100666

Technical Memorandum 4

Groundwater Sampling

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DATE: September 23, 1993

REVISED: July 5, 1994

SUBJECT: Groundwater Sampling at Halby Chemical Company
Operable Unit 2 Site, New Castle County, Wilmington, Delaware

PROJECT: Work Assignment No. 39-3LL7
WDC63154.FI.FQ

Introduction

Purpose and Scope

This technical memorandum (TM) describes the groundwater-sampling activities at the Halby Chemical Company (Halby) Operable Unit 2 (OU-2) site. Round 1 of the groundwater sampling was performed over the 3-week period from August 2 until August 25, 1993. A second round of groundwater sampling was performed between December 1 and December 17, 1993. CH2M HILL field personnel collected groundwater samples from 34 monitoring wells and surface water samples from 3 locations. The groundwater and surface water samples were submitted to CLP and CRL laboratories for analysis for a selected suite of chemicals. The results of the analyses were not available for this TM and will be discussed in the remedial investigation report.

Objectives

The objectives of the groundwater and surface water sampling at the Halby OU-2 site are as follows:

- Collect and analyze two rounds of groundwater samples from the new and preexisting monitoring wells to delineate the distribution of groundwater contamination at the site.
- Collect surface water samples near monitoring wells screened in the shallow aquifer to help determine the degree of hydraulic interconnection between the surface water system and the shallow aquifer.

- Evaluate upgradient, onsite, and downgradient contamination levels in each aquifer.

Methodology

Groundwater Sampling, First Round

The first round of groundwater sampling during the RI involved sampling 34 new and preexisting monitoring wells. Figures 1 and 2 illustrate the monitoring-well locations. CH2M HILL conducted the groundwater sampling in accordance with SOP No. 21, "Groundwater Sampling." Before sample collection, groundwater was purged from the monitoring wells until pH, conductivity, and temperature stabilized. Table 1 presents the groundwater parameters recorded in the field during the purge process at each well.

Two-inch submersible pumps were substituted for the surface pumps that were originally specified, because the surface pumps were pumping faster than the wells recovered and were unable to lift water when the head was lowered. The submersible pumps were used to purge the necessary well volumes. Samples were collected with a bailer. The sampling equipment was decontaminated in accordance with SOP No. 6, "Decontamination of Drilling Rigs and Equipment."

Groundwater Sampling, Second Round

During the second round of groundwater sampling, wells were purged and sampled using 2-inch submersible pumps. Three very slow wells were purged over multiple days, using dedicated bailers. The sampling equipment was decontaminated as described in the sampling and analysis plan (SAP). Table 2 presents the groundwater parameters recorded in the field during the purge process at each well.

Surface Water Sampling

Locations of surface water sampling are included in Figure 2. The three surface water samples were collected in accordance with SOP No. 8, "Surface-Water Sampling," near monitoring-well clusters 1, 2, and 10.

Quality Control Sampling

Quality control (QC) during the first round of groundwater sampling involved collecting equipment blanks, trip blanks, and field blanks. Equipment and field blanks were collected daily when possible but at a rate of at least 1 per 20 samples. Trip blanks were included in each cooler carrying samples for analysis of volatiles. The duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples were collected at a rate of 1 per 20 samples per medium and laboratory.

The equipment blanks were collected in accordance with the procedures outlined in SOP No. 16, "Field Rinse Blank Preparation." The collection of the other QC samples corresponded to the methodologies stated in part 3, section 6, of the SAP.

Sample Management

After collecting the groundwater and surface water samples, the field crews immediately placed the samples on ice and maintained custody until the time of sample shipment. Before shipment, sample tags and tracking numbers were affixed to the sample bottles, and the traffic reports and chains of custody were completed.

The samples were shipped to preassigned laboratories and to the Central Regional Laboratory for the analyses listed in Table 3. SOP No. 21, "Region III Sample Paperwork," and part 3, section 6, of the SAP contain details on sample-management procedures.

Waste Management

Wastes derived from the groundwater sampling include personal protective equipment (PPE) and groundwater purged from monitoring wells before sample collection. PPE that was used on the site was placed in 55-gallon drums that were bolted, labeled, and stored in the drum-storage area.

As stated in SOP No. 7, "Disposal of Fluids and Solids," purged groundwater was contained and transported to a central storage area. However, 500-gallon and 3,000-gallon plastic tanks were used to store the groundwater instead of 55-gallon drums. The plastic tanks were placed near the drum-storage area.

Health and Safety

CH2M HILL field personnel conducted field operations in accordance with the site-specific health and safety plan (HSP). Most monitoring wells were sampled in Level D PPE, but monitoring of volatiles at several well clusters indicated that a protection upgrade was necessary. As a result, monitoring wells at clusters 1, 8, 9, and 10 were sampled in Level B PPE in the first round and Level C PPE in the second round.

WDCR846/040.WP5

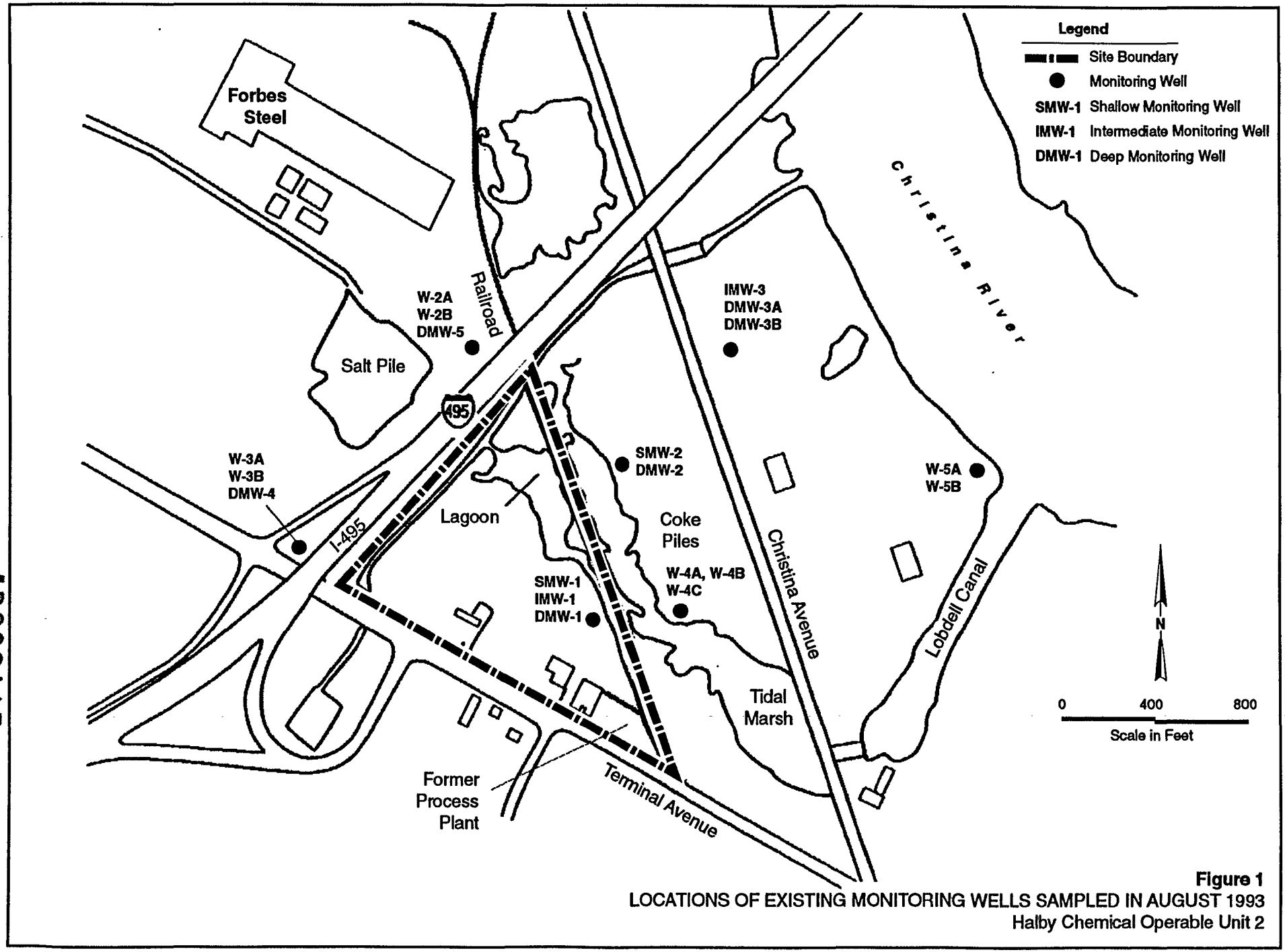

Figure 1
LOCATIONS OF EXISTING MONITORING WELLS SAMPLED IN AUGUST 1993
Halby Chemical Operable Unit 2

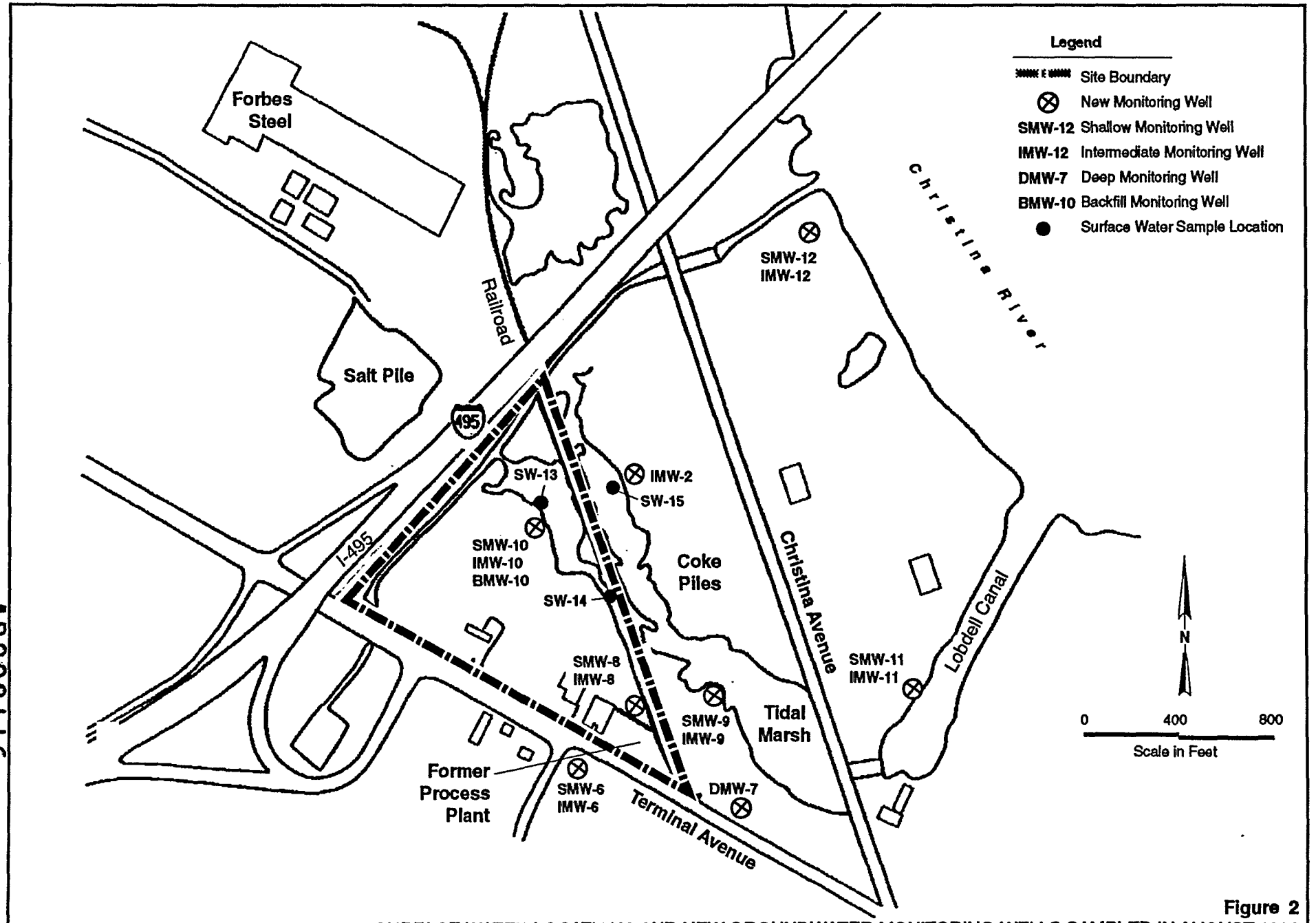

Figure 2

SURFACE WATER LOCATIONS AND NEW GROUNDWATER MONITORING WELLS SAMPLED IN AUGUST 1993

Halby Chemical O[illegible]ble Unit 2

Table 1
SUMMARY OF PARAMETERS MEASURED DURING GROUNDWATER SAMPLING
REMEDIAL INVESTIGATION
HALBY CHEMICAL OU-2

Sample Location and Internal Sample No.	TOC* to Water Table (feet)	Date	Time	Volume Purged (Gal)	pH	Conductivity (μmho/cm)	Temp (°C)	Eh (mV)	Dissolved Oxygen (ppm)	Salinity 0/00
W-5A	7.15	8/3/93	1055	2.2	6.34	3750	21.0	-	-	-
AA2101			1100	4.4	6.41	3920	20.0	-	-	-
			1105	6.6	6.41	4180	19.0	-	-	-
W-5B	8.58	8/2/93	1347	11	5.79	8500	16.5	-	-	7.5
AA3002		8/3/93	1420	21.5	5.95	8200	18.0	+17	-	-
			1436	32	6.06	8800	17.0	+17	-	-
			1450	42.5	6.08	8600	16.5	-6	-	-
DMW-5	13.52	8/25/93	0850	0	8.62	250	17.0	+87	-	-
AA2122			0902	52	9.33	172	16.0	+67	-	-
			0913	104	9.12	142	16.0	-22	-	-
			0930	156	9.09	140	16.0	-80	-	-
SMW-11	9.53	8/3/93	1604	3.2	5.88	3440	17.5	+53	-	-
AA3003			1608	6.4	5.95	3400	17.0	+47	-	-
			1614	9.6	6.02	3280	17.0	+25	-	-
IMW-11	9.37	8/4/93	1410	7	5.96	1120	20.0	-3	1.4	-
AA1101			1425	14	6.08	1180	19.0	-16	1.8	-
			1440	21	6.04	1480	19.0	-10	1.4	-
			1445	28	6.05	1560	18.0	-10	1.8	-
			1455	35	6.07	1820	18.0	+3	2.2	-
			1510	42	6.08	2200	17.0	-10	2.1	-
			1530	49	6.06	2600	20.0	-6	1.6	-
W-2A	11.04	8/4/93	1045	3	6.51	2100	18.0	-65	-	-
AA3005			1055	6	6.70	1725	15.5	-72	-	-
			1100	9	6.78	1800	16.5	-76	-	-
			1106	12	6.74	1850	16.0	-78	-	-

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W-2B	12.25	8/4/93	0928	7	5.21	>50,000	16.5	+115	-	-
AA3004			0940	14	4.72	>50,000	17.0	+146	-	-
			0950	21	4.58	>50,000	17.0	+193	-	-
			1005	28	4.51	>50,000	16.8	+196	-	-
W-3A[a]	6.1	8/2/93	1515	4	6.33	225	18.0	-	-	-
AA1102			1545	8	6.45	195	19.0	-	-	-
		8/5/93	1010	12	6.29	220	19.0	-68	0.7	-
			1017	16	6.46	175	16.0	-74	0.8	-
W-3B	7.06	8/5/93	0915	7	5.64	115	16.5	+32	2.3	-
AA3006			0923	14	5.56	160	16.0	+12	2.3	-
			0931	21	5.94	85	16.0	-15	2.3	-
			0942	28	5.50	87	15.5	-18	2.5	-
DMW-4	11.90	8/24/93	1305	0	8.36	160	21.0	-16	-	-
AA2121			1318	52	7.77	120	20.0	-72	-	-
			1340	104	7.60	120	20.0	-103	-	-
			1403	156	7.43	125	20.0	-125	-	-
SMW-12[a]	17.32	8/2/93	1048	4.5	6.29	2800	18.0	-	-	-
AA2104			1405	6.5	6.64	2400	20.0	-	-	-
		8/5/93	1205	-[b]	6.78	2680	17.0	-	-	1.6
IMW-12[a]	14.8	8/2/93	1104	8.5	6.86	3300	18.0	-	-	-
AA2102		8/5/93	0900	-[b]	6.86	2900	17.0	-	-	2
SMW-6[a]	-[c]	8/2/93	1705	5	7.84	750	19.0	-	-	-
AA2105			1510	10	7.58	700	20.0	-	-	-
		8/5/93	1440	-[b]	8.3	680	19.0	-	-	0.2

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IMW-6 AA3021	7.28	8/17/93	1058	0	7.68	380	17.8	-8.0	-	-
			1105	10	7.40	375	16.0	+5.0	-	-
			1112	20	7.29	370	16.0	+6.0	-	-
			1119	30	-	370	16.0	+4.0	-	-
SMW-1 AA3024	6.20	8/18/93	1548	0	8.02	2330	18.0	-106	-	-
			1555	17	7.78	1930	17.0	-140	-	-
			1603	34	7.15	2150	16.0	-150	-	-
			1612	51	7.20	2300	16.0	-124	-	-
IMW-1 AA3008	6.65	8/10/93	1513	0	5.89	1600	18.9	-45	1.2	-
			1537	35	6.0	3100	16.5	+71	1.5	-
			1550	70	5.9	3200	17.5	+89	1.6	-
			1610	105	5.78	3150	16.7	+99	1.6	-
DMW-1 AA3007	11.55	8/10/93	1300	60	6.1	120	17.9	-	1.0	-
			1320	120	6.71	130	18.0	-53	0.8	-
			1330	160	7.12	120	18.0	-72	1.1	-
			1340	180	6.9	123	17.7	-75	1.2	-
BMW-10 AA3009	8.45	8/5/93	1522	1.5	6.2	2300	18.5	-75	0.5	-
			1527	3.0	6.35	1930	19.0	-87	0.4	-
			1534	4.5	5.9	2000	18.5	-75	0.4	-
		8/11/93	1100	7.5	5.48	1700	20.0	-31	0.8	-
			1105	10.5	5.61	1550	18.5	-68	4.0	-
			1110	13.5	5.9	1700	19.0	-60	4.1	-
SMW-10 AA3010	8.5	8/11/93	1430	3.5	5.92	1600	20.0	-51	1.5	-
			1515	7	5.88	1600	19.5	-67	0.4	-
			1521	11	5.95	1575	17.0	-62	0.7	-

