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THE UNIVERSITY OF UTAH

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November 7, 1979

Major Alvin Young
USAFSAM/EK
Brooks AFB, TX 78235

Dear Al,

Listed in the enclosed tables are the final pesticide analytical results for the soil samples from the Gulfport, Mississippi and Johnston Island Herbicide Orange storage facilities. These results along with the water sample analysis results discussed below represent completion of the chemical analysis for this contract. A formal final report will be forthcoming to summarize some of our observations of data trends and to augment the first year final report with any analytical procedure changes from last year.

The six enclosed tables contain results from three different types of soil samples for each of the two storage facilities. In Tables 1 and 2 are summarized the results from all the samples taken between July 1977 and August 1979 from Herbicide Orange spill sites at the Gulfport (GP) and Johnston Island (JI) facilities respectively. The sample date code is defined as follows: date code 9 for samples collected 28 July 1977 and 25 August 1977 from GP and JI sites respectively; date code 0 for samples collected in January 1978 from both sites; date code 1 for samples collected 6 November 1978 and 18 October 1978 from GP and JI sites respectively; and a date code of 2 for samples collected 14 June 1979 from a GP site and 8 August from JI sites. Given in Tables 3 and 4 are the results for soil penetration studies done at one GP and two JI sites respectively. The presence of pesticide components is here shown to extend more than 20 centimeters below that soil surface. The analytical results for non-spill sites for GP and JI are listed in Tables 5 and 6 respectively. The samples in these last two tables are primarily water drainage or ocean sediment samples but also include samples from two non-storage site islands in the Johnston Island area and two laboratory blanks. The two laboratory blanks reported were run on Fisher Scientific Co. Washed and Ignited Sea Sand and give some indication of the lower detection limits for the analytical methods. The exact source of these small blank contaminations is uncertain but they appear to possibly come from previous sample carry over. Thus the stated pesticide values for all of the sediment or other low concentration samples represent upper limits of actual contamination.

Major Alvin Young
November 7, 1979

Page Two

The twelve water samples from the two storage facilities were analyzed for TCDD only. These included five JI samples labelled JI-1/7879 through JI-5/7879 collected on 7 August 1979. The GP water samples consisted of two labelled simply W-1 and W-2 which were collected on 14 June 1979 and five (out of seven) potable water samples collected on 31 July 1979 which were labelled D331Y9, D431Y9, D131Y9, D231Y9 and D531Y9. Each of these samples were extracted by adding sodium chloride to an aliquot of the water to make a five percent salt solution and then extracting with pesticide grade hexane. The hexane extract was then reduced in volume to 50 microliters and analyzed by GC/MS the same as the soil extracts. The two GP samples from 14 June 1979 labelled W-1 and W-2 were analyzed as 100 milliliter (ml) aliquots and were found to contain <25 parts per trillion (1 ppt = 1×10^{-9} gram/liter) of TCDD. The five JI and the other five GP water samples were each analyzed as 200 ml aliquots and were found to contain <20 ppt of TCDD.

I believe these results fully satisfy the analytical requirements of the FRC on this contract and understand that their receipt will begin procedures for completion of payment to the University of Utah. I am still awaiting contact from Lt. Colonel Falcon concerning disposal of our contaminated wastes and samples. As mentioned earlier, the formal final report on this project will be in preparation during the next month. If you have any suggestions for the final report or any other questions or comments please feel free to contact either myself or Mason Hughes.

Sincerely,



William H. McClennen

WHM/mv

Enclosures

cc: B. M. Hughes

TABLE 2

SUMMARY OF ANALYTICAL RESULTS FOR HERBICIDE ORANGE, ITS HYDROLYSIS PRODUCTS AND TCDD
IN THE JOHNSTON ISLAND STORAGE FACILITIES

