F	
n	3
Mean	22.00
St.Dev.	11.53
95%UCL	43.17

Area G

16
26
13
16
36
7
7
11
31
4
218
19
17
107
30
4
21
4
36
35

Lead - Area G	
n	20
Mean	32.90
St.Dev.	49.05
95%UCL	55.71

Florida Steel
12/28/90
Recalculating Exposure Point Concentrations Using 95% UCL
Drinking Water (Unfiltered Samples)

Well #	Cadmium	Lead
19	0.02	0.122
22	0.008	0.043
26	0.009	0.037
50	0.021	0.079
51	0.01	0.02
54	0.006	0.018
55	0.003	0.013
56	0.02	0.06

Cadmium	
n	8
Mean	0.012125
St.Dev.	0.00712
95%UCL	0.02

Lead	
n	8
Mean	0.049
St.Dev.	0.037087
95%UCL	0.08

3 12 0570

Appendix E - Radionuclide Risk Assessment
(pages 225-237)

ASSESSMENT OF POTENTIAL HEALTH RISKS ASSOCIATED WITH GROUNDWATER CONTAMINATION BY RADIUM 228 AND 226. FLORIDA STEEL CORPORATION, INDIANTOWN MILL SITE

1.0 INTRODUCTION

This section contains information for addressing comments 19, 59 and 66. All three comments indicate that potential human health effects associated with potential exposure to Ra-226 and Ra-228 should be quantitatively evaluated. The following information is a summary of the approaches and results of that quantification.

2.0 APPROACH

No current exposures to radium in groundwater were determined to exist. However, it may be assumed that on-site (non-potable) and off-site (potable) wells will be developed in the future. Potential future residential exposures are based on the assumption that wells will be developed in the future beyond the boundary of the site before remediation. Future occupational exposures are based on the assumption that wells will be developed in the future within the boundary of the site before plume remediation.

Envirologic Data, Inc. has evaluated the potential exposure pathways and routes of exposure associated with the human use of groundwater contaminated with Radium 228 and Radium 226. The two pathways identified are (1) occupational water use (dermal contact) and (2) residential water use (dermal contact and ingestion of water). Descriptions of the parameters related to the quantification of risk resulting from these exposure pathways are provided in Tables 2, 3, 4 and 5.

The approaches used to quantify radionuclide risk at this site correspond to *Radiation Risk Assessment Guidance* as summarized in Chapter 10 of RAGS (EPA, 1989b). The quantification of risk to human health involved the following sequence of tasks:

1) Identification of exposure parameters which define exposure scenarios which are representative of the Reasonable Maximum Exposure (RME) individual (EPA, 1989b). The exposure pathways are provided above.

2) Estimation of the exposure point concentrations of Ra-226 and Ra-228 using site sampling data. Exposure point concentrations are assumed to be representative of RMEs.

3) Estimation of background concentrations.

4) The fourth quarter, FY 1989 Health Effects Assessment Summary Tables (EPA, 1989) contain slope factors for radionuclides of concern at Superfund sites. Estimation of potential risk to the exposed population using slope factors which represent the age-averaged lifetime excess cancer incidence per unit intake. Intake is calculated for an entire exposure period without averaging over the body weight (10.7.2 in RAGS). Calculated risks can be compared to acceptable or *de minimis* ranges of risk.

5) Estimation of organ-specific and effective (whole-body) committed dose equivalents using Committed Dose Conversion Factors (DCFs) (EPA, 1988) for ingestion. The annual intake is calculated from ingestion rates and based on exposure point concentrations. The annual intake is multiplied by the appropriate DCF to estimate committed doses. Committed doses can be compared to available limiting doses (40 CFR Part 61, National Emission Standards for Hazardous Air pollutants (NESHAPS): Radionuclides) or primary guides for occupational exposure (EPA, 1988).

2.1 EXPOSURE POINT AND BACKGROUND CONCENTRATIONS

Data used to estimate exposure point concentrations of Ra-226 and Ra-228 in groundwater are summarized in Table 1. Exposure point concentrations were estimated from the average of the most recent unfiltered samples taken from wells 22, 26, 50, 51, 54, 55 and 56 (taken between 1986 and 1988). These well locations are representative of current concentrations of the total dissolved solids immpacted plume within the boundary of the site. Concentrations are assumed to be representative of the RME individual. Radium 226 was detected in 14 groundwater samples. The concentrations ranged from 2 to 91 pCi/L with an average of 24.6 pCi/L. Radium 228 was detected in 9 water samples. The concentration ranged from 2 to 5.7 pCi/L. TABLE 1 summarizes the analytical results conducted on non-filtered water samples. In addition, the data of sampling and location of the monitoring wells are identified.

Background concentrations of radium in groundwater for the central Florida area range from non-detect to 4.1 pCi/liter (Watson et al., 1984). The average concentration of 16 samples from the central Florida region is 0.80 pCi/liter (Watson et al., 1984). Site specific information regarding background concentrations of radium is limited. One sample taken from MW17 detected Radium 226 at a concentration of 0.6 pCi/liter (sampled 9-15-87). This value corresponds to the concentrations determined by Watson et al. (1984). Therefore, potential health risks associated with background concentrations of radium 226 were calculated from the one representative sample (0.6 pCi/liter). Radium 228 was not detected in any of the samples taken. However,

concentrations of radium generally comprise the most significant portion of risk from the radionuclides. This approach provides a conservative estimate of risk from consumption of groundwater containing background concentrations of radium.

TABLE 1
AVERAGE CONCENTRATION OF RADIUM IN GROUNDWATER SAMPLES BASED ON UNFILTERED SAMPLES

CONCENTRATION (pCi/L) RADIUM 226	RADIUM 228	LOCATION	DATE
10.9	(N.D.)	M22	Oct-86
28.4	(N.D.)	M22	Jun-87
10.9	3	M22	Jun-88
64.9	(N.D.)	M26	Mar-86
80.4	(N.D.)	M26	Jun-87
91	(N.D.)	M26	Sep-87
26.2	(N.D.)	M50	Sep-87
2	2	M50	Jun-88
(filtered)	5.7	M50	Dec-88
8.2	(N.D.)	M51	Sep-87
7.6	1.8	M51	Oct-88
2.9	2	M54	Jun-88
2.6	2	M55	Jun-88
8.1	3.6	M56	Oct-88
11.4	2.5	M56	Oct-88
13.6	3.7	M56	Dec-88

AVERAGE CONCENTRATION (pCi/L) *RADIUM-226*	*RADIUM 228*
24.6	2.9

(N.D.): Nuclides not detected

2.2 CALCULATION OF RISK

Incremental cancer risks were calculated for each isotope based on the cancer slope factor cited in the HEAST (EPA, FY 89, fourth quarter). These values represent the slope as a function of risk per unit intake (risk/pCi). The cancer slope factor for Radium 228 is 1.0×10^{-10} per pCi. The cancer slope factor for Radium 226 is 1.2×10^{-10} per pCi. Ingestion slope factors were used for both the dermal absorption intakes and the groundwater ingestion intakes.

Dermal Contact Parameters:

Transdermal uptake of radium is quantified based on the assumption that absorption occurs at the rate which water passes through skin. According to EPA (1986), water passes through skin at the rate of 5.0×10^{-7} kg water per cm^2/hour. This simplified and conservative approach assumes that substances are carried as solutes in water and are freely, rather than preferentially, absorbed. This assumption may be reasonable when considering dermal absorption of contaminants in dilute aqueous media. Incremental risk was calculated by multiplying the lifetime dose of isotope received by the ingestion cancer slope factor.

A resident was assumed to contact water during bathing and hand washing on a daily basis. It was conservatively assumed that an individuals entire body surface area (18,000 cm^2) would be in contact with water for 30 minutes each day. This conservative exposure duration is sufficient to quantify the amount of time spent bathing and incorporates any additional contact resulting from hand washing etc. In the occupational setting, a worker is assumed to wash his or her hands and forearms (1700 cm^2) for a period of 0.167 hours/day (10 minutes).

Groundwater Ingestion Parameters:

Ingestion of groundwater was assumed to apply only to the residential scenario. Average concentrations of Radium 228 and 226 were calculated from analytical results of groundwater samples obtained between 1986 and 1988 (Table 1). It was assumed that an individual would consume 2 liters of water per day for a 30 year exposure (representative of the length of time a resident remains at one location for 90 percent of the general population)(EPA, 1989a) period. Absorption was assumed to be 100% (some allocation for absorption in the gut may have been made when deriving the slope factors).

Occupational Risk:

Groundwater in the area may be used in the occupational setting. These occupational applications may include hand and forearm washing which may require an individual to physically contact water during the course of the work period. Envirologic Data conservatively assumed that an individual would contact water with their hands and forearms for a period of 0.167 hours/day (10 minutes/day), 250 days per year for 40 years. The exposure calculations and risk estimates are presented in Table 2. The conservative risk estimate is 4.6×10^{-9} indicates that occupational exposure to radium through dermal contact is not likely to be of concern.

Residential Risk:

Residential exposure was assumed to involve an exposure duration of 30 years (Upper 90th percentile length of residence at one location)(EPA, 1989a). Routes of uptake include both dermal contact and ingestion of groundwater. From Tables 3 and 4, it is evident that the majority of potential risk is expected to result from the ingestion pathway. The conservative estimate of potential risk associated with the hypothetical exposure to radium through ingestion of groundwater is 7.3×10^{-5} (Table 4), while the conservative risk estimate associated with residential dermal contact is 1.6×10^{-7} (Table 3).

It is important to emphasize that risk associated with exposure to background levels of radium may be significant. Table 4 results indicate that residential ingestion exposure to groundwater containing background concentrations of 0.6 pCi/l can be calculated to result in potential risks of up to 1.6×10^{-6}.

According to EPA NESHAPS policy for radionuclides (40 CFR Part 61, Federal Register Vol. 54, No. 240), "EPA strives to provide maximum feasible protection against risks to health from hazardous air pollutants by (1) protecting the greatest number of persons possible to an individual lifetime risk level no higher than 1×10^{-8} and (2) limiting to no higher than approximately 1×10^{-4} the maximum estimated risk that a person living near a plant would have if he or she were exposed to the emitted pollutant for 70 years". Though radium is not emitted at this site, this policy still provides a range of acceptable risk associated with exposure to radionuclides to which the risk estimates at this site can be compared.

TABLE 2
POTENTIAL OCCUPATIONAL EXPOSURE TO RADIUM THROUGH DERMAL CONTACT WITH GROUNDWATER

Calculation of Incremental Cancer Risk

EQUATIONS:

[1] Risk = SF * LD

[2] LD = C * V

[3] V = ES * AR * EH * ED * EY * CF

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUE*
Risk = Incremental Risk	unitless	see below
SF = Slope Factor for Radium:		
Radium 228	Risk/pCi	1×10^{-10}
Radium 226	Risk/pCi	1.2×10^{-10}
C = Concentration of Radium in Water		
Radium 228	pCi/L	2.9
Radium 226	pCi/L	24.6
ES = Exposed Skin Surface Area	cm^2	1700
AR = Dermal Absorption Rate	kg $H2O/cm^2$-hr	5×10^{-7}
EH = Exposure Duration (hours)	hours/day	0.167
ED = Exposure Duration (days)	days/year	250
EY = Exposure Duration (years)	years	40
CF = Conversion Factor (H20)	l H2O/kg H2O	1
V = Volume of Water Passing through Skin	liters	1.42
AB = Dermal Bioavailavility	unitless	1
LD = Lifetime Dose of Radium		
Radium 228	pCi	4.1
Radium 226	pCi	34.9
Risk = Lifetime Incremental Cancer Risk		
Radium 228	unitless	4.1×10^{-10}
Radium 226	unitless	4.2×10^{-9}
TOTAL	unitless	4.6×10^{-9}

TABLE 3
POTENTIAL RESIDENTIAL EXPOSURE TO RADIUM THROUGH DERMAL CONTACT WITH GROUNDWATER (BATHING)

Calculation of Incremental Cancer Risk

EQUATIONS:

[1] Risk = SF * LD

[2] LD = C * V

[3] V = ES * AR * EH * ED * EY * CF

SYMBOLS AND DESCRIPTIONS	*UNITS*	*VALUE*
Risk = Incremental Risk	unitless	see below
SF = Slope Factor		
Radium 228	Risk/pCi0	1×10^{-10}
Radium 226	Risk/pCi	1.2×10^{-10}
C = Concentration of Radium in Water		
Radium 228	pCi/L	2.9
Radium 226	pCi/L	24.6
ES = Exposed Skin Surface Area	cm^2	18000
AR = Dermal Absorption Rate	kg H2O/cm^2-hr	5×10^{-7}
EH = Exposure Duration (hours)	hours/day	0.5
ED = Exposure Duration (days)	days/year	365
EY = Exposure Duration (years)	years	30
CF = Conversion Factor (H20)	l H2O/kg H2O	1
V = Volume of Water Passing through Skin	liters	49
AB = Dermal Bioavailavility	unitless	1
LD = Lifetime Dose of Radium		
Radium 228	pCi	143
Radium 226	pCi	1212
Risk = Lifetime Incremental Cancer Risk		
Radium 228		1.4×10^{-8}
Radium 226		1.5×10^{-7}
TOTAL		1.6×10^{-7}

TABLE 4
POTENTIAL RESIDENTIAL EXPOSURE TO RADIUM 228 AND 226 THROUGH INGESTION OF GROUNDWATER

Calculation of Lifetime Incremental Cancer Risk

EQUATIONS:

[1] Risk = SF * LD

[2] LD = C * WI * EY * ED

SYMBOLS AND DESCRIPTIONS	*UNITS*	*EXPOSURE VALUES* site	background
Risk = Incremental Risk	unitless	(SEE-BELOW)	
SF = Slope Factor			
Radium 228	RISK/pCi	1×10^{-10}	
Radium 226	RISK/pCi	1.2×10^{-10}	
C = Radium Conc. in Groundwater			
Radium 228	pCi	2.9	0
Radium 226	pCi	24.6	0.6
WI = Water Ingestion Rate	l/day	2	2
EY = Exposure Duration (years)	years	30	30
ED = Exposure Duration (days)	days/year	365	365
LD = Lifetime Dose			
LD Radium 228	pCi/lftm	63510	0
LD Radium 226	pCi/lftm	538740	13140
RISK = Incremental Cancer Risk			
Radium 228	unitless	6×10^{-6}	0
Radium 226	unitless	6.5×10^{-5}	2×10^{-6}
Total RISK from Groundwater Ingestion		7.1×10^{-5}	2×10^{-6}

2.3 CALCULATION OF ORGAN-SPECIFIC AND EFFECTIVE COMMITTED DOSE EQUIVALENTS

The estimation of dose equivalents has been the conventional method for assessing risk at Nuclear Regulatory Commission licensed facilities. A committed dose equivalent is equal to dose equivalent to an organ or to the whole-body (effective) over a 50 year period following intake. The effective dose equivalent is a weighted sum of the dose equivalents to all irradiated organs or tissues and represents a measure of overall detriment (EPA, 1989b). Committed dose equivalents are obtained by multiplying the annual intake in pCi by the isotope-specific and route-specific Dose Conversion Factor (DCF)(EPA, 1988). DCFs are available for calculating effective dose equivalents and organ-specific dose equivalents.

A summary of committed dose equivalents estimated for exposure point concentrations and background concentrations is presented in Table 5.

The primary guides for assessed worker dose protects against carcinogenic and genetic effects state that the effective committed dose equivalent is not to exceed 5000 mrem and that the organ-specific committed dose equivalent is not to exceed 50,000 mrem (EPA, 1988). Results provided in Table 5 indicate that all estimated doses fall below the primary guides. It should be emphasized, however, that the primary guides are applicable to occupational exposures and not necessarily representative of the allowable exposure to the general public.

Department of Energy facilities are currently regulated by a radionuclide NESHAP which states that emissions shall not result in an individual whole-body (effective) dose greater than 25 mrem/year or a 75 mrem/year dose to any organ (Federal Register Vol. 54, No. 240). The combined Ra-226 and Ra-228 effective committed dose, 26.8 mrem is just above the DOE NESHAP for effective annual dose and the dose equivalent for bone surface exceeds the organ-specific DOE NESHAP of 75 mrem. EPA is currently promulgating a NESHAP for DOE facilities. This NESHAP states that effective dose equivalents shall not exceed 10 mrem/year.

TABLE 5

ESTIMATES OF EXPOSURE AND 50-YEAR DOSE COMMITMENT FOR 1 YEAR EXPOSURE TO RA-226 AND RA-228 IN DRINKING WATER

	SITE	BACKGROUND	
RADIONUCLIDE	Ra-226	Ra-228	Ra-226
CONCENTRATION (µCi/l)	0.0000246	0.0000029	0.0000006
ANNUAL INGESTION (l)	730	730	730
ANNUAL EXPOSURE (µCi)	0.017958	0.002117	0.000438
COMMITTED DOSE EQUIVALENTS BY ORGAN (mrem)			
GONAD	6.4 (355)	1.2 (585)	0.2 (355)
BREAST	6.1 (340)	1.2 (581)	0.2 (340)
LUNG	6.1 (339)	1.2 (581)	0.2 (339)
BONE MARROW	39.7 (2213)	5.1 (2416)	1.0 (2213)
BONE SURFACE	453.8 (25271)	45.8 (21645)	11.1 (25271)
THYROID	6.1 (339)	0.2 (581)	0.2 (339)
REMAINDER	6.8 (381)	1.3 (603)	0.2 (381)
EFFECTIVE	23.8 (1325)	3.0 (1436)	0.6 (1325)

Bracketed numbers are Dose conversion factor (mrem/µCi)

2.4 SUMMARY

Envirologic has identified and evaluated two exposure pathways associated with human use of groundwater at the Florida Steel Indiantown Mill Site (1) occupational water use and (2) residential water use. The exposure pathways were further refined into exposure scenarios associated with the respective pathways. The scenario associated with occupational water use is dermal contact with contaminated groundwater. Two exposure scenarios associated with household water use were identified (1) Dermal Contact (Bathing) and (2) Ingestion of Groundwater.

Incremental risks associated with pathways indicate that ingestion of groundwater is the most significant exposure scenario. Cumulative risks resulting from ingestion of Radium 228 and 226 in groundwater range from 0 to 7.1×10^{-5}, which lies within the the range of acceptable risk of 1×10^{-6} to 1×10^{-4} according to NESHAP policy. Incremental risks resulting from potential exposure to Radium 228 and 226 in groundwater used for bathing range from 0 to 1.6×10^{-7}. Risks resulting from occupational exposure to radionuclide contaminated groundwater used for industrial purposes ranges from 0 to 4.6×10^{-9}. Judging from the results, it is unlikely that industrial water use would pose significant risks to exposed populations.

The initial results of this analysis indicate that the use of groundwater as a dirnking water source may result in risks which exceed the 1×10^{-6} *de minimis* risk level. It should be noted that the incremental risks and lifetime doses calculated in this document are conservative estimates and represent upper-bound values. Additional refinement of the exposure parameters may result in a reduction of lifetime doses and incremental risks.

Committed dose equivalents were estimated for the groundwater ingestion scenario. Estimated doses do not exceed primary guides for annual occupational exposure, however, effective and bone surface committed dose equivalents were estimated to exceed current DOE NESHAP limiting doses of 25 mrem/yr and 75 mrem/yr respectively.

REFERENCES

Watson, AP, EL Etner and LM McDowell-Boyer. 1984. Radium-226 in Drinking Water and Terrestrial Food Chains: Transfer Parameters and Normal Exposure and Dose. Nuclear Safety 25:6 815.

EPA. 1986. Superfund Exposure Assessment Manual. Draft. Office of Emergency and Remedial Response. Environmental Protection Agency. Washington, DC. OSWER Directive 9285.5-1. January.

EPA. 1988. Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Ingestion. Federal Guidance Report No. 11. Office of Radiation Programs, Environmental Protection Agency. EPA-520/1-88-020.

EPA. 1989. Health Effects Assessment Summary Tables. Radionuclide Carcinogenicity. Fourth Quarter FY 1989. July.

EPA. 1989a. Exposure Factors Handbook. Exposure Assessment Group, Environmental Protection Agency. EPA/600/8-89/043.

EPA. 1989b. Risk Assessment Guidance for Superfund, Vol.1, Human Health Evaluation Manual (PART A). Office of Emergency and Remedial Response, Environmental Protection Agency. EPA/540/1-89/002.

Appendix F - Declaration of Covenants, Conditions and Restrictions
(pages 238-241)

844108

This Instrument Prepared By
and Should Be Returned to:
BENJAMIN G. MORRIS, ESQUIRE
Allen, Dell, Frank & Trinkle
P. O. Box 2111
Tampa, Florida 33602-2111

DECLARATION OF COVENANTS, CONDITIONS AND RESTRICTIONS

FLORIDA STEEL CORPORATION of 1715 Cleveland Street, Tampa, Florida 33606 is the owner in fee simple of the following described real property located in Martin County, Florida:

Parcel I:

Commence at a point 100 feet southwestwardly measured at right angles, from the center line of Seaboard Coast Line Railroad Company's main track, said point being on the east line of said Section 35, and run northwestwardly, parallel with said center line, 900 feet; thence southwestwardly, at right angles from the last described course, 700 feet to the POINT OF BEGINNING of the parcel of land hereinafter described; thence continue southwestwardly, along the last described course, 1300 feet; thence northwestwardly, at right angles from the last described course and 2100 feet southwestwardly from said center line, 3300 feet; thence northeastwardly, at right angles from the last described course, 1300 feet; thence southeastwardly, at right angles from the last described course and 800 feet southwestwardly from said center line, 3300 feet to the POINT OF BEGINNING; containing 98.48 acres, more or less, and being shown outlined in YELLOW as Parcel "B" on print of undated survey prepared by Schwebke-Shiskin & Associates, Inc., which print is attached hereto and made a part hereof; and

Parcel II:

Commence at a point 100 feet southwestwardly, measured at right angles, from the center line of Seaboard Coast Line Railroad Company's main track, said point being on the east line of said Section 35, and run northwestwardly, parallel with said center line, 900 feet to the POINT OF BEGINNING of the parcel of land hereinafter described; thence continue northwestwardly, along the last described course, 3300 feet; thence southwestwardly, at right angles from the last described course, 700 feet; thence southeastwardly, at right angles

from the last described course and 800 feet southwestwardly; measured at right angles, from said center line, 3300 feet; thence northeastwardly, at right angles from the last described course; 700 feet to the POINT OF BEGINNING; containing 53.03 acres, more or less, and being shown outlined in YELLOW as Parcel "A" on print of undated survey prepared by Schwebke-Shiskin & Associates, Inc., which print is attached hereto and made a part hereof.