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IMW-10	8.42	8/11/93	0900	6	5.02	4500	19.0	+06	2.5	-
AA3011			0918	12	5.09	>4000	21.0	+19	3.6	-
			0925	18	5.34	4350	16.0	+39	2.2	-
DMW-7	9.71	8/12/93	0835	21	7.14	248	15.0	+114	-	-
AA3013			0855	42	7.60	160	15.0	-78	-	-
AA3014			0922	63	7.86	153	15.0	-76	-	-
SMW-8	8.72	8/12/93	1415	9.2	7.42	2800	21.0	-143	-	-
AA3012			1430	18.4	7.64	2100	19.5	-134	-	-
AA3015			1540	27.6	7.72	2200	19.5	-136	-	-
IMW-8	9.37	8/12/93	1500	0	7.16	6000	17.5	-68	-	-
AA3016			1520	42	7.27	5200	17.0	-56	-	-
			1550	84	7.21	4600	16.5	-47	-	-
			1620	126	7.14	4200	16.7	-37	-	-
SMW-3	6.65	8/18/93	0925	36	6.50	1480	15.2	-65	-	-
AA3022			0942	72	7.33	1400	15.0	-51	-	-
AA3023			1000	108	7.29	1410	15.0	-55	-	-
IMW-3	8.75	8/13/93	0905	0	6.13	258	15.5	-82	-	-
AA3017			0926	55	8.36	255	16.0	-98	-	-
			1008	110	8.37	190	16.0	-96	-	-
			1030	165	8.26	185	16.0	-84	-	-
DMW-3	9.05	8/16/93	1505	0	6.49	278	15.0	-92	-	-
AA3018			1525	72	7.24	275	15.5	-84	-	-
			1555	144	7.30	215	15.5	-94	-	-
			1635	216	7.50	240	16.0	-104	-	-

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SMW-9 AA3020	5.87	8/18/93	1350	0	7.47	3750	20.5	-194	-	-
			1353	2.5	7.70	3700	18.0	-221	-	-
			1356	5.0	8.30	3700	17.8	-227	-	-
			1359	7.5	8.28	3640	17.2	-219	-	-
IMW-9 AA3019	5.85	8/17/93	0916	0	6.72	210	14.0	-37	-	-
			0921	10.5	6.59	190	14.0	-19	-	-
			0928	210	7.06	160	13.7	-09	-	-
			0932	31.5	7.02	140	13.7	-	-	-
SMW-2 AA3026	7.71	8/19/93	1220	0	5.91	3800	18.8	+119	-	-
			1234	23	6.33	3700	16.0	+85	-	-
			1245	46	6.03	3800	17.0	+80	-	-
			1322	69	6.33	3700	17.4	+77	-	-
IMW-2 AA3025	7.43	8/19/93	1424	0	6.25	3100	17.0	+26	-	-
			1430	11	6.18	3180	16.5	+43	-	-
			1436	22	6.16	3180	16.5	+48	-	-
			1441	33	6.05	3190	16.5	+46	-	-
DMW-2 AA3028	10.7	8/24/93	0815	0	6.91	133	16.0	+101	-	-
			0830	60	7.46	120	15.3	+29	-	-
			0958	120	8.20	128	16.5	-45	-	-
			1050	180	7.72	120	17.4	-35	-	-
W-04A AA2115	7.24	8/13/93	0900	3.5	7.0	3980	18.0	-	-	2.5
			0915	7	7.0	3760	18.0	-	-	2.5
			0931	11	7.0	4040	17.5	-	-	2.5

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HALBY CHEMICAL OU-2

Sample Location and Internal Sample No.	TOC* to Water Table (feet)	Date	Time	Volume Purged (Gal)	pH	Conductivity (μmho/cm)	Temp (°C)	Eh (mV)	Dissolved Oxygen (ppm)	Salinity 0/00
W-4B AA2123	6.84	8/25/93	1232	0	7.44	100	22.0	-52	-	-
			1236	11	7.36	80	19.7	-46	-	-
			1242	22	7.28	70	19.0	-37	-	-
			1246	33	7.03	70	19.0	-40	-	-
W-4C AA3029	11.0	8/25/93	1128	0	7.70	182	20.5	-51	-	-
			1133	18	7.84	140	18.0	-69	-	-
			1153	36	7.83	142	20.0	-98	-	-
			1200	54	7.58	140	19.0	-103	-	-

Notes:
[a]Well bailed dry during purge and/or sampling events.
[b]Final volume purged not recorded in field.
[c]Water level measured prior to well development. The established well volume was used as a standard for purging volumes.
*TOC = Top of steel protective casing.
"-" = Parameter not measured.

Table 2
GROUNDWATER-SAMPLING PARAMETERS
DECEMBER 1993
HALBY CHEMICAL OU-2

Well Number	Date	Time	Purge Volume (gallons)	pH (pH units)	Conductivity (ms/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Temperature (Deg. C)	Eh (mv)
SMW-1	12/16/93	11:14	18	6.39	1.53	31	1.44	13	NR
		11:35	36	6.41	1.47	28	1.69	13	NR
		--	DRY	DRY	DRY	DRY	DRY	DRY	DRY
IMW-1	12/16/93	10:20	36	5.23	3.89	80	1.94	13	NR
		10:34	72	5.17	4.00	40	2.00	14	NR
		10:47	108	5.10	4.00	25	2.04	14	NR
DMW-1	12/16/93	9:00	60	6.65	0.14	480	1.32	14	NR
		9:20	120	6.44	0.13	386	0.92	14	NR
		9:40	180	6.44	0.13	167	1.02	14	NR
SMW-2	12/15/93	8:04	24	5.14	4.93	214	0.85	13	NR
		8:16	48	5.21	4.90	640	3.00	14	NR
		8:26	72	5.23	4.93	80	5.10	14	NR
IMW-2	12/9/93	15:04	11	5.00	4.56	999	0.69	13	NR
		15:16	22	5.29	4.26	999	2.00	13	NR
		15:35	33	5.28	4.23	678	1.95	13	NR
DMW-2	12/14/93	12:55	59	6.45	0.17	999	1.67	17	NR
		13:10	118	6.62	0.16	999	1.88	15	NR
		13:30	177	6.66	0.16	999	1.98	15	NR
IWM-3	12/6/93	14:25	36	6.20	1.33	16	0.85	22	NR
		14:40	72	6.22	1.18	2	0.62	30	NR
		14:55	108	6.21	1.20	1	1.00	20	NR
DMW-3A	12/6/93	12:00	55	6.55	0.06	466	0.50	30	NR
		12:17	110	6.48	0.17	906	0.66	27	NR
		12:35	165	6.61	0.22	924	1.25	15	NR
DMW-3B	12/3/93	11:18	72	6.87	0.25	20	1.98	15	NR
		11:38	144	7.16	0.20	6	1.30	15	NR
		11:54	216	7.05	0.20	12	1.62	15	NR
DMW-4	12/7/93	11:50	30	6.83	0.22	999	0.41	26	NR
		13:24	70	6.81	0.25	48	1.00	14	NR
		14:18	103	6.82	0.25	49	0.75	14	NR
		15:12	150	6.78	0.25	54	0.78	14	NR

Table 2
GROUNDWATER-SAMPLING PARAMETERS
DECEMBER 1993
HALBY CHEMICAL OU-2

Well Number	Date	Time	Purge Volume (gallons)	pH (pH units)	Conductivity (ms/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Temperature (Deg. C)	Eh (mv)
DMW-5	12/9/93	8:35	52	6.59	0.20	395	2.27	13	NR
		8:55	104	6.89	0.17	95	2.37	14	NR
		9:19	156	6.95	0.17	54	2.47	14	NR
SMW-6	12/2/93	1510	7	6.70	0.59	999	3.72	16	17.60
		DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
IMW-6	12/3/93	1112	10	6.19	0.31	852	1.74	15	6.29
		1124	20	5.97	0.38	999	3.48	15	5.69
		1144	31	5.84	0.39	999	1.11	15	6.13
DMW-7	12/8/93	11:00	21	7.30	0.20	999	0.74	14	NR
		11:15	41	7.02	0.19	999	0.77	14	NR
		11:26	62	6.99	0.19	764	0.67	14	NR
SMW-8	12/16/93	14:22	42	6.40	7.31	260	0.83	14	NR
		14:45	84	6.36	6.98	74	1.10	14	NR
		15:05	126	6.34	6.71	56	1.07	14	NR
IMW-8	12/16/93	15:24	10	7.50	2.30	80	0.93	14	NR
		15:33	19	7.48	2.33	129	0.79	14	NR
		15:44	29	7.48	2.37	120	1.15	14	NR
SMW-9	12/15/93	12:57	3	9.01	4.38	287	1.09	12	NR
		13:00	5	9.00	4.39	217	1.15	13	NR
		13:03	8	8.99	4.37	144	1.14	13	NR
IMW-9	12/15/93	11:17	11	6.00	0.25	999	1.11	13	NR
		11:20	22	5.99	0.23	890	1.25	13	NR
		11:25	33	5.96	0.21	628	1.09	13	NR
SMW-10	12/13/93	14:35	4	6.26	1.33	999	2.51	15	NR
		14:39	7	6.29	1.76	999	3.12	14	NR
		14:43	11	6.32	1.75	999	2.66	14	NR
IMW-10	12/8/93	14:03	6	5.19	5.13	999	1.16	14	NR
		14:07	12	5.16	4.84	999	1.21	14	NR
		14:12	18	5.12	4.74	628	1.13	14	NR
		14:16	24	5.12	4.69	447	1.09	14	NR

Table 2
GROUNDWATER-SAMPLING PARAMETERS
DECEMBER 1993
HALBY CHEMICAL OU-2

Well Number	Date	Time	Purge Volume (gallons)	pH (pH units)	Conductivity (ms/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Temperature (Deg. C)	Eh (mv)
BMW-10	12/13/93	12:40	2	6.75	2.11	999	0.71	13	NR
		12:50	3	6.79	2.10	999	0.74	14	NR
		12:58	5	6.90	2.06	999	0.74	14	NR
SMW-11	12/2/93	15:40	3	5.74	3.54	525	1.54	14	NR
		15:50	6	5.76	3.49	999	1.08	15	NR
		15:57	10	5.86	3.30	999	1.58	14	NR
IMW-11	12/7/93	9:25	7	5.51	1.44	940	1.01	19	NR
		9:34	14	5.74	1.41	807	0.94	18	NR
		9:40	21	5.76	1.58	255	0.51	19	NR
		9:45	28	5.76	1.55	158	0.60	25	NR
SMW-12	12/13/93	1105	NR	NR	NR	NR	NR	NR	NR
IMW-12	12/13/93	1105	NR	NR	NR	NR	NR	NR	NR
W-2A	12/3/93	9:46	3	6.12	3.27	999	0.70	13	7.59
		9:50	6	6.24	2.70	999	0.48	14	8.06
		9:54	9	6.29	2.67	999	0.56	14	8.04
W-2B	12/9/93	11:06	8	4.32	64.20	999	0.92	13	NR
		11:17	16	4.23	65.20	634	1.43	14	NR
		11:30	25	4.29	65.40	783	2.05	14	NR
W-3A	12/7/93	11:55	4	6.47	0.27	370	1.01	21	NR
		12:02	8	6.48	0.28	999	0.42	--	NR
			DRY	DRY	DRY	DRY	DRY	DRY	DRY
W-3B	12/8/93	8:49	9	5.26	0.14	999	1.17	13	NR
		8:52	18	5.86	0.10	999	1.61	13	NR
		8:56	27	5.98	0.10	999	1.26	14	NR
		9:00	36	6.03	0.10	999	0.80	14	NR

Table 2
GROUNDWATER-SAMPLING PARAMETERS
DECEMBER 1993
HALBY CHEMICAL OU-2

Well Number	Date	Time	Purge Volume (gallons)	pH (pH units)	Conductivity (ms/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Temperature (Deg. C)	Eh (mv)
W-4A	12/2/93	12:47	3.5	7.13	3.58	999	1.11	17	-40
		12:55	7	7.20	3.77	999	2.80	17	-60
		13:02	10.5	7.34	3.84	837	4.43	17	-80
W-4B	12/10/93	11:48	11	6.24	0.18	999	2.12	14	NR
		12:00	21	6.31	0.08	999	1.55	14	NR
		12:08	32	6.28	0.07	999	3.28	14	NR
W-4C	12/15/93	9:47	18	6.73	0.17	830	1.31	14	NR
		9:53	36	6.71	0.17	440	1.37	14	NR
		9:59	54	6.72	0.17	324	1.48	14	NR
W-5A	12/2/93	15:57	2.5	6.50	6.05	450	0.80	15	8.40
		16:01	5	6.48	6.47	364	0.96	16	-15.6
		16:05	7.5	6.46	6.61	365	0.99	16	13.10
W-5B	12/10/93	9:55	11	5.70	9.30	999	1.52	13	NR
		10:05	22	5.80	9.30	999	2.17	13	NR
		10:12	33	5.84	9.20	999	3.93	14	NR

Notes:
NR = Not recorded

Table 3
ANALYSES PERFORMED ON GROUNDWATER AND SURFACE-WATER SAMPLES
HALBY CHEMICAL OU-2

TCL Volatiles
TCL Semivolatiles
TCL Pesticides and PCBs
TAL Metals (Total)
TAL Metals (Dissolved)
Total Cyanide
Weak Dissociable Cyanide
Thiocyanate
Sulfate
Nitrate and Nitrite
Sulfide
Hardness
Ammonia
Alkalinity
Total Suspended Solids
Total Dissolved Solids
Total Organic Carbon
Hexavalent Chromium
Biocarbonate*
Choride*

*Analysis performed only in second round.

WDCR750/029.51

Technical Memorandum 5

Qualitative Species Inventory, Onsite and Background Fish Sampling, and Toxicity Identification Evaluation Sampling

PREPARED FOR: Eric Newman/EPA III

PREPARED BY: Bob Root, Mike Mischuk, and Kerry Iliff/CH2M HILL

DATE: March 1, 1995

SUBJECT: Qualitative Species Inventory (September 1993), Onsite and Background Fish Sampling (November 1994), and Toxicity Identification Evaluation Sampling (November 1994) of the Halby Chemical Site

PROJECT: MAE63154.FI.FB

Introduction

On September 23 and 24, 1993, a qualitative species inventory was conducted at the Halby Chemical site. The purpose of the inventory was to establish a baseline description of the environmental setting of the property and to identify potential environmental receptors most likely to be exposed to site contaminants. On November 8 and 10, 1994, fish were collected in the onsite lagoon and in a background location and catalogued to assess the level of contamination in fish on the site. Also in November 1994 samples of sediment from the onsite lagoon were collected to provide pore water for a toxicity identification evaluation (TIE), a means of determining the toxicity of the sediment to aquatic life in the lagoon.

The purpose of this technical memorandum (TM) is to describe the methods and briefly discuss the results of field activities for the qualitative species inventory, the fish sampling, and the TIE sampling. The standard operating procedures (SOPs) for the activities are commonly referenced for details on methods. All SOPs for fish sampling are contained in the Halby Chemical OU2 Sampling and Analysis Plan (SAP); SOP 28, Qualitative Biodiversity Survey, and SOP 29, Sediment Sampling for TIE Testing, were not included in the SAP and are provided in Attachment A of this TM. Only the results of field activities are provided in this TM; the evaluation of the data is discussed in the RI report in Chapter 3, Physical Characteristics of the Study Area. Chemical analyses were requested for biota samples; the analytical results are discussed in the RI report in Chapter 6, Baseline Human Health Risk Assessment, and Chapter 7, Ecological Risk Assessment.

Qualitative Species Inventory

The qualitative species inventory was performed according to SOP 28 (Attachment A). Representative sample points were identified within each major habitat type on the site. These points were located along transects which were established in representative plant communities or habitat types.

The plant community within each sample point (each sample point was approximately 30 feet in diameter) was assessed by identifying individual species and describing the plant community within that area. Signs of stress or other effects of possible contaminants were described. Information was recorded on data sheets (Attachment B) and the locations plotted on a map of the site (Figure 1).

Surveys for signs and direct observations of potential environmental receptors, including mammals, birds, reptiles and amphibians were conducted at or near each sample point and recorded on the attached data sheets (Attachment B). Signs included tracks, scat, burrows, paths, signs of feeding, and nests or dens. Bird observations were recorded using the American Ornithological Union's *Standard Abbreviations for Common Names of Birds* (see SOP 28 in Attachment A). Reptile and amphibian surveys were conducted around the lagoon and ditches located on the site.

Fish Sampling

Fish were collected from the onsite lagoon (Figure 1) and at a background location (Figure 2) using a Smith-Root Type VII-POW backpack electrofishing unit employed in an open boat. A beach seine was used in the first attempt to collect samples in the onsite lagoon. However, the muddy conditions at the edges of the lagoon and the presence of concealed obstructions in the bottom of the lagoon (e.g., old drums and sunken logs) precluded effective use of the beach seine and the electroshocker was used instead. SOPs related to fish sampling (24, 25, 26, and 27) are provided in the SAP.

The background location was selected by reviewing aerial photographs of the site vicinity in search of a marsh or wetland up the Christina River from the site (to preclude the migration of site contaminants into the background location) and connected to the Christina River by a ditch. Such a location was identified on Delmarva Power property about 1/2 mile north of the site (Figure 2). The marsh was connected to the river by a shallow ditch running parallel to the railroad tracks. A tide gate was located in the ditch near the confluence of the ditch with the river; the tide gate was about one-half open and allowed fairly unrestricted movement of water in the ditch. Written permission to sample in the marsh was obtained from Delmarva Power.

A Delaware Scientific Collection Permit was obtained to perform the fish sampling. Collected fish were carried in a bucket of water to the shore of the sampling location and categorized, measured, and weighed. The physical condition of samples was noted, including physical abnormalities. Larger samples were grouped by species type for fileting; smaller fish were grouped as whole-body samples. Fish samples were submitted to the ChemTech Consulting Group, Inc., laboratory for analysis of Target Compound List (TCL) organic chemicals, the Target Analyte List (TAL) inorganic chemicals, thiocyanate, and percent lipids; the results of the chemical analyses are discussed in the RI report in Chapter 5, Nature and Extent of Contamination, and Chapter 7, Ecological Risk Assessment.

TIE Sampling

The TIE sampling was performed according to SOP 29 (Attachment A). The locations sampled are shown in Figure 3 and included one sample from the center of the lagoon (T-G-1-01), one from just outside the lagoon in the I-495 drainage ditch (T-G-1-02 and a duplicate, T-G-1-04), and one at the inlet of the process plant drainage ditch to the lagoon (T-G-1-03). These locations provided a good distribution of samples from different depositional environments at the lagoon.

Because of the muddy nature of the sediments in the lagoon and the difficulty of accessing the sampling locations in the lagoon by foot, a boat was used to collect the samples after the tide had come in. Samples T-G-1-01 and T-G-1-03 were collected using a Ponar sampler lowered to the bottom of the lagoon at the end of a rope. Samples T-G-1-02 and T-G-1-04 were collected using a shovel.