µg/g

Sample Date ^a Code	Site No.	IMPURITIES		HYDROLYSIS PRODUCTS		HERBICIDE ORANGE COMPONENTS				
		Dichloro- phenol	Trichloro- phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
9 0 1	01	ND1 ^b	0.4	10.1	10.8	ND1	ND1	ND2	ND2	N/A ^c
	01	ND1	1.3	0.8	0.1	ND1	ND1	ND2	ND2	N/A
	01	ND1	0.1	3.0	4.0	0.1	0.3	2.2	6.4	N/A
9 0 1	02	5.4	0.3	12.0	18.0	ND1	0.1	ND2	ND2	N/A
	02	ND1	0.8	2.8	0.7	0.2	1.8	ND2	0.5	N/A
	02	ND1	0.1	1.0	2.0	ND1	0.1	0.9	2.5	N/A
9 0 1	03	ND1	ND1	0.7	7.6	ND1	ND1	ND2	ND2	N/A
	03	ND1	0.7	3.3	0.6	0.1	0.3	ND2	ND2	N/A
	03	ND1	0.1	0.2	0.4	ND1	0.03	0.1	0.5	N/A
9 0 1	04	ND1	0.3	14.4	29.3	ND1	0.2	ND2	ND2	N/A
	04	ND1	1.7	5.6	0.1	0.5	1.3	ND2	ND2	N/A
	04	ND1	ND1	0.2	0.4	0.2	ND1	0.1	0.5	N/A
9 0 1 2	05	ND3	93.0	12600	8750	4230	12500	ND3	ND3	.0330
	05	ND3	123	11800	10200	1980	13800	<600	~600	.0340
	05	ND3	34.2	7930	22000	ND3	1510	ND3	ND3	.0191
	05	ND3	ND2	971	2590	ND3	ND3	ND3	ND3	.041
9 0 1	06	ND3	63.5	4720	638	31200	10300	7900	30600	≤.065
	06	ND3	255	6050	1720	10400	7630	~15000	32000	≤.006
	06	ND3	136	17600	10900	ND3	143	1800	11300	~.0076
9 0 1	07	ND2	32.7	1980	1250	6600	6790	520	424	.0113
	07	6.8	14.1	1970	1670	25.2	197	910	340	.007
	07	1.6	7.2	944	628	8.0	29.9	23.2	121	.0082

Summary of Analytical Results for Herbicide Orange, Its Hydrolysis Products and TCDD in the Johnston Island Storage Facilities (Continued)

PAGE TWO

µg/g

Sample Date ^a Code	Site No.	IMPURITIES		HYDROLYSIS PRODUCTS		HERBICIDE ORANGE COMPONENTS				
		Dichloro-phenol	Trichloro-phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
9	08	ND2	13.2	1520	525	ND1	211	ND3	1270	.0046
0	08	ND1	2.3	1.7	2.0	ND1	0.5	2.0	7.8	N/A
1	08	ND1	ND1	0.1	0.2	0.1	0.1	0.1	0.4	N/A
9	09	ND3	205	1370	1390	22100	19100	5140	3170	.0417
0	09	ND3	181	7800	5790	21400	21100	9000	5000	.022
1	09	ND3	111	15700	11500	14700	12300	3900	2430	.0286
2	09	ND3	149	15500	15600	2240	4440	3480	2970	.053
9	10	ND3	460	42600	45600	24600	19800	<1600	1050	.196
0	10	ND3	477	31100	46600	23300	27300	~9000	-4000	.230
1	10	ND3	456	38700	61000	27100	25900	-4000	-3000	.235
2	10	ND3	136	21200	26400	100	83.8	-520	-360	.13
9	11	ND3	34.9	4080	3650	24400	24500	<560	330	.0534
0	11	ND1	1.9	2.1	3.6	0.9	6.2	7.2	9.4	≤.0025
1	11	0.1	0.6	5.0	38.5	0.8	4.3	6.3	10.1	≤.0038
9	12	ND3	172	1560	1370	32800	33500	ND3	-300	.178
0	12	ND3	110	2300	1200	26200	27300	ND3	ND3	.080
1	12	ND3	46.6	13200	18200	7150	4290	ND3	ND3	.111
2	12	ND3	53.6	6530	8680	817	1900	≤400	100	.081
0	13	ND2	11.2	23.9	23.7	ND2	1.0	ND2	ND2	≤.0003
1	13	ND1	ND1	ND1	0.1	ND1	ND1	ND1	0.2	N/A
0	14	ND1	0.8	4.4	0.6	0.2	1.0	ND2	1.2	N/A
1	14	ND1	ND1	0.1	0.3	0.1	0.2	0.4	0.6	N/A
0	15	ND1	1.5	3.8	ND1	ND1	ND1	ND1	ND1	N/A
1	15	ND1	ND1	0.1	0.3	ND1	ND1	0.1	0.2	N/A