This declaration is for the purpose of recording the following restrictive covenants which shall be deemed to be covenants running with the above-described land ("the Property") and shall be enforceable by all interested parties and all persons claiming under them, including the Grantor, the United States Environmental Protection Agency, Florida Department of Environmental Regulation and all applicable similar or successor regulatory bodies or agencies.

The following restrictions shall apply to the Property herein conveyed:

1. The Property shall not be used for residential purposes;

2. No day care facilities, kindergartens, playgrounds, schools or other facilities catering to children under the age of sixteen years shall be operated on the Property.

3. The Property shall not be used for swimming, fishing, camping or hunting.

4. No structures or improvements intended for use for recreational purposes shall be constructed or operated on the Property.

5. The Property shall not be used for the purpose of growing any crops to provide food for humans or animals.

The above restrictions are being placed on the Property in the interest of protecting the health and welfare of the general public due to soil contamination currently existing on portions of said Property, which contamination is expected to remain at levels which will, in the view of the U.S. Environmental Protection Agency and the Florida Department of Environmental Regulation, render it unsuitable for any of the above uses for a currently indeterminable period of time. Said property may however, be used for commercial, public utility (including, without limitation, electric transmission, distribution and power generation facilities) and industrial purposes.

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TO HAVE AND TO HOLD the same, together with all and singular the appurtenances thereunto belonging or in anywise appertaining, and all the estate, right, title, interest and claim whatsoever of the Grantor, either in law or equity, subject to the afore-described restrictions.

IN WITNESS WHEREOF, the FLORIDA STEEL CORPORATION has caused its corporate seal to be hereunto affixed and this instrument to be signed by its duly authorized officer the day and year first above written.

Signed, sealed and delivered in our presence:

Edward L. Flem

Cassandra Schafer

By: Thomas G. Creed

STATE OF FLORIDA
COUNTY OF HILLSBOROUGH

I HEREBY CERTIFY that on this date before me, an officer duly authorized in the state and county named above to take acknowledgements, personally appeared Thomas G. Creed, as President of FLORIDA STEEL CORPORATION, this day acknowledged before me that he executed the foregoing instrument as such officer of said corporation, and that he affixed thereto the official seal of said corporation; and I further certify that I know the said person making said acknowledgement to be the individual described in and who executed the same.

WITNESS my hand and official seal at Tampa, County of Hillsborough, and State of Florida, this 22nd day of August, 1990.

Patricia E. Cassell
NOTARY PUBLIC
My Commission Expires:
Notary Public State of Florida at Large
My Commission Expires Apr. 2, 1991

FILED FOR RECORD
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Appendix G - Order of Governor and Cabinet: re: 500 KV Electical Transmission Line
(pages 242-250)

STATE OF FLORIDA
DIVISION OF ADMINISTRATIVE HEARINGS

IN RE: FLORIDA POWER & LIGHT COMPANY LEVEE-MIDWAY 500 kV TRANSMISSION LINE CORRIDOR CERTIFICATION APPLICATION NO. TA89-0	DOAH Case No. 89-0279 OGC Case No. 89-8907

RECOMMENDED ORDER

Pursuant to notice, a formal hearing was held before Diane K. Kiesling, Hearing Officer of the Division of Administrative Hearings, on November 13-17, 27-31, and December 4-6, 1989, in Fort Lauderdale, Florida. Additional hearings were conducted on November 20, 1989, in Fort Pierce, Florida; November 21, 1989, in Stuart, Florida; November 30, 1989, in Davie, Florida; and December 1, 1989, in West Palm Beach, Florida.

The issues for determination are whether any of the properly proposed corridors complies with the criteria in Section 403.529(3), Florida Statutes; and, if so, which of the corridors proper for consideration have the least adverse impacts with respect to the criteria in Section 403.529(3), Florida Statutes, including cost; and, if two or more corridors proper for consideration comply with the criteria in Section 403.529(3), Florida Statutes, and have the least adverse impacts, and are substantially equal in impacts, whether the corridors preferred by Florida Power & Light Company (FPL), TCRPC Corridor 1 and the SFWMD Corridor, should be certified as the location for the Levee-Midway 500 kV Transmission Line.

separated from the City of Tamarac by the Sawgrass Expressway, and there is no development on the site. Little or no native vegetation is found on the site, and the site provides no important habitat for listed, threatened, or endangered wildlife species.

RECOMMENDATION

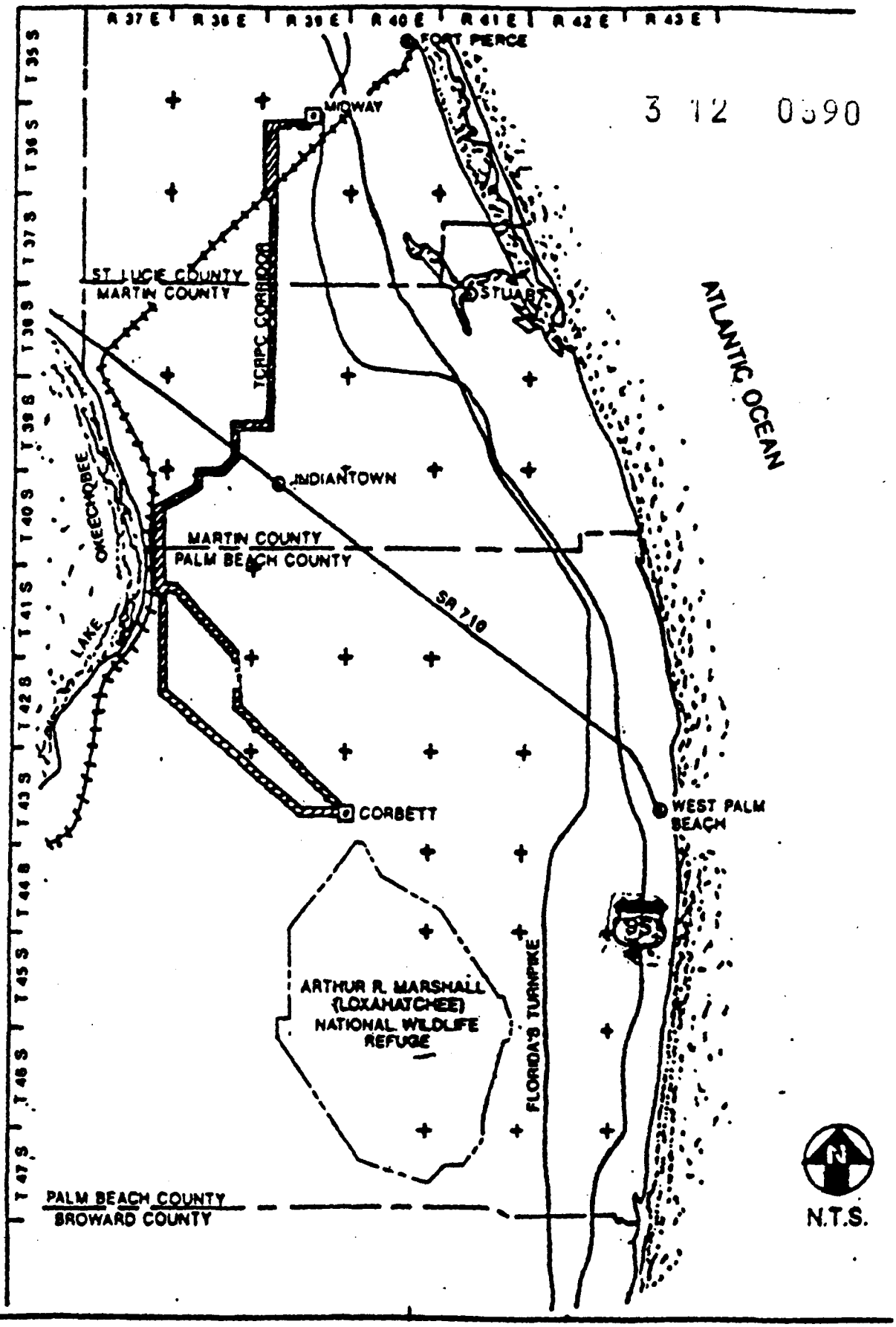
Based on the foregoing Findings of Fact and Conclusions of Law, it is

RECOMMENDED that the Governor and Cabinet, sitting as the Siting Board, enter a Final Order and therein dismiss the parties who failed to make and appearance; ratify the partial Summary Recommended Order; and grant certification for the location of the Lavee-Midway Transmission Line in TCRPC Corridor 1 and the SFWMD Corridor and for the construction and maintenance of the transmission line within those corridors as proposed in the application and in accordance with the conditions of certification contained in Appendices C, D, E, F, G, H, I, and K, as modified and recommended on pages 98 and 99 herein.

DONE AND ENTERED this 2nd day of March, 1990, in Tallahassee, Florida.

DIANE K. KIESLING, Hearing Officer
Division of Administrative Hearings
The DeSoto Building
1230 Apalachee Parkway
Tallahassee, Florida 32399-1550
(904) 488-9675

Filed with the Clerk of the Division of Administrative Hearings this 2nd day of March, 1990.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INDIANTOWN
OKEECHOBEE
LAKE
MARTIN COUNTY
PALM BEACH COUNTY
SR 710
CORBETT
WEST PALM BEACH
ARTHUR R. MARSHALL (LOXAHATCHEE) NATIONAL WILDLIFE REFUGE
FLORIDA'S TURNPIKE
PALM BEACH COUNTY
BROWARD COUNTY
N
N.T.S.

BEFORE THE GOVERNOR AND CABINET
OF THE STATE OF FLORIDA

RECEIVED
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IN RE:

FLORIDA POWER AND LIGHT COMPANY
LEVEE-MIDWAY 500 kV TRANSMISSION
LINE CORRIDOR CERTIFICATION
APPLICATION NO. TA89-07

DOAH CASE NO. 89-0279
OGC FILE NO. 89-8907

FINAL ORDER

On April 12, 1990, this matter came before the Governor and Cabinet, sitting as the Siting Board pursuant to the Transmission Line Siting Act, Section 403.52 et seq., Florida Statutes (1989), for final action concerning a Recommended Order dated March 2, 1990, attached as Exhibit 1, which recommends certification of the Florida Power and Light Company Line Corridor Application. As allowed by Rule 17-17.682, F.A.C., timely written exceptions to the Recommended Order were filed by the Florida Sugar Cane League (FSCL) on behalf of itself and affiliated companies (New Hope Sugar Company, Okeelanta Corporation, Sugar Cane Growers Cooperative of Florida, South Bay Growers, Inc., United States Sugar Corporation, and S.D. Sugar Corporation); by Metropolitan Dade County (Metro Dade); and jointly by A. Duda and Sons, Inc./Allapattah Properties Partnership (Duda).

FSCL's primary exceptions are directed at a series of findings by the hearing officer (Paragraphs 48-64) of the Recommended Order) entitled "System Reliability and Separation from Existing Transmission Lines." (Exhibit 1, pp. 24-28) Specifically, FSCL excepts to finding 52 that a one-mile

separation between the existing 500 kV line and the proposed Levee-Midway line is appropriate to prevent a simultaneous outage of both lines caused by fire. In the same vein, FSCL excepts to finding 58 that the Levee-Midway 500 kV line be located "at least four [sugar cane] field lengths or one mile, whichever is shorter, from the existing transmission lines to avoid the simultaneous outage of these transmission lines from a sugar cane wildfire." (Exhibit 1, p. 27)

Review of the record discloses that these key findings with respect to transmission line spacing are supported by competent substantial evidence and are therefore binding on the Siting Board and all parties. FSCL selectively criticizes certain aspects of the findings it challenges, but this amounts to no more than quibbling in light of the evidentiary support for the findings, taken as a whole. For example, FSCL correctly notes that finding 57 erroneously specifies 1979 as a year in which uncontrolled sugar cane fires occurred; record testimony indicates that these fires occurred in 1989: an obvious scrivener's error of no actual significance to the decision. No party questions that the burning of sugar cane fields is a regular agricultural practice within the Everglades Agricultural Area which sometimes results in uncontrolled fires. It is immaterial whether such fires are properly characterized as "wild fires", as FSCL asserts in its Exception 3. FSCL exceptions 1-5 are without merit, except as to the scrivener's error noted above, and are rejected.

certification necessitated by the emergency conditions described in Condition G-13.A.3 below shall not be considered a modification pursuant to Section 403.5315, Florida Statutes. A verbal report of the emergency shall be made to DER as soon as possible. Within 14 calendar days after correction of an emergency which would require the Permittee to perform an activity not in accordance with the conditions of certification, a report to the DER shall be made outlining the details of the emergency and the steps taken for its temporary relief. The report shall be a written description of all of the work performed and shall set forth any pollution control measures or mitigative measures which were utilized or are being utilized to prevent pollution of waters, harm to sensitive areas, or alteration of archaeological or historical esources.

Citations: Sections 403.529 and 403.531, F.S.

11. Certified Corridor. The corridor for which certification is granted is generally depicted in Attachment A.

Citations: Section 403.531, F.S.

corridor certifiability in reaching the conclusion that only the TCRPC 1 and SFWMD alternatives were certifable as a matter of fact and law. Duda exception 35 is rejected.

Finally, the Board approves and adopts the discussion "Conservation Substation" found at pages 108-109 of Exhibit 1. For the reasons found by the hearing officer, the proposed substation site is an appropriate general location for an intermediate substation, as specified in Section 403.522(15), Florida Statutes.

Having considered the Recommended Order, exceptions, argument of counsel, and otherwise being fully advised in the premises, it is ORDERED:

1. The Recommended Order (Exhibit 1) is approved and adopted in its entirety by the Board, with the exception noted on page 2 of this order.

2. The application of Florida Power and Light Company for certification of the Levee-Midway transmission line corridor is granted, as recommended in Exhibit 1, subject to the conditions of certification contained in Appendices C, D, E, F, G, H, I, and K, as specifically modified at pages 98 and 99 of Exhibit 1.

3. The exceptions of the Florida Sugar Cane League and affiliated companies are rejected for the reasons set forth above.

4. The exceptions of A. Duda and Sons, Inc./Allapattah Properties Partnership are rejected for the reasons set forth above.

5. The exceptions of Metropolitan Dade County are rejected for the reasons set forth above.

DONE AND ORDERED this 12th day of April, 1990, in Tallahassee, Florida, pursuant to the vote of the Governor and Cabinet, sitting as the Siting Board, at a duly noticed and constituted Cabinet meeting on April 12, 1990.

FILING AND ACKNOWLEDGEMENT
FILED, on this date, pursuant to S120.52 Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Clerk 4-20-90 Date

FOR THE GOVERNOR AND CABINET
SITTING AS THE SITING BOARD

By
The Honorable Bob Martinez, Governor

3 12 0596

Appendix H - Soil Ingestion Studies
(pages 251-254)

Of the four studies in the published literature that provide direct empirical measurements of soil ingestion in children (Binder, et al., 1986; Clausing, et al., 1987; Calabrese, et al., 1989; and Davis et al., 1990), the latter two studies were not available to the Office of Solid Waste and Emergency Response (OSWER) in issuing the interim guidance.

Davis et al. (1990) estimated the daily soil ingestion rate of a randomly selected group of children (ages 2-7) in a four consecutive day study. This study used a mass balance equation, which accounted for tracer elements in the diet, excreta, soil and house dust from each child's home. They found the average daily ingestion rates of the tracer elements were: aluminum, 38.9 mg/day (median 25.3 mg/day); silicon, 82.4 mg/day (median 59.4 mg/day); and titanium, 245.5 mg/day (median 81.3 mg/day). No consistent pattern emerged regarding a demographic or behavioral profile that was predictive of soil ingestion. The average for silicon, titanium, and aluminum median values reported in this study was 55.3 mg/day.

Calabrese et al. (1989) and Davis et al. (1990) are likely to be the most comprehensive and precise studies estimating child soil ingestion rates for the following reasons. Calabrese et al. (1989) quantitatively evaluated eight different tracer elements and background sources of metals in the feces, food, soil and house dust, and corrected for the pharmacokinetics of the tracer elements. They also determined which tracer elements are the most reliable, based on a controlled soil ingestion study in which adults were fed soil with known concentrations of tracer elements. By measuring the concentration of tracer element in food, soil and excreta using a mass balance approach, Calabrese et al. (1989) determined aluminum, silicon and yttrium as the most accurately traced elements of the eight tracer elements tested. The median soil intake based on results from all eight tracers ranged from 9-96 mg/day, with seven of the eight tracer values having median values < 50 mg/day. The three most reliable tracers (Al, Si, Y), based on recovery studies, revealed a range in median values of 9 to 40 mg of soil ingested/day. The average of the median values for these three elements was 26 mg/day.

Most adults do not intentionally ingest soil. Adult soil ingestion rates have been estimated based on studies of children. LaGoy (1987) estimated an average soil ingestion rate of 50 mg/day for adults with frequent hand-to-mouth contact (i.e., smokers) or those who are in direct

contact with contaminated soil (i.e., gardeners). For the average adult, LaGoy (1987) estimated a soil ingestion rate of 25 mg/day.

Paustenbach (1989) evaluated the methods and results of a variety of studies which estimate child soil ingestion rates and concluded that recent soil tracer studies provide the most accurate estimates, particularly Calabrese et al. (1989). In consideration of studies estimating child soil ingestion rates from 1977 to 1989, Paustenbach cited Calabrese et al. (1989) as the most rigorous study which provided a likely child soil ingestion rate estimate; this range was reported to be 25-50 mg/day. For adults, Paustenbach evaluated ingestion of food contaminated with soil and incidental ingestion via poor personal hygiene as potential routes of soil ingestion exposure and concluded adult soil ingestion rates are likely to range from 2-5 mg/day.

The EPA has developed age-specific soil ingestion rates based on the results provided by several researchers including Lepow et al. (1975), Roels et al. (1980), Kimbrough et al. (1984). Generally, the adult ingestion rate has been estimated at approximately 50% that of children. More recent studies suggest the soil ingestion rate may be lower.

Preliminary direct evidence that adult soil ingestion rates are significantly lower than that of children has been described in detail by Gradient (1989). This evaluation described urinary arsenic levels in Mill Creek Montana residents before and after relocation. It was found that children had 15 times higher arsenic intake levels than the adults. The excess levels of arsenic were attributed to differences to intake of arsenic from soil ingestion, suggesting that the soil ingestion rate of older children and adults is much less than one-half that of the younger child (Gradient, 1989).

Based on consideration of the child soil ingestion rates, a more realistic estimate of adult soil ingestion rate is 25 mg/day. Soil ingestion rates of 100 mg/day and 25 mg/day are used in comparative calculations of health based soil concentrations for lead. The comparison of the alternative results are discussed in the conservatism section (5.8.2). However, EPA Region IV directed that 100 mg/day be used as the adult soil ingestion rate. For the reasons explained in the above paragraphs, Envirologic Data concludes that this value of 100 mg/day is at least 4

times higher than that supported by the current scientific literature. Based on what appears to be the best available science, the authors therefore recommend that 25 mg/day be used. However, in deference to the above directives, 100 mg/day is used in Table 27 and Appendix C.

Appendix I - Letter of Application to EPA and FDER for Groundwater Remediation
(pages 255-257)

FLORIDA STEEL CORPORATION
"Steel when you want it"

Phone 813/251-8811

GENERAL OFFICES
1716 CLEVELAND ST. • P.O. BOX 23328 • TAMPA, FL 33630

3 12 0401

November 1, 1990

Dr. Marvin Collins
Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Dear Dr. Collins:

Section 300.430(a)(ii) of the 1990 National Contingency Plan provides:

> "ii Program Management Principles. EPA shall generally consider the following general principles of program management during the remedial process:
>
> "A. Sites should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly . . . ." (emphasis supplied)

Consistent with the above management principle, Florida Steel Corporation ("FSC") advised during its meeting with you and EPA in Tallahassee on July 18, 1990, that it desired to remediate the Indiantown site in phases using operable units to expedite the completion of the total site clean up. One of the operable units mentioned for early action was the contaminated groundwater.

As reported in the RI and RA a plume of groundwater with degraded quality extends 600 feet south of the FSC property boundary. The plume is moving at a rate of approximately 40 feet per year and at this rate will reach the nearest user in 35 years. The degraded groundwater is presently confined to a sand unit in the depth interval from 20 to 30 feet below land surface. This depth interval is 50 feet above the depth interval commonly used as a source of water supply in the area.

As stated at the meeting with the DER and EPA on July 18, 1990, FSC would like to expedite remediation of the plume with the immediate priority being to pull the plume back to the FSC property line. FSC recognizes that the longer remediation is delayed, the longer it will take to bring the plume back onto FSC property and the greater the volume of water that will have to be treated and disposed of.

3 12 0402

A 24-hour pumping test with nine observation wells was conducted in May, 1988, (and reported in the RI) in order to generate the aquifer coefficients needed to design an efficient groundwater recovery system. Computer modeling using these coefficients indicates that a total pumping rate of 50 gpm from several recovery wells will bring the plume back to the FSC property line after approximately five years of pumping. Additional pumping may be required to totally remediate groundwater quality under the site.

The principal technical issue that needs to be resolved prior to pumping is disposal of the water generated by the recovery wells. To address this issue FSC solicited treatability study proposals from five firms specializing in treatment of waste streams containing heavy metals and radionuclides. Two firms were selected to conduct treatability studies: Alcoa Separation Technology, Inc., and Lancy International, Inc. The criteria used in selection of these firms included experience with similar waste streams, number and types of treatability tests to be performed, completeness of analytical data generated, consideration of quantity and nature of sludges and other residuals, and ability to design a full-scale treatment system.