The samples were collected in 5-gallon buckets provided by CH2M HILL's bioassay laboratory in Milwaukee. Five buckets of sediment were collected for each sample. The samples were packed in ice in large coolers and shipped to the Milwaukee laboratory for the TIE. The results of the TIE are discussed in the RI report in Chapter 7, Ecological Risk Assessment.

Samples of sediment were also collected and submitted to the ChemTech laboratory for analysis for analysis for TCL, TAL, thiocyanate, weak-acid dissociable cyanide, and ammonia. The results of these analyses are discussed in the RI report in Chapter 4, Nature and Extent of Contamination, and Chapter 7, Ecological Risk Assessment.

Results

Qualitative Species Inventory

A list of plant species observed in wetlands and other habitat types is provided in Table 1. The data sheets in Attachment B also list plant species identified at each sample point. Observations of plants were recorded as incidental if they were observed outside of the sample-point area. Wildlife observations were recorded on

the data sheets included in Attachment B. A list of wildlife species observed during the survey is provided in Table 2.

The major habitats identified on the site were:

- Lagoon and associated wetlands
- Ditches
- Disturbed, undeveloped upland
- Developed upland

The lagoon and surrounding marsh wetlands are tidal, freshwater systems that support a variety of plant species dominated by pickerel weed and common reed. The tidal range was observed to be approximately 2 to 3 feet and salinity has been measured at approximately 5 parts per million. At low tide much of the lagoon is exposed as vegetated mudflats. Deeper open water accounts for approximately 25 percent of the lagoon at low tide; the open water supports several fish species. Among the fish species observed in the lagoon were mummichog and catfish.

Wildlife signs and direct observations were most numerous in and around the lagoon area. Several signs in the form of tracks and scat, were identified in the area, including rat, mouse, mallard duck, heron species, other birds, and domestic or feral dogs and cats (Table 2).

Signs of potential contamination or plant stress observed in the lagoon area included a sheen on the water surface and several areas of exposed mudflat, and wilted leaves on some plant species.

The ditches on the site provide a connection from the lagoon to the Christina River, or serve as stormwater drainages. The large ditch at the northwest border of the site is tidal and mostly unvegetated. Through a breach in the berm on the northwest side of the site, water flows from the lagoon down the ditch to the Christina River, to the northeast (Figure 1). The ditch is shallow at low tide (approximately 3 inches or less deep). At high tide the ditch was approximately 1.5 feet deep. It appeared, based on tracks, that wildlife (e.g., birds and small mammals) take advantage of the shallow water and cross the ditches, or feed at low tide. Mummichogs were seen in large numbers in the ditch, and appeared trapped in several small, isolated pools in which predators such as raccoon, rats, and wading birds could easily feed. No sign of contamination was observed in the large ditch. However, signs of potential contamination, including oil sheen and odor, were observed in the small onsite drainage ditches that discharge into the lagoon.

The undeveloped parts of the property are located in the vicinity of the lagoon; along a small corridor adjacent to the railroad tracks; and at the northern corner of the site, adjacent to the lagoon and I-495. These areas have been disturbed in the past by activities associated with the development of the Halby Chemical property, the highway, and the railroad. The northern corner of the site encompasses the most

undisturbed area and is located under a powerline right-of-way. The land along the railroad tracks encompasses the area adjacent to the lagoon and associated wetlands.

The plant community here is dominated by species adapted to growing in disturbed, undeveloped upland soils. Habitat is provided to small mammals and birds, such as rats, mice, cardinals, starlings, red-winged blackbirds, sparrows, and similar species. Because these areas occur near the lagoon, reptiles and amphibians may also utilize these areas for cover during migration or other times of movement. However, these areas are small, and because of past disturbances and surrounding development, they do not support a plant community that provides adequate habitat to a wide variety of wildlife, except possibly as temporary cover and food to transient species, and to other species adapted to living in disturbed environments. Signs of vegetated stress in the undeveloped portion of the property includes small areas with no vegetation, and stunted or wilted vegetation.

The developed parts of the property encompass the largest part of the site. Warehouses, equipment, trucks, and the former process plant are located on the site. Impervious and semipervious surfaces occur throughout the area in the form of asphalt or gravel parking lots. Wildlife habitat is limited in these areas and occurs only along the ditch on the northwestern part of the property and near the railroad tracks, where several empty buildings and storage tanks are located in the vicinity of the former process plant. Birds (especially starlings and crows) were observed in this area, especially in the empty buildings and other structures. Signs indicating the presence of cottontail rabbit, deer, mice, rats, and domestic or feral cats and dogs were observed in this area. Signs of potential contamination were common in the developed part of the property, especially the former process plant. Signs included open pits, oily sheen on the surface of the soil, odor, and containers.

Fish Sampling

The following types or species of fish were collected onsite and at the background location:

- American eel
- Redear sunfish
- Mummichog
- Black bullhead
- Golden shiner
- Goldfish
- White perch
- Minnow sp.

Data sheets describing the fish collected are provided in Attachment C.

TIE Sampling

Because this effort was strictly for obtaining samples for the TIE there are few results that can be presented. It was observed that all sediment samples, particularly the two from the lagoon itself and especially from the head of the lagoon (sample T-G-1-03) had very strong odors, predominantly of ammonia. It was also observed that the salinity of the surface water in the I-495 drainage ditch was on the order of 5 parts per thousand (ppt). This is much higher than the value of 0.0 ppt reported from the Christina River (USFWS and USEPA, 1991) and may be due to the salt piles located just north of I-495 discharging high-chloride groundwater into the drainage ditch; alternatively the high salinity may be from wash off of road salt from the highway.

Reference

USFWS and USEPA. 1991. *Analytical Chemistry and Solid Phase Toxicity Bioassay on the Halby Chemical Company Superfund Site, New Castle County, Delaware.* Prepared by the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency Environmental Response Team under Interagency Agrrement No. DW 14933552-01-2. April 1991.

Table 1
Halby Chemical Baseline Biodiversity/Species Inventory
Plant List Based on Observations in September 1993

Plant Species Occurring in Lagoon and Associated Wetlands

Herbaceous

Tickseed Sunflower	*Bidens coronata*
Common Reed	*Phragmites australis*
Pickeral Weed	*Pontedaria cordata*
Jewel Weed	*Impatiens capensis*
Swamp Milkweed	*Asclepias sp.*
Switch Grass	*Panicum virgatum*
Arrow-leaved Tearthumb	*Polygonum saggitatum*
Water pepper	*Polygonum hydropiper*
Virginia Bugleweed	*Lycopus virginicus*
Water Horehound	*Lycopus americana*
Soft Rush	*Juncus effusus*
Path Rush	*Juncus tenuis*
Redtop Grass	*Agrostis alba*
Sensitive Fern	*Onoclea sensibilis*
Cattail	*Typha latifolia*
Water parsnip	*Siam suave*
Climbing Hempweed	*Mikania scandens*
Sneeze Weed	*Helinium autumnale*
Swamp Rose Mallow	*Hibiscus palustris*

Trees and Shrubs

Black Willow	*Salix nigra*
Green Ash	*Fraxinus pennsylvatica*
Box Elder	*Acer negundo*
Arrowwood	*Viburnum recognitum*
Sycamore	*Platanus occidentalis*
Hightide Bush	*Baccharis halmifolia*
Black Gum	*Nyssa sylvatica*
Cottonwood	*Populus deltoides*

Plant Species Occurring in Open Spaces and Developed Areas

Herbaceous

Jimsonweed	*Datura stramonium*
Snakeroot	*Eupatorium spp.*
Aster spp.	*Aster spp.*
Narrow-leaved Goldenrod	*Solidago spp.*

Plant Species Occurring in Open Spaces and Developed Areas, cont.

Herbaceous

Teasel	*Dipsacus sylvestris*
Foxtail Grass	*Setaria spp.*
Nodding Polygonum	*Polygonum lapathifolium*
Virginia Creeper	*Parthinocissus quincifolia*
Butter and Eggs	*Linaria vulgaris*
Pokeweed	*Phytolacca americanus*
Japanese Honeysuckle	*Lonoicera japonica*
Poison Ivy	*Toxicodendron radicans*
Slender Bush Clover	*Lespodeza virginica*
Vetch spp.	*Vicia spp.*
Queen Anne's Lace	*Daucus carota*
Mugwort	*Artemesia vulgaris*
Wild Garlic	*Allium vineale*
Upland Boneset	*Eupatorium sessifolium*
Dogbane	*Apocynum spp.*
Gerardia sp.	*Gerardia spp.*
Day Lily	*Hemerocallis fulva*
Trailing Wild Bean	*Strophostyles helvola*
Pilewort	*Erechtites hiceracifolia*
Common Mullein	*Verbascum thapus*

Trees and Shrubs

Tartarian Honeysuckle	*Lonicera tartaria*
Princess Tree	*Paulownia tomentosa*
Blackberry sp.	*Rubus spp.*
Red Cedar	*Juniperus virginiana*
Multiflora Rose	*Rosa multiflora*
False Indigo	*Amorpha frulicosa*
Sassafras	*Sassafras albidum*
Winged Sumac	*Rhus copallina*
Mulberry	*Morus spp.*
Siberian Elm	*Ulmus pumila*
Tree of Heaven	*Ailanthus altissima*
Black Cherry	*Prunus serotina*
Black Locust	*Robinia psuedo-acacia*
Staghorn Sumac	*Rhus typhina*
Crab Apple	*Molus spp.*

Table 2
Halby Chemical Baseline Biodiversity/Species Inventory
Wildlife List Based on Observations in September 1993

Mammals/Reptiles/Amphibians/Invertebrates

Whitetail Deer	*Odocoileus virginianus*
Cat (feral)	*Felis domesticus*
Dog (domestic)	*Canus domesticus*
Cotton Rabbit	*Sylvilagus floridanus*
Raccoon	*Procyon lotor*
Rat	*Rattus spp.*
Mouse	*Peromyscus spp.*
Cricket Frog	*Acris spp.*
Painted Turtle	*Chrysemus spp.*
Crayfish	*Cambarus spp.*
Praying Mantis	*Mantis spp.*

Birds

Mallard Duck	*Anas platyrhynchos*
Green-backed Heron	*Butorides striatus*
Great Egret	*Casmerodius albus*
Double-crested Cormorant	*Phalacrocorax auritus*
Killdeer	*Charadrius vociferous*
Red-winged Blackbird	*Agelaius phoeniceus*
Kestral	*Falco sparverius*
Turkey Vulture	*Coraqupys atratus*
Yellow-shafted Flicker	*Colaptes auratus*
Ring-billed Gull	*Larus delawarensis*
American Crow	*Corvus brachyrhynchos*
Mourning Dove	*Zenaida macroura*
Pigeon	*Columba livia*
European Starling	*Sturnus vulgaris*
Grey Catbird	*Dumetella carolinensis*
Black-capped Chickadee	*Parus atricapillus*
Warbler spp.	*Dendroica spp.*
Prarie Warbler	*Dendroica discolor*
Song Sparrow	*Melospiza melodia*
Northern Cardinal	*Cardinalis cardinalis*
Blue Jay	*Cyanocitta cristata*
Mockingbird	*Mimus polyglottos*

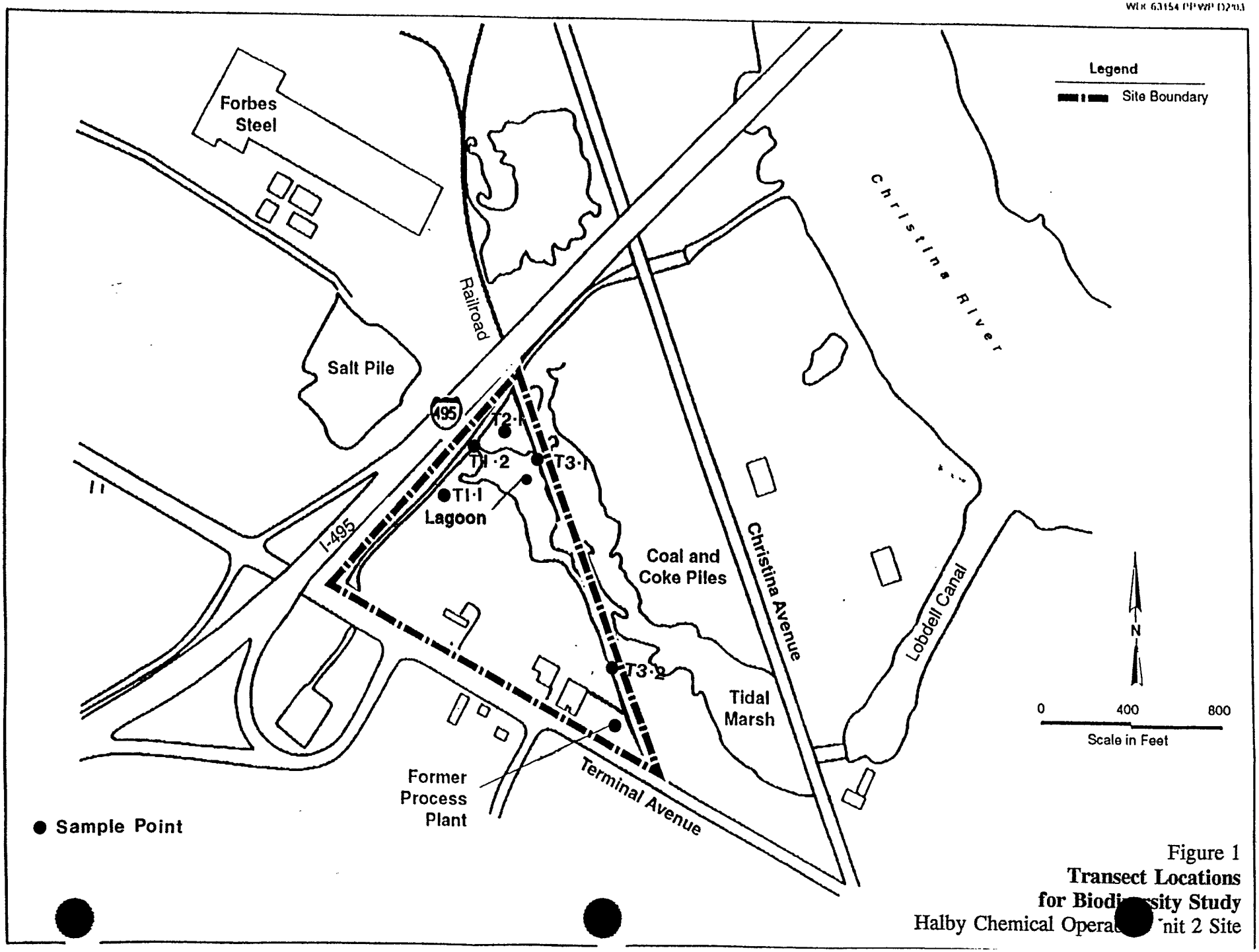

Figure 1
Transect Locations for Biodiversity Study
Halby Chemical Operable Unit 2 Site

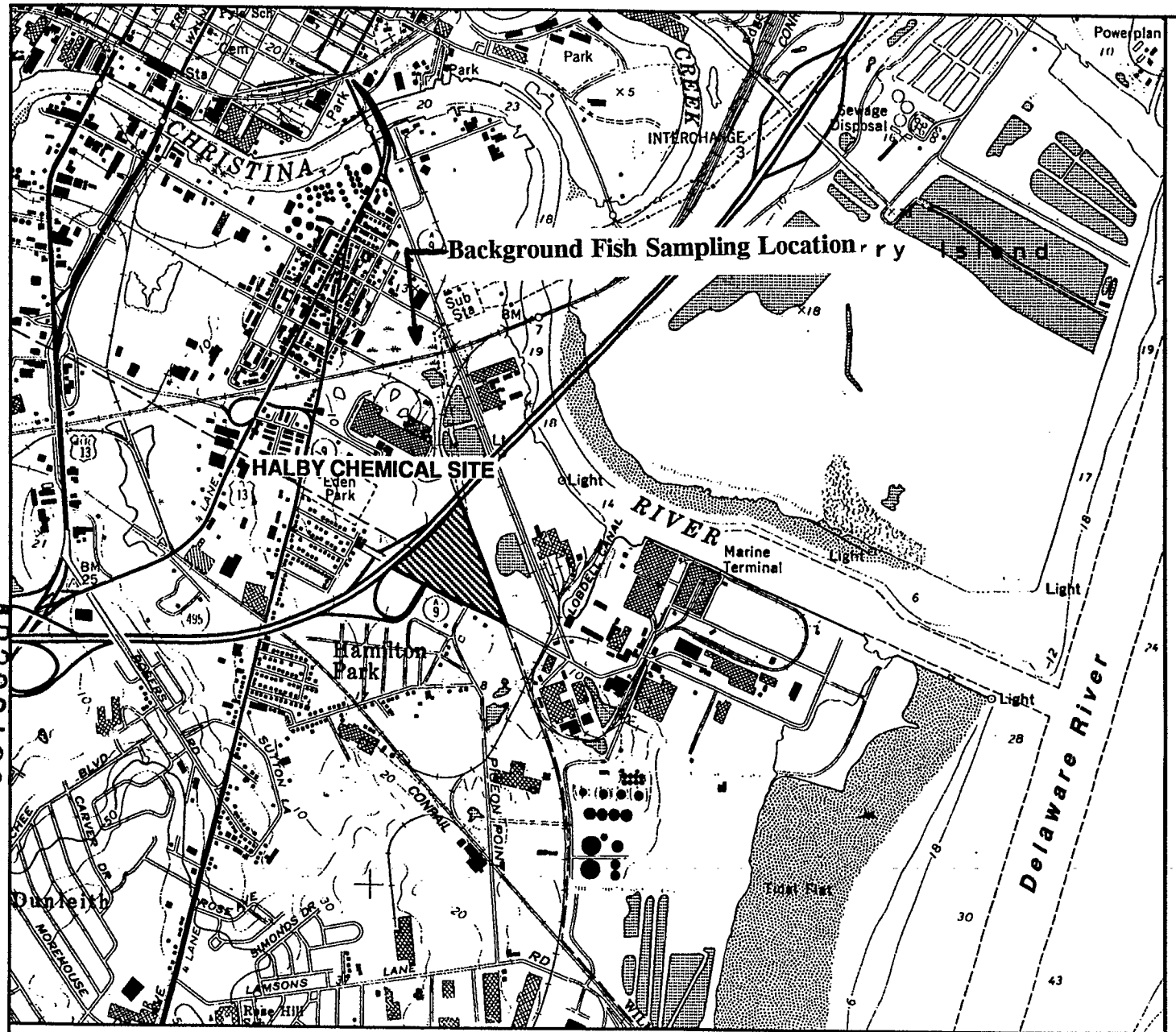

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Figure 2
Background Fish Sampling Location
Halby Chemical Operable Unit 2 Site