Summary of Analytical Results for Herbicide Orange, Its Hydrolysis Products and TCDD in the Johnston Island Storage Facilities (Continued)
PAGE THREE

µg/g

Sample Date Code ^a	Site No.	IMPURITIES		HYDROLYSIS PRODUCTS		HERBICIDE ORANGE COMPONENTS				
		Dichloro-phenol	Trichloro-phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
0	16	ND1	1.5	1.2	0.1	ND1	0.1	ND1	ND1	N/A
1	16	ND1	ND1	0.1	0.1	ND1	ND1	0.1	0.2	N/A
0	17	ND2	12.5	5.8	6.8	ND2	ND1	ND2	ND2	N/A
1	17	ND1	0.1	0.1	0.3	ND1	0.1	0.1	0.2	N/A
0	18	ND2	11.1	691	2920	28.8	57.2	13.1	46.0	.001
1	18	ND2	0.4	2.0	4.9	0.7	1.5	ND2	ND2	<.0014
0	19	ND1	1.4	1.3	0.2	0.1	0.2	ND2	ND2	N/A
1	19	ND1	ND1	ND1	0.2	ND1	ND1	0.1	0.1	N/A
0	20	ND1	1.3	4.7	0.1	ND1	ND1	ND1	0.1	N/A
1	20	ND1	ND1	ND1	0.1	ND1	ND1	0.1	0.1	N/A
0	21	ND1	1.4	1.0	0.3	ND1	ND1	ND1	ND1	N/A
1	21	ND1	ND1	ND1	0.1	ND1	0.1	0.1	0.2	N/A
0	22	ND1	0.1	0.6	0.2	ND1	ND1	ND1	ND1	N/A
1	22	ND1	0.2	3.9	8.8	1.9	2.4	1.6	1.5	N/A
0	23	ND2	9.0	47.6	23.4	ND2	3.4	ND2	ND2	≤.0006
1	23	ND1	0.1	0.9	2.4	0.4	3.7	0.4	0.4	N/A
0	24	ND3	206	3440	2130	24500	22000	-9000	8000	.025
1	24	ND3	81.3	9690	12100	ND3	646	-500	-2000	.024
2	24	ND3	125	19500	20600	ND3	341	2900	3100	.064
0	25	ND2	4.2	6.0	4.6	ND2	1.2	ND2	2.7	N/A
1	25	0.1	1.8	20.6	38.1	11.0	36.9	34.3	27.2	N/A

Summary of Analytical Results for Herbicide Orange, Its Hydrolysis Products and TCDD in the Johnston Island Storage Facilities (Continued)

PAGE FOUR

µg/g

Sample Date Code ^a	Site No.	IMPURITIES		HYDROLYSIS PRODUCTS		HERBICIDE ORANGE COMPONENTS				
		Dichloro-phenol	Trichloro-phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
0	26	ND2	3.8	45.3	88.6	2.2	18.6	≤10	≤20	.010
1	26	ND2	0.2	1.0	6.1	0.2	0.4	1.4	1.4	.003
2	26	ND3	8.0	245	256	ND3	ND3	ND3	ND3	.011
0	27	ND2	3.2	3.1	1.5	0.5	0.5	ND2	ND2	≤.0002
1	27	ND1	0.1	0.5	5.0	0.1	1.1	0.8	0.6	N/A
0	28	ND3	31.8	26800	38800	ND3	316	ND3	ND3	.0002
1	28	ND3	14.3	9010	13200	ND3	461	ND3	ND3	<.0009
0	29	0.7	4.0	13.6	62.8	18.1	69.7	6.2	11.7	.0008
1	29	ND2	0.1	0.2	0.6	ND2	ND1	ND2	1.0	N/A
0	30	ND3	45.1	4480	2600	6980	11800	1400	500	.038
1	30	ND3	22.2	3170	4760	2400	2250	ND3	ND3	.036
2	30	ND3	20.0	708	3270	193	563	340	97	.040
0	31	ND2	4.5	71.8	303	2.3	21.3	≤17	19.9	.002
1	31	ND2	0.3	0.9	6.6	0.5	0.4	1.2	0.5	<.0014
0	32	ND3	138	18800	17700	3590	7680	ND3	ND3	.0007
1	32	ND3	18.8	10100	20100	ND2	ND2	ND3	ND3	≤.0023
0	33	ND1	0.6	13.8	0.4	0.3	1.3	1.1	0.4	N/A
1	33	1.4	27.1	197	151	60.7	4.9	1.3	1.4	N/A
0	34	ND3	23.9	2280	2080	81.5	583	ND3	ND3	.029
1	34	ND3	27.7	3240	7770	ND3	133	ND3	ND3	.152
2	34	ND3	32.0	2970	9130	ND3	10.1	ND3	ND3	.15
0	35	ND3	99.0	16500	14700	350	350	-6000	12000	.008
1	35	ND3	82.5	23400	26100	ND3	444	-4000	-28000	≤.0056