Groundwater samples were collected from monitoring wells in the plume in August, 1990, and sent to Alcoa and Lancy for treatability testing. An additional sample was sent to the U.S. Bureau of Mines in Salt Lake City to assess removal efficiencies obtained using the "bio-fix" porous polymer developed for such applications by this agency.

It is anticipated that the results of the treatability studies will be available in December of this year or January, 1991.

The disposal of the treated wastewater will be dependent upon effluent quality. Preliminary work is now being performed to determine the feasibility of using the St. Lucie canal as the point of discharge for the treated water.

Your assistance in expediting groundwater remediation will be appreciated.

Very truly yours,

Luis Nieves

LN/er
cc: Randy Bryant

Appendix J - Calculation of Arithmetic Average and 95% Upper Confidence Limit
(pages 258-263)

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3 10 0433

Site: FL Steel
Break: 3.10
Other: phase VII

10018240

Remedial Investigation Report - Phase II
October 17, 1989
Florida Steel Corporation
Indiantown Mill Site
Martin County, Florida

VOLUME II

APPENDICES

Ardaman & Associates, Inc.

Bureau of Waste Cleanup

OCT 20 1989

Hazardous Waste
Cleanup Section

OFFICES

Orlando, 8008 S. Orange Avenue, P.O. Box 593003, Orlando [illegible] 32859-3003, Phone (407) [illegible]
Bartow, 1987 S. Holland Parkway, P.O. Box 812, Bartow, [illegible] 33830, Phone (813) 533-0855
Bradenton, 209 A 6th Avenue East, P.O. Box 1335, Bradenton, [illegible] 33508, Phone (813) 748-397[illegible]
Cocoa, 1300 N. Cocoa Blvd., P.O. Box 3557, Cocoa, Florida [illegible], Phone (407) 632-2503
Fort Myers, 2508 Rockfill Road, Fort Myers, Florida 33916, Phone (813) 337-1288
Miami, 2608 W. 84th Street, Hialeah, Florida 33016, Phone (305) 825-2583
Port St. Lucie, 1017 S.E. Holbrook Ct., P.O. Box 8687, Port St. Lucie, Florida 34985, Phone (407) [illegible]
Sarasota, 2500 Bee Ridge Road, P.O. Box 15008, Sarasota, Florida 34277, Phone (813) 922-3526
Tallahassee, 3175 West Tharpe Street, Tallahassee, Florida 32303, Phone (904) 576-613[illegible]
Tampa, 105 N. Faulkenburg Road, Suite D, P.O. Box 1506, Brandon, Florida 34299-1506, Phone (813) [illegible]
West Palm Beach, 2511 Westgate Avenue, Suite 10, West Palm Beach, Florida 33409, Phone (407) [illegible]

MEMBERS:
American Concrete Institute
American Society for Testing and Materials
American Consulting Engineers Council
Association of State and Territorial Engineers
Florida Institute of Consulting Engineers
Professional Engineers in Private Practice

3 10 0434

Appendix A

LOGS OF BORINGS AND TEST PITS

Bureau of Waste Cleanup

OCT 20 1989

Hazardous Waste
Cleanup Section

BORING NUMBER: P2A2

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-2-4-6 (14)	1 6" sand, f to vf, little organic material, brown-gray-black
			2 6" sand, f to vf, tr organic matter, gray-black
			2" sand, as above (discarded)

TEST PIT: P2A1

DATE SAMPLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, roots, 1/2" leaf litter at top, gray
2	0.5-1.0	Sand, fine, some roots, gray, moist

BORING NUMBER: P2A4

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: MARK SCHULTZ

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	7-9-13-19 (24)	1 2" sand, f, tr clay, silt, rock frags, mill scale, brown 2" sand, f, and organic material, roots, brown 2" sand, f, dk gray
			2 6" sand, f to m, lt gray-brown
			12" sand, as above (discarded)

BORING NUMBER: P2A3

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-2-4-5 (21)	1 6" sand, f to vf, little organic material, gray-black
			2 6" sand, f to vf, tr organic matter, gray-black
			9" sand, as above (discarded)

BORING NUMBER: P2A6

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-4-8-11 (24)	1 6" sand, f to vf, tr to little organic material, gray- black
			2 6" sand, f to vf, little m, tr organic material, gray-black
			12" sand, as above (discarded)

BORING NUMBER: P2A5

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	3-5-8-10 (24)	1 4" sand, f, tr clay, silt, organic material, gray-brown 2" sand, f to vf, tr organic material, gray-black
			2 6" sand, f to vf, tr organic matter, gray-black
			12" sand, as above (discarded)

TEST PIT: P2A8

DATE SAMPLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, roots, 1/2" leaf litter at top, gray and black
2	0.5-1.0	Sand, fine, some roots, gray, some black

BORING NUMBER: P2A7

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	41-28-18-22 (22)	1 8" slag (crushed) and mill scale, tr shell frags, greasy, black-brown-gray 4" slag, poorly sorted, brown-gray-yellow
			2 2" crushed limerock, white
			3 6" sand, f to vf, tr m and organic material, gray-black
			2" sand, as above (discarded)

Sample 4 = 1 + 2

BORING NUMBER: P2A10

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	5-22-26-31 (24)	1 6" sand, f to vf, and slag, tr organic material, brown-gray
			2 4" sand, f to vf, some organic matter, gray-black 2" sand, f to vf, little organic matter, gray-black
			11" sand, as above (discarded)

BORING NUMBER: P2A9

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-6-7 (18)	1 6" sand, f to vf, tr rock frags, little organic material, brown-gray
			2 6" sand, f to vf, tr m and organic material, gray-black-brown
			6" sand, as above (discarded)

BORING NUMBER: P2A12

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-2-5-7 (20)	1 6" sand, f to vf, tr slag, mill scale and organic material, brown-gray
			2 6" sand, f to vf, tr m and organic matter, gray-black
			8" sand, as above (discarded)

BORING NUMBER: P2A11

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	430-60-32-25 (24)	1 14" slag, poorly sorted, tr mill scale, brown-gray-red
			2 6" sand, f to vf, tr organic matter, gray-black
			4" sand, as above (discarded)

BORING NUMBER: P2A14

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-2-3-4 (16)	1 6" sand, f to vf, tr m, and organic material, gray-black
			2 6" sand, f to vf, tr m and organic material, gray-black
			4" sand, as above (discarded)

BORING NUMBER: P2A13

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-4-5 (20)	1 6" sand, f to vf, tr m, and slag, little organic material, gray-black-brown
			2 6" sand, f to vf, tr m and organic matter, gray-black
			8" sand, as above (discarded)

BORING NUMBER: P2A16

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-5-6-9 (20)	1 6" sand, f to vf, tr m, little organic material, gray-black
			2 6" sand, f to vf, tr m and organic matter, gray-black
			8" sand, as above (discarded)

BORING NUMBER: P2A15

3 10 0450

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)
1 & 2	0-2.0	11-10-12-12 (24)

Description

1 15" sand, f to vf and rock frags, some organic material in upper 2" and tr in next 13", gray-white-black brown

2 6" sand, f to vf, some organic material, gray-black-brown

3" sand, f to vf, tr organic materia (discarded)

BORING NUMBER: P2A18

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	3-5-7-9 (19)	1 6" sand, f to vf, tr m, rock frags, and metal, little organic material, gray-black-brown
			2 6" sand, f to vf, tr m and organic matter, gray-black-brown
			7" sand, as above (discarded)

BORING NUMBER: P2A17

DATE INSTALLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-5-7 (19)	1 6" sand, f to vf, some organic material, gray-black-brown
			2 6" sand, f to vf, tr to little organic matter, gray-black-brown
			7" sand, as above (discarded)

BORING NUMBER: P2A20

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	12-10-7-8 (24)	1 2" sand, f to vf, tr m, and organic material, gray-black 14" slag, poorly sorted, little to some f to vf sand, tr m, rock frags and metal 2 6" sand, f to vf, tr rock frags and organic matter, gray-black 2" sand, as above (discarded)

BORING NUMBER: P2A19

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-3-7-10 (21)	1 6" sand, f to vf, tr m, mill scale, slag, and organic material, brown-gray-white
			2 2" sand, f to vf, tr organic matter, gray-black 2" organic material, some f to vf sand, black-brown-gray 2" sand, f to vf, tr m and organic material gray-black
			9" sand, as above (discarded)

BORING NUMBER: P2A22

3 10 0455

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	40-22-15-14 (21)	1 11" slag, poorly sorted, little f to vf sand, tr mill scale and metal, brown-gray
			2 6" sand, f to vf, and organic material, gray-black
			4" sand, as above (discarded)

3 10 0456

BORING NUMBER: P2A21

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	21-13-12-10 (24)	1 8" crushed limerock, tr slag and f to vf sand, white
			2 6" sand, f to vf, tr organic material, gray-black
			10" sand, as above (discarded)

3 10 0457

BORING NUMBER: P2A24

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-4-6-7 (21)	1 6" sand, f to vf and organic material, upper 2" contains EC dust
			2 6" sand, f to vf, tr m and organic material, gray-brown-black
			9" sand, as above (discarded)

BORING NUMBER: P2A23

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	3-5-7-8 (20)	1 7" sand, f to vf, tr m, slag, and limerock, little organic material, brown-gray-white
			2 4" sand, f to vf, tr m and nodules (f sand, peat and cement), little organic material brown-gray 2" sand, f to vf, tr m and organic material, gray-black-brown
			7" sand, as above (discarded)

BORING NUMBER: P2A26

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	1-4-6-7 (21)	Sand, f to vf and slag, brown-gray
2	2.0-4.0	6-6-7-7 (14)	2 6" sand, f to vf, tr m and organic material, white-gray-black
			8" sand, as above (discarded)

TEST PIT: P2A25

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, f to vf, and organic material, gray-black
2	0.5-1.0	Sand, f to vf, some organic material, gray-black

BORING NUMBER: P2A28

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1,2,3	0-2.0	92-32-27-24 (24)	1 2" sand, f to vf, and slag, brown-gray
			2 11" 1" asphalt over 10" crushed limerock, white-gray
			3 6" sand, f to vf, little organic material, black-gray
			5" sand, as above (discarded)

Sample 4 = 1 + 2

BORING NUMBER: P2A27

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-5-6 (21)	1 4" sand, f to vf, and slag, little organic material, brown-gray 2" sand, f to vf, tr organic material, gray-black, brown 2 6" sand, f to vf, tr m and organic material, gray-black-brown 9" sand, as above (discarded)

TEST PIT: P2A30

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
	0-0.3	Limerock and sand (not sampled)
	0.3-0.6	Asphalt (not sampled)
1	0.6-1.2	Crushed limerock, white
2	1.2-1.8	Sand, f to vf, tr shell frags and organic material, brown-gray-black
3	1.8-2.3	Sand, f to vf, little organic material, gray-black-brown

Sample 4 = 1 + 2

BORING NUMBER: P2A29

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
1 & 2	0-2.0	25-23-13-13 (24)	1	6" limerock and f to vf sand, tr slag, gray-white-black-brown
				2" slag and tarry material, little f to vf sand, black-brown
				8" crushed limerock, white-gray
			2	6" sand, f to vf, little organic material, gray-black
				2" sand, as above (discarded)

BORING NUMBER: P2A32

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	4-4-3-3 (18)	1 18" sand, f to vf, and slag, tr EC dust and firebrick and organic material, brown-gray-white
2	2.0-4.0	2-2-2-5 (18)	2 6" sand, f to vf, tr m and organic material, gray-black
			12" sand, as above (discarded)

BORING NUMBER: P2A31

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	151-44-35-46 (18)	1 { 6" wood (railroad tie) 9" crushed limerock, tr f sand, white-gray
2	2.0-4.0	7-10-10-19 (19)	2 { 3" sand, f to vf, tr organic material, gray-black 3" sand, as above 16" sand, as above (discarded)

TEST PIT: P2A34

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
1	0-1.5	Slag, poorly sorted, tr to little sand, tr metal, brown-gray
2	1.5-2.0	Sand, f to vf, little organic material, black-gray

Water at 2.8'.

BORING NUMBER: P2A33

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1,2,3	0-2.0	14-61-12-10 (24)	1 6" greasy mill scale, little to some slag, brown-black 2 11" slag, poorly sorted, gray 3 7" EC dust, little slag, brown-gray
4	2.0-4.0	3-5-6-8 (19)	4 6" sand, f to vf, tr m and organic material, gray-black-brown 13" sand, as above (discarded)

Sample 5 = 1 + 2 + 3

BORING NUMBER: P2A36

DATE INSTALLED: 5-6-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	10-44-22-20 (24)	1 21" slag, poorly sorted, tr glass, brown-gray
2	2.0-4.0	7-11-11-13 (19)	2 3" sand, f to vf, tr m and organic material, brown-gray-black 1" sand, as above 2" organic material and f to vf sand, black-gray 16" sand, f to vf, tr m and organic material, gray-brown (discarded)

BORING NUMBER: P2A35

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	4-8-16-16 (14)	1 14" slag, poorly sorted, tr limerock, brown-gray
1 & 2	2.0-4.0	88-62-44-56 (20)	1 12" slag, poorly sorted, tr fire brick, brown-gray-white
			2 6" sand, f to vf, and organic material, gray-black
			2" sand, as above (discarded)

BORING NUMBER: P2A38

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1,2,3	0-2.0	2-6-6-7 (22)	1 13" sand, f to vf, tr organic material, slag, mill scale, brown-gray-black
			2 2" mill scale, tr f to vf sand, gray-brown
			3 7" sand, f to vf, little organic material, tr shell frags, brown-gray
4	2.0-4.0	3-6-6-5 (22)	4 6" sand, f to vf, tr m and organic material, gray-black-brown
			16" sand, as above (discarded)

Sample 5 = 1 + 2 + 3

BORING NUMBER: P2A37

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-4-4 (21)	1 6" sand, f to vf, tr m, silt, clay, rock frags and organic material, tan-brown-gray-black
			2 6" sand, f to vf, tr organic material, tan-brown-gray-black
			9" sand, as above (discarded)

BORING NUMBER: P2A40

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-5-7 (22)	1 6" sand, f to vf, and organic material, brown-gray-black
			2 6" sand, f to vf, and organic material, brown-gray-black
			10" sand, as above (discarded)

BORING NUMBER: P2A39

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-4-6-6 (21)	1 2" sand, f to vf, tr m, and organic material, brown 4" sand, f to vf, tr organic material, brown-gray-black 2 6" sand, f to vf, and organic material, brown-gray-black 9" sand, as above (discarded)

TEST PIT: P2A42

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
1	0-1.4	Slag, poorly sorted, tr metal and rubber, brown-gray
2	1.4-1.9	Sand, f to vf, little organic material, gray-black

Water at 2.8'.

BORING NUMBER: P2A41

DATE INSTALLED: 5-6-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	38-20-10-6 (22)	1 12" slag, poorly sorted, tr f sand, brown-gray
			2 2" sand, f to vf, and organic material, tr m sand, black-brown-gray 4" sand, f to vf, tr m and organic material, gray-black
			4" sand, as above (discarded)

BORING NUMBER: P2A44

DATE INSTALLED: 5-6-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
1 & 2	0-2.0	1-4-5-3 (18)	1	4" sand, f to vf, tr m, gray-brown, bottom 2" contains some organic material 6" crushed limerock, white
			2	8" sand, f to vf, tr m, mill scale and organic material, brown-gray-black
3	2.0-4.0	3-5-6-8 (24)	3	6" sand, f to vf, tr m and organic material, gray-black
				18" sand, as above (discarded)

Sample 4 = 1 + 2

BORING NUMBER: P2A43

DATE INSTALLED: 5-6-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
1	0-2.0	10-50-52-81 (24)	1	24" slag, poorly sorted, tr fire brick, brown-gray-white, top 6 " is mixed with sand
1 & 2	2.0-4.0	7-13-13-22 (21)		15" slag, poorly sorted, tr glass, brown-gray-green
			2	4" clay, white, strip clear plastic at base
				2" silt, tr clay, brown
3	4.0-6.0	22-20 (12)	3	6" sand, f to vf, tr m and organic material, gray-black
				6" sand, as above (discarded)

Sample 4 = 1 + 2

3 10 0479

BORING NUMBER: P2A46

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-4-6-8 (21)	1 7" sand, f to vf, some organic material, tr slag and shell frags, brown-gray-white
			2 6" sand, f to vf, some organic material, gray-black-brown
			8" sand, as above (discarded)

BORING NUMBER: P2A45

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1,2,3	0-2.0	4-14-22-20 (20)	1 [1" sand, f to vf, tr m and slag, brown-gray 4" brown silty material (possibly EC dust), little mill scale, tr slag and limerock, brown-gray-white-black] 2 10" crushed limerock, tr sand, white-brown
3	2.0-4.0	7-9-14-19 (21)	3 [5" sand, f to vf, little organic material brown-black-gray 1" sand, f to vf, little organic material, black-gray] 20" sand, as above (discarded)

Sample 4 = 1 + 2

BORING NUMBER: P2A48

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-3-5 (19)	1 6" sand, f to vf, and organic matter, tr med sand, gray-black-brown
			2 6" sand, f to vf, tr to little organic matter, tr med sand, gray-black-brown
			7" sand, f to vf, little to some organic matter, tr med sand, gray-brown-black

TEST PIT: P2A47

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, roots, salt and pepper color
2	0.5-1.0	Sand, fine, gray, some roots

TEST PIT: P2A50

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-1.8	Slag, very poorly sorted but no very coarse, some brown dust
2	1.8-2.3	Sand, fine, organic black at top and gray at bottom
	2.3-3.5	Sand, fine, gray (not retained)

Water at 3.5'.

TEST PIT: P2A49

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, 1" leaf litter at top, salt and pepper color
2	0.5-1.0	Sand, fine, gray

BORING NUMBER: P2A52

3 10 0485

DATE INSTALLED: 5-6-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-4-2-5 (21)	1 9" sand, f to vf, tr m, shell frags, slag, and organic material, gray-brown
			2 6" sand, f to vf, tr m and organic material, gray-black
			6" sand, as above (discarded)

TEST PIT: P2A51

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-1.5	Slag, sand, and silt, deep brown
2	1.5-2.0	Sand, fine, and organic material, roots, brown
	2.0-4.0	Sand fine, gray (not retained)

Water at 4'.

BORING NUMBER: P2A54

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	8-4-6-9 (21)	1 8" sand, f to vf, little rock frags, tr organic material, silt and clay, brown 13" sand, f to vf, little shell frags, tr organic material, gray-white-black
2	2.0-4.0	6-7-8-7 (17)	2 6" sand, f to vf, tr organic material, gray-white-black 11" sand, as above (discarded)

TEST PIT: P2A53

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
	0-0.9	Clean fill of gray sand with layer of plastic at base (not sampled)
1	0.9-1.1	2" slag, poorly sorted, brown-gray 1" mill scale (greasy) 3" sand, f to vf, and organic material, black-gray
2	1.1-1.6	sand, f to vf, some organic material, gray-black

Pit is dry.

3 10 0489

BORING NUMBER: P2A56

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	12-26-40-22 (20)	Slag, poorly sorted, tr sand, brown-gray-white
2 & 3	2.0-4.0	7-7-9-12 (18)	2 12" sand, f to vf, tr to little slag, tr plastic and organic matter, brown-gray-black
			3 6" sand, f to vf, tr to little organic matter, gray-brown-black

Sample 4 = 1 + 2

3 10 0490

BORING NUMBER: P2A55

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-2-2-5 (22)	1 6" sand, f to vf, little to some organic matter, tr med sand, brown-gray
			2 6" sand, f to vf, little to some organic matter, tr med sand, gray-black-brown
			10" sand, f to vf, tr to little organic matter, tr med sand, gray-black-brown (discarded)

BORING NUMBER: P2A58

3 10 0491

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	52-70-14-13 (24)	1 19" slag, poorly sorted, brown-gray
			2 5" sand, f to vf, tr m, little and organic material, gray-black
2	2.0-4.0	7-8-10-10 (20)	1" sand, as above
			19" sand, as above (discarded)

BORING NUMBER: P2A57

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	34-35-34-20 (20)	1 20" slag, poorly sorted, brown-gray
2	2.0-4.0	15-15-14-13 (17)	2 9" sand, f to vf, little organic material, tr slag and metal, black-gray
			3 6" sand, f to vf tr organic material, white gray-black-brown
			2" sand, as above (discarded)

Sample 4 = 1 + 2

3 1U 0493

BORING NUMBER: P2A60

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
				3" asphalt (discarded)
1 & 2	0-2.0	69-19-18-16 (21)	1	8" crushed limerock, white
			2	10" crushed shells and f to vf sand, tr m and organic material, white-gray-brown-black
3	2.0-4.0	7-9-18-18 (21)	3	6" sand, f to vf, tr organic material, gray-black
				15" sand, as above (discarded)

Sample 4 = 1 + 2

3 10 0494

BORING NUMBER: P2A59

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	16-30-26-22	1 4" EC dust, little f to vf sand, brown (24) 2 20" slag, poorly sorted, brown-gray
3	2.0-4.0	5-7-7-9 (19)	3 6" sand, f to vf, little organic material, gray-black-brown 13" sand, as above (discarded)

Sample 4 = 1 + 2

3 10 0495

BORING NUMBER: P2A62

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	26-13-13-18 (22)	1 3" sand, f to vf, and slag, brown 7" crushed limerock, gray-white
			2 5" crushed shells and f to vf sand, tr organic material, brown-gray-white-black
			3 6" sand, f to vf, little to some organic material, brown-gray-black
			1" sand, as above (discarded)

Sample 4 = 1 + 2

BORING NUMBER: P2A61

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
1 & 2	0-2.0	10-14-18-27 (21)	1	1" sand, brown-gray 8" crushed limerock, gray-white
			2	12" slag, poorly sorted, brown-gray
3 & 4	2.0-4.0	10-7-7-9 (16)	3	9" sand, f to vf, some limerock, tr m sand and organic material, brown-gray-black
			4	6" sand, f to vf, tr organic material, gray-black
				1" sand, as above (discarded)

Sample 5 = 1 + 2 + 3

TEST PIT: P2A64

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-1.0	8" slag and brown dust 4" limerock, powdery
2	1.0-1.5	Sand, fine, gray

BORING NUMBER: P2A63

DATE INSTALLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
			2" asphalt (discarded)
1 & 2	0-2.0	26-15-18-18 (22)	1 10" crushed limerock, gray-white
			2 10" sand, f to vf, and crushed shells, tr rock frags and organic materials, brown-gray-white
3	2.0-4.0	10-12-12-10 (20)	3 6" sand, f to vf, and organic material, brown-gray
			14" sand, as above (discarded)

Sample 4 = 1 + 2

TEST PIT: P2A66

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" sand and shredder fluff 3" sand, fine, gray
2	0.5-1.0	Sand, as above
		Water at 3'.