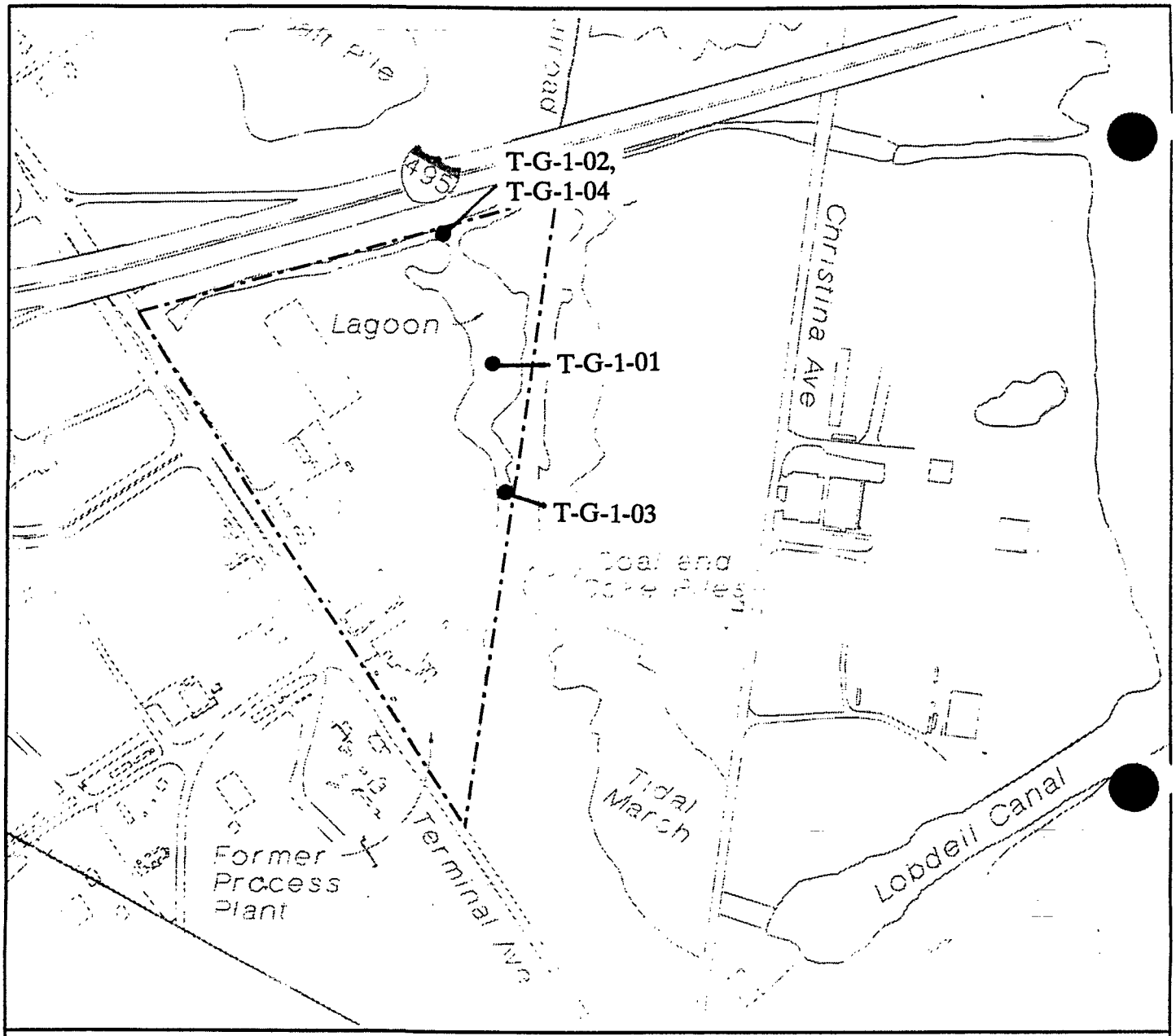

Figure 3
LOCATIONS OF TIE SAMPLES
Halby Chemical Site

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Attachment A

SOP 28: QUALITATIVE BIODIVERSITY SURVEY

I. PURPOSE

To provide a general guideline for conducting a qualitative biodiversity survey.

II. SCOPE

Standard terrestrial plant, mammal, herpetofauna, and avian-community survey methods are provided. Site-specific details are discussed in related sections of the field sampling plan.

III. EQUIPMENT AND MATERIALS

- Topographic and site area maps
- Aerial photographs
- Compass
- Data sheets
- Hand lens
- Field guides or keys
- Binoculars
- Hand lens
- Tools to turn over rocks and logs
- Portable tape player and prerecorded tape recording of regional herpetofauna vocalizations
- Species lists, if available
- Tape measure
- Appropriate safety equipment

- Camera
- Site Health and Safety Plan

IV. PROCEDURES AND GUIDELINES

1. Subjectively select a representative sample point within each major plant community or habitat type on the site. These points may be located along pre-established transects or simply by initially cruising the site area. Selected sample points should be no closer than 50 feet from the nearest perceptible change in the plant community.

2. Establish an appropriate size sample plot for sampling vegetation. In forested areas a sample plot of approximately 30 feet in radius will be sufficient. Other size plots may be used depending on characteristics of the community being sampled.

3. Identify the dominant species in each strata or size class as follows:

   Trees - greater than 10 cm diameter at breast height (dbh) and greater than 20 feet tall.

   Saplings - less than 10 cm dbh and greater than 20 feet tall.

   Shrubs - less than 20 feet tall.

   Herbaceous plants - non-woody plants and ground covers.

4. Estimate the percent areal cover of saplings, shrubs, and herbaceous plants at each sample point.

5. Record information on prepared data sheets and plot the location of the sample point on a map of the site.

6. Record any signs of plant stress or other effects of possible contaminants such as wilting, discoloration, or abnormal growth form or shape.

7. Photograph major plant community types and any observed signs of plant stress.

8. Proceed along a series of pre-established sample transects over the site, being sure to include every major plant community or habitat type.

9. Search additional areas or locations that may provide areas of mammal concentration or opportunities for observation of mammal signs such as tracks.

10. Record direct observations of mammals and any signs of mammal activity on the site including but not limited to the following:

    Tracks or foot prints

    Scats, droppings, or other fecal material

    Burrows or holes in stream banks, hill sides, or den trees

    Leave, grass, or stick nests on the ground or in trees

    Ridges, mounds, or tunnels in the ground or in vegetation

    Trails or runways through the study area

    Signs of grazing, browsing, rubbing, or clawing on trees, shrubs, or other vegetation

11. Photograph representative signs of mammal activity and plot the location of nests, burrow, etc., on a map of the site.

13. Conduct herpetofauna surveys at pre-established sample points over the site. Sample points should be located in each major plant community or habitat type.

14. Search areas that provide specific habitats and/or opportunities for reptile and amphibian observations such as wetlands, stream banks, and pond borders.

15. Search for herpetofauna by overturning rocks, logs, and other objects, being sure to carefully replace the objects.

16. Record direct observations of amphibians and reptiles including their sign such tracks, burrows, tunnels, etc.

17. Record observations on pre-made data sheets and plot significant sitings on maps of the site.

18. Schedule special observation periods following precipitation events and at evening hours to record herpetofauna vocalizations.

19. Conduct avian surveys at pre-established sample points over the site. Sample points should be located in each major plant community or habitat type of the survey area and should be far enough apart to avoid counting the same birds twice.

19. Record all birds heard or seen from the sample point for a period of approximately 20 minutes. Shorter time intervals may be used under some circumstances.

20. Scan for birds at all levels of vegetation and take care not to record the same bird more than once.

21. Record the species, number, sex, and age, if possible, for all birds observed. If birds occur in flocks too large to be counted estimate the number of birds by counting the number of birds in a part of the group and estimating the number of parts in the entire flock.

22. Record the activity, habitat, and type of observation (i.e. seen, heard, or both) using the codes on the data sheet.

23. Birds flying over the site but not actually landing within a specific habitat type should be recorded as "fly overs." However, if a bird flies through an area and never lands, but the observer feels it is using the particular habitat type, then record that type.

24. Record bird species using the appropriate AOU four letter code. Unidentifiable birds should be recorded with an "unknown code."

25. Surveys should be conducted between daybreak and 9:30 a.m., if possible. Surveys should not be conducted in high winds, heavy rains, or heavy fog. Weather conditions at the time of survey should be recorded on the data sheets.

26. Record other signs of bird use of the site such as stick nests, nest or roost cavities, droppings or pellets, tracks, and signs of foraging.

V. ATTACHMENTS

- Standard abbreviations for common names of birds.

VI. KEY CHECKS AND ITEMS

- Avoid counting the same bird, mammal, or herpetofauna more than once.
- Record all birds, even those that cannot be identified accurately.
- Record signs of bird use of the site such as nests in trees and cavities, droppings or pellets, and tracks.
- Look for mammal signs on the ground, in trees and other vegetation, and along wetlands and water bodies.
- Look for herpetofauna under rocks and logs.
- Record signs of plant stress or other effects of possible site contaminants on vegetation.
- Have appropriate keys and field guides for plant and wildlife identification.
- Record herpetofauna vocalizations.

STANDARD ABBREVIATIONS FOR COMMON NAMES OF BIRDS

LOONS

1	COLO	'Common Loon'	(Gavia immer)
2	YBLO	'Yellow-billed Loon'	(Gavia adamsii)
3	ARLO	'Arctic Loon'	(Gavia arctica)
4	RTLO	'Red-throated Loon'	(Gavia stellata)

GREBES

5	RNGR	'Red-necked Grebe'	(Podiceps grisegena)
6	HOGR	'Horned Grebe'	(Podiceps auritus)
7	EAGR	'Eared Grebe'	(Podiceps nigricollis)
8	LEGR	'Least Grebe'	(Tachybaptus dominicus)
9	WEGR	'Western Grebe'	(Aechmorphorus occidentalis)
10	PBGR	'Pied-billed Grebe'	(Podilymbus podiceps)
	UNGR	'Unidentified Grebe'	

ALBATROSSES

11	BFAL	'Black-footed Albatross'	(Diomedea nigripes)
12	LAAL	'Laysan Albatross'	(Diomedea immutabilis)

SHEARWATERS

13	NOFU	'Northern Fulmar'	(Fulmarus glacialis)
14	GRSH	'Greater Shearwater'	(Puffinus gravis)
15	SOSH	'Sooty Shearwater'	(Puffinus griseus)
16	MASH	'Manx Shearwater'	(Puffinus puffinus)
17	COSH	'Cory's Shearwater'	(Calonectris diomedea)
18	PFSH	'Pink-footed Shearwater'	(Puffinus creatopus)
19	STSH	'Short-tailed Shearwater'	(Puffinus tenuirostris)
20	BLSH	'Buller's Shearwater'	(Putfinus bulleri)
21	AUSH	'Audubon's Shearwater'	(Puffinus lherminieri)
22	BEPE	'Bermuda Petrel'	(Pterodroma cahow)
23	BOPE	'Bonin Petrel'	(Pterodroma hypoleuca)

STORM-PETRELS

24	FTSP	'Fork-tailed Storm-Petrel'	(Oceanodroma furcata)
25	LSPE	'Leach's Storm-Petrel'	(Oceanodroma leucorhoa)
26	ASPE	'Ashy Storm-Petrel'	(Oceanodroma homochroa)
27	BSPE	'Black Storm-Petrel'	(Oceanodroma melania)
28	LTPE	'Least Storm-Petrel'	(Oceanodroma microsoma)
29	WSPE	'Wilson's Storm-Petrel'	(Oceanites oceanicus)

TROPICBIRDS

30	RBTR	'Red-billed Tropicbird'	(Phaethon aethereus)
31	WTTR	'White-tailed Tropicbird'	(Phaethon lepturus)
32	RTTR	'Red-tailed Tropicbird'	(Phaethon rubricauda)

PELICANS

33 AWPE	'American White Pelican'	(Pelecanus erythrorhynchos)
34 BRPE	'Brown Pelican'	(Pelecanus occidentalis)

BOOBIES, GANNETS

35 MABO	'Masked Booby'	(Sula dactylatra)
36 BLBO	'Blue-footed Booby'	(Sula nebouxii)
37 BRBO	'Brown Booby'	(Sula leucogaster)
38 RFBO	'Red-footed Booby'	(Sula sula)
39 NOGA	'Northern Gannet'	(Sula bassanus)

CORMORANTS

40 GRCO	'Great Cormorant'	(Phalacrocorax carbo)
41 DCCO	'Double-crested Cormorant'	(Phalacrocorax auritus)
42 OLCO	'Olivaceous Cormorant'	(Phalacrocorax olivaceus)
43 BNCO	'Brandt's Cormorant'	(Phalacrocorax penicillatus)
44 PECO	'Pelagic Cormorant'	(Phalacrocorax pelagicus)
45 RFCO	'Red-faced Cormorant'	(Phalacrocorax urile)

ANHINGAS

46 ANHI	'Anhinga'	(Anhinga anhinga)

FRIGATEBIRDS

47 MAFR	'Magnificent Frigatebird'	(Fregata magnificens)
48 GRFR	'Great Frigatebird'	(Fregata minor)
49 LEFR	'Lesser Frigatebird'	(Fregata ariel)

HERONS

50 GBHE	'Great Blue Heron'	(Ardea herodias)
51 GRHE	'Green-backed Heron'	(Butorides striatus)
52 LBHE	'Little Blue Heron'	(Egretta caerulea)
53 CAEG	'Cattle Egret'	(Bubulcus ibis)
54 REEG	'Reddish Egret'	(Egretta rufescens)
55 GREG	'Great Egret'	(Casmerodius albus)
56 SNEG	'Snowy Egret'	(Egretta thula)
57 TRHE	'Tricolored Heron'	(Egretta tricolor)
58 BCNH	'Black-Crowned Night Heron'	(Nycticorax nycticorax)
59 YCNH	'Yellow-Crowned Night Heron'	(Nycticorax violaceus)
60 LEBI	'Least Bittern'	(Ixobrychus exilis)
61 AMBI	'American Bittern'	(Botaurus lentiginosus)
UNHE	'Unidentified Heron/Egret'	

STORKS

62 WOST	'Wood Stork'	(Mycteria americana)

IBISES

63	GLIB	'Glossy Ibis'	(Plegadis falcinellus)
64	WFIB	'White-faced Ibis'	(Plegadis chihi)
65	WHIB	'White Ibis'	(Eudocimus albus)
66	SCIB	'Scarlet Ibis'	(Eudocimus ruber)
67	ROSP	'Roseate Spoonbill'	(Ajaia ajaja)

FLAMINGOS

68	GAFL	'Greater American Flamingo'	(Phoenicopterus ruber)

WATERFOWL

69	MUSW	'Mute Swan'	(Cygnus olor)
70	WPSW	'Whooper Swan'	(Cygnus cygnus)
71	BESW	'Bewick's Swan'	(Cygnus columbianus bewickii)
72	TUSW	'Tundra Swan'	(Cygnus columbianus)
73	TPSW	'Trumpeter Swan'	(Cygnus buccinator)
74	CAGO	'Canada Goose'	(Branta canadensis)
75	BRAN	'Brant'	(Branta bernicla)
76	BAGO	'Barnacle Goose'	(Branta leucopsis)
77	EMGO	'Emperor Goose'	(Chen canagica)
78	GWFG	'Greater White-fronted Goose'	(Anser albifrons)
79	SNGO	'Snow Goose'	(Chen caerulescens)
80	ROGO	'Ross' Goose'	(Chen rossii)
81	BBWD	'Black-bellied Whistling-Duck'	(Dendrocygna autumnalis)
82	FWDU	'Fulvous Whistling-Duck'	(Dendrocygna bicolor)
83	MALL	'Mallard'	(Anas platyrhynchos)
84	ABDU	'American Black Duck'	(Anas rubripes)
85	MODU	'Mottled Duck'	(Anas fulvigula)
86	GADW	'Gadwall'	(Anas strepera)
87	NOPI	'Northern Pintail'	(Anas acuta)
88	GWTE	'Green-winged Teal'	(Anas crecca)
89	BWTE	'Blue-winged Teal'	(Anas discors)
90	CITE	'Cinnamon Teal'	(Anas cyanoptera)
91	GATE	'Garganey Teal'	(Anas querquedula)
92	UNTE	'Unidentified Teal'	
93	EUWI	'Eurasian Widgeon'	(Anas penelope)
94	AMWI	'American Widgeon'	(Anas americana)
95	NOSH	'Northern Shoveler'	(Anas clypeata)
96	WODU	'Wood Duck'	(Aix sponsa)
97	REDH	'Redhead'	(Aythya americana)
98	RNDU	'Ring-necked Duck'	(Aythya collaris)
99	CANV	'Canvasback'	(Aythya valisineria)
100	GRSC	'Greater Scaup'	(Aythya marila)
101	LESC	'Lesser Scaup'	(Aythya affinis)
102	COGO	'Common Goldeneye'	(Bucephala clangula)
103	BWGO	'Barrow's Goldeneye'	(Bucephala islandica)
104	BUFF	'Bufflehead'	(Bucephala albeola)
105	OLDS	'Oldsquaw'	(Clangula hyemalis)
106	HADU	'Harlequin Duck'	(Histrionicus histrionicus)

108	COEI	'Common Eider'	(Somateria mollissima)
109	KIEI	'King Eider'	(Somateria spectabilis)
110	SPEI	'Spectacled Eider'	(Somateria fischeri)
111	WWSC	'White-winged Scoter'	(Melanitta fusca)
112	SUSC	'Surf Scoter'	(Melanitta perspicillata)
113	BLSC	'Black Scoter'	(Melanitta nigra)
114	RUDU	'Ruddy Duck'	(Oxyura jamaicensis)
115	MADU	'Masked Duck'	(Oxyura dominica)
116	HOME	'Hooded Merganser'	(Lophodytes cucullatus)
117	COME	'Common Merganser'	(Mergus merganser)
118	RBME	'Red-breasted Merganser'	(Mergus serrator)
	UNDU	'Unidentified Duck'	

VULTURES

119	TUVU	'Turkey Vulture'	(Cathartes aura).
120	BLVU	'Black Vulture'	(Coragyps atratus)
121	CACO	'California Condor'	(Gymnogyps californianus)