Summary of Analytical Results for Herbicide Orange, Its Hydrolysis Products and TCDD in the Johnston Island Storage Facilities (Continued)

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µg/g

Sample Date Code ^a	Site No.	IMPURITIES		HYDROLYSIS PRODUCTS		HERBICIDE ORANGE COMPONENTS				
		Dichloro-phenol	Trichloro-phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
0	36	ND3	150	15300	10500	37100	44800	ND3	ND3	.015
1	36	ND3	61.1	14200	29900	ND3	841	ND3	ND3	.019
2	36	ND3	179	29200	36600	1040	8570	ND3	ND3	.074
0	37	ND3	223	10800	10800	21000	30200	ND3	ND3	.074
1	37	ND3	113	19900	20600	12300	11900	ND3	ND3	.094
2	37	ND3	81.7	10900	11000	402	1170	<200	<500	.14
0	38	ND3	169	2780	1230	8630	7350	22000	14000	.006
1	38	ND3	134	12900	7840	ND3	1640	~10000	10000	≤.0018
0	39	ND3	38.8	1740	1370	6380	10200	ND3	ND3	.029
1	39	ND3	30.4	1640	2290	1960	2250	ND3	ND3	.041
2	39	ND3	7.9	492	1530	ND3	24.7	ND3	ND3	.050
0	40	ND3	236	11400	9350	31700	29700	13000	5000	.055
1	40	ND3	120	21900	21900	10100	6330	~1000	~2000	.053
2	40	ND3	116	13000	12900	635	1940	2700	2700	.084
0	41	ND3	280	11900	10600	25100	32600	5000	-2200	.085
1	41	ND3	143	26900	29700	10200	5850	-300	-800	.127
2	41	ND3	183	36300	38700	1990	5840	-1000	900	.12
0	42 ^d	ND3	274	2470	5050	16700	17600	~13000	~5000	.025
1	42	ND3	98.7	5460	3930	4430	4390	-1500	-1500	.020
2	42	ND3	108	2650	3330	1060	2600	-2000	-1900	.021
0	43 ^d	ND1	0.1	0.5	0.5	ND1	ND1	ND2	ND2	≤.0001
0	44	ND1	0.4	2.4	23.9	0.4	1.6	ND2	ND2	N/A

Summary of Analytical Results for Herbicide Orange, Its Hydrolysis Products and TCDD in the Johnston Island Storage Facilities (Continued)

PAGE SIX

µg/g

Sample Date Code ^a	Site No.	IMPURITIES		HYDROLYSIS PRODUCTS		HERBICIDE ORANGE COMPONENTS				
		Dichloro-phenol	Trichloro-phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
0	45	ND1	0.1	0.5	2.5	0.1	0.6	ND2	ND2	N/A
0	46 ^d	ND3	203	2830	2170	17800	16100	6000	4000	.024
0	47 ^d	5.8	10.6	574	25.9	10.2	ND1	ND2	ND2	<.0002
0	48 ^d	ND1	0.3	1.2	0.4	ND1	ND1	ND2	ND2	<.0002