3 10 0500

TEST PIT: P2A65

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-2.0	Sand, slag, some scrap, glass, probably some shredder fluff, brown
2	2.0-2.5	Sand, fine, white-gray

TEST PIT: P2A68

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-1.1	Sand, auto parts, glass, bright brown suggests shredder fluff
2	1.1-1.6	Sand, fine, salt and pepper color

Water at 3.5'.

TEST PIT: P2A67

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-1.0	Shredder fluff-like material: sand, silt, glass and metal fragments, deep brown
2	1.0-1.5	Sand, fine, salt and pepper color extending to bottom of pit at 3.5'

3 10 0503

BORING NUMBER: P2A70

DATE INSTALLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	7-12-11-8 (22)	1 16" slag, poorly sorted, tr limerock, asphalt and possibly EC dust, brown-gray-white
			2 6" sand, f to vf, little organic material, gray-black

TEST PIT: P2A69

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-2.0	Slag and limerock RR ballast, roots, bright brown suggests rust or EC dust
2	2.0-2.5	Sand, fine, gray

3 10 0505

BORING NUMBER: P2A72

DATE INSTALLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	7-12-11-8 (21)	1 11" slag, poorly sorted, little EC dust, brown-gray
			2 10" crushed limerock, white
3	2.0-4.0	12-12-13-12 (22)	3 6" sand, f to vf, and organic material, black-gray-brown
			16" sand, as above (discarded)

Sample 4 = 1 + 2

3 10 0506

BORING NUMBER: P2A71

DATE INSTALLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	12-14-20-12 (22)	1 16" slag, poorly sorted, little limerock in bottom 8", possible tr EC dust, brown-gray
			2 6" sand, f to vf, little organic material, gray-black

3 10 0507

TEST PIT: P2A74

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, some roots, dry, salt and pepper color
2	0.5-1.0	Sand, fine, gray

BORING NUMBER: P2A73

DATE INSTALLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	11-20-19-12 (22)	1 10" limerock and EC dust, tr slag, sand, and organic material, brown-white-gray
			2 6" sand, f to vf, little organic material, gray-brown-black
			6" sand, as above (discarded)

Pit was dry.

TEST PIT: P2A76

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, roots, salt and pepper color
2	0.5-1.0	Sand, fine, white, some black

TEST PIT: P2A75

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" sand, fine, clayey, lt tan-brown, probably fill 3" sand, fine, some roots, salt and pepper color
2	0.5-1.0	Sand, fine, gray

TEST PIT: P2A78

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" sand and silt, dusty, possibly some EC dust, roots 3" sand fine roots, salt and pepper color
2	0.5-1.0	Sand, as above, whiter with depth
	1.0-3.0	Sand, fine, light gray (not retained)

Water at 2.8 '.

TEST PIT: P2A77

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, 1" leaf litter at top, roots, salt and pepper color
2	0.5-1.0	Sand, fine, gray

BORING NUMBER: P2C1

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
With Split Spoon			
1 & 2	0-2.0	28-25-23-16 (16)	1 13" slag, poorly sorted, tr glass, some organic material in upper 2", brown-gray-white-green
			2 3" sand, f to vf, tr organic material, gray-black
With Backhoe			
3	0.8-1.3		3" slag, poorly sorted, brown-gray 3" sand, f to vf, tr organic material, gray-black
4	1.3-1.8		6" sand, f to vf, tr m sand and organic material, gray-black

TEST PIT: P2B1

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-2.0	6" slag and EC dust 18" slag, very poorly sorted, gray
2	2.0-2.5	Sand, fine, some organic material, very dark brown
	2.5-4.0	Sand, fine, gray, not retained

BORING NUMBER: P2C3

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1,2,3	0-2.0	110-96-19-9 (24)	1 13" slag, poorly sorted, brown-gray
			2 3" slag, poorly sorted, brown-gray 3" sand, f to vf and organic material, black-gray
			3 5" sand, f to vf, tr organic material, gray-black 1" sand, as above
3	2.0-4.0	5-4-4-9 (20)	19" sand, as above (discarded)

BORING NUMBER: P2C2

DATE INSTALLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
With Split Spoon			
1 & 2	0-2.0	20-21-12-10 (24)	1 17" slag, poorly sorted, and f to vf sand, tr metal, firebrick, and organic material, brown-gray-red 2 6" sand, f to vf, tr m and organic materia' gray-black
With Backhoe			
3	1.2-1.7		3" slag, poorly sorted, and f to vf sand, brown-gray 3" sand, f to vf, tr organic material, gray-black
4	1.7-2.2		6" sand, f to vf, tr m sand and organic material, gray-black

TEST PIT: P2C5

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
1	0-0.9	Slag, poorly sorted, possibly some EC dust, brown-gray
2	0.9-2.2	Slag, poorly sorted, brown-gray
3	2.2-2.8	3" slag, poorly sorted, brown-gray 3" sand, f to vf, some organic material, gray-black
4	2.8-3.2	Sand, f to vf, little organic material, gray-black

BORING NUMBER: P2C4

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	44-32-30-31 (22)	Slag, poorly sorted, brown-gray
1	2.0-4.0	48-63-50-30 (17)	Slag, as above
1,2,3	4.0-6.0	10-10-10 (17)	1 1" slag as above
			2 3" slag, as above 3" sand, f to vf, tr organic material, white-gray
			3 6" sand, f to vf, and organic material, brown-black-gray
			4" sand, as above (discarded)

3 10 0519

BORING NUMBER: P2C7

DATE INSTALLED: 5-8-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	172-100-90-32 (24)	1 21" slag, poorly sorted, brown-gray
2 & 3	2.0-4.0	10-13-12-8 (19)	2 3" slag, poorly sorted, brown-gray 3" sand, f to vf, tr m sand and organic material, gray-black
			3 6" sand, as above
			10" sand, as above (discarded)

TEST PIT: P2C6

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
1	0-1.2	Slag, poorly sorted, possibly some EC dust, brown-gray
2	1.2-1.7	3" slag, poorly sorted, little f to vf sand, tr organic material, possible tr EC dust, brown-black-gray 3" sand, f to vf, and organic material, gray-black
3	1.7-2.2	Sand, f to vf, little organic material, gray-black-brown

Water at 3'.

TEST PIT: P2C9

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: GREG ADAMSON

Sample No.	Depth (ft)	Description
1	0-1.8	Slag, poorly sorted, tr fire brick and metal, brown-gray
2	1.8-2.3	3" slag, poorly sorted, brown-gray 3" sand, f to vf, little organic material, tr m sand, gray-black-brown
3	2.3-2.8	Sand as above

Water at 3'.

TEST PIT: P2C8

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-2.8	Slag, relatively fine but poorly sorted, gray
2	2.8-3.3	3" slag, as above 3" sand, f, gray
3	3.3-3.8	Sand, as above

Water at 4.5'.

TEST PIT: P2C11

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-2.8	Slag, relatively fine but poorly sorted, possibly some EC dust from 6"-9", gray
2	2.8-3.3	3" slag, as above 3" sand, f, some organic material, brown
3	3.3-3.8	Sand, as above grading into sand, f, white

Water at 4'.

TEST PIT: P2C10

DATE SAMPLED: 5-10-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-3.2	Slag, very poorly sorted, some cobble size, some fire brick, gray
2	3.2-3.7	3" slag, as above 3" sand, f, gray-black
3	3.7-4.2	Sand, as above

Water at 3.5'.

TEST PIT: P2C12

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: BACKHOE TEST PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-1.8	Slag, very poorly sorted, some rebar, gray
2	1.8-2.3	3" slag, as above 3" sand, f, gray
3	2.3-2.8	Sand, as above

Water at 4'.

BORING NUMBER: P2D1

(same location as P1D13)

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	4-9-14-19	1 9" sand, f to vf, little to some organic matter; tr med. sand, silt, clay, slag, rock frag, metal and glass
			2 6" sand, f to vf, tr organic matter, gray-black
			9" sand, as above (discarded)

BORING NUMBER: P2D2

(same location as P1D12)

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
1 & 2	0-2.0	32-46-20-20 (24)		14" slag, poorly sorted; tr-f to vf sand, rock frags, metal, and organic matter; gray brown-white
			1	4" sand, f to vf, tr to little slag, tr metal, brown-gray
			2	6" sand, f to vf; tr med sand and organic matter; gray-black

BORING NUMBER: P2D3

(same location as P1D11)

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	32-46-20-20 (24)	1 11" sand, f to vf; little to some slag, tr metal and rock fragments, some organic matter in top 3"
			2 6" sand, f to vf, tr to little organic matter
			7" sand, as above (discarded)

BORING NUMBER: P2D4

(same location as P1D10)

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1	0-2.0	5-15-29-19 (19)	1 6" sand, f to vf, little to some slag, little organic matter, tr med and coarse sand, brown-gray 6" slag, poorly sorted, gray-yellow 7" slag poorly sorted and f to vf sand, tr glass, brown-gray
2	2.0-4.0	5-6-9-12 (24)	7" sand, f to vf, and slag, brown-gray (discarded) 2 5" sand, f to vf and organic matter, gray-black 1" sand, f to vf, tr organic matter, gray-black 11" sand, as above, (discarded)

BORING NUMBER: P2D5

(same location as P1D8)

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON *DRILLER: ARDAMAN*

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
1 & 2	0-2.0	108-24-16-20 (24)	1	9" slag, poorly sorted, tr glass, gray 4" sand, f to vf, some slag and organic matter, tr glass and metal
			2	6" sand, f to vf, tr organic matter, gray-black
				5" sand, as above (discarded)
2	2.0-4.0	5-6-9-12	2	5" sand, f to vf and organic matter, gray-black 1" sand, f to vf, tr organic matter, gray-black
				11" sand, as above, (discarded)

BORING NUMBER: P2D6

(same location as P1D9)

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)		Description
1 & 2	0-2.0	5-7-8-11 (24)	1	18" sand, f to vf; tr med sand, slag, glass, metal, plastic, organic matter; brown-gray-white; some organic matter in top 2"
			2	6" sand, f to vf, tr to little organic matter, gray-black

BORING NUMBER: P2D7

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	75-30-7-8 (21)	1 15" slag, poorly sorted, tr sand, f to vf, brown-gray
			2 4" organic matter and sand, f to vf, gray black
			2" sand, f to vf, tr to little organic matter, gray-black

BORING NUMBER: P2F1

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-2-3-5 (21)	1 6" sand, f to vf, little to some organic matter, tr med sand, gray-black
			2 6" sand, f to vf; tr med sand and organic matter, gray-black-brown
			9" sand, as above (discarded)

BORING NUMBER: P2F2

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	1-3-5-8 (24)	1 12" sand, f to vf, tr slag and coal, some organic material in upper 4" and tr in lower 2", brown-gray-black
			2 6" sand, f to vf, tr m and organic material, brown-gray
			6" sand, as above (discarded)

TEST PIT: P2F3

3 10 0555

DATE SAMPLED: 5-7-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray, roots, some black particles
2	0.5-1.0	Sand, fine, gray

3 10 0536

TEST PIT: P2G1

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine to medium, some roots, gray
2	0.5-1.0	Sand, as above
		Water at 1'.

TEST PIT: P2G2

3 10 0537

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Leaf litter, organic material and fine sand, dk brown
2	0.5-1.0	Organic material and fine sand, dk brown
		Water at 1'.

TEST PIT: P2G3

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine to medium, some roots, gray
2	0.5-1.0	Sand, as above, fewer roots

BORING NUMBER: P2G4

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: GREG ADAMSON DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-3-4-6 (24)	1 6" sand, f to vf, some organic matter, tr med sand, gray-black-brown
			2 6" sand, f to vf, little organic matter, tr med sand, gray-black-brown
			12" sand, as above (discarded)

BORING NUMBER: P2G5

DATE INSTALLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	2-4-5-6 (21)	1 6" sand, f to vf, some organic matter, tr med sand, gray-black
			2 6" sand, f to vf, tr to ittle organic matter, tr med sand, gray-black
			9" sand, as above (discarded)

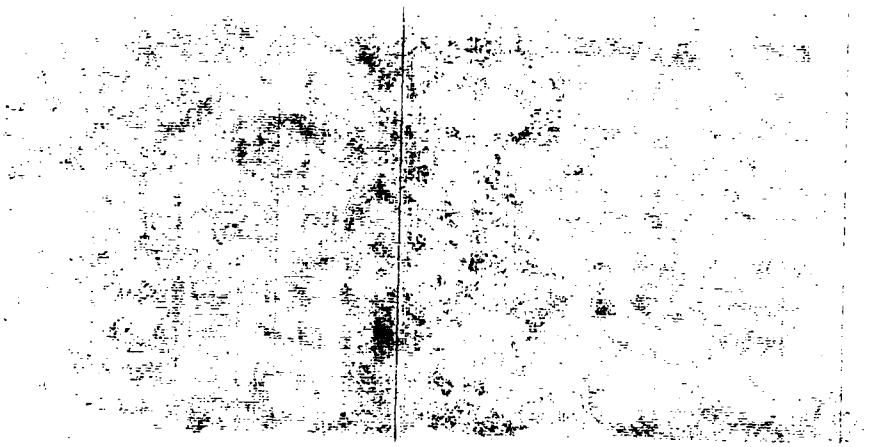
TEST PIT: P2G6

3 10 0541

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Clay, silt and cattail roots, lt brown
2	0.5-1.0	Sand, and organic material, dark brown

Water at 1'.



TEST PIT: P2G7

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, white, thin organic layer at 1"
2	0.5-1.0	Sand, as above

TEST PIT: P2G8

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray, some dk brown-black organic material
2	0.5-1.0	Sand, fine, gray, soft

TEST PIT: P2G9

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray, some dk brown-black organic material
2	0.5-1.0	Sand, fine, gray, soft

TEST PIT: P2G10

DATE SAMPLED: 5-7-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray, roots, some black particles
2	0.5-1.0	Sand, fine, gray

TEST PIT: P2G11

DATE SAMPLED: 5-7-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray and black, abundant roots
2	0.5-1.0	Sand, as above

TEST PIT: P2G12

DATE SAMPLED: 5-7-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Organic litter humus
2	0.5-1.0	Sand, fine, gray, some black organic layers, moist

TEST PIT: P2G13

DATE SAMPLED: 5-7-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Organic material, some fine sand
2	0.5-1.0	As above

TEST PIT: P2G14

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation
2	0.5-1.0	As above, some organic muck

Water at 1'.

TEST PIT: P2G15

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" decomposed vegetation 3" as above mixed with sand, very dark brown to gray
2	0.5-1.0	Organic muck, vegetation, and fine sand

Water at 1'.

TEST PIT: P2G16

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" decomposed vegetation 3" as above mixed with sand, very dark brown to gray
2	0.5-1.0	Sand, some organic muck, dark brown

Water at 1.5'.

TEST PIT: P2G17

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray, roots, dry
2	0.5-1.0	Sand, as above, slightly moist

TEST PIT: P2G18

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, roots, gray, some black, dry
2	0.5-1.0	Sand, as above, moist

TEST PIT: P2G19

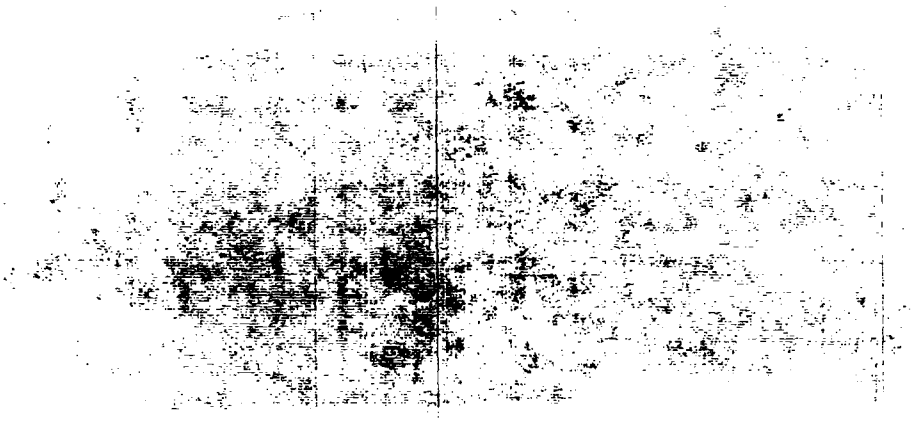
DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, roots, gray, some black, dry
2	0.5-1.0	Sand, as above, moist

TEST PIT: P2G20

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray, roots, dry
2	0.5-1.0	Sand, as above, slightly moist



TEST PIT: P2G21

(located on side of ditch)

DATE SAMPLED: 5-9-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, white, some roots
2	0.5-1.0	Sand, as above

TEST PIT: P2G22

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	1" leaf litter 5" sand, fine, some roots, gray, dry
2	0.5-1.0	Sand, as above

TEST PIT: P2G23

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, roots, salt and pepper color, dry
2	0.5-1.0	Sand, as above, less roots, slightly moist

TEST PIT: P2G24

DATE SAMPLED: 5-11-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine, gray, roots, dry
2	0.5-1.0	Sand, as above, slightly moist

BORING NUMBER: P2G25

DATE INSTALLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
SAMPLE METHOD: SPLIT SPOON
LOGGED BY: GREG ADAMSON

DRILLING METHOD: HOLLOW STEM AUGER
DRILLER: ARDAMAN

Sample No.	Depth (ft)	Blows per 6 inches (recovery in inches)	Description
1 & 2	0-2.0	3-3-4-7 (22)	1 6" sand, f to vf and organic material, gray-black
			2 6" sand, f to vf, some organic material, gray-black
			10" as above (no sample retained)

TEST PIT: P2SD1

DATE SAMPLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.4	2" sand, medium, some organic material, brown 3" decomposed vegetation and roots

TEST PIT: P2SD2

DATE SAMPLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

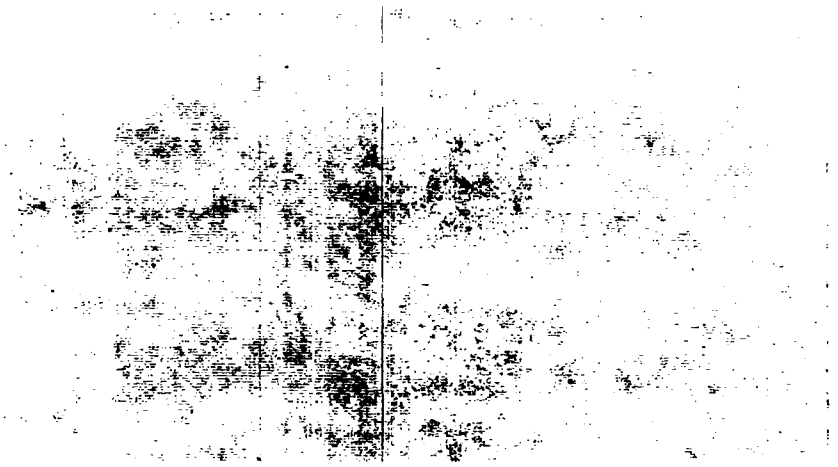
Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation and roots, dark brown
	0.5-1.0	As above (no sample retained)

TEST PIT: P2SD3

DATE SAMPLED: 5-2-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation and roots, dark brown
2	0.5-1.0	As above
	1.0-2.5	As above, vegetation more decomposed with depth (no sample retained)

Water at 2'.



TEST PIT: P2SD4

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation and roots, dark brown
2	0.5-1.0	As above (no sample retained)

TEST PIT: P2SD5

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.3	Roots, decomposed vegetation, and fine sand, brown to dark brown

Water at 2'.

TEST PIT: P2SD6

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation, more decomposed at bottom, dark brown
	0.5-2.0	As above, only more decomposed (no sample retained)

Water at 8".

TEST PIT: P2SD7

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation, more decomposed at bottom, dark brown
	0.5-1.5	As above, only more decomposed (no sample retained)
	1.5+	Sand based on resistance to driven stake

Water at 1'.

TEST PIT: P2SD8

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation, more decomposed at bottom, dark brown
	0.5-1.0	Sand, fine, brown (no sample retained)

Water at 8".

TEST PIT: P2SD9

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.3	1.5" decomposed vegetation, dark brown 1.5" sand, fine to medium, gray

TEST PIT: P2SD10

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation, some sand at bottom, dark brown
	0.5-1.0	Sand. fine to medium, white (no sample retained)

TEST PIT: P2SD11

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Decomposed vegetation, possibly slightly oily, dark brown

3 10 0572

TEST PIT: P2SD12

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.3	1" decomposed vegetation, and roots, dark brown 2" sand, fine to medium, gray

TEST PIT: P2SD13

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.3	1" decomposed vegetation, and roots, dark brown 2" sand, fine to medium, gray

TEST PIT: P2SD14

DATE SAMPLED: 5-3-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	1" decomposed vegetation, and sand, dark brown 5" sand, fine to medium, gray to black

TEST PIT: P2SD15

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" sand, fine to medium, some black organic material 3" sand, fine to medium, gray

TEST PIT: P2SD16

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" organic muck, soft, black 3" sand, fine, gray
	0.5-1.0	Sand, fine, brown (no sample retained)

TEST PIT: P2SD17

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" organic muck and roots, black 3" sand, fine, light tan

TEST PIT: P2SD18

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: STAINLESS TROWEL IN SHOVELED PIT
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" roots with some organic muck, dark brown 3" sand (hardpan)

Water at 6".