KITES, HAWKS

122	WTKI	'White-tailed Kite'	(Elanus caeruleus)
123	ASTK	'American Swallow-tailed Kite'	(Elanoides forficatus)
124	MIKI	'Mississippi Kite'	(Ictinia mississippiensis)
125	SNKI	'Snail Kite'	(Rostrhamus sociabilis)
126	NOGO	'Northern Goshawk'	(Accipiter gentilis)
127	SSHA	'Sharp-shinned Hawk'	(Accipiter striatus)
128	COHA	'Cooper's Hawk'	(Accipiter cooperii)
129	RTHA	'Red-tailed Hawk'	(Buteo jamaicensis)
130	RSHA	'Red-shouldered Hawk'	(Buteo lineatus)
131	BWHA	'Broad-winged Hawk'	(Buteo platypterus)
132	SWHA	'Swainson's Hawk'	(Buteo swainsoni)
133	ZTHA	'Zone-tailed Hawk'	(Buteo albonotatus)
134	WTHA	'White-tailed Hawk'	(Buteo albicaudatus)
135	STHA	'Short-tailed Hawk'	(Buteo brachyurus)
136	RLHA	'Rough-legged Hawk'	(Buteo lagopus)
137	FEHA	'Ferruginous Hawk'	(Buteo regalis)
138	GRHA	'Gray Hawk'	(Buteo nitidus)
139	HAHA	'Harris' Hawk'	(Parabuteo unicinctus)
140	CBHA	'Common Black Hawk'	(Buteogallus anthracinus)
141	GOEA	'Golden Eagle'	(Aquila chrysaetos)
142	BAEA	'Bald Eagle'	(Haliaeetus leucocephalus)
143	NOHA	'Northern Harrier'	(Circus cyaneus)
	UNHA	'Unidentified Hawk'	

OSPREY

144	OSPR	'Osprey'	(Pandion haliaetus)

FALCONS

145	CRCA	'Crested Caracara'	(Polyborus plancus)
146	GYRF	'Gyrfalcon'	(Falco rusticolus)
147	PRFA	'Prairie Falcon'	(Falco mexicanus)
148	PEFA	'Peregrine Falcon'	(Falco peregrinus)
149	APFA	'Aplomado Falcon'	(Falco femoralis)
150	MERL	'Merlin'	(Falco columbarius)
151	AMKE	'American Kestrel'	(Falco sparverius)
	UNFA	'Unidentified Falcon'	

CHACHALACA

152	PLCH	'Plain Chachalaca'	(Ortalis vetula)

GROUSE, PTARMIGAN

153	BUGR	'Blue Grouse'	(Dendragapus obscurus)
154	SPGR	'Spruce Grouse'	(Dendragapus canadensis)
155	RUGR	'Ruffed Grouse'	(Bonasa umbellus)
156	WIPT	'Willow Ptarmigan'	(Lagopus lagopus)
157	ROPT	'Rock Ptarmigan	(Lagopus mutus)
158	WTPT	'White-tailed Ptarmigan'	(Lagopus leucurus)
159	GPCH	'Greater Prairie-Chicken'	(Tympanuchuscupido)
160	LPCH	'Lesser Prairie-Chicken'	(Tympanuchus pallidicinctus)
161	STGR	'Sharp-tailed Grouse'	(Tympanuchus phasianellus)
162	SAGR	'Sage Grouse'	(Centrocercus urophasianus)

QUAIL, PHEASANT

163	NOBO	'Northern Bobwhite'	(Colinus virginianus)
164	MABW	'Masked Bobwhite'	(Colinus virginianus ridgwayi)
165	SCQU	'Scaled Quail'	(Callipepla squamata)
166	CAQU	'California Quail'	(Callipepla californica)
167	GAQU	'Gambel's Quail'	(Callipepla gambelii)
168	MOQU	'Mountain Quail'	(Oreortyx pictus)
169	MZQU	'Montezuma Quail'	(Cyrtonyx montezumae)
170	RNPH	'Ring-necked Pheasant'	(Phasianus colchicus)
171	CHUK	'Chukar'	(Alectoris chukar)
172	GRPA	'Gray Partridge'	(Perdix perdix)
173	BLFR	'Black Francolin'	(Francolinus francolinus)

TURKEY

174	WITU	'Wild Turkey'	(Meleagris gallopavo)

CRANES

175	WHCR	'Whooping Crane'	(Grus americana)
176	GSCR	'Greater Sandhill Crane'	(Grus canadensis tabida)
177	SACR	'Sandhill Crane'	(Grus canadensis)

LIMPKIN

178	LIMP	'Limpkin'	(Aramus guarauna)

RAILS, GALLINULES, COOTS

179	KIRA	'King Rail'	(Rallus elegans)
180	CLRA	'Clapper Rail'	(Rallus longirostris)
181	VIRA	'Virginia Rail'	(Rallus limicola)
182	SORA	'Sora'	(Porzana carolina)
183	YERA	'Yellow Rail'	(Coturnicops noveboracensis)
184	BLRA	'Black Rail'	(Laterallus jamaicensis)
185	PUGA	'Purple Galinule'	(Porphyrula martinica)
186	COMO	'Common Moorhen'	(Gallinula chloropus)
187	AMCO	'American Coot'	(Fulica americana)

JACANA

188	NOJA	'Northern Jacana'	(Jacana spinosa)

OYSTERCATCHERS

189	AMOY	'American Oystercatcher'	(Haematopus palliatus)
190	ABOY	'American Black Oystercatcher'	(Haematopus bachmani)

PLOVERS

191	NOLA	'Northern Lapwing'	(Vanellus vanellus)
192	CRPL	'Common Ringed Plover'	(Charadrius hiaticula)
193	SEPL	'Semipalmated Plover'	(Charadrius semipalmatus)
194	PIPL	'Piping Plover'	(Charadrius melodus)
195	SNPL	'Snowy Plover'	(Charadrius alexandrinus)
196	WIPL	'Wilson's Plover'	(Charadrius wilsonia)
197	KILL	'Killdeer'	(Charadrius vociferus)
198	MOPL	'Mountain Plover'	(Charadrius montanus)
199	LGPL	'Lesser Golden-Plover'	(Pluvialis dominica)
200	BBPL	'Black-bellied Plover'	(Pluvialis squatarola)
201	SURF	'Surfbird'	(Aphriza virgata)
202	RUTU	'Ruddy Turnstone'	(Arenaria interpres)
203	BLTU	'Black Turnstone'	(Arenaria melanocephala)
	UNPL	'Unidentified Plover'	

SANDPIPERS

204	AMWO	'American Woodcock'	(Scolopax minor)
205	COSN	'Common Snipe'	(Gallinago gallinago)
206	LBCU	'Long-billed Curlew'	(Numenius americanus)
207	WHIM	'Whimbrel'	(Numenius phaeopus)
208	BTCU	'Bristle-thighed Curlew'	(Numenius tahitiensis)
209	UPSA	'Upland Sandpiper'	(Bartramia longicauda)
210	SPSA	'Spotted Sandpiper'	(Actitis macularia)
211	SOSA	'Solitary Sandpiper'	(Tringa solitaria)
212	WATA	'Wandering Tattler'	(Heteroscelus incanus)

213	WILL	'Willet'	(Catoptrophorus semipalmatus)
214	GRYE	'Greater Yellowlegs'	(Tringa melanoleuca)
215	LEYE	'Lesser Yellowlegs'	(Tringa flavipes)
216	REKN	'Red Knot'	(Calidris canutus)
217	PUSA	'Purple Sandpiper'	(Calidris maritima)
218	ROSA	'Rock Sandpiper'	(Calidris ptilocnemis)
219	SHSA	'Sharp-tailed Sandpiper'	(Calidris acuminata)
220	PESA	'Pectoral Sandpiper'	(Calidris melanotos)
221	WRSA	'White-rumped Sandpiper'	(Calidris fuscicollis)
222	BASA	'Baird's Sandpiper'	(Calidris bairdii)
223	LESA	'Least Sandpiper'	(Calidris minutilla)
224	CUSA	'Curlew Sandpiper'	(Calidris ferruginea)
225	DUNL	'Dunlin'	(Calidris alpina)
226	SBDO	'Short-billed Dowitcher'	(Limnodromus griseus)
227	LBDO	'Long-billed Dowitcher'	(Limnodromus scolopaceus)
228	STSA	'Stilt Sandpiper'	(Calidris himantopus)
229	SESA	'Semipalmated Sandpiper'	(Calidris pusilla)
230	WESA	'Western Sandpiper'	(Calidris mauri)
231	BBSA	'Buff-breasted Sandpiper'	(Tryngites subruficollis)
232	MAGO	'Marbled Godwit'	(Limosa fedoa)
233	BTGO	'Bar-tailed Godwit'	(Limosa lapponica)
234	HUGO	'Hudsonian Godwit'	(Limosa haemastica)
235	BKGO	'Black-tailed Godwit'	(Limosa limosa)
236	RUFF	'Ruff'	(Philomachus pugnax)
237	SAND	'Sanderling'	(Calidris alba)
	UNSA	'Unidentified Sandpiper'	

AVOCET, STILT

238	AMAV	'American Avocet'	(Recurvirostra americana)
239	BNST	'Black-necked Stilt'	(Himantopus mexicanus)

PHALAROPES

240	REPH	'Red Phalarope'	(Phalaropus fulicaria)
241	WIPH	'Wilson's Phalarope'	(Phalaropus tricolor)
242	RDPH	'Red-necked Phalarope'	(Phalaropus lobatus)

JAEGERS, SKUAS

243	POJA	'Pomerine Jaeger'	(Stercorarius pomarinus)
244	PAJA	'Parasitic Jaeger'	(Stercorarius parasiticus)
245	LTJA	'Long-tailed Jaeger'	(Stercorarius longicaudus)
246	GRSK	'Great Skua'	(Catharacta skua)
247	SPSK	'South Polar Skua'	(Catharacta maccormicki)

GULLS, TERNS

248	GLGU	'Glaucous Gull'	(Larus hyperboreus)
249	ICGU	'Iceland Gull'	(Larus glaucoides)
250	KUGU	'Kumlien's Gull'	(Larus glaucoides kumlieni)
251	GWGU	'Glaucous-Winged Gull'	(Larus glaucescens)
252	GBBG	'Great Black-backed Gull'	(Larus marinus)

254	LBBG	'Lesser Black-backed Gull'	(Larus fuscus)
255	HERG	'Herring Gull'	(Larus argentatus)
256	THGU	'Thayer's Gull'	(Larus thayeri)
257	CAGU	'California Gull'	(Larus californicus)
258	RBGU	'Ring-billed Gull'	(Larus delawarensis)
259	MEGU	'Mew Gull'	(Larus canus)
260	CBHG	'Common Black-headed Gull'	(Larus ridibundus)
261	LAGU	'Laughing Gull'	(Larus atricilla)
262	FRGU	'Franklin's Gull'	(Larus pipixcan)
263	BOGU	'Boneparte's Gull'	(Larus philadelphia)
264	LIGU	'Little Gull'	(Larus minutus)
265	HMGU	'Heermann's Gull'	(Larus heermanni)
266	IVGU	'Ivory Gull'	(Pagophila eburnea)
267	BLKI	'Black-legged Kittiwake'	(Rissa tridactyla)
268	RLKI	'Red-legged Kittiwake'	(Rissa brevirostris)
269	ROGU	'Ross' Gull'	(Rhodostethia rosea)
270	SAGU	'Sabine's Gull'	(Xema sabini)
271	GBTE	'Gull-billed Tern'	(Sterna nilotica)
272	FOTE	'Forster's Tern'	(Sterna forsteri)
273	COTE	'Common Tern'	(Sterna hirundo)
274	ARTE	'Arctic Tern'	(Sterna paradisaea)
275	RSTE	'Roseate Tern'	(Sterna dougallii)
276	ALTE	'Aleutian Tern'	(Sterna aleutica)
277	SOTE	'Sooty Tern'	(Sterna fuscata)
278	BRTE	'Bridled Tern'	(Sterna anaethetus)
279	LETE	'Least Tern'	(Sterna antillarum)
280	ROTE	'Royal Tern'	(Sterna maxima)
281	ELTE	'Elegant Tern'	(Sterna elegans)
282	SATE	'Sandwich Tern'	(Sterna sandvicensis)
283	CATE	'Caspian Tern'	(Sterna caspia)
284	BLTE	'Black Tern'	(Chlidonias niger)
285	WWBT	'White-winged Black Tern'	(Chlidonias leucopterus)
286	BRNO	'Brown Noddy'	(Anous stolidus)
287	BLNO	'Black Noddy'	(Anous minutus)
288	HYTE	'Hybrid Tern'	(Sterna spp)
	UNGU	'Unidentified Gull/Tern'	

SKIMMER

289	BLSK	'Black Skimmer'	(Rynchops niger)

ALCIDS

290	RAZO	'Razorbill'	(Alca torda)
291	COMU	'Common Murre'	(Uria aalge)
292	TBMU	'Thick-billed Murre'	(Uria lomvia)
293	DOVE	'Dovekie'	(Alle alle)
294	BLGU	'Black Guillemot'	(Cepphus grylle)
295	MAGU	'Mandt's Guillemot'	(Cepphus grylle mandti)
296	PIGU	'Pigeon Guillemot'	(Cepphus columba)
297	MAMU	'Marbled Murrelet'	(Brachyramphus marmoratus)
298	KIMU	'Kittlitz's Murrelet'	(Brachyramphus brevirostris)
299	XAMU	'Xantus' Murrelet'	(Synthliboramphus hypoleucus)
300	CRMU	'Craveri's Murrelet'	(Synthliboramphus craveri)

301	ANMU	'Ancient Murrelet'	(Synthliboramphus antiquus)
302	CAAU	'Cassin's Auklet'	(Ptychoramphus aleuticus)
303	PAAU	'Parakeet Auklet'	(Cyclorrhynchus psittacula)
304	CRAU	'Crested Auklet'	(Aethia cristatella)
305	LEAU	'Least Auklet'	(Aethia pusilla)
306	WHAU	'Whiskered Auklet'	(Aethia pygmaea)
307	RHAU	'Rhinoceros Auklet'	(Cerorhinca monocerata)
308	ATPU	'Atlantic Puffin'	(Fratercula arctica)
309	HOPU	'Horned Puffin'	(Fratercula corniculata)
310	TUPU	'Tufted Puffin'	(Fratercula cirrhata)

PIGEONS, DOVES

311	WCPI	'White-crowned Pigeon'	(Columba leucocephala)
312	BTPI	'Band-tailed Pigeon'	(Columba fasciata)
313	RBPI	'Red-billed Pigeon'	(Columba flavirostris)
314	ZEDO	'Zenaida Dove'	(Zenaida aurita zenaida)
315	WWDO	'White-winged Dove'	(Zenaida asiatica)
316	MODO	'Mourning Dove'	(Zenaida macroura)
317	RODO	'Rock Dove'	(Columba livia)
318	SPDO	'Spotted Dove'	(Streptopelia chinensis)
319	RTDO	'Ringed Turtle Dove'	(Streptopelia risoria)
320	CGDO	'Common Ground Dove'	(Columbina passerina)
321	RGDO	'Ruddy Ground Dove'	(Columbina talpacoti)
322	INDO	'Inca Dove'	(Columbina inca)
323	WTDO	'White-tipped Dove'	(Leptotila verreauxi)
324	KWQD	'Key West Quail Dove'	(Oreopeleia chrysia)
325	RQDO	'Ruddy Quail Dove'	(Oreopeleia montana montana)
	UNDO	'Unidentified Dove'	

PARROT

326	CWPA	'Canary-winged Parakeet'	(Brotogeris versicolurus)

CUCKOOS, ROADRUNNER, ANIS

327	MACU	'Mangrove Cuckoo'	(Coccyzus minor)
328	YBCU	'Yellow-billed Cuckoo'	(Coccyzus americanus)
329	BBCU	'Black-billed Cuckoo'	(Coccyzus erythropthalmus)
330	GRRO	'Greater Roadrunner'	(Geococcyx californianus)
331	SBAN	'Smooth-billed Ani'	(Crotophaga ani)
332	GBAN	'Groove-billed Ani'	(Crotophaga sulcirostris)

BARN OWL

333	CBOW	'Common Barn Owl'	(Tyto alba)

TYPICAL OWLS

334	ESOW	'Eastern Screech-Owl'	(Otus asio)
335	WSOW	'Western Screech-Owl'	(Otus kennicottii)
336	WHOW	'Whiskered Owl'	(Otus trichopsis)
337	FLOW	'Flammulated Owl'	(Otus flammeolus)
338	GHOW	'Great Horned Owl'	(Bubo virginianus)

339	SNOW	'Snowy Owl'	(Nyctea scandiaca)
340	NHOW	'Northern Hawk-Owl'	(Surnia ulula)
341	NPOW	'Northern Pygmy-Owl'	(Glaucidium gnoma)
342	FPOW	'Ferruginous Pygmy-Owl'	(Glaucidium brasilianum)
343	ELOW	'Elf Owl'	(Micrathene whitneyi)
344	BUOW	'Burrowing Owl'	(Athene cunicularia)
345	BDOW	'Barred Owl'	(Strix varia)
346	SPOW	'Spotted Owl'	(Strix occidentalis)
347	GGOW	'Great Gray Owl'	(Strix nebulosa)
348	LEOW	'Long-eared Owl'	(Asio otus)
349	SEOW	'Short-eared Owl'	(Asio flammeus)
350	BOOW	'Boreal Owl'	(Aegolis funereus)
351	NSWO	'Northern Saw-whet Owl'	(Aegolius acadicus)
	UNOW	'Unidentified Owl'	

GOATSUCKERS

352	CWWI	'Chuck-will's-widow'	(Caprimulgus carolinensis)
353	WPWI	'Whip-poor-will'	(Caprimulgus vociferus)
354	CPWI	'Common Poor-will'	(Phalaenoptilus nuttallii)
355	COPA	'Common Pauraque'	(Nyctidromus albicollis)
356	CONI	'Common Nighthawk'	(Chordeiles minor)
357	LENI	'Lesser Nighthawk'	(Chordeiles acutipennis)
	UNGO	'Unidentified Goatsucker'	

SWIFTS

358	BLSW	'Black Swift'	(Cypseloides niger)
359	CHSW	'Chimney Swift'	(Chaetura pelagica)
360	VASW	'Vaux's Swift'	(Chaetura vauxi)
361	WTSW	'White-throated Swift'	(Aeronautes saxatalis)

HUMMINGBIRDS

362	LUHU	'Lucifer Hummingbird'	(Calothorax lucifer)
363	RTHU	'Ruby-throated Hummingbird'	(Archilochus colubris)
364	BCHU	'Black-chinned Hummingbird'	(Archilochus alexandri)
365	COHU	'Costa's Hummingbird'	(Calypte costae)
366	ANHU	'Anna's Hummingbird'	(Calypte anna)
367	BRHU	'Broad-tailed Hummingbird'	(Selasphorus platycercus)
368	RUHU	'Rufous Hummingbird'	(Selasphorus rufus)
369	ALHU	'Allen's Hummingbird'	(Selasphorus sasin)
370	CAHU	'Calliope Hummingbird'	(Stellula calliope)
371	RIHU	'Rivoli's Hummingbird'	(Eugenes fulgens)
372	BUHU	'Blue-throated Hummingbird'	(Lampornis clemenciae)
373	BFHU	'Buff-bellied Hummingbird'	(Amazilia yucatanensis)
374	BBHU	'Broad-billed Hummingbird'	(Cynanthus latirostis)
	UNHU	'Unidentified Hummingbird'	