^a Sample Date Code: 9 - 25 August 1977
 0 - January 1978
 1 - 18 October 1978
 2 - 8 August 1979

^b ND - none detected: ND1 - lower limit of detectability of 0.1 µg/g
 ND2 - lower limit of detectability of 1.0 µg/g
 ND3 - lower limit of detectability of 100 µg/g

^c N/A - not analyzed

^d Soil depth studies done on Johnston Island sites 42 and 46 in January 1978:

0-42 from 0-8 cm depth at site 42
 0-43 from 8-16 cm depth at site 4
 0-46 from 0-15 cm depth at site 4
 0-47 from 15-30 cm depth at site
 0-48 from 30-45 cm depth at site

TABLE 4

PESTICIDE ANALYSIS RESULTS OF PENETRATION STUDY CORAL SAMPLES TAKEN FROM JOHNSTON ISLAND SITES NO. 10 AND NO. 37 ON 8 AUGUST 1979.

µg/g

Sample Depth (cm)	Dichloro-phenol	Trichloro-phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
Site #10									
0-2	ND3 ^a	120	29200	30200	65.1	257	590	500	.067
2-4	ND3	243	24900	31400	57.9	38.0	630	680	.14
4-6	ND3	115	15200	24100	36.5	19.4	630	220	.17
6-8	ND3	68.0	15600	20100	239	21.4	<240	50	.10
8-12	ND3	44.3	7220	9800	119	37.2	64	22	.042
12-16	ND3	43.6	9930	13600	182	131	60	12	.045
16-20	ND3	52.8	10100	12900	240	398	57	47	.055
20-24	ND3	60.1	9410	10500	364	1020	51	84	.042
Site #37									
0-2	ND3	133	17700	22300	681	2530	280	640	.14
2-4	ND3	108	13500	11500	355	1310	290	840	.14
4-6	ND3	75.5	9570	7290	210	826	300	430	.135
6-8	ND3	10.5	2670	2990	360	17.6	64	210	.049
8-12	ND3	7.9	638	646	ND3	ND2	ND3	ND3	.015
12-16	ND3	7.0	130	230	ND3	ND2	ND3	ND3	.006
16-20	ND3	7.2	286	695	ND3	11.0	ND3	ND3	.011
20-24	ND3	7.9	66.2	138	ND3	ND2	ND3	ND3	.005

^a ND - none detected

ND1 - lower limit of detectability of 0.1 µg/g

ND2 - lower limit of detectability of 1.0 µg/g

ND3 - lower limit of detectability of 100 µg/g

TABLE 6

PESTICIDE ANALYSIS RESULTS OF OCEAN FLOOR SEDIMENT SAMPLES AND CONTROL SOIL SAMPLES FROM JOHNSTON ISLAND AND LABORATORY BLANKS. THE SEDIMENT SAMPLES WERE TAKEN ON 7 AUGUST 1979 AND THE CONTROL SAMPLES FROM SAND ISLAND AND NORTH ISLAND WERE TAKEN IN OCTOBER 1978.

Sample	µg/g								
	Dichloro-phenol	Trichloro-phenol	2,4-D	2,4,5-T	Butyl Ester 2,4-D	Butyl Ester 2,4,5-T	Octyl Ester 2,4-D	Octyl Ester 2,4,5-T	TCDD
JISED-1	0.13	0.03	1.4	2.1	ND1 ^a	ND1	<0.02	<0.04	≤.0005
JISED-2	0.07	0.03	0.2	0.2	ND1	0.01	<0.01	<0.1	≤.001
SAND IS.	ND1	0.02	0.11	0.06	ND1	0.01	ND1	ND1	N/A ^b
NORTH IS.	ND1	0.09	ND1	0.09	ND1	0.02	ND1	ND1	N/A
BLANK-1	ND1	ND1	0.2	0.02	ND1	ND1	ND1	ND1	
BLANK-2	ND1	ND1	0.3	0.07	ND1	0.02	ND1	ND1	

^a ND1 - none detected, lower limit of detectability of 0.1 µg/g.

^b N/A - not analyzed.