3 10 0579

PISTON SAMPLE: P2SD19

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.3	Organic muck, some fine sand, very dark brown
	0.3-0.6	Sand, fine, gray (no sample retained)

PISTON SAMPLE: P2SD20

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Sand, fine to medium, some organic material, brown

PISTON SAMPLE: P2SD21

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.2	1" organic silt, black 1" sand, fine, brown

PISTON SAMPLE: P2SD22

DATE SAMPLED: 5-5-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	3" sand, fine, some organic material, slight odor and sheen

PISTON SAMPLE: P2SD23

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.5	Organic muck, very dark brown
	0.5-1.0	Sand, fine, white, some shells (no sample retained)

PISTON SAMPLE: P2SD24

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.3	Organic muck and sand, dark brown
	0.3-0.5	Sand, fine, gray (no sample retained)

PISTON SAMPLE: P2SD25

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.2	Organic muck and sand, dark brown
	0.3-0.5	Sand, fine, gray (no sample retained)

PISTON SAMPLE: P2SD26

DATE SAMPLED: 5-4-89
PROJECT: FSC INDIANTOWN MILL
METHOD: PISTON SAMPLER
LOGGED BY: MARK SCHULTZ

Sample No.	Depth (ft)	Description
1	0-0.3	Sand, fine to medium, some black organic muck
	0.3-1.0	Sand, fine, gray (no sample retained)

Appendix B

CHAIN-OF-CUSTODY FORMS

FSC - INDIANTOWN

Samplers (Signature) Mark Schultz

Sta No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	9 oz cl gla	250 cc amber	pl 500 unp	pl 125 HNO	pl gal HNO		Remarks
P2A1-1	5/8	15:20		✓		1	✓						Pb + Ba + PCB-1
P2A2-1	5/2	–					✓						
P2A3-1	5/2	–						✓					+ PCB-1
P2A4-1	5/2	–					✓						
P2A5-1	5/2	–					✓						
P2A6-1	5/2	–					✓						
P2A7-4	5/8	8:31					✓						
P2A8-1	5/8	15:45					✓						
P2A9-1	5/2	–					✓						
P2A10-1	5/2	–					✓						
P2A11-1	5/2	–					✓						
P2A12-1	5/3	–					✓						
P2A13-1	5/3	13:15					✓						
P2A14-1	5/3	14:15					✓						
P2A15-1	5/4	16:15					✓						
P2A16-1	5/3	–						✓					+ PCB-1
P2A17-1	5/2	–					✓						
P2A18-1	5/3	–						✓					+ PCB-1
P2A19-1	5/3	–					✓						~~[illegible]~~
P2A20-1	5/3	–					✓						

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by: (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature) [signature]	5-12-89 1515	Remarks	

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3 10 0588

CHAIN OF CUSTODY RECORD

Proj No.

Project Name: FSC - INDIANTOWN

Samplers (Signature): Mark Schulty

Sta. No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	9 oz clear glass	250 cc amber glass	100 ml plastic (HNO_3)				Remarks
P2SD21-1	5/5	–		✓		1		✓					Pb + Cd + Fe + Zn + Ba
P2SD22-1	5/5	–		↓		↓		✓					↓
P2SD23-1	5/4	–		↓		↓	✓						+ PCB's
P2SD24-1	5/4	–		↓		↓	✓						+ PCB's
P2SD25-1	5/4	–		↓		↓		✓					+ PCB's
P2SD26-1	5/4	–		↓		↓	✓						+ PCB's
P2SD3-2	5/2	–		↓		↓		✓					+ PCB's

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schulty	5/12/87 15:15				
Relinquished by (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5/12/87 15:15	Remarks	

FSC - INDIANTOWN

Sampler (Signature) Mark Schultz

Sta No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	9 oz clear glass	250 cc amber glass	100 ml plastic (NaO)				Remarks
P2SD1-1	5/2	–		✓		1	✓						Pb + Cd + Fe + Zn + Ba + PCB1
P2SD2-1	5/2	–						✓					+ PCB1
P2SD3-1	5/2	–						✓					+ PCB1
P2SD4-1	5/3	–						✓					+ PCB1
P2SD5-1	5/3	–						✓					+ PCB1
P2SD6-1	5/3	–						✓					+ PCB1
P2SD7-1	5/3	–						✓					+ PCB1
P2SD8-1	5/3	–						✓					+ PCB1
P2SD9-1	5/3	–					✓						
P2SD10-1	5/3	–					✓						
P2SD11-1	5/3	–						✓					
P2SD12-1	5/3	–					✓						
P2SD13-1	5/3	–					✓						
P2SD14-1	5/3	–					✓						
P2SD15-1	5/4	–					✓						+ PCB1
P2SD16-1	5/4	–					✓						+ PCB1
P2SD17-1	5/4	–					✓						+ PCB1
P2SD18-1	5/4	–					✓						+ PCB1
P2SD19-1	5/5	–						✓					+ PCB1
P2SD20-1	5/5	–						✓					+ PCB1

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5-12-89 15:15	Remarks	

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CHAIN OF CUSTODY RECORD

PROJ NO.

PROJECT NAME: Florida Steel (Industtown)

SAMPLERS: (Signature) Client (Mark Schulte)

STA NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO OF CONTAINERS	HNO3 glass	unpr glass	H2SO4 plastic	unpr plastic	NaOH plastic	VIALS	ZnOAc plastic	REMARKS
	5-9-89	1350		✓	P2C11 - 1	42019								Ba', Pb
	5-11-89	1224		✓	P2C5 - 1	42020								Ba', Pb
	5-11-89	1245		✓	P2C6 1	42021								Ba, Pb

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
	9/15/89 1320	[signature]	[signature]		
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

3 10 0591

3-0605

FSC - INDIANTOWN

Sampler (Signature) Mark Schultz

3 10 0592

Site No.	Date	Time	Comp.	Grab	Station Location	No of Containers	9 oz clear glass	250 cc amber glass					Remarks
P2H1-1	5/3	—		✓		1		✓					Pb + Ba
P2H2-1	5/3	16:28						✓					
P2H3-1	5/4	14 20						✓					
P2H4-1	5/11	11:25							✓				+ PCBs
P2H5-1	5/6	14 20						✓					
P2H6-1	5/8	15:20						✓					
P2H7-1	5/9	14 45						✓					
P2H8-1	5/11	16:45					✓						
P2J1-1	5/2	—					✓						Pb + Cd + Fe + Zn + Ba
P2J2-1	5/3	—					✓						PCBs
P2J3-1	5/3	—		✓			✓						PCBs
P2K1-1	5/4	—		✓		1	✓						Pb + Cd + Fe + Zn + PCBs + Ba
P2K2-1	5/4	—						✓					
P2K3-1	5/5	—						✓					
P2K4-1	5/8	15:20					✓						Pb + Ba
P2K5-1	5/9	12:06					✓						
P2K6-1	5/10	10 30					✓						
P2K7-1	5/10	14 50					✓						

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/87 15:15				
Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5-12-87 1515	Remarks	

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3 10 0593

ROD SHAW

Samplers (Signature) Mark Schulty

Sta No.	Date	Time	Comp.	Grab	Station Location	No of Containers	9 oz clear glass	250 cc amber glass	100 ml plastic (HNO3)				Remarks
P2M1-1	5/12	8:20		✓		1		✓					Pb + PCBs
P2M2-1	↓	8:10		✓		↓		✓					↓
P2M3-1		8:00		✓				✓					
P2M3-2		8:00		✓				✓					

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schulty	5/12/89 15:15				
Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5-12-89 1515	Remarks	

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3 10 0594

CHAIN OF [illegible]STODY RECORD

Proj

Project Name: FSC - INDIANTOWN

Samplers (Signature): Mark Schultz

Sta No.	Date	Time	Comp	Grab	Station Location	No. of Containers	9 oz clear glass	250 cc amber glass	100 ml plastic (HNO_3)				Remarks
P2G1-1	5/4	–		✓		1	✓						Pb + Ba
P2G2-1	5/5	–					✓						
P2G3-1	5/5	–					✓						
P2G4-1	5/4	13:50					✓						
P2G5-1	5/4	14:20					✓						
P2G6-1	5/5	–					✓						
P2G7-1	5/5	–					✓						
P2G8-1	5/5	16:50					✓						
P2G9-1	5/5	–					✓						
P2G10-1	5/8	14:50					✓						
P2G11-1	5/8	17:00					✓						
P2G12-1	5/8	17:45					✓						
P2G13-1	5/8	18:15					✓						
P2G14-1	5/9	9:20					✓						
P2G15-1	5/9	9:40					✓						
P2G16-1	5/9	10:05					✓						
P2G17-1	5/9	12:30					✓						
P2G18-1	5/9	11:35					✓						+ PCBs
P2G19-1	5/9	11:50					✓						+ PCBs
P2G20-1	5/9	12:06					✓						

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5-11-89 1511	Remarks	

[illegible]ADES LABORATORIES, INC. 1602 CLARE AVENUE WEST PA[illegible]AGU, FL [illegible]

3 10 0595

CHAIN OF CUSTODY RECORD

Proj No.	Project Name
	FSC - INDIANTOWN

Samplers (Signature): Mark Schultz

Sta No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	9 oz clear glass	250 cc amber glass	100 ml plastic (HNO3)				Remarks
P2G21-1	5/9	12:50		✓		1	✓						Pb + Ba
P2G22-1	5/11	18 10					✓						
P2G23-1	5/11	15:25						✓					
P2G24-1	5/11	18 50					✓						
P2G25-1	5/3	16:28					✓						
P2EQB-1	5/3	—		✓	after P2A16-1	1		✓					Pb + Ba + PCBs
P2EQB-2	5/3	17 20			after [redacted] P2G25-1		✓						
P2EQB-3	5/4	15:10			after P2G5-1		✓						
P2EQB-4	5/3	—			after P2SD10-1		✓						
P2EQB-5	5/4	—			after P2SD24-1		✓						+ PCBs
P2EQB-6	5/5	—			after P2SD20-1			✓					+ PCBs
P2EQB-7	5/5	12:05			after P2C3-1		✓						+ PCBs
P2EQB-8	5/6	14 20			after P2A41-1		✓						
P2EQB-9	5/8	15:20			after P2A38-1		✓						
P2EQB-10	5/8	15:30			after P2A1-1		✓						+ PCBs
P2EQB-11	5/9	12:06			after P2G20-1		✓						
P2EQB-12	5/9	14:45			after P2A62-4		✓						
P2EQB-13	5/10	10:30			after P2A51-1		✓						
P2EQB-14	5/10	14:50			after P2A66-1		✓						

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature) [signature]	5-16-89 [illegible]	Remarks	

E SL RAT S.II 160 RE IUE STF FL 1-40 3-42

3 10 0596

Proj No.: | Project Name: FSC - INDIANTOWN

Samplers (Signature): Mark Schulz

Sta No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	9 oz clear glass	250 cc amber glass	100 ml plastic (HNO_3)				Remarks
P2D1-1	5/4	8:35		✓		1	✓						Pb + Ba + PCBs
P2D2-1	5/4	9:10		↓		↓	✓						↓
P2D3-1	5/4	10:40		↓		↓	✓						↓
P2D4-1	5/4	10:05		↓		↓	✓						↓
P2D5-1	5/4	10:55		↓		↓	✓						↓
P2D6-1	5/4	11:25		↓		↓	✓						↓
P2D7-1	5/4	11:45		↓		↓	✓						Pb + Ba
P2TB-1	5/1	15:00			Trip Blank	1	✓						Pb + Cd + Zn + Fe + Ba + PCBs
P2TB-2	5/1	15:00			Trip Blank	↓		✓					↓
~~P2TB-3~~	~~5/1~~	~~15:00~~			~~Trip Blank~~	↓			✓				~~Pb + Cd + Zn + Fe~~
P2F1-1	5/4	13:28		✓		1	✓						Pb + Ba
P2F2-1	5/4	15:22		↓		↓	✓						Pb + Ba
P2F3-1	5/4	14:25		↓		↓	✓						Pb + Ba
P2B1-1	5/9	—		✓		1	✓						Pb + Ba
P2EQB-15	5/11	16:45		✓		1	✓						Pb + Ba

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schulz	5/12/89 15:15				
Relinquished by (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5/12/89 1515	Remarks	

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

FSC - INDIANTOWN

Samplers (Signature) Mark Schultz

Sta No.	Date	Time	Comp.	Grab	Station Location	No of Containers	9 oz clear glass	250 cc amber glass	100 ml plastic (HNO3)				Remarks
P2C1-3	5/5	-		✓		1	✓						Pb + Ba + PCB
P2C2-3	5/5	-					✓						
P2C3-2	5/8	11:05					✓						
P2C4-2	5/8	11:30					✓						
P2C5-3	5/11	12:24					✓						
P2C6-2	5/11	12:45						✓					
P2C7-2	5/8	17:10					✓						+ PCB
P2C8-2	5/9	14:30					✓						
P2C9-2	5/9	13:50					✓						+ PCB
P2C10-2	5/10	9:55					✓						
P2C11-2	5/9	14:50					✓						
P2C12-3	5/9	16:23		↓		↓		✓					

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5-12-89 15:15	Remarks	

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

3 10 0597

FSC - INDIANTOWN

Samp (Signature) Mark Schultz

Sta No.	Date	Time	Comp	Grab	Station Location	No of Containers	9 oz clr glass	250 cc amber glass	pl 500 unp	pl 125 HNO3	pl gal HNO3		Remarks
P2A61-5	5/9	13:50		✓		1	✓						Pb + Ba
P2A62-4	5/9	14:45					✓						
P2A63-4	5/9	15:15					✓						
P2A64-1	5/10	12:50						✓					
P2A65-1	5/10	15:05						✓					+ PCB 1
P2A66-1	5/10	14:50					✓						
P2A67-1	5/10	--						✓					+ PCB 1
P2A68-1	5/9	15:45					✓						
P2A69-1	5/9	15:25					✓						+ PCB 1
P2A70-1	5/10	13:45					✓						+ PCB 1
P2A71-1	5/10	-					✓						
P2A72-4	5/10	14:23					✓						+ PCB 1
P2A73-1	5/10	15:05					✓						
P2A74-1	5/10	13:10						✓					
P2A75-1	5/10	13:20						✓					
P2A76-1	5/10	13:30						✓					
P2A77-1	5/10	13:40						✓					
P2A78-1	5/10	13:45						✓					

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for laboratory by (Signature)	5-12-89 1515	Remarks	

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0598

FSC - INDIANTOWN

Samplers (Signature): Mark Schultz

Sta No.	Date	Time	Comp.	Grab	Station Location	No of Containers	9 oz clr glass	250 cc amber gl	pl 500 unp	pl 125 HNO3	pl gal HNO3		Remarks
P2A41-1	5/6	14 20		✓		1	✓						Pb + Ba
P2A42-1	5/11	17:11					✓						
P2A43-4	5/6	10:45					✓						
P2A44-4	5/6	9:45					✓						
P2A45-4	5/5	16:47					✓						
P2A46-1	5/8	14 28					✓						
P2A47-1	5/10	15:40						✓					
P2A48-1	5/8	16:29					✓						+ PCBs
P2A49-1	5/10	11:50						✓					
P2A50-1	5/10	11:20					✓						+ PCBs
P2A51-1	5/10	10:30					✓						
P2A52-1	5/6	13:00					✓						
P2A53-1	5/11	16:45											
P2A54-1	5/8	14 55					✓						
P2A55-1	5/9	8 45					✓						
P2A56-4	5/9	10:09					✓						
P2A57-4	5/9	9:15					✓						
P2A58-1	5/9	9:40					✓						
P2A59-4	5/9	10:41					✓						
P2A60-4	5/9	12:40					✓						

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5-12-89 1515	Remarks	

3 10 0599

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

FSC - INDIANTOWN

Samp. (signature) Mark Schultz

Sta No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	9 oz clr glass	250 cc amber gl	pl 500 unp	pl 125 HNO3	pl gal HNO3		Remarks
P2A21-1	5/3	14:55		✓		1	✓						Pb + Ba
P2A22-1	5/3	15:35					✓						
P2A23-1	5/3	16:05					✓						
P2A24-1	5/5	15:10					✓						
P2A25-1	5/11	11 40						✓					
P2A26-1	5/5	15:40					✓						
P2A27-1	5/5	16:03					✓						
P2A28-4	5/5	16:20					✓						
P2A29-1	5/4	16:55					✓						
P2A30-4	5/11	14 55					✓						
P2A31-1	5/4	17:43					✓						
P2A32-1	5/5	8:03					✓						
P2A33-5	5/5	9:00					✓						
P2A34-1	5/11	11:25						✓					+ PCB 1
P2A35-1	5/8	10:20					✓						
P2A36-1	5/6	-					✓						+ PCB 1
P2A37-1	5/8	9:20					✓						
P2A38-5	5/8	15:20					✓						
P2A39-1	5/8	14:05					✓						
P2A40-1	5/8	13:50					✓						

Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
M. Schultz	5/12/89 15:15				
Relinquished by: (Signature)	Date Time	Received by (Signature)	Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by (Signature)	5-12-89 1515	Remarks	

3 10 0600

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0601

Appendix C

LAB DATA SHEETS
(Soil and Sediment)
(Surface Water)

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

3 10 0602

DATE: 07-17-89

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: BARIUM ANALYSIS, FSC - INDIANTOWN

THE FOLLOWING SAMPLES WERE ANALYZED FOR BARIUM.

SAMPLE #	LOCATION		RESULTS,mg/Kg
39955	P2G11-1		<20
39956	P2G12-1		<20
39957	P2G13-1		<20
39958	P2G14-1		<20
39959	P2G15-1		<20
39960	P2G16-1		<20
39963	P2G19-1		<20
39964	P2G20-1		<20
39969	P2G25-1		<20
39997	P2B1-1		380
39999	P2H1-1	Blind duplicate of P2A10-1	<20
40000	P2H2-1	" " P2G25-1	<20
40001	P2H3-1	" " P2G5-1	<20
40002	P2H4-1	" " " P2A34-1	260
40003	P2H5-1	" " " P2A41-1	380
40004	P2H6-1	" " " P2A38-5	<20
40005	P2H7-1	" " " P2A62-4	100
40006	P2H8-1	" " " P2A53-1	60

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0603

BARIUM ANALYSIS CONT'D

SAMPLE #	LOCATION		RESULTS, mg/Kg
40013	P2K4-1	[illegible] of P2A1-1	<20
40014	P2K5-1	" " " P2G2-1	<20
40015	P2K6-1	" " " P2D5-1	180
40016	P2K7-1	" " P2H6-1	<20
40017	P2C1-3		110
40018	P2C2-3		<20
40019	P2C3-2		80
40020	P2C4-2		150
40021	P2C5-3		150
40022	P2C6-2		270
40023	P2C7-2		120
40024	P2C8-2		100
40025	P2C9-2		90
40026	P2C10-2		100
40027	P2C11-2		290
40028	P2C12-3		<20
40029	P2A1-1		<20
40030	P2A2-1		<20
40031	P2A3-1		<20
40032	P2A4-1		<20
40033	P2A5-1		<20
40034	P2A6-1		<20

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

3 10 0604

BARIUM ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS, mg/Kg
40035	P2A7-4	110
40036	P2A8-1	<20
40037	P2A9-1	<20
40038	P2A10-1	60
40039	P2A11-1	710
40040	P2A12-1	<20
40041	P2A13-1	<20
40042	P2A14-1	<20
40043	P2A15-1	100
40044	P2A16-1	<20
40045	P2A17-1	<20
40046	P2A18-1	<20
40047	P2A19-1	40
40048	P2A20-1	70
40049	P2A21-1	<20
40050	P2A22-1	190
40051	P2A23-1	<20
40052	P2A24-1	<20
40053	P2A25-1	30
40054	P2A26-1	70
40055	P2A27-1	30
40056	P2A28-4	<20
40057	P2A29-1	<20

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0605

BARIUM ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS, mg/kg
40058	P2A30-4	30
40059	P2A31-1	60
40060	P2A32-1	70
40061	P2A33-5	140
40062	P2A34-1	180
40063	P2A35-1	310
40064	P2A36-1	150
40065	P2A37-1	<20
40066	P2A38-5	<20
40067	P2A39-1	<20
40068	P2A40-1	<20
40069	P2A41-1	330
40070	P2A42-1	170
40071	P2A43-4	150
40072	P2A44-4	40
40073	P2A45-4	<20
40074	P2A46-1	<20
40077	P2A49-1	<20
40078	P2A50-1	<20
40079	P2A51-1	120
40080	P2A52-1	<20
40081	P2A53-1	90
40082	P2A54-1	<20
40085	P2A57-4	400
40086	P2A58-1	530

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE . WEST PALM BEACH, FL 33401 . 407/833-4200

3 10 0606

BARIUM ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS,mg/Kg
40087	P2A59-4	340
40088	P2A60-4	70
40089	P2A61-5	180
40090	P2A62-4	160
40091	P2A63-4	80
40095	P2A67-1	300
40096	P2A68-1	470
40097	P2A69-1	310
40098	P2A70-1	320
40099	P2A71-1	270
40100	P2A72-4	130
40101	P2A73-1	120
40104	P2A76-1	<20
40105	P2A77-1	<20
40106	P2A78-1	<20

BY _____
BEN MARTIN, PH.D.

LAB ID 86122,86109,E86048

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0607

DATE: 7-13-89

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: BARIUM

THE FOLLOWING SAMPLES WERE ANALYZED FOR BARIUM.