TROGON

KINGFISHERS

376	BEKI	'Belted Kingfisher'	(Ceryle alcyon)
377	RIKI	'Ringed Kingfisher'	(Ceryle torquata)
378	GNKI *	'Green Kingfisher'	(Chloroceryle americana)

WOODPECKERS

379	NOFL	'Northern Flicker'	(Colaptes auratus)
380	PIWO	'Pileated Woodpecker'	(Dryocopus pileatus)
381	RBWO	'Red-bellied Woodpecker'	(Melanerpes carolinus)
382	GFWO	'Golden-fronted Woodpecker'	(Melanerpes aurifrons)
383	GIWO	'Gila Woodpecker'	(Melanerpes uropygialis)
384	RHWO	'Red-headed Woodpecker'	(Melanerpes erythrocephalus)
385	ACWO	'Acorn Woodpecker'	(Melanerpes formicivorus)
386	LEWO	'Lewis' Woodpecker'	(Melanerpes lewis)
387	YBSA	'Yellow-bellied Sapsucker'	(Sphyrapicus varius)
388	RBSA	'Red-breasted Sapsucker'	(Sphyrapicus ruber)
389	WISA	'Williamson's Sapsucker'	(Sphyrapicus thyroideus)
390	HAWO	'Hairy Woodpecker'	(Picoides villosus)
391	DOWO	'Downy Woodpecker'	(Picoides pubescens)
392	LBWO	'Ladder-backed Woodpecker'	(Picoides scalaris)
393	NUWO	'Nuttall's Woodpecker'	(Picoides nuttallii)
394	ARWO	'Arizona Woodpecker'	(Picoides stricklandi)
395	RCWO	'Red-cockaded Woodpecker'	(Picoides borealis)
396	WHWO	'White-headed Woodpecker'	(Picoides albolarvatus)
397	BBWO	'Black-backed Woodpecker'	(Picoides arctus)
398	TTWO	'Three-toed Woodpecker'	(Picoides tridactylus)
399	IBWO	'Ivory-billed Woodpecker'	(Campephilus principalis)
	UNWO	'Unidentified Woodpecker'	

COTINGA

400	RTBE	'Rose-throated Becard'	(Pachyramphus aglaiae)

TYRANT FLYCATCHERS

401	EAKI	'Eastern Kingbird'	(Tyrannus tyrannus)
402	GRKI	'Gray Kingbird'	(Tyrannus dominicensis)
403	TRKI	'Tropical Kingbird'	(Tyrannus melancholicus)
404	WEKI	'Western Kingbird'	(Tyrannus verticalis)
405	CAKI	'Cassin's Kingbird'	(Tyrannus vociferans)
406	TBKI	'Thick-billed Kingbird'	(Tyrannus crassirostris)
407	FTFL	'Fork-tailed Flycatcher'	(Tyrannus savana)
408	STFL	'Scissor-tailed Flycatcher'	(Tyrannus forficatus)
409	KIFL	'Greater Kiskadee'	(Pitangus sulphuratus)
410	SBFL	'Sulfur-bellied Flycatcher'	(Myiodynastes luteiventris)
411	GCFL	'Great Crested Flycatcher'	(Myiarchus crinitus)
412	BCFL	'Brown Crested Flycatcher'	(Myiarchus tyrannulus)
413	ATFL	'Ash-throated Flycatcher'	(Myiarchus cinerascens)
414	DCFL	'Dusky-capped Flycatcher'	(Myiarchus tuberculifer)
415	EAPH	'Eastern Phoebe'	(Sayornis phoebe)
416	BLPH	'Black Phoebe'	(Sayornis nigricans)

417	SAPH	'Say's Phoebe'	(Sayornis saya)
418	YBFL	'Yellow-bellied Flycatcher'	(Empidonax flaviventris)
419	ACFL	'Acadian Flycatcher'	(Empidonax virescens)
420	WIFL	'Willow Flycatcher'	(Empidonax traillii)
421	ALFL	'Alder Flycatcher'	(Empidonax alnorum)
422	LEFL	'Least Flycatcher'	(Empidonax minimus)
423	HAFL	'Hammond's Flycatcher'	(Empidonax hammondii)
424	DUFL	'Dusky Flycatcher'	(Empidonax oberholseri)
425	GRFL	'Gray Flycatcher'	(Empidonax wrightii)
426	WEFL	'Western Flycatcher'	(Empidonax difficilis)
427	BBFL	'Buff-breasted Flycatcher'	(Empidonax fulvifrons)
	EMFL	'Unidentified Empidonax Flycatcher'	
428	COFL	'Coues' Flycatcher'	(Contopus pertinax)
429	EWPE	'Eastern Wood-Pewee'	(Contopus virens)
430	WWPE	'Western Wood-Pewee'	(Contopus sordidulus)
431	OSFL	'Olive-sided Flycatcher'	(Contopus borealis)
432	VEFL	'Vermillion Flycatcher'	(Pyrocephalus rubinus)
433	NBTY	'Northern Beardless Tyrannulet'	(Camptostoma imberbe)
434	UNFL	'Unidentified Flycatcher'	

LARKS

435	EUSK	'Eurasian Skylark'	(Alauda arvensis)
436	HOLA	'Horned Lark'	(Eremophila alpestris)

SWALLOWS

437	VGSW	'Violet-green Swallow'	(Tachycineta thalassina)
438	TRSW	'Tree Swallow'	(Tachycineta bicolor)
439	BKSW	'Bank Swallow'	(Riparia riparia)
440	NRWS	'Northern Rough-winged Swallow'	(Stelgidopteryx serripennis)
441	BASW	'Barn Swallow'	(Hirundo rustica)
442	CLSW	'Cliff Swallow'	(Hirundo pyrrhonota)
443	CASW	'Cave Swallow'	(Hirundo fulva)
444	PUMA	'Purple Martin'	(Progne subis)
	UNSW	'Unidentified Swallow'	

JAYS, MAGPIES, CROWS

445	GRJA	'Gray Jay'	(Perisoreus canadensis)
446	BLJA	'Blue Jay'	(Cyanocitta cristata)
447	STJA	'Steller's Jay'	(Cyanocitta stelleri)
448	SCJA	'Scrub Jay'	(Aphelocoma coerulescens)
449	GBJA	'Gray-breasted Jay'	(Aphelocoma ultramarina)
450	GEJA	'Green Jay'	(Cyanocorax yncas)
451	BBMA	'Black-billed Magpie'	(Pica pica)
452	YBMA	'Yellow-billed Magpie'	(Pica nuttalli)
453	CORA	'Common Raven'	(Corvus corax)
454	CHRA	'Chihuahua Raven'	(Corvus cryptoleucus)
455	AMCR	'American Crow'	(Corvus brachyrhynchos)
456	NOCR	'Northwestern Crow'	(Corvus caurinus)
457	FICR	'Fish Crow'	(Corvus ossifragus)
	UNCR	'Unidentified Crow'	
458	PIJA	'Pinyon Jay'	(Gymnorhinus cyanocephalus)

459	CLNU	'Clark's Nutcracker'	(Nucifraga columbiana)

TITMICE, VERDIN, BUSHTIT

460	BCCH	'Black-capped Chickadee'	(Parus atricapillus)
461	CACH	'Carolina Chickadee'	(Parus carolinensis)
462	MECH	'Mexican Chickadee'	(Parus sclateri)
463	MOCH	'Mountain Chickadee'	(Parus gambeli)
464	SITI	'Siberian Tit'	(Parus cinctus)
465	BOCH	'Boreal Chickadee'	(Parus hudsonicus)
466	CBCH	'Chestnut-backed Chickadee'	(Parus rufescens)
467	TUTI	'Tufted Titmouse'	(Parus bicolor)
468	BCTI	'Black-crested Titmouse'	Tufted race
469	PLTI	'Plain Titmouse'	(Parus inornatus)
470	BRTI	'Bridled Titmouse'	(Parus wollweberi)
471	VERD	'Verdin'	(Auriparus flaviceps)
472	BUSH	'Bushtit'	(Psaltriparus minimus)

NUTHATCHES

473	WBNU	'White-breasted Nuthatch'	(Sitta carolinensis)
474	RBNU	'Red-breasted Nuthatch'	(Sitta canadensis)
475	BHNU	'Brown-headed Nuthatch'	(Sitta pusilla)
476	PYNU	'Pygmy Nuthatch'	(Sitta pygmaea)

CREEPER

477	BRCR	'Brown Creeper'	(Certhia americana)

WRENTIT

478	WREN	'Wrentit'	(Chamaea fasciata)

BULBUL

479	RWBU	'Red-whiskered Bulbul'	(Pycnonotus jocosus)

DIPPER

480	AMDI	'American Dipper'	(Cinclus mexicanus)

WRENS

481	HOWR	'House Wren'	(Troglodytes aedon)
482	WIWR	'Winter Wren'	(Troglodytes troglodytes)
483	BEWR	'Bewick's Wren'	(Thryomanes bewickii)
484	CAWR	'Carolina Wren'	(Thryothorus ludovicianus)
485	CTWR	'Cactus Wren'	(Campylorhynchus brunneicapillus)
486	MAWR	'Marsh Wren'	(Cistothorus palustris)
487	SEWR	'Sedge Wren'	(Cistothorus platensis)
488	CNWR	'Canyon Wren'	(Catherpes mexicanus)
489	ROWR	'Rock Wren'	(Salpinctes obsoletus)
	UNWR	'Unidentified Wren'	

MOCKINGBIRDS, THRASHERS

490	NOMO	'Northern Mockingbird'	(Mimus polyglottus)
491	GRCA	'Gray Catbird'	(Dumetella carolinensis)
492	BRTH	'Brown Thrasher'	(Toxostoma rufum)
493	LBTH	'Long-billed Thrasher'	(Toxostoma longirostre)
494	GRTH	'Gray Thrasher'	(Toxostoma cinereum)
495	BETH	'Bendire's Thrasher'	(Toxostoma bendirei)
496	CBTH	'Curve-billed Thrasher'	(Toxostoma curvirostre)
497	CATH	'California Thrasher'	(Toxostoma redivivum)
498	LCTH	'LeConte's Thrasher'	(Toxostoma lecontei)
499	CRTH	'Crissal Thrasher'	(Toxostoma dorsale)
500	SATH	'Sage Thrasher'	(Oreoscoptes montanus)
	UNTH	'Unidentified Thrasher'	

THRUSHES

501	AMRO	'American Robin'	(Turdus migratorius)
502	FIEL	'Fieldfare'	(Turdus pilaris)
503	CCRO	'Clay-colored Robin'	(Turdus grayi)
504	VATH	'Varied Thrush'	(Ixoreus naevius)
505	WOTH	'Wood Thrush'	(Hylocichla mustelina)
506	HETH	'Hermit Thrush'	(Catharus guttatus)
507	SWTH	'Swainson's Thrush'	(Catharus ustulatus)
508	GCTH	'Gray-cheeked Thrush'	(Catharus minimus)
509	VEER	'Veery'	(Catharus fuscescens)
510	EABL	'Eastern Bluebird'	(Sialia sialis)
511	WEBL	'Western Bluebird'	(Sialia mexicana)
512	MOBL	'Mountain Bluebird'	(Sialia currucoides)
513	EMBL	'Eastern/Mountain Blueb.Hybrid'	(Sialia spp)
514	NOWH	'Northern Wheatear'	(Oenanthe oenanthe)
515	BLUE	'Bluethroat'	(Luscinia svecica)
516	TOSO	'Townsend's Solitaire'	(Myadestes townsendi)
	UNTU	'Unidentified Thrush'	

OLD WORLD WARBLERS, GNATCATCHERS, KINGLETS

517	ARWA	'Arctic Warbler'	(Phylloscopus borealis)
518	BGGN	'Blue-gray Gnatcatcher'	(Polioptila caerulea)
519	BCGN	'Black-capped Gnatcatcher'	(Polioptila nigriceps)
520	BTGN	'Black-tailed Gnatcatcher'	(Polioptila melanura)
	UNGN	'Unidentified Gnatcatcher'	
521	GCKI	'Golden-crowned Kinglet'	(Regulus satrapa)
522	RCKI	'Ruby-crowned Kinglet'	(Regulus calendula)

WAGTAILS, PIPITS

523	WHWA	'White Wagtail'	(Motacilla alba)
524	YLWA *	'Yellow Wagtail'	(Motacilla flava)
525	WAPI	'Water Pipit'	(Anthus spinoletta)
526	RTPI	'Red-throated Pipit'	(Anthus cervinus)
527	SPPI	'Sprague's Pipit'	(Anthus spragueii)

WAXWINGS

528 BOWA	'Bohemian Waxwing'	(Bombycilla garrulus)
529 CEWA	'Cedar Waxwing'	(Bombycilla cedrorum)

SILKY FLYCATCHER

530 PHAI	'Phainopepla'	(Phainopepla nitens)

SHRIKES

531 NRSH	'Northern Shrike'	(Lanius excubitor)
532 LOSH	'Loggerhead Shrike'	(Lanius ludovicianus)

STARLING

533 EUST	'European Starling'	(Sturnus vulgaris)

VIREOS

534 BCVI	'Black-capped Vireo'	(Vireo atricapillus)
535 WEVI	'White-eyed Vireo'	(Vireo griseus)
536 HUVI	'Hutton's Vireo'	(Vireo huttoni)
537 BEVI	'Bell's Vireo'	(Vireo bellii)
538 GRVI	'Gray Vireo'	(Vireo vicinior)
539 YTVI	'Yellow-throated Vireo'	(Vireo flavifrons)
540 SOVI	'Solitary Vireo'	(Vireo solitarius)
541 BWVI	'Black-whiskered Vireo'	(Vireo altiloquus)
542 REVI	'Red-eyed Vireo'	(Vireo olivaceus)
543 YGVI	'Yellow-green Vireo'	(Vireo olivaceus flavoviridis)
544 PHVI	'Philadelphia Vireo'	(Vireo philadelphicus)
545 WAVI	'Warbling Vireo'	(Vireo gilvus)
UNVI	'Unidentified Vireo'	

WOOD WARBLERS

546 BAWW	'Black-and-white Warbler'	(Mniotilta varia)
547 POWA	'Prothonotary Warbler'	(Protonotaria citrea)
548 SWWA	'Swainson's Warbler'	(Limnothlypis swainsonii)
549 WEWA	'Worm-eating Warbler'	(Helmitheros vermivorus)
550 GWWA	'Golden-winged Warbler'	(Vermivora chrysoptera)
551 BWWA	'Blue-winged Warbler'	(Vermivora pinus)
552 BRWA	'Brewster's Warbler'	Golden-winged/Blue-winged Hybrid
553 LAWA	'Lawrence's Warbler'	Golden-winged/Blue-winged Hybrid
554 BAWA	'Bachman's Warbler'	(Vermivora bachmanii)
555 TEWA	'Tennessee Warbler'	(Vermivora peregrina)
556 OCWA	'Orange-crowned Warbler'	(Vermivora celata)
557 NAWA	'Nashville Warbler'	(Vermivora ruficapilla)
558 VIWA	'Virginia's Warbler'	(Vermivora virginiae)
559 CLWA	'Colima Warbler'	(Vermivora crissalis)
560 LUWA	'Lucy's Warbler'	(Vermivora luciae)
561 NOPA	'Northern Parula'	(Parula americana)
562 TRPA	'Tropical Parula'	(Parula pitiayumi)

563	OLWA	'Olive Warbler'	(Peucedramus taeniatus)
564	YEWA	'Yellow Warbler'	(Dendroica petechia)
565	MAWA	'Magnolia Warbler'	(Dendroica magnolia)
566	CMWA	'Cape May Warbler'	(Dendroica tigrina)
567	BTBW	'Black-throated Blue Warbler'	(Dendroica caerulescens)
568	YRWA	'Yellow-rumped Warbler'	(Dendroica coronata)
569	BGWA	'Black-throated Gray Warbler'	(Dendroica nigrescens)
570	TOWA	'Townsend's Warbler'	(Dendroica townsendi)
571	BTGW	'Black-throated Green Warbler'	(Dendroica virens)
572	GCWA	'Golden-cheeked Warbler'	(Dendroica chrysoparia)
573	HEWA	'Hermit Warbler'	(Dendroica occidentalis)
574	CRWA	'Cerulean Warbler'	(Dendroica cerulea)
575	BLWA	'Blackburnian Warbler'	(Dendroica fusca)
576	YTWA	'Yellow-throated Warbler'	(Dendroica dominica)
577	SUWA	'Sutton's Warbler'	(Dendroica potomac)
578	GRWA	'Grace's Warbler'	(Dendroica graciae)
579	CSWA	'Chestnut-sided Warbler'	(Dendroica pensylvanica)
580	BBWA	'Bay-breasted Warbler'	(Dendroica castanea)
581	BPWA	'Blackpoll Warbler'	(Dendroica striata)
582	PIWA	'Pine Warbler'	(Dendroica pinus)
583	KIWA	'Kirtland's Warbler'	(Dendroica kirtlandii)
584	PRWA	'Prairie Warbler'	(Dendroica discolor)
585	PAWA	'Palm Warbler'	(Dendroica palmarum)
586	OVEN	'Ovenbird'	(Seiurus aurocapillus)
587	NOWA	'Northern Waterthrush'	(Seiurus noveboracesis)
588	LOWA	'Louisiana Waterthrush'	(Seiurus motacilla)
589	KEWA	'Kentucky Warbler'	(Oporornis formosus)
590	COWA	'Connecticut Warbler'	(Oporornis agilis)
591	MOWA	'Mourning Warbler'	(Oporornis philadelphia)
592	MGWA	'MacGillivray's Warbler'	(Oporornis tolmiei)
593	COYE	'Common Yellowthroat'	(Geothlypis trichas)
594	GRCH	'Ground Chat'	(Geothlypis poliocephala)
595	YBCH	'Yellow-breasted Chat'	(Icteria virens)
596	RFWA	'Red-faced Warbler'	(Cardellina rubrifrons)
597	HOWA	'Hooded Warbler'	(Wilsonia citrina)
598	WIWA	'Wilson's Warbler'	(Wilsonia pusilla)
599	CAWA	'Canada Warbler'	(Wilsonia canadensis)
600	AMRE	'American Redstart'	(Setophaga ruticilla)
601	PARE	'Painted Redstart'	(Myioborus pictus)
	UNWA	'Unidentified Warbler'	

WEAVER FINCHES

602	HOSP	'House Sparrow'	(Passer domesticus)
603	ETSP	'Eurasian Tree Sparrow'	(Passer montanus)

MEADOWLARKS, BLACKBIRDS, ORIOLES

604	BOBO	'Bobolink'	(Dolichonyx oryzivorus)
605	EAME	'Eastern Meadowlark'	(Sturnella magna)
606	WEME	'Western Meadowlark'	(Sturnella neglecta)
607	YHBL	'Yellow-headed Blackbird'	(Xanthocephalus xanthocephalus)
608	RWBL	'Red-winged Blackbird'	(Agelaius phoeniceus)
609	TRBL	'Tricolored Blackbird'	(Agelaius tricolor)

610	OROR	'Orchard Oriole'	(Icterus spurius)
611	AUOR	'Audubon's Oriole'	(Icterus graduacauda)
612	SBOR	'Spotted-breasted Oriole'	(Icterus pectoralis)
613	STOR	'Streak-backed Oriole'	(Icterus pustulatus)
614	HOOR	'Hooded Oriole'	(Icterus cucullatus)
615	ALOR	'Altamira Oriole'	(Icterus gularis)
616	SCOR	'Scott's Oriole'	(Icterus parisorum)
617	NOOR	'Northern Oriole'	(Icterus galbula)
	UNOR	'Unidentified Oriole'	
618	RUBL	'Rusty Blackbird'	(Euphagus carolinus)
619	BRBL	'Brewer's Blackbird'	(Euphagus cyanocephalus)
620	GTGR	'Great-tailed Grackle'	(Quiscalus mexicanus)
621	BTGR	'Boat-tailed Grackle'	(Quiscalus major)
622	COGR	'Common Grackle'	(Quiscalus quiscula)
623	BHCO	'Brown-headed Cowbird'	(Molothrus ater)
624	BRCO	'Bronzed Cowbird'	(Molothrus aeneus)
625	UNBL	'Unidentified Blackbird'	

TANAGERS

626	WETA	'Western Tanager'	(Piranga ludoviciana)
627	SCTA	'Scarlet Tanager'	(Piranga olivacea)
628	HETA	'Hepatic Tanager'	(Piranga flava)
629	SUTA	'Summer Tanager'	(Piranga rubra)
	UNTA	'Unidentified Tanager'	

GROSBEAKS, FINCHES, SPARROWS, BUNTINGS

630	NOCA	'Northern Cardinal'	(Cardinalis cardinalis)
631	PYRR	'Pyrrhuloxia'	(Cardinalis sinuatus)
632	RBGR	'Rose-breasted Grosbeak'	(Pheucticus ludovicianus)
633	BHGR	'Black-headed Grosbeak'	(Pheucticus melanocephalus)
634	BLGR	'Blue Grosbeak'	(Guiraca caerulea)
	UNGR	'Unidentified Grosbeak'	
635	INBU	'Indigo Bunting'	(Passerina cyanea)
636	LABU	'Lazuli Bunting'	(Passerina amoena)
637	VABU	'Varied Bunting'	(Passerina versicolor)
638	PABU	'Painted Bunting'	(Passerina ciris)
639	DICK	'Dickcissel'	(Spiza americana)
640	EVGR	'Evening Grosbeak'	(Coccothraustes vespertinus)
641	PUFI	'Purple Finch'	(Carpodacus purpureus)
642	CAFI	'Cassin's Finch'	(Carpodacus cassinii)
643	HOFI	'House Finch'	(Carpodacus mexicanus)
644	WCSE	'White-collared Seedeater'	(Sporophila torqueola)
645	PIGR	'Pine Grosbeak'	(Pinicola enucleator)
646	ROFI	'Rosy Finch'	(Leucosticte arctoa)
647	EUGO	'European Goldfinch'	(Carduelis carduelis)
648	HORE	'Hoary Redpoll'	(Carduelis hornemanni)
[illegible]	[illegible]	'Common Redpoll'	(Carduelis flammea)
650	PISI	'Pine Siskin'	(Carduelis pinus)
651	AMGO	'American Goldfinch'	(Carduelis tristis)

653 LAGO	Lawrence's Goldfinch	(Carduelis lawrencei)
654 RECR	Red Crossbill	(Loxia curvirostra)
655 WWCR	'White-winged Crossbill'	(Loxia leucoptera)
656 OLSP	'Olive Sparrow'	(Arremonops rufivirgatus)
657 GTTO	'Green-tailed Towhee'	(Pipilo chlorurus)
658 RSTO	'Rufous-sided Towhee'	(Pipilo erythrophthalmus)
659 BRTO	'Brown Towhee'	(Pipilo fuscus)
660 ABTO	'Abert's Towhee'	(Pipilo aberti)
661 LKBU	'Lark Bunting'	(Calamospiza melanocorys)
662 SASP	'Savannah Sparrow'	(Passerculus sandwichensis)
663 GRSP	'Grasshopper Sparrow'	(Ammodramus savannarum)
664 BDSP	'Baird's Sparrow'	(Ammodramus bairdii)
665 LCSP	'LeConte's Sparrow'	(Ammodramus leconteii)
666 HESP	'Henslow's Sparrow'	(Ammodramus henslowii)
667 STSP	'Sharp-tailed Sparrow'	(Ammodramus caudacutus)
668 SESP	'Seaside Sparrow'	(Ammodramus maritimus)
669 VESP	'Vesper Sparrow'	(Pooecetes gramineus)
670 LASP	'Lark Sparrow'	(Chondestes grammacus)
671 FSSP	'Five-striped Sparrow'	(Amphispiza quiquestriata)
672 RWSP	'Rufous-winged Sparrow'	(Aimophila carpalis)
673 RCSP	'Rufous-crowned Sparrow'	(Aimophila ruficeps)
674 BASP	'Bachman's Sparrow'	(Aimophila aestivalis)
675 BOSP	'Botteri's Sparrow'	(Aimophila botterii)
676 CASP	'Cassin's Sparrow'	(Aimophila cassinii)
677 BTSP	'Black-throated Sparrow'	(Amphispiza bilineata)
678 SGSP	'Sage Sparrow'	(Amphispiza belli)
679 DEJU	'Dark-eyed Junco'	(Junco hyemalis)
680 YEJU	'Yellow-eyed Junco'	(Junco phaeonotus)
681 ATSP	'American Tree Sparrow'	(Spizella arborea)
682 CHSP	'Chipping Sparrow'	(Spizella passerina)
683 CCSP	'Clay-colored Sparrow'	(Spizella pallida)
684 BRSP	'Brewer's Sparrow'	(Spizella breweri)
685 FISP	'Field Sparrow'	(Spizella pusilla)
686 BCSP	'Black-chinned Sparrow'	(Spizella atrogularis)
687 HASP	'Harris' Sparrow'	(Zonotrichia querula)
688 WCSP	'White-crowned Sparrow'	(Zonotrichia leucophrys)
689 GCSP	'Golden-crowned Sparrow'	(Zonotrichia atricapilla)
690 WTSP	'White-throated Sparrw'	(Zonotrichia albicollis)
691 FOSP	'Fox Sparrow'	(Passerella iliaca)
692 LISP	'Lincoln's Sparrow'	(Melospiza lincolnii)
693 SWSP	'Swamp Sparrow'	(Melospiza georgiana)
694 SOSP	'Song Sparrow'	(Melospiza melodia)
695 MCLO	'McCown's Longspur'	(Calcarius mccownii)
696 LALO	'Lapland Longspur'	(Calcarius lapponicus)
697 SMLO	'Smith's Longspur'	(Calcarius pictus)
698 CCLO	'Chestnut-collared Longspur'	(Calcarius ornatus)
699 SNBU	'Snow Bunting'	(Plectrophenax nivalis)
700 MCBU	'McKay's Bunting'	(Plectrophenax hyperboreus)
701 UNSP	'Unidentified Sparrow'	

UNIDENTIFIED BIRDS

UNBI	'Unidentified Birds'

SOURCE: American Ornithological Union

SOP 29: SEDIMENT SAMPLING FOR TIE TESTING

I. PURPOSE

To provide a general guideline for collecting sediment samples to be used in the toxicity indication evaluation (TIE) testing at the site.

II. SCOPE

A sediment-sampling approach is provided. Site-specific details are discussed in related sections of the field sampling plan.

III. EQUIPMENT AND MATERIALS

- Log book
- Map of the lagoon with sampling locations
- Hip boots or chest waders
- 4' x 8' plywood sheets
- Non-slip bathtub mats or equivalent
- Twelve new 5-gallon plastic buckets with sealable lids
- Stainless-steel trowel and plastic shovel
- Stainless-steel or wooden tongue depressors
- Stainless-steel bowl
- Sample containers
- Personal protective equipment
- Coolers
- Vermiculite for packing samples in coolers
- Strapping tape
- Chain of Custody forms
- Chain of Custody seals

- Water buckets
- Decontamination materials
- Site Health and Safety Plan

IV. PROCEDURES AND GUIDELINES

1. Samples will be collected from the three locations shown in the figure. All sampling stations are located in or near the lagoon.

   The first station will be at the end of the drainage inlet to the lagoon, just at the point where it is tidally exposed. This should be a depositional area and one that is rather muddy or silty.

   The second station will be in the middle of the lagoon. It will be as close to the center of the lagoon one can reach by walking from the inlet down the middle of the lagoon until the point where the mud reaches the top of a the sampler's boots. The bottom of the lagoon grades from sandy to silty to muddy in this area.

   The third station is the depositional area, just a few feet from the outlet. It is the first depositional area in the outlet ditch to the Christina River.

2. The samples should be collected as soon as possible as the tide goes out so that the maximum amount of pore fluids can be obtained.

3. Difficulties accessing the sampling stations should be anticipated. Previous sampling teams encountered deep, sticky mud that made walking difficult. It is suggested that sheets of plywood be laid down on the surface of the sediment to distribute the weight of the samplers and equipment. Rubber bath mats may be used to increase foothold.

4. The sediment samples will be collected from a depth of 0 to 3 inches after removing surface debris such as sticks and weeds. At each location samples will be collected for the following analyses:

   - Two 40-ml vials for VOCs (including tentatively identified compounds)
   - Two 40-ml vials for VOCs (including tentatively identified compounds); this sample will serve as a trip blank
   - One 6-ounce glass bottle for BNA extractables, pesticides, and PCBs (including tentatively identified compounds)
   - One 6-ounce glass bottle for cyanide

- One 6-ounce glass bottle for TAL metals
- One 3-ounce glass bottle for thiocyanate
- One 3-ounce glass bottle for weak dissociated cyanide
- One 6-ounce glass bottle for ammonia
- One 3-ounce glass bottle for total organic carbon

The VOC samples will be collected first and according to procedures described in SOP 4.

At one location a duplicate sample will be collected.

For one of the samples the following extra volumes will be collected as MS/MSDs:

- VOCs: four extra vials
- All other analyses: one extra bottle each

The samples for VOC analysis will be collected directly into the sample containers with a stainless-steel or dedicated wooden tongue depressor. Sediment for other analyses will be placed in a stainless-steel bowl with a stainless-steel trowel and mixed; samples from this composited sediment will be collected directly into the sample containers with a stainless-steel or dedicated wooden tongue depressor. Rocks, plant fragments, and other large debris will be removed by hand.

5. The pH of the pore fluids in the samples will be measured in the field according to SOP 10. The dissolved-oxygen content of the pore fluids in the samples will be measured according to SOP 20. Pore fluids will be accessed by making a shallow depression in the sediment and testing the fluid in the depression.

6. Samples will be collected directly into 5-gallon plastic containers with a stainless-steel trowel or shovel. Rocks, plant fragments, and other debris will be removed by hand. Four 5-gallon containers will be filled for each of the 3 samples. The samples will be visually described in the field logbook.

7. Samples for grain-size analysis will be collected at each station. The samples will be placed in 32-ounce glass containers.

8. One equipment rinsate blank will be collected according to SOP 16 and one field blank will be prepared.

10. The locations of the samples will be marked with 8-foot-long wood stakes

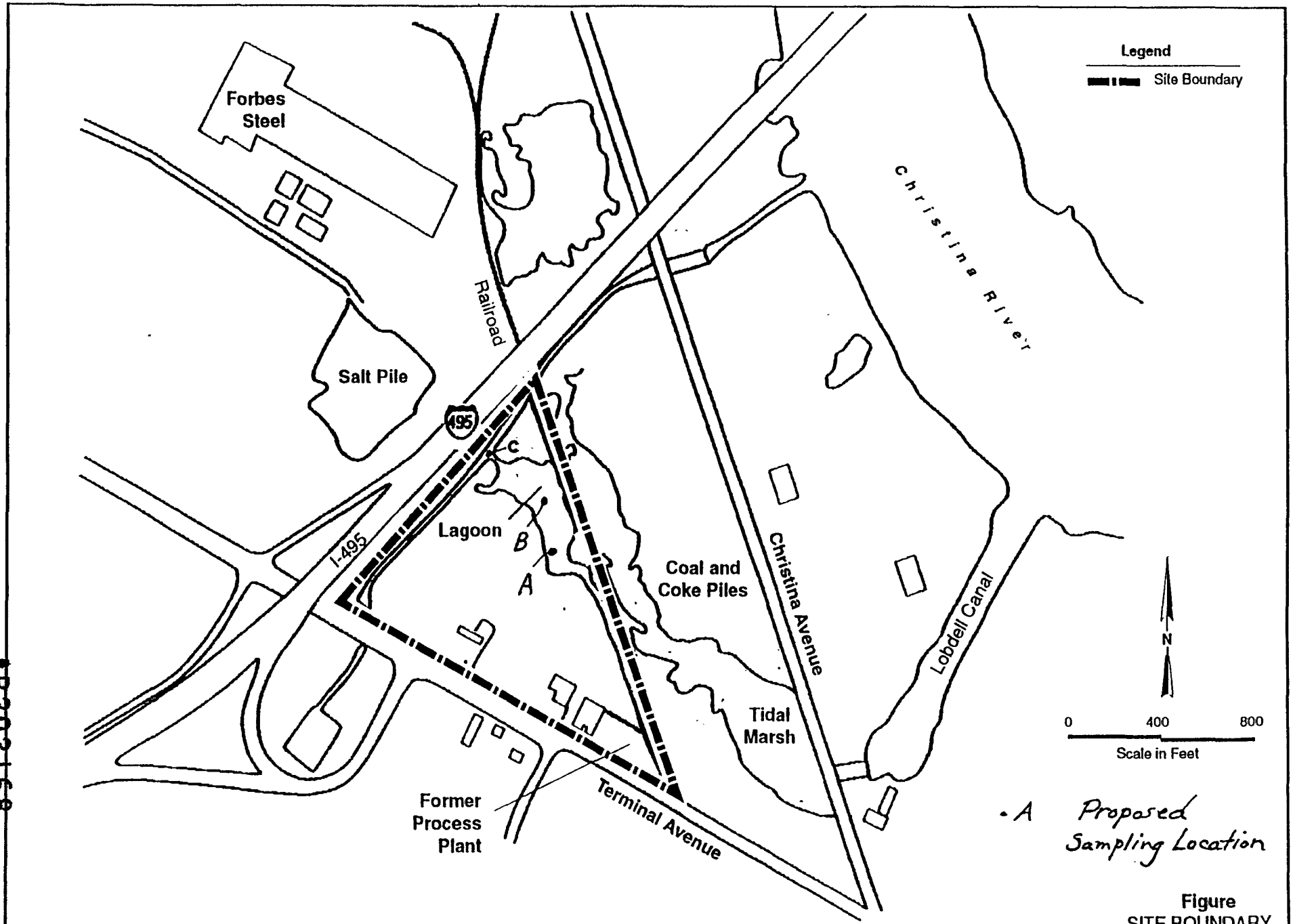

Figure
SITE BOUNDARY
Halby Chemical Operable Unit 2 Site

with an indication of the sampling location clearly and permanently marked on the stake.

11. The samples for analysis for VOCs, BNAs, etc. will be packed and shipped to CRL or a CLP laboratory by standard procedures. Each 5-gallon plastic container will be packed in a cooler and bags of ice will be placed around the container. The twelve 5-gallon containers will be shipped to CH2M HILL's Milwaukee laboratory by overnight shipper.

12. Equipment will be decontaminated as described in SOP 6. RI-derived wastes will be disposed of according to SOP 7. Health and safety monitoring will be performed according to SOPs 12 and 13.

V. ATTACHMENTS

Figure showing sample station locations.

VI. KEY CHECKS AND ITEMS

- Follow recommended safety precautions in performing all operations.
- Clean sample equipment between sample stations.
- Materials laid down to access sampling locations need to be removed and treated as RI-derived waste.

Attachment B

Field Data
Notes and Observations

Site: T1.1 Date: 9/24/93 Project: HALBY

PLANTS

INCEDENTAL OBSERVATIONS:

Jimson Weed
Smartweed sp.
Snakeroot
Common reed
Narrow-leaved goldenrod
Aster sp.
Black willow

} observed along area in between warehouse and ditch.

Bidens sp.
Common reed
Teasel
Foxtail Grass
Nodding Smartweed
Staghorn Sumac
Black locust
Tree of Heaven
Elm
Cherry

} Observed near Terminal road between warehouse building & road.

Common Reed
Snakeroot
Green Ash
Mulberry
Winged Sumac
Virginia Creeper

} Seen along Terminal road near ditch.

Initials: KPI Date: 9/24/93 Page 1 of 1

wdc-gf-fldnote2.wk1(.all)

AR303171

Field Data
Notes and Observations

Site: T1-1 Parking lot near lagoon Date: 9/24/93 Project: HALBY WILDLIFE

Disturbed area in between ditch & parking lot, next to CH2M HILL trailor.

No wildlife observations, nor signs.

No bird sightings

No INCEDENTAL observations.

praying mantis

Initials: KPI Date: 9/24/93 Page 1 of 1

wdc-gf-fldnote2.wk1(.all)

AR303172

Field Data
Notes and Observations

Site: T1-2 Date: 9/24/93 Project: HALBY

WILDLIFE

INCEDENTALS OBS.
(Culvert @ ditch confluence)
Black-capped chickadees - seen / heard
Starlings - fly over
Sea Gulls - probably ring-billed - fly over
Mallard ducks - scat
American crow - feeding on dead catfish next to lagoon
Culverts have odor, slight sheen on lagoon surface waters.
Sensitive fern

Initials: KPF Date: 9/24/93 Page 1 of 1

wdc-gf-fldnote2.wk1(.all)

AR303173

Field Data
Notes and Observations

Site: Lagoon Date: 9/24/93 Project: HALBY

Painted turtle

Water level in pond @ .88 ft. @ 1:15 pm

Rat – tracks crossing ditch – noticable at low tide.

Mummichogs in ditch

Other rodent tracks – mice

Catfish feeding near reed roots

Initials: KPI Date: 9/24/93 Page 1 of 1

wdc-gf-fldnote2.wk1(.all)

AR303174

Field Data
Notes and Observations

Site: T2-1 Date: 9/24/93 Project: HALBY

WILDLIFE AND PLANTS
INCIDENTAL OBS.