SAMPLE #	LOCATION	RESULTS,mg/L
39945	P2G1-1	<20
39946	P2G2-1	<20
39947	P2G3-1	<20
39948	P2G4-1	<20
39949	P2G5-1	<20
39950	P2G6-1	110
39951	P2G7-1	<20
39952	P2G8-1	<20
39953	P2G9-1	<20
39954	P2G10-1	<20
39961	P2G17-1	<20
39962	P2G18-1	<20
39965	P2G21-1	<20
39966	P2G22-1	<20
39967	P2G23-1	<20
39968	P2G24-1	65
39984	P2D1-1	75
39985	P2D2-1	310
39986	P2D3-1	110

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

BARIUM ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS, mg/L
39987	P2D4-1	580
39988	P2D5-1	270
39989	P2D6-1	<20
39990	P2D7-1	270
39994	P2F1-1	<20
39995	P2F2-1	<20
39996	P253-1	<20
40075	P2A47-1	<20
40076	P2A48-1	<20
40083	P2A55-1	<20
40084	P2A56-4	300
40092	P2A64-1	320
40093	P2A65-1	320
40094	P2A66-1	140
40102	P2A74-1	<20
40103	P2A75-1	35

---------- LAB ID 86122,86109,E86048

BEN MARTIN, Ph.D.

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0609

% RECOVERY FOR BARIUM ANALYSIS

SAMPLE #	% RECOVERY		AVG % RECOVERY
	A	B	
39953	103.0	100.6	101.8
39994	103.0	97.8	100.4

SPIKE LEVEL APPROXIMATELY 1000 mg/Kg

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

DATE: 07-17-89

3 10 0610

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: BARIUM ANALYSIS, FSC - INDIANTOWN

THE FOLLOWING SAMPLES WERE ANALYZED FOR BARIUM.

SAMPLE #	LOCATION	RESULTS,mg/L
39970	P2EQB-1 P2A16-1	<0.10
39971	P2EQB-2 P2G25-1	<0.10
39972	P2EQB-3 P2G5-1	<0.10
39973	P2EQB-4 P25D10-1	<0.10
39974	P2EQB-5 P25D24-1	<0.10
39975	P2EQB-6 P25D20-1	<0.10
39976	P26EQB-7 P2C3-1	<0.10
39977	P2EQB-8 P2A41-1	<0.10
39978	P2EQB-9 P2A38-1	<0.10
39979	P2EQB-10 P2A1-1	<0.10
39980	P2EQB-11 P2G20-1	<0.10
39981	P2EQB-12 P2A62-4	<0.10
39982	P2EQB-13 P2A51-1	<0.10
39983	P2EQB-14 P2A66-1	<0.10
39998	P2EQB-15	<0.10

BY _____ LAB ID 86122,86109,E86048
BEN MARTIN, Ph.D.

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407 833-7280

3 10 0611

% RECOVERY FOR BARIUM ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVE % RECOVERY
39963	88.6	90.4	89.5
40003	112.8	111.7	112.3
40025	96.3	100.4	98.4
40035	109.9	107.5	108.7
40045	91.4	102.0	96.7
40075	102.8	101.0	101.9
40085	102.1	100.4	101.3
40095	103.0	120.2	111.6
SPIKE LEVEL APPROXIMATELY 1000 mg/Kg			
40015	86.7	91.4	89.1
40055	96.6	98.5	97.6
40065	87.5	95.0	91.3
40105	93.5	93.5	93.5
SPIKE LEVEL APPROXIMATELY 400 mg/Kg			

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

3 10 0612

DATE: 07-17-89

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: LEAD ANALYSIS, FSC - INDIANTOWN

THE FOLLOWING SAMPLES WERE ANALYZED FOR LEAD.

SAMPLE #	LOCATION		RESULTS,mg/Kg
39955	P2G11-1		<4.0
39956	P2G12-1		218
39957	P2G13-1		190
39958	P2G14-1		5030
39959	P2G15-1		810
39960	P2G16-1		503
39963	P2G19-1		107
39964	P2G20-1		30.0
39969	P2G25-1		35.2
39997	P2B1-1		1580
39999	P2H1-1	Blind duplicate of P2A16-1	167
40000	P2H2-1	" " " P2G25-1	40.2
40001	P2H3-1	" " " P2G5-1	31.7
40002	P2H4-1	" " " P2A34-1	683
40003	P2H5-1	" " " P2A41-1	429
40004	P2H6-1	" " " P2A32-5	710
40005	P2H7-1	" " P2A62-4	616
40006	P2H8-1	" " " P2A53-1	1950

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0613

LEAD ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS, mg/Kg
40013	P2K4-1 Blind duplicate of P2A1-1	25.7
40014	P2K5-1 " " P2G20-1	24.8
40015	P2K6-1 " " " P2A51-1	624
40016	P2K7-1 P2A66-1	632
40017	P2C1-3	185
40018	P2C2-3	286
40019	P2C3-2	295
40020	P2C4-2	1330
40021	P2C5-3	155
40022	P2C6-2	471
40023	P2C7-2	327
40024	P2C8-2	196
40025	P2C9-2	252
40026	P2C10-2	318
40027	P2C11-2	964
40028	P2C12-3	<4.0
40029	P2A1-1	22.7
40030	P2A2-1	58.7
40031	P2A3-1	<4.0
40032	P2A4-1	175
40033	P2A5-1	12.7
40034	P2A6-1	<4.0

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3 10 0614

LEAD ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS, mg/Kg
40035	P2A7-4	545
40036	P2A8-1	21.6
40037	P2A9-1	229
40038	P2A10-1	445
40039	P2A11-1	483
40040	P2A12-1	95.6
40041	P2A13-1	121
40042	P2A14-1	64.4
40043	P2A15-1	37.9
40044	P2A16-1	217
40045	P2A17-1	28.7
40046	P2A18-1	161
40047	P2A19-1	283
40048	P2A20-1	289
40049	P2A21-1	207
40050	P2A22-1	840
40051	P2A23-1	365
40052	P2A24-1	1170
40053	P2A25-1	228
40054	P2A26-1	260
40055	P2A27-1	121
40056	P2A28-4	195
40057	P2A29-1	879

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3 TU 0615

LEAD ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS, mg/kg
40058	P2A30-4	133
40059	P2A31-1	897
40060	P2A32-1	10,200
40061	P2A33-5	12,200
40062	P2A34-1	701
40063	P2A35-1	701
40064	P2A36-1	758
40065	P2A37-1	45.9
40066	P2A38-5	668
40067	P2A39-1	<4.0
40068	P2A40-1	274
40069	P2A41-1	584
40070	P2A42-1	352
40071	P2A43-4	899
40072	P2A44-4	354
40073	P2A45-4	5480
40074	P2A46-1	266
40077	P2A49-1	272
40078	P2A50-1	421
40079	P2A51-1	591
40080	P2A52-1	491
40081	P2A53-1	2270
40082	P2A54-1	424
40085	P2A57-4	502
40086	P2A58-1	717

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3 10 0616

LEAD ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS,mg/Kg
40087	P2A59-4	5180
40088	P2A60-4	99.5
40089	P2A61-5	390
40090	P2A62-4	475
40091	P2A63-4	673
40095	P2A67-1	1680
40096	P2A68-1	2840
40097	P2A69-1	1910
40098	P2A70-1	2760
40099	P2A71-1	3150
40100	P2A72-4	4660
40101	P2A73-1	7030
40104	P2A76-1	65.1
40105	P2A77-1	398
40106	P2A78-1	408

BY _____
BEN MARTIN, Ph.D.

LAB ID 86122,86109,E86048

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0617

% RECOVERY FOR LEAD ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVG % RECOVERY
39963	97.4	98.6	98.0
40003	129.6	116.5	123.1
40015	91.1	97.6	94.4
40025	90.7	88.9	89.8
40035	87.2	95.6	91.4
40045	102.7	106.2	104.5
40055	86.7	77.9	82.3
40065	98.5	88.9	93.7
40085	90.0	81.9	86.0
40095	111.5	101.4	106.5
40105	111.8	102.5	107.2

SPIKE LEVEL APPROXIMATELY 400 mg/Kg

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0618

DATE: 07-12-89

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: LEAD

THE FOLLOWING SAMPLES WERE ANALYZED FOR LEAD.

SAMPLE #	LOCATION	RESULTS,mg/Kg
39945	P2G1-1	15.5
39946	P2G2-1	25.6
39947	P2G3-1	13.3
39948	P2G4-1	16.0
39949	P2G5-1	35.6
39950	P2G6-1	5530
39951	P2G7-1	7.0
39952	P2G8-1	6.6
39953	P2G9-1	10.9
39954	P2G10-1	30.9
39961	P2G17-1	19.0
39962	P2G18-1	17.0
39965	P2G21-1	<4.0
39966	P2G22-1	20.7
39967	P2G23-1	<4.0
39968	P2G24-1	35.9
39984	P2D1-1	272
39985	P2D2-1	535

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3 TU 0619

LEAD ANALYSIS CONT'D

SAMPLE #	LOCATION	RESULTS, mg/Kg
39986	P2D3-1	372
39987	P2D4-1	480
39988	P2D5-1	314
39989	P2D6-1	150
39990	P2D7-1	348
39994	P2F1-1	9.9
39995	P2F2-1	33.0
39996	P2F3-1	22.8
40075	P2A47-1	106
40076	P2A48-1	<4.0
40083	P2A55-1	78.4
40084	P2A56-4	417
40092	P2A64-1	341
40093	P2A65-1	1620
40094	P2A66-1	571
40102	P2A74-1	14.6
40103	P2A75-1	79.3

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3 10 0620

% RECOVERY FOR LEAD ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVG % RECOVERY
39953	95.2	95.1	95.2
39994	104	99.0	101.5
40075	86.7	94.0	90.4

SPIKE LEVEL APPROXIMATELY 400 mg/Kg

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

DATE: 07-17-89

3 10 0621

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: LEAD ANALYSIS, FSC - INDIANTOWN

THE FOLLOWING SAMPLES WERE ANALYZED FOR LEAD.

SAMPLE #	LOCATION	RESULTS,mg/L
39970	P2EQB-1 P2A16-1	<0.005
39971	P2EQB-2 P2G25-1	<0.005
39972	P2EQB-3 P2G5-1	<0.005
39973	P2EQB-4 P25D10-1	<0.005
39974	P2QEB-5 P25D24-1	<0.005
39975	P2EQB-6 P25D20-1	<0.005
39976	P26EQB-7 P2C3-1	<0.005
39977	P2EQB-8 P2A41-1	<0.005
39978	P2EQB-9 P2A38-1	<0.005
39979	P2EQB-10 P2A1-1	<0.005
39980	P2EQB-11 P2G20-1	<0.005
39981	P2EQB-12 P2A62-4	<0.005
39982	P2EQB-13 P2A51-1	<0.005
39983	P2EQB-14 P2A66-1	<0.005
39998	P2EQB-15	<0.005

---------- LAB ID: 86122,86109,E86048
BEN MARTIN,PH.D.

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 305 833-4200

3 TU 0622

DATE: 07-31 89

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: PCB ANALYSIS FSC-INDIANTOWN
DATE TIME RECEIVED: 05-12-89 1515

THE FOLLOWING SAMPLES WERE ANALYZED FOR PCB.

SAMPLE #	LOCATION	RESULTSmg/kg	TYPE
39997	P2B1-1	2.4	A1248
40083	P2A55-1	<1	
40084	P2A56-4	3.0	A1248
40085	P2A57-4	9.8	A1248
40086	P2A58-1	2.4	A1248
40027	P2C11-2	<1	
40028	P2C12-3	<1	
40092	P2A64-1	<1	
40094	P2A66-1	12.6	A1248
40096	P2A68-1	1.04	A1248
40102	P2A74-1	<1	
40103	P2A75-1	<1	
40104	P2A76-1	<1	
40105	P2A77-1	<1	
40106	P2A78-1	<1	

BY ---------- LAB ID 86122,86109,E86048
BEN MARTIN,Ph.D.

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

3 10 0623

DATE: 07-17-89

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: PCB ANALYSIS INDIANTOWN
DATE TIME RECEIVED: 05-12-89 1515
THE FOLLOWING SAMPLES WERE ANALYZED FOR PCB.

SAMPLE #	LOCATION	RESULTS,mg/kg	TYPE
39908	P25D23-1	<1	
39909	P25D24-1	<1	
39910	P25D25-1	<1	
39911	P25D26-1	<1	
39912	P25D3-2	<1	
39913	P25D1-1	<1	
39914	P25D2-1	7.3	A1248
39915	P25D3-1	<1	
39916	P25D4-1	<1	
39917	P25D5-1	<1	
39918	P25D6-1	<1	
39919	P25D7-1	<1	
39920	P25D8-1	<1	
39927	P25D15-1	<1	
39928	P25D16-1	<1	
39929	P25D17-1	7.9	A1242
39930	P25D18-1	<1	
39931	P25D19-1	<1	
39932	P25D20-1	<1	

BY
---------- LAB ID 86122,86109,E86048
DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0624

DATE: 07-17-89

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: PCB ANALYSIS
DATE TIME RECEIVED: 05-12-89 1515

THE FOLLOWING SAMPLES WERE ANALYZED FOR PCB.

SAMPLE #	LOCATION	RESULTSmg/kg	TYPE
39962	P2G18-1	<1	
39963	P2G19-1	<1	
39970	P2EQB-1 P2A16-1	<1	
39974	P2EQB-5 P25D24-1	<1	
39975	P2EQB-6 P25D20-1	<1	
39976	P2EQB-7 P2C3-1	<1	
39979	P2EQB-10 P2A1-1	<1	
39984	P2D1-1	<1	
39985	P2D2-1	<1	
39986	P2D3-1	<1	
39987	P2D4-1	<1	
39988	P2D5-1	<1	
39989	P2D6-1	7.4	A1248
39991	P2TB-1	<1	
39992	P2TB-2	<1	
40002	P2H4-1 Blind duplicate of P2A14-1	1.5	A1248
40008	P2J2-1 EPA spike	<1	
40009	P2J3-1 EPA spike	<1	
40010	P2K1-1 Blind dup of P25D24-1	<1	

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3 10 0625

SAMPLE #	LOCATION	RESULTS, mg/kg	TYPE
40011	P2K2-1	<1	
40012	P2K3-1	<1	
40017	P2C1-3	<1	
40023	P2C7-2	<1	
40025	P2C9-2	<1	
40029	P2A1-1	<1	
40031	P2A3-1	<1	
40044	P2A16-1	<1	
40046	P2A18-1	<1	
40062	P2A34-1	2.2	A1248
40064	P2A36-1	12.7	A1248
40076	P2A48-1	<1	
40078	P2A50-1	<1	
40093	P2A65-1	25.9	A1248
40095	P2A67-1	38.1	A1248
40097	P2A69-1	2.9	1248
40098	P2A70-1	<1	
40100	P2A72-4	3.7	A1248

BEN MARTIN, Ph.D.

LAB ID 86122,86109, E86048

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	
TAMPA, FL 33630	3 TU 0626
39913	SAMPLE NUMBER
05-02-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D1-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	35.9
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	946
ZINC	01092	07-21 ND 78-41	410
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

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MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	
TAMPA, FL 33630	3 10 0627
39914	SAMPLE NUMBER
05-02-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D2-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	621
CADMIUM	01027	07-24 MD 78-44	26.6
IRON	01045	07-24 MD 78-47	4300
ZINC	01092	07-21 ND 78-41	6090
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

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MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	
TAMPA, FL 33630	3 10 0628
39915	SAMPLE NUMBER
05-02-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D3-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	547
CADMIUM	01027	07-24 MD 78-44	15.7
IRON	01045	07-24 MD 78-47	6120
ZINC	01092	07-21 ND 78-41	6320
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630

3 10 0629

39912 — SAMPLE NUMBER

05-02-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D3-2

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	22.8
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	1940
ZINC	01092	07-21 ND 78-41	150
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

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MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0630
TAMPA, FL 33630	
39916	SAMPLE NUMBER
05-03-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D4-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	271
CADMIUM	01027	07-24 MD 78-44	8.0
IRON	01045	07-24 MD 78-47	2350
ZINC	01092	07-21 ND 78-41	2480
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

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MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630

3 10 0631

39917 — SAMPLE NUMBER

05-03-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D5-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	267
CADMIUM	01027	07-24 MD 78-44	7.3
IRON	01045	07-24 MD 78-47	2380
ZINC	01092	07-21 ND 78-41	1730
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	
TAMPA, FL 33630	3 10 0652
39918	SAMPLE NUMBER
05-03-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D6-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	38.1
CADMIUM	01027	07-24 MD 78-44	2.2
IRON	01045	07-24 MD 78-47	931
ZINC	01092	07-21 ND 78-41	398
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407.833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	
TAMPA, FL 33630	3 10 0653
39919	SAMPLE NUMBER
05-03-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D7-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	PREVIOUSLY REPORTED
CADMIUM	01027	07-24 MD 78-44	16.6
IRON	01045	07-24 MD 78-47	3020
ZINC	01092	07-21 ND 78-41	5260
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0634
TAMPA, FLORIDA 33630	
39919	SAMPLE NUMBER
05-03-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P2SD7-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	06-08 68-458	657

DATE 06-08-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0635
TAMPA, FL 33630	
39920	SAMPLE NUMBER
05-03-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D8-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	575
CADMIUM	01027	07-24 MD 78-44	16.6
IRON	01045	07-24 MD 78-47	5690
ZINC	01092	07-21 ND 78-41	4480
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE . WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

3 TU 0656

TAMPA, FL 33630

39921 — SAMPLE NUMBER

05-03-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D9-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	126
CADMIUM	01027	07-24 MD 78-44	4.2
IRON	01045	07-24 MD 78-47	675
ZINC	01092	07-21 ND 78-41	1060
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE . WEST PALM BEACH, FL 33401 . 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630

3 10 0637

39922 — SAMPLE NUMBER

05-03-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D10-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	287
CADMIUM	01027	07-24 MD 78-44	14.6
IRON	01045	07-24 MD 78-47	637
ZINC	01092	07-21 ND 78-41	1750
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630

3 10 0658

39923 — SAMPLE NUMBER

05-03-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D11-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	1410
CADMIUM	01027	07-24 MD 78-44	46.5
IRON	01045	07-24 MD 78-47	7972
ZINC	01092	07-21 ND 78-41	14800
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630 — 3 10 0639

39924 — SAMPLE NUMBER

05-03-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D12-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	213
CADMIUM	01027	07-24 MD 78-44	4.7
IRON	01045	07-24 MD 78-47	4920
ZINC	01092	07-21 ND 78-41	1430
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 1U 0640
TAMPA, FL 33630	
39925	SAMPLE NUMBER
05-03-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D13-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	196
CADMIUM	01027	07-24 MD 78-44	5.6
IRON	01045	07-24 MD 78-47	5790
ZINC	01092	07-21 ND 78-41	1720
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0641
TAMPA, FL 33630	
39926	SAMPLE NUMBER
05-03-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D14-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	43.2
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	1130
ZINC	01092	07-21 ND 78-41	285
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0642
TAMPA, FL 33630	
39927	SAMPLE NUMBER
05-04-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D15-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS, mg/Kg
LEAD	01051	07-21 MD 78-38	29.2
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	122
ZINC	01092	07-21 ND 78-41	32
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0643
TAMPA, FL 33630	
39928	SAMPLE NUMBER
05-04-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D16-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	142
CADMIUM	01027	07-24 MD 78-44	4.7
IRON	01045	07-24 MD 78-47	2880
ZINC	01092	07-21 ND 78-41	1720
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630

3 IU 0644

39929 — SAMPLE NUMBER

05-04-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D17-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	1270
CADMIUM	01027	07-24 MD 78-44	35.5
IRON	01045	07-24 MD 78-47	3270
ZINC	01092	07-21 ND 78-41	10600
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE, WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630

3 10 0645

39930 — SAMPLE NUMBER

05-04-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D18-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	610
CADMIUM	01027	07-24 MD 78-44	23.9
IRON	01045	07-24 MD 78-47	5370
ZINC	01092	07-21 ND 78-41	5250
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0646
TAMPA, FL 33630	
39931	SAMPLE NUMBER
05-05-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D19-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	124
CADMIUM	01027	07-24 MD 78-44	4.3
IRON	01045	07-24 MD 78-47	1010
ZINC	01092	07-21 ND 78-41	917
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0647
TAMPA, FL 33630	
39932	SAMPLE NUMBER
05-05-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D20-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	26.4
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	354
ZINC	01092	07-21 ND 78-41	187
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

3 10 0648

TAMPA, FL 33630

39906 — SAMPLE NUMBER

05-05-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D21-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	33.8
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	599
ZINC	01092	07-21 ND 78-41	225
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 10 0649
TAMPA, FL 33630	
39907	SAMPLE NUMBER
05-05-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D22-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	70.2
CADMIUM	01027	07-24 MD 78-44	2.6
IRON	01045	07-24 MD 78-47	1120
ZINC	01092	07-21 ND 78-41	424
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	3 TU 0650
TAMPA, FL 33630	
39908	SAMPLE NUMBER
05-04-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D23-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	12.2
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	4470
ZINC	01092	07-21 ND 78-41	77
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P.O. BOX 23328	
TAMPA, FL 33630	3 TU 0651
39909	SAMPLE NUMBER
05-04-89 CLIENT 05-12-89 1515	DATE TIME COLL RECD
FCS - INDIANTOWN	LOCATION
P25D24-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	5.3
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	1760
ZINC	01092	07-21 ND 78-41	30
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328 — 3 10 0652

TAMPA, FL 33630

39910 — SAMPLE NUMBER

05-04-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P2SD25-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	6.5
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	1490
ZINC	01092	07-21 ND 78-41	<20
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P.O. BOX 23328

TAMPA, FL 33630

3 10 0653

39911 — SAMPLE NUMBER

05-04-89 CLIENT 05-12-89 1515 — DATE TIME COLL RECD

FCS - INDIANTOWN — LOCATION

P25D26-1

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
LEAD	01051	07-21 MD 78-38	<4.0
CADMIUM	01027	07-24 MD 78-44	<2.0
IRON	01045	07-24 MD 78-47	738
ZINC	01092	07-21 ND 78-41	<20
BARIUM	01007	07-24 MD 78-50	<20