Starlings - fly over
Winged sumac
High tide bush
Vulture - fly over

Area under tower - disturbed w/ signs of plant stress - stunted growth or patches w/ no vegetation. No sign of obvious contamination.

Scrub- shrub / common reed - upland

Panicum virgatum - Switch grass
Sassafras
Black Gum
Pokeweed
False indigo
Crab apple
Rushes
multiflora rose
Raccoon sign - scat.
Day lily

Initials: KPI Date: 9/24/93 Page 1 of 1

wdc-gf-fldnote2.wk1(.all)

Field Data
Notes and Observations

Site: Process Plant Date: 9/24/93 Project: HALBY
WILDLIFE & PLANTS

INCEDENTAL OBS.

Deer - scat
Rabbit - scat
Starlings - flyover / roosting on building
Kestral - roosting on wire
Dogbane
Princess Tree
Un I.D. grasses
Many signs of wildlife use - tracks, scat, food
Dog
Cat
Yellow-shafted Flicker - seen
Killdeer - heard
Ring-billed Gull - flyover
Tartarian honeysuckle

Initials: KPI Date: 9/24/93 Page 1 of 1

wdc-gf-fldnote2.wk1(.all)

AR303176

Field Data
Notes and Observations

Site: T3-1 Date: 9/24/93 Project: HALBY

WILDLIFE + PLANTS

INCIDENTALS AT RAILROAD TRACK corridor - near lagoon

OILY SHEEN on surface water + sediment next to lagoon + tracks (near ROW)

Crayfish - holes

Crow - feeding

Mallard ducks - several in lagoon - feeding

Trailing wild bean

Aster sp.

Commalina sp

Mockingbird - fly over

Cottontail

Dog

Cat

Initials: KRZ Date: 9/24/93 Page 1 of 1

wdc-gf-fldnc~2.wk1(.all)

Field Data
Notes and Observations

Site: T-3-2 Date: 9/24/93 Project: HAURY

WILDLIFE & PLANTS

INCEDENTAL OBS. Near tracks near processing plant + Terminal Road.

E. Cottonwood
Black cherry

Adjacent wetland: other side of tracks

Wild rice
Cattail
Common Reed
muskrat sign

} Wetland has less sign of prior disturbance

Deer - tracks
Cat
Dog

Initials: KPV Date: 9/24/93 Page 1 of 1

wdc-gf-fldnote2.wk1(.all)

AR303178

DATA FORM
INTERMEDIATE ONSITE DETERMINATION METHOD
QUADRAT TRANSECT SAMPLING PROCEDURE
(Vegetation Data)

Field Investigator(s): Kerry J. Teet / Eden Britt
Project/Site: HALBY
Applicant/Owner: E.P.A
Transect #: T1
Date: 9/24/93
State: DE
County: New Castle
Plot #: 1

Note: If a more detailed site description is necessary, use the back of the form or a field notebook.

DOMINANT PLANT SPECIES

	Herbs (Bryophytes)	Indicator Status	Saplings	Status
1.	Lespedeza virginicus	FACU		
2.	Artemesia sp	—		
3.	Vicia sp	—		
4.	Daucus carota	UPL		
5.	Morus sp.	—		
6.	Toxicodendron radicans	FAC		
7.	Acer negunde	FAC		
8.	Solidago sp.	—		
9.	Lythrum salicaria	FACW+		
10.	Lonicera japonica	FAC		
11.	Phragmites australis	FACW		
12.	Datura stramonium	UPL		
13.	Phytolacca americana	FACU+		

	Shrubs	Indicator Status	Trees	Indicator Status
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				

	Woody Vines	Indicator Status
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		

Percent of dominant species that are OBL, FACW, and/or FAC: < 50%

DATA FORM
INTERMEDIATE ONSITE DETERMINATION METHOD
QUADRAT TRANSECT SAMPLING PROCEDURE
(Vegetation Data)

Field Investigator(s): Kerry Iliff / Eden Britt
Project/Site: HALBY
Applicant/Owner: BFA
State: DE County: New Castle
Transect #: T1
Plot #: 2
Date: 9/24/93

Note: If a more detailed site description is necessary, use the back of the form or a field notebook.

DOMINANT PLANT SPECIES

	Herbs (Bryophytes)	Indicator Status
1.	Lycopus virginicus	OBL
2.	Polygonum hydropiper	OBL
3.	Polygonum sagittatum	OBL
4.	Eupatorium sp.	—
5.	Echinochloa walteri	FACW+
6.	Panicum sp.	—
7.	Asclepias incarnata	OBL
8.	Parthenocissus quinquefolia	FACU
9.	Lonicera japonica	FAC
10.	Impatiens capensis	OBL
11.	Pontederia cordata	OBL
12.	Leersia virginica	FACW
13.	Toxicodendron radicans	FAC

	Saplings	Status
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		

	Shrubs	Indicator Status
1.	Rubus sp	—
2.	Acer negundo	FAC
3.	Viburnum recognitum	FAC
4.	Rhus typhina	UPL
5.	Prunus serotina	FACU
6.		
7.		
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9.		
10.		
11.		
12.		
13.		

	Trees	Indicator Status
1.		
2.		
3.		
4.		
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6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		

	Woody Vines	Indicator Status
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		

Percent of dominant species that are OBL, FACW, and / or FAC: >50%

B-3.

DATA FORM
INTERMEDIATE ONSITE DETERMINATION METHOD
QUADRAT TRANSECT SAMPLING PROCEDURE
(Vegetation Data)

Field Investigator(s): Kerry Iliff / Eden Britt
Project/Site: HALEY
Applicant/Owner: BPA
State: DE
County: New Castle
Date: 9/24/93
Transect #: T2
Plot #: 1

Note: If a more detailed site description is necessary, use the back of the form or a field notebook.

DOMINANT PLANT SPECIES

	Herbs (Bryophytes)	Indicator Status	Saplings	Status
1.	Agrostis alba	FACW		
2.	Eupatorium sp.	—		
3.	Solidago sp.	—		
4.	Lonicera japonica	FAC		
5.	Phragmites australis	FACW		
6.	Eupatorium sessilifolium	UPL		
7.	Bidens sp.	—		
8.	Artemesia vulgaris	FACU		
9.	Verbascum thapsus	UPL		
10.	Lythrum salicaria	FACW+		
11.				
12.				
13.				

	Shrubs	Indicator Status	Trees	Indicator Status
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				

	Woody Vines	Indicator Status
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		

Percent of dominant species that are OBL, FACW, and / or FAC: < 50%

(B-3)

DATA FORM
INTERMEDIATE ONSITE DETERMINATION METHOD
QUADRAT TRANSECT SAMPLING PROCEDURE
(Vegetation Data)

Field Investigator(s): Kerry Britt / Brian Britt
Project/Site: HALBY
Applicant/Owner: EPA
Transect #: T3
Plot #: 1
Date: 9/24/93
State: DE
County: New Castle

Note: If a more detailed site description is necessary, use the back of the form or a field notebook.

DOMINANT PLANT SPECIES

	Herbs (Bryophytes)	Indicator Status
1.	Ambrosia artemisiifolia	FACU
2.	Eupatorium sp.	—
3.	Phragmites australis	FACW+
4.	Typha latifolia	OBL
5.	Setaria sp.	—
6.	Lythrum salicaria	FACW+
7.	Pontederia cordata	OBL
8.	Sium suave	OBL
9.	Mikania scandens	FACW+
10.	Polygonum hydropiper	OBL
11.	Panicum virgatum	FAC
12.	Helianthus atrorubens	FACW+
13.	Sagittaria latifolia	OBL
	Hibiscus palustris	OBL

	Saplings	Status
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		

	Shrubs	Indicator Status
1.		
2.		
3.		
4.		
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13.		

	Trees	Indicator Status
1.		
2.		
3.		
4.		
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8.		
9.		
10.		
11.		
12.		
13.		

	Woody Vines	Indicator Status
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		

Percent of dominant species that are OBL, FACW, and / or FAC: ≥ 50%

CH2[redacted].LL
625 Herndon Parkway
Herndon, VA 22070
703 471 1441

Migratory Bird Observation Form

Project No: WDC 63154
Client: HALBY - EPA
Observers: Kerry ILIFF
EDEN BRITT
Site: HALBY

Estimated weather conditions

(circle one)

Approximate temperature (°F):	70					
Cloud Cover:	(0-25%)	26-50%	51-75%	76-100%		
Wind:	Calm	(Slight)	Moderate	Gusting		
Other:	(Clear)	Partly cloudy	Cloudy	Drizzle	Fog	
	Heavy dew	Haze				

Date	Field or Transect No.	Location (1)	Species Code (2)	No. Observed	Activity	Habitat	Sex	Age	S/H/B	Time Begin	Time End
9/24/93	T3	Behind Lagoon	RWBB	1	3	5	—	A	S	7:45	
			GRCA	many	3	5	—				
			EUST	many	3	5	—				
			MODO	1	7	0	—				
			RWBB	2	3	5	m/f				
			RWBB	5	7	5	F				
			MALL	6	3	5	m/f				
			PRWA	3	3	0	—				8:05

ACTIVITY
1 = singing or other display
3 = foraging
4 = gathering nesting material
5 = bathing/dusting
6 = nesting
7 = other behaviors

HABITAT
0 = flyover
1 = woodland
2 = pole/sapling
3 = old field/early succession
4 = meadow
5 = marsh
6 = cropland/pasture
7 =
8 =

SEX
M = male
F = female
U = unknown or mixed flock

AGE
A = adult
J = juvenile
U = unknown

S/H/B
S = seen only
H = heard only
B = both seen and heard

AR303183

Notes:
(1) Location is defined by:
(2) Found in A.O.U. checklist

Initials: KPE Date: 9/24/93

09/27/93
WDC/gf-birddata.wk1(.all)

CH2M HILL
625 Herndon Parkway
Herndon, VA 22070
703 471 1441

Migratory Bird Observation Form

Project No: WDC 63154
Client: EPA
Observers: Kerry Ilg & Eden Britt
Site: HALBY

Estimated weather conditions

	Approximate temperature (°F):	70				
(circle one)	Cloud Cover:	0-25%	26-50%	51-75%	76-100%	
	Wind:	Calm	Slight	Moderate	Gusting	
	Other:	Clear	Partly cloudy	Cloudy	Drizzle	Fog
		Heavy dew	Haze			

Date	Field or Transect No.	Location (1)	Species Code (2)	No. Observed	Activity	Habitat	Sex	Age	S/H/B	Time Begin	Time End
9/24/93	T3	near lagoon	BCCH	1	1	5	U?	A	S	725	
			GRCA	1	1/3	5			S		
			BCCH	1	1	5			S		
			NOCA	1	7	0			S		
			NOMO	1	7	0			S		
			GRCA	1	3	5			B		
			BLJA	1	1	1			H		
			DCCO	1	7	0			S		
			GREG	1	7	0			S		
			EUST	many	7	0			S		
			RODO	4	7	0			S		
			PRWA	2	3	5			S		740

ACTIVITY
1 = singing or other display
3 = foraging
4 = gathering nesting material
5 = bathing/dusting
6 = nesting
7 = other behaviors

HABITAT
0 = flyover
1 = woodland
2 = pole/sapling
3 = old field/early succession
4 = meadow
5 = marsh
6 = cropland/pasture
7 =
8 =

SEX
M = male
F = female
U = unknown or mixed flock

AGE
A = adult
J = juvenile
U = unknown

S/H/B
S = seen only
H = heard only
B = both seen and heard

Notes
(1) Location is defined by:
(2) Found in A O U. checklist

Initials: KPI Date: 9/24/93

09/27/93
WDC/gf-birddata.wk1(.all)

AR303184

CH2[redacted]LL
625 Her[redacted]Parkway
Herndon, VA 22070
703 471-1441

Migratory Bird Observation Form

Project No: WDC 63154
Client: EPA
Observers: Kerry Ilg Et
Eden Britt
Site: HALBY

Estimated weather conditions

	Approximate temperature (°F):	60°				
(circle one)	Cloud Cover:	(0-25%)	26-50%	51-75%	76-100%	
	Wind:	Calm	(Slight)	Moderate	Gusting	
	Other:	(Clear)	Partly cloudy	Cloudy	Drizzle	Fog
		Heavy dew		Haze		

Date	Field or Transect No.	Location (1)	Species Code (2)	No. Observed	Activity	Habitat	Sex	Age	S/H/B	Time Begin	Time End
9/24/93	T3	near Term. road	GRCA	1	7	1	U	A	S	7:05	
			GRCA	2	3	1			B		
			UNWA	1	7	1			S		
			RBGU	1	7	0			S		
			GRCA	1	3	1			B		
			NOMO	1	3	7			S		
			EUST	many	1	7			B		
			NOCA	3	1/3	1			B		
			BCCH	1	1	1			B		
			GRCA	2	1	1			B		
			BCCH	2	1	1			B		
			SOSP	1	7	7			S		720

ACTIVITY
1 = singing or other display
3 = foraging
4 = gathering nesting material
5 = bathing/dusting
6 = nesting
7 = other behaviors

HABITAT
0 = flyover
1 = woodland
2 = pole/sapling
3 = old field/early succession
4 = meadow
5 = marsh
6 = cropland/pasture
7 =
8 =

SEX
M = male
F = female
U = unknown or mixed flock

AGE
A = adult
J = juvenile
U = unknown

S/H/B
S = seen only
H = heard only
B = both seen and heard

AR303185

Notes:
(1) Location is defined by:
(2) Found in A.O.U. checklist

09/27/93
WDC/gf-birddata.wk1(.all)

Initials: VPF Date: 9/24/93

CH2M HILL
625 Herndon Parkway
Herndon, VA 22070
703 471 1441

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Date	Field or Transect No.	Location (1)	Species Code (2)	No. Observed	Activity	Habitat	Sex	Age	S/H/B	Time Begin	Time End
9/24/93	Lagoon(T3)	heur trax	MALL or ABDU	4	3	7	m/F	A	B	645	
			RBGU	1	7	0	U		S		
			EUST	13	7	0	U		S		
			MODO	2	7	0	U		S		
			MALL	2	7	0	m/F		S		
			EUST	5	7	0	U		S		
			EUST	16	7	0	U		B		
			UNWA	1	7	0	U		B		
			EUST	50	7	0	U		S		
			GRCA	1	1	5	U		H		
			EUST	1	7	5	U		S		
			AMCR	1	7	5	U		S		705

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AR303186

Notes
(1) Location is defined by
(2) Found in A O U. checklist

09/27/93
WDC/gf-bird data.wk1(.all)

Initials: KPI Date: 9/24/93

Attachment C

FISH FIELD COLLECTION DATA SHEET

Date 11-8-94
Time 1521 End
Location/Station # Halby Chemical Pond
Sampling Duration (min) (1707 sec)
Sampling Distance (ft) —

Crew Mike Mischuk, Mike Schowalter
Weather Clear
Gear Used Smith Root Type VII - POW
Fish (preserved) Number of Individuals 3
Number of Anomalies 5

	Name	Length (mm)	Weight (gm)	Anomalies *	
R	BLACK BULLHEAD	189	85		
R	BLACK BULLHEAD	265	225		
R	BLACK BULLHEAD	272	265		
R	BLACK BULLHEAD	170	60		
R	Minnow SP.	112	13		
R	" "	104	12		
R	" "	114	16		
R	" "	85	7	MALFORMED UPPER JAW	RETAINED (Ref.)
R	" "	110	15		
R	" "	107	14		
R	" "	103	11		
R	" "	108	12		
R	" "	105	14		
R	" "	109	15		
R	" "	97	10		
R	" "	104	13		
	WHITE PERCH?	72	5		RETAINED (Ref.
	MUM	60	4		RETAINED (Ref.)
R	Minnow SP.	91	9		
R	MUM	55	4		
R	MUM	63	5		

Anomalies * Discoloration, Deformities, Eroded Fins, Excessive Mucus, Excessive External Parasites, Fungus, Poor Condition, Reddening, Tumors, and Ulcers

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Note R = retained for tissue Analysis
MUM = MUMMICHOG

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AR303189

Date 11-8-94

Location/Station # HALBY CHEM. / Onsite Lagoon

Page 2

	Name	Length (mm)	Weight (gm)	Anomalies *
R	MUM	80	8	ULCER ON HEAD
R	MUM	48	2	
R	~~BLUEGILL~~ REDEAR	130	49	NO RED MARKING.
R	REDEAR	125	40	RED MARKING.
R	GOLDFISH	265	340	
R	GOLDFISH	228	235	
R	GOLDEN SHINER	165	47	
R	REDEAR	89	15	
R	MUM	75	6	
R	MUM	76	8	
R	BLACK BULLHEAD	72	5	
R	REDEAR	60	5	
R	MUM	50	2	
R	MUM	50	2	
R	MUM	48	2	
	AMERICAN EEL	320	65	
	" "	300	35	
R	MUM	82	8	
R	MUM	50	2	ULCER BEFORE DORSAL FIN.
R	MUM	40	1	
R	MUM	50	2	

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FISH FIELD COLLECTION DATA SHEET

Date 11-10-94
Time 1545 - 1730
Location/Station # Reference / Background
Sampling Duration (min) 2674 sec / 45 min
Sampling Distance (ft) —

Crew M. Mischuk / M. Schawalter
Weather Clear
Gear Used Smith-Root Type VII-POW
Fish (preserved) Number of Individuals —
Number of Anomalies —

	Name	Length (mm)	Weight (gm)	Anomalies *
R	REDEAR SUNFISH	129	40	
R	" "	129	38	
R	" "	130	41	
R	GOLDFISH	210	210	
R	" "	205	165	
R	" "	193	130	
R	REDEAR	127	43	
R	GOLDFISH	205	145	
R	REDEAR	104	22	
R	" "	106	28	
R	" "	96	20	
R	" "	95	18	
R	" "	84	12	
R	" "	104	20	
R	" "	123	44	
R	" "	120	34	
R	GOLDFISH	107	22	
R	REDEAR	65	6	
R	" "	122	36	
R	" "	45	4	
R	" "	67	6	

Anomalies * Discoloration, Deformities, Eroded Fins, Excessive Mucus, Excessive External Parasites, Fungus, Poor Condition, Reddening, Tumors, and Ulcers

Note: R = retained for tissue analysis

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Date 11-10-94
Location/Station # REFERENCE/BACKGROUND

Page 2

	Name	Length (mm)	Weight (gm)	Anomalies *
	REDEAR	75	10	
	AMERICAN EEL (5)		6Z (TOTAL)	
R	MINNOW SP. (1)			
R	EASTERN MUDMINNOW (1)			
R	Darter sp. (1)		6.0 C Total)	
R	MUMMICHOG (81)			

R = Recapture

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