DATE 07-25-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0654
TAMPA, FL 33630	
40010	SAMPLE NUMBER
05-04-89 SHULTZ 05-15-89 1515	DATE TIME COLL RECD
P2K1-1 Wind duplicate of P25D24-1	LOCATION
FSC - INDIANTOWN	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
CADMIUM	01027	06-09 MD 68-460	<2.0
ZINC	01092	05-25 MD 68-430	26
IRON	01045	06-21 MD 68-483	1600
LEAD	01051	06-07 MD 68-456	5.1
BARIUM	01007	06-27 MD 68-493	<20

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FL 33630	3 10 0655
40011	SAMPLE NUMBER
05-04-89 SHULTZ 05-15-89 1515	DATE TIME COLL RECD
P2K2-1 blind duplicate of P2SD25-1	LOCATION
FSC - INDIANTOWN	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
CADMIUM	01027	06-09 MD 68-460	<2.0
ZINC	01092	05-25 MD 68-430	<20
IRON	01045	06-21 MD 68-483	1480
LEAD	01051	06-07 MD 68-456	4.1
BARIUM	01007	06-27 MD 68-493	<20

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0656
TAMPA, FL 33630	
40012	SAMPLE NUMBER
05-05-89 SHULTZ 05-15-89 1515	DATE TIME COLL RECD
P2K3-1 blind duplicate of P25D20-1	LOCATION
FSC - INDIANTOWN	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
CADMIUM	01027	06-09 MD 68-460	<2.0
ZINC	01092	05-25 MD 68-430	176
IRON	01045	06-21 MD 68-483	305
LEAD	01051	06-07 MD 68-456	27.3
BARIUM	01007	06-27 MD 68-493	<20

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0657
TAMPA, FL 33630	
39991	SAMPLE NUMBER
05-01-89 1500 MS 05-15-89 1515	DATE TIME COLL RECD
P2TB-1 TRIP BLANK	LOCATION
FSC - INDIANTOWN	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
CADMIUM	01027	06-09 MD 68-460	<0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	<0.030
LEAD	01051	06-07 MD 68-456	<0.005
BARIUM	01007	06-27 MD 68-493	<0.10

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FL 33630

3 IU 0658

39992 — SAMPLE NUMBER

05-01-89 1500 MS 05-15-89 1515 — DATE TIME COLL RECD

P2TB-2 TRIP BLANK — LOCATION

FSC - INDIANTOWN

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
CADMIUM	01027	06-09 MD 68-460	<0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	<0.030
LEAD	01051	06-07 MD 68-456	0.007
BARIUM	01007	06-27 MD 68-493	<0.10

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0659
TAMPA, FL 33630	
40007	SAMPLE NUMBER
05-02-89 SHULTZ 05-15-89 1515	DATE TIME COLL RECD
P2J1-1 — EPA SPIKE	LOCATION
FSC - INDIANTOWN	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/Kg
CADMIUM	01027	06-09 MD 68-460	<2.0
ZINC	01092	05-25 MD 68-430	<20
IRON	01045	06-21 MD 68-483	171
LEAD	01051	06-07 MD 68-456	<4.0
BARIUM	01007	06-27 MD 68-493	<20

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

3 TU 0660

% RECOVERY FOR CADMIUM ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVG % RECOVERY
39913	108.2	96.8	102.5
39923	96.6	95.3	96.0

CADMIUM SPIKE LEVEL APPROXIMATELY 200 mg/Kg

% RECOVERY FOR LEAD ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVG % RECOVERY
39913	103.8	95.9	99.9
38823	107.0	96.0	101.5
39933	95.4	95.2	95.3

LEAD SPIKE LEVEL APPROXIMATELY 400 mg/Kg

% RECOVERY FOR BARIUM ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVE % RECOVERY
39913	100.2	97.6	98.9
39923	98.0	104.0	101.0

BARIUM SPIKE LEVEL APPROXIMATELY 1000 mg/Kg

% RECOVERY FOR IRON ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVE % RECOVERY
39913	93.4	121.5	107.5
39923	93.2	90.8	92.0

IRON SPIKE LEVEL APPROXIMATELY 1000 mg/Kg

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE, WEST PALM BEACH, FL 33401 • 407/833-4200

10-4-89

3 10 0661

REPORT TO: MARK SCHULTZ

SUBJECT: REANALYSIS OF THREE FLORIDA STEEL SAMPLES

THE THREE SAMPLES IN QUESTION WERE THOROUGHLY MIXED AND SUBSAMPLES TAKEN IN DUPLICATE. THE SUBSAMPLES WERE ANALYZED FOR PCB BY METHOD 8080. THE RESULTS ARE:

#		PCB, mg/kg
39913	P2SD1-1	3.2, 3.0
39919	P2SD7-1	<1, <1
39920	P2SD8-1	3.5, 5.4

B MARTIN Ph.D.

GEO TEC inc. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-7280

3 10 0662

% RECOVERY FOR ZINC ANALYSIS

SAMPLE #	% RECOVERY A	% RECOVERY B	AVE % RECOVERY
39913	108.7	152.3	130.5
39923	93.2	90.8	92.0

ZINC SPIKE LEVEL APPROXIMATELY 400 mg/Kg

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3 10 0663

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FL 33630	
39937	SAMPLE NUMBER
05-05-89 M.SHULTZ 05-12-89 1515	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
P2SW1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	0.031
CADMIUM	01027	06-09 MD 68-460	<0.001
ZINC	01092	05-25 MD 68-430	0.16
IRON	01045	06-21 MD 68-483	0.158
SPECIFIC COND uho/cm	00095	05-05 MS COC	625
pH	00400	05-05 MD COC	6.55
TEMPERATURE (F)		05-05 MS COC	78

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

3 10 0664

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FL 33630

39938 — SAMPLE NUMBER

05-05-89 M.SHULTZ 05-12-89 1515 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

P2SW2

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	0.016
CADMIUM	01027	06-09 MD 68-460	<0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	0.255
SPECIFIC COND uho/cm	00095	05-05 MS COC	750
pH	00400	05-05 MD COC	7.80
TEMPERATURE (F)		05-05 MS COC	79

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407:833-4200

3 10 0665

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FL 33630	
39939	SAMPLE NUMBER
05-08-89 M.SHULTZ 05-12-89 1515	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
P25W3	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	0.016
CADMIUM	01027	06-09 MD 68-460	0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	0.215
SPECIFIC COND uho/cm	00095	05-05 MS COC	950
pH	00400	05-05 MD COC	7.05
TEMPERATURE (F)		05-05 MS COC	78

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

3 IU 0666

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FL 33630	
39940	SAMPLE NUMBER
05-08-89 M.SHULTZ 05-12-89 1515	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
P25W4	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	0.019
CADMIUM	01027	06-09 MD 68-460	0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	0.152
SPECIFIC COND uho/cm	00095	05-05 MS COC	900
pH	00400	05-05 MD COC	6.75
TEMPERATURE (F)		05-05 MS COC	80

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

3 10 0667

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FL 33630	
39941	SAMPLE NUMBER
05-08-89 M.SHULTZ 05-12-89 1515	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
P25W5	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	0.012
CADMIUM	01027	06-09 MD 68-460	<0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	0.114
SPECIFIC COND uho/cm	00095	05-05 MS COC	580
pH	00400	05-05 MD COC	7.05
TEMPERATURE (F)		05-05 MS COC	79

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT 3 JUL 0668

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FL 33630	
39942	SAMPLE NUMBER
05-08-89 M.SHULTZ 05-12-89 1515	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
P25W6	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	0.008
CADMIUM	01027	06-09 MD 68-460	<0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	0.073
SPECIFIC COND uho/cm	00095	05-05 MS COC	830
pH	00400	05-05 MD COC	7.85
TEMPERATURE (F)		05-05 MS COC	79

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FL 33630	3 TU 0669
39943	SAMPLE NUMBER
05-08-89 M.SHULTZ 05-12-89 1515	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
P2SW10	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	0.011
CADMIUM	01027	06-09 MD 68-460	0.002
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	0.163

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE . WEST PALM BEACH, FL 33401 . 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FL 33630

3 10 0670

39944 — SAMPLE NUMBER

05-01-89 1500 MS 05-12-89 1515 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

P2TB3 TRIP BLANK

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	06-07 MD 68-456	<0.005
CADMIUM	01027	06-09 MD 68-460	<0.001
ZINC	01092	05-25 MD 68-430	<0.10
IRON	01045	06-21 MD 68-483	<0.030

DATE 07-24-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

DATE: 10-02-89

3 10 0671

REPORT TO: FLORIDA STEEL CORPORATION
P.O.BOX 23328
TAMPA, FL 33630

SUBJECT: BARIUM & LEAD ANALYSIS
DATE TIME RECEIVED: 09-15-89 1530
LOCATION: FSC - INDIANTOWN

THE FOLLOWING SAMPLES WERE ANALYZED FOR BARIUM & LEAD.

SAMPLE #	LOCATION	RESULTS,mg/Kg BARIUM	LEAD
42019	P2C11-1	366	686
42020	P2C5-1	484	795
42021	P2C6-1	477	718

THE FOLLOWING SAMPLES WERE ANALYSED FOR CALCIUM MAGNESIUM HARDNESS & ZINC.

SAMPLE #	LOCATION	RESULTS, mg/L CALCIUM	MAGNSEIUM	HARDNESS	ZINC
39937	P2SW1	98.4	5.63	270	0.155
39938	P2SW2	14.8	19.3	116	0.072
39939	P2SW3	24.9	6.82	90	0.045
39940	P2SW4	23.8	6.30	85	0.018
39941	P2SW5	46.3	5.28	137	0.013
39942	P2SW6	44.6	11.6	159	0.011
39943	P2SW10	23.8	5.97	84	0.026
39944	P2TB3	<0.5	<0.5	<1	0.011

THE FOLLOWING SAMPLES ARE ANALYZED FOR ZINC ONLY.

		RESULTS,mg/L
41355	MW50	0.046
41368	MW56	0.063

DIRECTOR _____ LAB ID 86122,86109,E86048

3 10 0672

Appendix D

LAB DATA SHEETS
(Groundwater)

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407-833-4200

3 10 0673

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	
41339	SAMPLE NUMBER
07-14-89 1130 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-1	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	1195
pH	00400	07-14 JP 166-58	4.82
TURBIDITY	82078	07-14 BM TB-67	188
SPEC CONDUCT umhos/cm	00095	07-14 JP 166-58	1982
TEMPERATURE (C)		07-14 JP 166-58	28.5
DEPTH (FT)		07-14 JP 166-58	14.92
TABLE (FT)		07-14 JP 166-58	7.21

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0674

41339 — SAMPLE NUMBER

07-14-89 1130 JP/TM 07-14-89 1700 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-1

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.321
CADMIUM	01027	08-03	MD	78-61	0.018
SODIUM	00929	08-10	MD	78-73	286
BARIUM	01007	08-04	MD	78-64	0.28
IRON	01045	08-11	MD	78-85	9.16
ZINC	01092	08-10	MD	78-77	2.55
CALCIUM	00916	08-10	MD	78-79	8.6
CHLORIDE	00940	08-05	BM	#2462	762

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0675
TAMPA, FLORIDA 33630	
41340	SAMPLE NUMBER
07-14-89 1140 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-1F	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-01 MD 78-56	0.065
CADMIUM	01027	08-03 MD 78-61	0.010
BARIUM	01007	08-10 MD 78-73	0.88
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-16 MD 78-79	34.5
MAGNESIUM	00927	08-10 MD 78-83	44.8

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0676
TAMPA, FLORIDA 33630	
41341	SAMPLE NUMBER
07-14-89 1430 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-4	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	1712
pH	00400	07-14 JP 166-58	3.70
TURBIDITY	82078	07-14 BM TB-67	42.0
SPEC CONDUCT umhos/cm	00095	07-14 JP 166-58	2710
TEMPERATURE (C)		07-14 JP 166-58	28
DEPTH (FT)		07-14 JP 166-58	24.00
TABLE (FT)		07-14 JP 166-58	5.03

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE, WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0677
TAMPA, FLORIDA 33630	
41341	SAMPLE NUMBER
07-14-89 1430 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-4	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-01 MD 78-56	0.035
CADMIUM	01027	08-03 MD 78-61	0.006
SODIUM	00929	08-10 MD 78-73	437
BARIUM	01007	08-04 MD 78-64	0.42
IRON	01045	08-11 MD 78-85	20.6
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	29.3
CHLORIDE	00940	08-05 BM #2463	1240

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0678

41342 — SAMPLE NUMBER

07-14-89 1440 JP/TM 07-14-89 1700 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-4F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
BARIUM	01007	08-04	MD	78-64	0.37

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0679

41271 — SAMPLE NUMBER

07-11-89 1010 JP/TM 07-11-89 1635 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-17

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	253
pH	00400	07-11 166-57	5.56
TURBIDITY	82078	07-12 BM TB-68	7.8
SPECIFIC COND (umhos/cm)	00095	07-11 JP 166-57	414
TEMPERATURE (C)		07-11 JP 166-57	26
DEPTH (FT)		07-11 JP 166-57	19.14
TABLE (FT)		07-11 JP 166-57	4.60

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0680
41271	SAMPLE NUMBER
07-11-89 1010 JP/BM 07-11-89 1635	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-17	

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.017
CADMIUM	01027	08-03	MD	78-61	<0.001
SODIUM	00929	08-10	MD	78-73	47.8
BARIUM	01007	08-04	MD	78-64	<0.10
IRON	01045	08-11	MD	78-85	0.406
ZINC	01092	08-10	MD	78-77	<0.10
CALCIUM	00916	08-10	MD	78-79	16.0
CHLORIDE	00940	08-05	BM	#2302	83.4

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0681
TAMPA, FLORIDA 33630	
41272	SAMPLE NUMBER
07-11-89 1545 JP/TM 07-11-89 1635	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-18	

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.013
CADMIUM	01027	08-03	MD	78-61	<0.001

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0682
41343	SAMPLE NUMBER
07-14-89 1310 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-19	

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.122
CADMIUM	01027	08-03	MD	78-61	0.020
SODIUM	00929	08-10	MD	78-73	1160
BARIUM	01007	08-04	MD	78-64	0.53
IRON	01045	08-11	MD	78-85	12.3
ZINC	01092	08-10	MD	78-77	<0.10
CALCIUM	00916	08-10	MD	78-79	194
CHLORIDE	00940	08-05	BM	#2464	1870

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0683

41343 — SAMPLE NUMBER

07-14-89 1310 JP/TM 07-14-89 1700 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-19

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	4663
pH	00400	07-14 JP 166-58	6.09
TURBIDITY	82078	07-14 BM TB-67	15.2
SPEC CONDUCT umhos/cm	00095	07-14 JP 166-58	6830
TEMPERATURE (C)		07-14 JP 166-58	29
DEPTH (FT)		07-14 JP 166-58	17.11
TABLE (FT)		07-14 JP 166-58	4.01

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0684
41344	SAMPLE NUMBER
07-14-89 1320 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-19F	

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.177
CADMIUM	01027	08-03	MD	78-61	0.020
BARIUM	01007	08-04	MD	78-64	0.43
IRON	01045	08-11	MD	78-85	6.90
NICKEL	01067	08-14	MD	78-90	<0.005

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0685
41273	SAMPLE NUMBER
07-11-89 1440 JP/TM 07-11-89 1635	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-20	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	488
pH	00400	07-11 JP 166-57	6.18
TURBIDITY	08078	07-12 BM TB-68	6.4
SPEC CONDUCT umhos/cm	00095	07-11 JP 166-57	1570
TEMPERATURE (C)		07-11 JP 166-57	27
DEPTH (FT)		07-11 JP 166-57	15.41
TABLE (FT)		07-11 JP 166-57	5.34

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 TU 0686

41273 — SAMPLE NUMBER

07-11-89 1440 JP/TM 07-11-89 1645 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-20

PARAMETER	STORET #	DATE BY NUMBER	RESULTS,mg/L
LEAD	00151	08-01 MD 78-56	0.019
CADMIUM	01027	08-03 MD 78-61	<0.001
SODIUM	00929	08-10 MD 78-73	9.9
BARIUM	01007	08-04 MD 78-64	<0.10
IRON	01045	08-11 MD 78-85	0.041
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	36.4
CHLORIDE	00940	08-05 BM #2305	12.5
NICKEL	01067	08-14 MD 78-90	<0.005

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 TU 0687
41345	SAMPLE NUMBER
07-14-89 1150 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-21	

PARAMETER	STORET #	DATE BY NUMBER	RESULTS,mg/L
LEAD	00151	08-01 MD 78-56	0.142
CADMIUM	01027	08-03 MD 78-61	0.011
BARIUM	01007	08-10 MD 78-73	0.88
ZINC	01092	08-10 MD 78-77	0.52
CALCIUM	00916	08-16 MD 78-79	41.2
CHLORIDE	00940	08-05 MD #2465	1680
SODIUM	00929	08-10 MD 78-72	655
IRON	01045	08-11 MD 78-85	40.4

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0688

41345 — SAMPLE NUMBER

07-14-89 1150 JP/TM 07-14-89 1700 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-21

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	2702
pH	00400	07-14 JP 166-58	3.83
TURBIDITY	82078	07-14 BM TB-67	43.6
SPEC CONDUCT umhos/cm	00095	07-14 JP 166-58	4150
TEMPERATURE (C)		07-14 JP 166-58	29
DEPTH (FT)		07-14 JP 166-58	38.36
TABLE (FT)		07-14 JP 166-58	5.62

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

3 TU 0689

TAMPA, FLORIDA 33630

41346 — SAMPLE NUMBER

07-14-89 1205 JP/TM 07-14-89 1700 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-21F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
BARIUM	01007	08-04	MD	78-64	0.36
LEAD	01051	08-01	MD	78-56	0.046

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0690
41347	SAMPLE NUMBER
07-14-89 1455 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-22	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	2150
pH	00400	07-14 JP 166-58	3.60
TURBIDITY	82078	07-14 BM TB-67	60.1
SPEC CONDUCT umhos/cm	00095	07-14 JP 166-58	3270
TEMPERATURE (C)		07-14 JP 166-58	29
DEPTH (FT)		07-14 JP 166-58	40.39
TABLE (FT)		07-14 JP 166-58	5.51

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0691
TAMPA, FLORIDA 33630	
41347	SAMPLE NUMBER
07-14-89 1455 JP/TM 07-14-89 1700	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-22	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.043
CADMIUM	01027	08-03 MD 78-61	0.008
SODIUM	00929	08-10 MD 78-73	541
BARIUM	01007	08-04 MD 78-64	0.63
IRON	01045	08-11 MD 78-85	21.4
ZINC	01092	08-10 MD 78-77	0.26
CALCIUM	00916	08-10 MD 78-79	62.2
CHLORIDE	00940	08-05 BM #2475	1370

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0692

41348 — SAMPLE NUMBER

07-14-89 1520 JP/TM 07-14-89 1700 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-22F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
BARIUM	01007	08-04	MD	78-64	0.63
LEAD	01007	08-08	MD	78-68	0.028

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0693
41278	SAMPLE NUMBER
07-12-89 1520 JP/TM 07-12-89 1715	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-25	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	823
pH	00400	07-12 JP 166-57	4.35
TURBIDITY	82078	07-12 BM TB-67	16.2
SPEC CONDUCT umhos/cm	00095	07-12 JP 166-57	1760
TEMPERATURE (C)		07-12 JP 166-57	25
DEPTH (FT)		07-12 JP 166-57	35.47
TABLE (FT)		07-12 JP 166-57	5.4

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0694
TAMPA, FLORIDA 33630	
41278	SAMPLE NUMBER
07-12-89 1520 JP/TM 07-12-89 1715	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-25	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-01 MD 78-56	0.022
CADMIUM	01027	08-03 MD 78-61	0.004
SODIUM	00929	08-10 MD 78-73	215
BARIUM	01007	08-04 MD 78-64	0.21
IRON	01045	08-04 MD 78-85	5.59
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	3.0
CHLORIDE	00940	08-05 BM #2430	460

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0695

41349 — SAMPLE NUMBER

07-17-89 1300 JP/TM 07-17-89 1615 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-26

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.037
CADMIUM	01027	08-03 MD 78-61	0.009
SODIUM	00929	08-10 MD 78-73	617
BARIUM	01007	08-07 MD 78-66	0.42
IRON	01045	08-11 MD 78-85	38.0
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	142
CHLORIDE	00940	08-05 BM #2477	1760

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0696
41349	SAMPLE NUMBER
07-17-89 1300 JP/TM 07-17-89 1615	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-26	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	3060
pH	00400	07-17 JP 166-59	5.28
TURBIDITY	82078	07-17 BM TB-68	70.2
SPEC CONDUCT umhos/cm	00095	07-17 JP 166-59	4090
TEMBERATURE (C)		07-17 JP 166-59	29
DEPTH (FT)		07-17 JP 166-59	50.50
TABLE (FT)		07-17 JP 166-59	8.39

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0697

41350 — SAMPLE NUMBER

07-17-89 1310 JP/TM 07-17-89 1615 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-26F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
BARIUM	01007	08-07	MD	78-66	0.37
LEAD	01007	08-08	MD	78-68	0.036
CADMIUM	01027	08-03	MD	78-61	0.008

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0698
TAMPA, FLORIDA 33630	
41274	SAMPLE NUMBER
07-11-89 1112 JP/TM 07-11-89 1645	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-27	

PARAMETER	STORET#	DATE	BY	NBR	RESULTS,mg/L
TDS	70304	07-18	CH	81-56	818
pH	00400	07-13	JP	166-58	4.87
TURBIDITY	82078	07-14	BM	TB-68	3.4
SPEC CONDUCT umhos/cm	00095	07-13	JP	166-58	1954
TEMPERATURE (C)		07-13	JP	166-58	26
DEPTH (FT)		07-13	JP	166-58	33.96
TABLE (FT)		07-13	JP	166-58	5.22

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

3 TU 0699

TAMPA, FLORIDA 33630

41274 — SAMPLE NUMBER

07-11-89 1112 JP/TM 07-11-89 1645 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-27

PARAMETER	STORET #	DATE BY NUMBER	RESULTS,mg/L
LEAD	00151	08-01 MD 78-56	0.021
CADMIUM	01027	08-03 MD 78-61	0.002
SODIUM	00929	08-10 MD 78-73	141
BARIUM	01007	08-04 MD 78-64	0.17
IRON	01045	08-11 MD 78-85	1.79
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	21.0
CHLORIDE	00940	08-05 BM #2428	436

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0700

41351 — SAMPLE NUMBER

07-17-89 1330 JP/TM 07-17-89 1615 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-33 M-26 duplicate

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	3084
pH	00400	07-17 JP 166-59	5.28
TURBIDITY	82078	07-17 BM TB-68	65.6
SPEC CONDUCT umhos/cm	00095	07-17 JP 166-59	4120
TEMBERATURE (C)		07-17 JP 166-59	29
DEPTH (FT)		07-17 JP 166-59	50.50
TABLE (FT)		07-17 JP 166-59	8.39

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0701
TAMPA, FLORIDA 33630	
41351	SAMPLE NUMBER
07-17-89 1330 JP/TM 07-17-89 1615	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-33 M-26 [illegible]	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.034
CADMIUM	01027	08-03 MD 78-61	0.008
SODIUM	00929	08-10 MD 78-73	601
BARIUM	01007	08-07 MD 78-66	0.42
IRON	01045	08-11 MD 78-85	38.2
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	137
CHLORIDE	00940	08-05 BM #2481	1510

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0702
41365	SAMPLE NUMBER
07-17-89 1415 JP/TM 07-17-89 1615	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-34	

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-08	MD	78-68	0.020
CADMIUM	01027	08-03	MD	78-61	0.006
BARIUM	01007	08-07	MD	788-66	0.29
IRON	01045	08-11	MD	78-85	24.6

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA

ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

3 10 0703

TAMPA, FLORIDA 33630

41279 — SAMPLE NUMBER

07-12-89 1320 JP/TM 07-12-89 1715 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-40

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	328
pH	00400	07-12 JP 166-57	6.94
TURBIDITY	82078	07-12 BM TB-68	7.2
SPEC COND umhos/cm	00095	07-12 JP 166-57	1286
TEMPERATURE (C)		07-12 JP 166-57	26
DEPTH (FT)		07-12 JP 166-57	>100
TABLE (FT)		07-12 JP 166-57	5.4

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0704
41279	SAMPLE NUMBER
07-12-89 1320 JP/TM 07-12-89 1715	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-40	

PARAMETER	STORET #	RESULTS,ug/L
PCB A1242	39496	<0.1

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0705

41279 — SAMPLE NUMBER

07-12-89 1320 JP/TM 07-12-89 1715 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-40

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.015
CADMIUM	01027	08-03	MD	78-61	0.001
SODIUM	00929	08-10	MD	78-73	13.1
BARIUM	01007	08-04	MD	78-64	<0.10
IRON	01045	08-11	MD	78-85	0.930
ZINC	01092	08-10	MD	78-77	<0.10
CALCIUM	00916	08-10	MD	78-79	10.3
CHLORIDE	00940	08-05	BM	#2433	26.6

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0706
TAMPA, FLORIDA 33630	
41280	SAMPLE NUMBER
07-12-89 1425 JP/TM 07-12-89 1715	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-41	

PARAMETER	STORET #	RESULTS,ug/L
PCB A1242	39496	<0.1

DATE

LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0707
TAMPA, FLORIDA 33630	
41280	SAMPLE NUMBER
07-12-89 1425 JP/TM 07-12-89 1715	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-41	

PARAMETER	STORET#	DATE	BY	NBR	RESULTS,mg/L
TDS	70304	07-18	CH	81-56	310
pH	00400	07-12	JP	166-57	6.76
TURBIDITY	82078	07-12	JP	166-57	1.6
SPEC CONDUCT umhos/cm	00095	07-12	JP	166-57	1890
TEMPERATURE (C)		07-12	JP	166-57	25
DEPTH (FT)		07-12	JP	166-57	>100
TABLE (FT)		07-12	JP	166-57	5.70

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0708

41280 — SAMPLE NUMBER

07-12-89 1425 JP/TM 07-12-89 1715 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-41

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.017
CADMIUM	01027	08-03	MD	78-61	0.003
SODIUM	00929	08-10	MD	78-73	11.4
BARIUM	01007	08-04	MD	78-64	<0.10
IRON	01045	08-11	MD	78-85	0.297
ZINC	01092	08-10	MD	78-77	<0.10
CALCIUM	00916	08-10	MD	78-79	89.4
CHLORIDE	00940	08-05	BM	#2435	17.5

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0709
TAMPA, FLORIDA 33630	
41354	SAMPLE NUMBER
07-17-89 1305 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-47	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	<0.005
CADMIUM	01027	08-03 MD 78-61	<0.001
SODIUM	00929	08-10 MD 78-73	10.1
BARIUM	01007	08-07 MD 78-66	<0.10
IRON	01045	08-11 MD 78-85	2.24
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	102
CHLORIDE	00940	08-05 BM #2497	16.0

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0710
41354	SAMPLE NUMBER
07-13-89 1305 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-47	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	336
pH	00400	07-13 JP 166-58	6.44
TURBIDITY	82078	07-13 BM TB-69	1.7
SPEC CONDUCT umhos/cm	00095	07-13 JP 166-58	540
TEMBERATURE (C)		07-13 JP 166-58	29
DEPTH (FT)		07-13 JP 166-58	>100
TABLE (FT)		07-13 JP 166-58	5.85

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0711
TAMPA, FLORIDA 33630	
41354	SAMPLE NUMBER
07-13-89 1305 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-47	

PARAMETER	STORET #	RESULTS,ug/L
PCB A1242	39496	<0.1

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0712
41355	SAMPLE NUMBER
07-13-89 1540 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-50	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	4655
pH	00400	07-13 JP 166-58	4.86
TURBIDITY	82078	07-13 BM TB-69	1.4
SPEC CONDUCT umhos/cm	00095	07-13 JP 166-58	6930
TEMBERATURE (C)		07-13 JP 166-58	30
DEPTH (FT)		07-13 JP 166-58	32.59
TABLE (FT)		07-13 JP 166-58	7.32

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE, WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0713
TAMPA, FLORIDA 33630	
41355	SAMPLE NUMBER
07-13-89 1540 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-50	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.079
CADMIUM	01027	08-03 MD 78-61	0.021
SODIUM	00929	08-10 MD 78-73	1397
BARIUM	01007	08-07 MD 78-66	1.50
IRON	01045	08-11 MD 78-85	24.6
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	84.5
CHLORIDE	00940	08-05 BM #2498	2430
NICKEL	01067	08-14 MD 78-90	<0.005

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0714

41356 — SAMPLE NUMBER

07-13-89 1825 JP/TM 07-13-89 1900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-50F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
BARIUM	01007	08-07	MD	78-66	1.63
LEAD	01007	08-08	MD	78-68	0.075
CADMIUM	01027	08-03	MD	78-61	0.020
IRON	01045	08-11	MD	78-85	25.6
CALCIUM	00916	08-10	MD	78-79	95.2
MAGNESIUM	00927	08-10	MD	78-83	24.1
NICKEL	01067	08-14	MD	78-90	<0.005

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE . WEST PALM BEACH, FL 33401 . 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0715
TAMPA, FLORIDA 33630	
41357	SAMPLE NUMBER
07-13-89 2040 JP/TM 07-14-89 0900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-51	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.016
CADMIUM	01027	08-03 MD 78-61	0.005
SODIUM	00929	08-10 MD 78-73	324
BARIUM	01007	08-07 MD 78-66	0.34
IRON	01045	08-11 MD 78-85	20.9
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	24.4
CHLORIDE	00940	08-05 BM #2500	690

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0716

41357 — SAMPLE NUMBER

07-13-89 2040 JP/TM 07-14-89 0900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-51

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	1254
pH	00400	07-13 JP 166-58	4.95
TURBIDITY	82078	07-14 BM TB-69	63.4
SPEC CONDUCT umhos/cm	00095	07-13 JP 166-58	2020
TEMBERATURE (C)		07-13 JP 166-58	25
DEPTH (FT)		07-13 JP 166-58	31.32
TABLE (FT)		07-13 JP 166-58	7.17

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

3 10 0717

TAMPA, FLORIDA 33630

41358 — SAMPLE NUMBER

07-13-89 2055 JP/TM 07-14-89 0900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-51F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
BARIUM	01007	08-07	MD	78-66	0.32
LEAD	01007	08-08	MD	78-68	0.015
CADMIUM	01027	08-03	MD	78-61	0.004
IRON	01045	08-11	MD	78-85	18.2
CALCIUM	00916	08-10	MD	78-79	24.2
MAGNESIUM	00927	08-10	MD	78-83	13.2
NICKEL	01067	08-14	MD	78-90	<0.005

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0718

41359 — SAMPLE NUMBER

07-13-89 1735 JP/TM 07-14-89 0900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-52

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	195
pH	00400	07-13 JP 166-58	4.80
TURBIDITY	82078	07-14 BM TB-69	17.1
SPEC CONDUCT umhos/cm	00095	07-13 JP 166-58	157
TEMBERATURE (C)		07-13 JP 166-58	23
DEPTH (FT)		07-13 JP 166-58	32.21
TABLE (FT)		07-13 JP 166-58	7.75

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4230

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 TU 0719

41359 — SAMPLE NUMBER

07-13-89 1735 JP/TM 07-14-89 0900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-52

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.011
CADMIUM	01027	08-03 MD 78-61	0.001
SODIUM	00929	08-10 MD 78-73	11.6
BARIUM	01007	08-07 MD 78-66	<0.10
IRON	01045	08-11 MD 78-85	4.95
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	4.1
CHLORIDE	00940	08-05 BM #2502	31.6

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0720

41360 — SAMPLE NUMBER

07-13-89 1745 JP/TM 07-14-89 0900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-52F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
MAGNESIUM	00927	08-10	MD	78-83	4.8
IRON	01045	08-11	MD	78-85	3.38
NICKEL	01067	08-14	MD	78-90	<0.005
CALCIUM	00916	08-10	MD	78-79	2.7

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0721
41361	SAMPLE NUMBER
07-13-89 1735 JP/TM 07-14-89 0900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-53	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	329
pH	00400	07-13 JP 166-58	6.5
TURBIDITY	82078	07-14 BM TB-69	36.4
SPEC CONDUCT umhos/cm	00095	07-13 JP 166-58	510
TEMBERATURE (C)		07-13 JP 166-58	23
DEPTH (FT)		07-13 JP 166-58	47.36
TABLE (FT)		07-13 JP 166-58	6.97

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0722

41361 — SAMPLE NUMBER

07-13-89 1715 JP/TM 07-14-89 0900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-53

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	<0.005
CADMIUM	01027	08-03 MD 78-61	0.001
SODIUM	00929	08-10 MD 78-73	9.2
BARIUM	01007	08-07 MD 78-66	<0.10
IRON	01045	08-11 MD 78-85	2.22
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	115
CHLORIDE	00940	08-05 BM #2503	19.1

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0723
TAMPA, FLORIDA 33630	
41363	SAMPLE NUMBER
07-17-89 1400 JP/TM 07-17-89 1615	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-54	

PARAMETER	STORET#	DATE	BY	NBR	RESULTS,mg/L
TDS	70304	07-24	CH	81-57	1519
pH	00400	07-17	JP	166-59	5.23
TURBIDITY	82078	07-17	BM	TB-69	120.1
SPEC CONDUCT umhos/cm	00095	07-17	JP	166-59	2280
TEMBERATURE (C)		07-17	JP	166-59	25
DEPTH (FT)		07-17	JP	166-59	32.47
TABLE (FT)		07-17	JP	166-59	6.56

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0724

41363 — SAMPLE NUMBER

07-17-89 1400 JP/TM 07-17-89 1615 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-54

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.018
CADMIUM	01027	08-03 MD 78-61	0.006
SODIUM	00929	08-10 MD 78-73	335
BARIUM	01007	08-07 MD 78-66	0.26
IRON	01045	08-11 MD 78-85	23.9
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	35.8
CHLORIDE	00940	08-05 BM #2505	607

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0725
TAMPA, FLORIDA 33630	
41364	SAMPLE NUMBER
07-17-89 1410 JP/TM 07-17-89 1615	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-54F	

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-08	MD	78-68	0.019
CADMIUM	01027	08-03	MD	78-61	0.004
BARIUM	01007	08-07	MD	788-66	0.29
IRON	01045	08-11	MD	78-85	23.3

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0726
TAMPA, FLORIDA 33630	
41366	SAMPLE NUMBER
07-17-89 1500 JP/TM 07-17-89 1615	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-55	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-24 CH 81-57	793
pH	00400	07-17 JP 166-59	5.80
TURBIDITY	82078	07-17 BM TB-69	257.0
SPEC CONDUCT umhos/cm	00095	07-17 JP 166-59	1140
TEMBERATURE (C)		07-17 JP 166-59	25
DEPTH (FT)		07-17 JP 166-59	33.30
TABLE (FT)		07-17 JP 166-59	7.53

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

3 10 0727

TAMPA, FLORIDA 33630

41366 — SAMPLE NUMBER

07-17-89 1500 JP/TM 07-17-89 1615 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-55

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.013
CADMIUM	01027	08-03 MD 78-61	0.003
SODIUM	00929	08-10 MD 78-73	137
BARIUM	01007	08-07 MD 78-66	0.16
IRON	01045	08-11 MD 78-85	8.44
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	57.0
CHLORIDE	00940	08-05 BM #2506	181

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0728

41367 — SAMPLE NUMBER

07-17-89 1510 JP/TM 07-17-89 1615 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-55F

PARAMETER	STORET #	DATE	BY	NUMBER	RESULTS,mg/L
LEAD	00151	08-01	MD	78-56	0.010
CADMIUM	01027	08-03	MD	78-61	0.002
BARIUM	01007	08-07	MD	78-66	0.16
IRON	01045	08-11	MD	78-85	5.34

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE, WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0729
TAMPA, FLORIDA 33630	
41368	SAMPLE NUMBER
07-13-89 1350 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-56	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-19 CH 81-57	3829
pH	00400	07-13 JP 166-58	4.52
TURBIDITY	82078	07-13 BM TB-69	76.6
SPEC CONDUCT umhos/cm	00095	07-13 JP 166-58	5470
TEMBERATURE (C)		07-13 JP 166-58	29
DEPTH (FT)		07-13 JP 166-58	33.29
TABLE (FT)		07-13 JP 166-58	8.05

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407:833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0730

41368 — SAMPLE NUMBER

07-13-89 1430 JP/TM 07-13-89 1900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-56

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.064
CADMIUM	01027	08-03 MD 78-61	0.017
SODIUM	00929	08-10 MD 78-73	1110
BARIUM	01007	08-07 MD 78-66	1.13
IRON	01045	08-11 MD 78-85	40.7
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	60.0
CHLORIDE	00940	08-05 BM #2507	1970

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

3 10 0731

TAMPA, FLORIDA 33630

41369 — SAMPLE NUMBER

07-13-89 1555 JP/TM 07-13-89 1900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-56F

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-01	MD	78-56	0.059
CADMIUM	01027	08-03	MD	78-61	0.014
BARIUM	01007	08-04	MD	78-64	1.38
IRON	01045	08-11	MD	78-85	37.4
NICKEL	01067	08-14	MD	78-90	<0.005

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0732
TAMPA, FLORIDA 33630	
41370	SAMPLE NUMBER
07-13-89 1715 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-57	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.139
CADMIUM	01027	08-03 MD 78-61	0.023
SODIUM	00929	08-10 MD 78-73	1930
BARIUM	01007	08-07 MD 78-66	2.63
IRON	01045	08-11 MD 78-85	35.5
ZINC	01092	08-10 MD 78-77	0.15
CALCIUM	00916	08-10 MD 78-79	141
CHLORIDE	00940	08-05 BM #2508	3500

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0733
TAMPA, FLORIDA 33630	
41370	SAMPLE NUMBER
07-13-89 1715 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-57	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-19 CH 81-57	6680
pH	00400	07-13 JP 166-58	4.53
TURBIDITY	82078	07-13 BM TB-69	84.6
SPEC CONDUCT umhos/cm	00095	07-13 JP 166-58	9600
TEMPERATURE (C)		07-13 JP 166-58	28
DEPTH (FT)		07-13 JP 166-58	31.60
TABLE (FT)		07-13 JP 166-58	7.00

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

3 10 0734

TAMPA, FLORIDA 33630

41371 — SAMPLE NUMBER

07-13-89 1720 JP/TM 07-13-89 1900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

M-57F

PARAMETER	STORET #	DATE BY NUMBER	RESULTS,mg/L
LEAD	00151	08-01 MD 78-56	0.118
CADMIUM	01027	08-03 MD 78-61	0.026
BARIUM	01007	08-07 MD 78-66	2.50
IRON	01045	08-11 MD 78-85	31.5
CALCIUM	00916	08-10 MD 78-79	138
MAGNESIUM	00927	08-10 MD 78-83	23.8

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES L ORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEE	PORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23		3 TU 0735
TAMPA, FLOR	3630	
41372		SAMPLE NUMBER
07-13-8 1525	1 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANT		LOCATION
M-58		

PARAMETER	STORET#	DATE	BY	NBR	RESULTS, mg/L
TDS	70304	07-19	CH	81-57	365
pH	00400	07-13	JP	166-58	6.5
TURBIDI	82078	07-13	BM	TB-69	4.8
SPEC CONDUCT	m 00095	07-13	JP	166-58	57.0
TEMPERATURE		07-13	JP	166-58	25
DEPTH (FT)		07-13	JP	166-58	58.60
TABLE (FT)		07-13	JP	166-58	6.75

DATE 3-31

LAB ID 86122,86109, E86048

BY

DIRECT

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0736
41372	SAMPLE NUMBER
07-13-89 1525 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-58	

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	<0.005
CADMIUM	01027	08-03 MD 78-61	0.001
SODIUM	00929	08-10 MD 78-73	20.6
BARIUM	01007	08-07 MD 78-66	<0.10
IRON	01045	08-11 MD 78-85	1.74
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	104
CHLORIDE	00940	08-05 BM #2509	58.4

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0737
TAMPA, FLORIDA 33630	
41373	SAMPLE NUMBER
07-13-89 1820 JP/TM 07-13-89 1900	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-58F	

PARAMETER	STORET #	DATE	BY	NBR	RESULTS,mg/L
LEAD	01051	08-08	MD	78-68	<0.005
CADMIUM	01027	08-03	MD	78-61	<0.001
BARIUM	01007	08-07	MD	788-66	<0.10
IRON	01045	08-11	MD	78-85	1.04

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	3 10 0738
TAMPA, FLORIDA 33630	
41374	SAMPLE NUMBER
07-13-89 1545 JP/TM 07-13-89	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
M-59	

PARAMETER	DATE BY NBR	RESULTS,mg/L
TEMPERATURE (C)	07-13 JP 166-58	28
TABLE (FT)	07-13 JP 166-58	5.98

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0739

41375 — SAMPLE NUMBER

07-13-89 1530 JP/TM 07-13-89 1900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

FIELD BLACK #1 COLLECTED AFTER M-50

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TEMPERATURE (C)		07-13 JP 166-58	30
pH	00400	07-13 JP 166-58	4.86
TDS	70304	07-18 CH 81-56	10
TURBIDITY	82078	07-13 BM TB-62	0.3

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION	CLIENT NAME AND ADDRESS
P. O. BOX 23328	
TAMPA, FLORIDA 33630	3 10 0740
41352	SAMPLE NUMBER
07-17-89 1340 JP/TM 07-17-89 1615	DATE TIME COLL RECD
FSC - INDIANTOWN	LOCATION
FIELD BLANK #2 AFTER M-26	

PARAMETER	STORET#	DATE BY NBR	RESULTS,mg/L
TDS	70304	07-18 CH 81-56	13
pH	00400	07-17 JP 166-59	5.28
TURBIDITY	82078	07-17 BM TB-68	0.1
SPEC CONDUCT umhos/cm	00095	07-17 JP 166-59	4090
TEMBERATURE (C)		07-17 JP 166-59	29
DEPTH (FT)		07-17 JP 166-59	50.50
TABLE (FT)		07-17 JP 166-59	8.39

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE · WEST PALM BEACH, FL 33401 · 407 833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0741

41375 — SAMPLE NUMBER

07-13-89 1530 JP/TM 07-13-89 1900 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

FIELD BLANK #1 COLLECTED AFTER M-50

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	<0.005
CADMIUM	01027	08-03 MD 78-61	<0.001
SODIUM	00929	08-10 MD 78-73	<0.5
BARIUM	01007	08-07 MD 78-66	<0.10
IRON	01045	08-11 MD 78-85	<0.030
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	<0.5
CHLORIDE	00940	08-05 BM #2509	<0.05

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR

EVERGLADES LABORATORIES, INC. 1602 CLARE AVENUE • WEST PALM BEACH, FL 33401 • 407/833-4200

MFORMA ANALYSIS REPORT

FLORIDA STEEL CORPORATION — CLIENT NAME AND ADDRESS

P. O. BOX 23328

TAMPA, FLORIDA 33630

3 10 0742

41352 — SAMPLE NUMBER

07-17-89 1340 JP/TM 07-17-89 1615 — DATE TIME COLL RECD

FSC - INDIANTOWN — LOCATION

FIELD BLANK #2 AFTER #26

PARAMETER	STORET #	DATE BY NBR	RESULTS,mg/L
LEAD	01051	08-08 MD 78-68	0.005
CADMIUM	01027	08-03 MD 78-61	<0.001
SODIUM	00929	08-10 MD 78-73	0.8
BARIUM	01007	08-07 MD 78-66	<0.10
IRON	01045	08-11 MD 78-85	<0.030
ZINC	01092	08-10 MD 78-77	<0.10
CALCIUM	00916	08-10 MD 78-79	<0.5
CHLORIDE	00940	08-05 BM #2493	0.110

DATE 08-31-89 LAB ID 86122,86109, E86048

BY

DIRECTOR