DECONTAMINATION OF CHROMIUM-CONTAMINATED SOIL AND WATER

PEARL HARBOR NAVAL SHIPYARD, PEARL HARBOR, HAWAI'I

PHASE 2

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[12]Abstract (Purpose, method, results, conclusions)

Phase 2 of this project represents the analytical monitoring of an estimated 64,800 ft^3 (1 835 m^3) of chromium-contaminated soil, classified as a hazardous waste (>5 mg/ℓ chromium extract concentration as measured by the standard EP toxicity test), that was treated at the Pearl Harbor Naval Shipyard during a two-month period in late 1982. Although the treatment process details (wash-water-detention times, number of wash-water-flow-through times, and type and amount of chemicals) were the contractor's proprietary information, the analytical monitoring treatment process essentially followed the general treatment methods developed in Phase 1 (laboratory and pilot plant studies). The treatment performed by Advanced Environmental Consultants, Inc., of Pittsburgh, Pennsylvania consisted of utilizing 2 yd^3 (1.53 m^3) modified dumpsters as the soil receptacles, using upflow/downflow washing to leach the chromium from the soil, adding a reducing agent to chemically reduce chromium Cr^{+6} to Cr^{+3}, raising the pH to approximately 8.5 to precipitate the chromium from solution and to dewater the chromium laden sludge. Each processed soil batch (nearly all 2 yd^3 dumpster units) were monitored for chromium extract. Only 35 of approximatley 1200 dumpster loads were above the 5-mg/ℓ limit, and these were reprocessed.

ABSTRACT

Phase 2 of this project represents the analytical monitoring of an estimated 64,800 ft^3 (1 835 m^3) of chromium-contaminated soil, classified as a hazardous waste (>5 mg/ℓ chromium extract concentration as measured by the standard EP toxicity test), that was treated at the Pearl Harbor Naval Shipyard during a two-month period in late 1982. Although the treatment process details (wash-water-detention times, number of wash-water-flow-through times, and type and amount of chemicals) were the contractor's proprietary information, the analytical monitoring treatment process essentially followed the general treatment methods developed in Phase 1 (laboratory and pilot plant studies). The treatment performed by Advanced Environmental Consultants, Inc., of Pittsburgh, Pennsylvania consisted of utilizing 2 yd^3 (1.53 m^3) modified dumpsters as the soil receptacles, using upflow/downflow washing to leach the chromium from the soil, adding a reducing agent to chemically reduce chromium Cr^{+6} to Cr^{+3}, raising the pH to approximately 8.5 to precipitate the chromium from solution and to dewater the chromium laden sludge. Each processed soil batch (nearly all 2 yd^3 dumpster units) were monitored for chromium extract. Only 35 of approximately 1200 dumpster loads were above the 5-mg/ℓ limit, and these were reprocessed.

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INTRODUCTION

An estimated 60,000 ft^3 (1 699 m^3) of soil was found to be contaminated with chromium under and adjacent to the new pipe shop at the Pearl Harbor U.S. Naval Shipyard. The contaminated soil was excavated and stored temporarily in an adjacent building (3A); however, the original schedule called for the contaminated soil to be completely removed from the building by 1 November 1982* (Mau 1981*a*, *b*).

The chromium-contaminated soil is classified as a hazardous waste, inasmuch as the soil leachate, measured by the standard EP toxicity test procedure (U.S. EPA 1980), has a chromium extract concentration of >5 mg/ℓ (hazardous waste limit). If the chromium concentration of the soil cannot be treated to an acceptable level (<5 mg/ℓ), then the next feasible recourse would be to place the material in 55-gal (208-ℓ) drums and to ship the drums to the continental United States for disposal in a Class 1 landfill, resulting in an estimated overall cost of $500/drum (Mau 1981*a*).

The technical feasibility of leaching the chromium from the soil to extract concentrations of <5 mg/ℓ and of concentrating and dewatering the chromium residue on a laboratory and pilot plant scale was demonstrated in Phase 1 of this project (Dugan, Gee, and Lau 1982), which was performed by the Water Resources Research Center (WRRC), University of Hawaii at Manoa. Once the soil is leached of chromium to safe levels, it can be readily handled by normal soil application, stockpiling, and disposal practices. The results of Phase 1 confirmed a preliminary laboratory study by Yamamoto (1981*a*) that the chromium contaminated soil could be leached to an extract concentration of <5 mg/ℓ.

The results of Phase 1 proved basically that by means of simple tech-

*F.K.Y. Mau 1981: personal communication.

nology, chromium could be effectively leached from the soil to a safe level by (1) using a weighted soil to a water ratio of approximately 1 to 4, (2) reducing the pH of the chromium-laden leachate to about 2.5, (3) adding sodium metabisulfite to chemically reduce chromium from Cr^{+6} to Cr^{+3}, and (4) raising the pH to around 8.5 to precipitate the chromium from solution. After a 3 day, sludge-settling time, the precipitated sludge (1.65% solids/ 98.35% water) consisted of a volume that was approximately 6% of that occupied by the original soil volume. The precipitated sludge would probably require further dewatering in order to decrease the volume for shipping purposes.

Because of the Phase 1 time restrictions (45 days from initiation of the project to completion of the report), only the treatment options that appeared the most promising in the literature or by preliminary testing were explored.

A call for proposals to remove the approximately 60,000 ft^3 (1 699 m^3) of chromium-contaminated soil from Building 3A at the Pearl Harbor Naval Shipyard was issued by the Pacific Division Facilities Command at Pearl Harbor during the spring of 1982. The final Phase 1 report was sent to contractors that expressed an interest in removing the chromium-contaminated soil. Thus, contractors could submit a bid to (1) remove the soil as is and ship it to a Class 1 landfill in the continental United States, or (2) treat the soil to a chromium extract concentration of <5 mg/ℓ for local safe disposal/reuse and ship only the concentrated chromium residue to a Class 1 landfill.

Proposals were received by the U.S. Navy for both soil removal as is and by treatment; however, the low bidders were those who chose the treatment option. The contract was awarded in the summer of 1982 to the low

bidder, Advanced Environmental Consultants, Inc. (AEC) in Pittsburgh, Pennsylvania.

The treatment initially proposed by AEC was basically the same process as was utilized in the Phase 1 pilot plant study except that the soil/rock mixture was crushed for passage through small diameter pipes during the chromium leaching process, and sodium hydroxide was used to raise the pH prior to adding lime (which was used to precipitate the chromium out of solution). Sodium hydroxide was utilized, rather than relying entirely on lime as in Phase 1, to raise the pH in order to decrease the quantity of lime-based sludge formed. Quality chromium tests, laboratory studies, and a proposed treatment process were prepared in report-type forms by AEC (1982*a*, *b*, *c*). The AEC laboratory findings essentially confirmed the Phase 1 results.

The soil treatment facilities at the Pearl Harbor Naval Shipyard's Building 3A site were established in August and September 1982 with testing of equipment and procedures being performed during the latter part of September and the first part of October. The crushing of the soil/rock mixture proved too time consuming and costly. Thereafter, modified 2-yd^3 (1.53-m^3) dumpsters (using the upflow/downflow washing principal) were substituted for the crushing/leaching treatment component (Sain 1982). The actual full-scale treatment process commenced just past mid-October 1982.

Although the proposed treatment process methods and facility plans were prepared and distributed on a limited basis to the U.S. Navy and WRRC (AEC 1982*a*, *b*, *c*), the actual process (wash-water-detention times, number of wash-water-flow-through times, type and amount of chemicals used) was the responsibility of the contractor, and thus not available for public distribution. The contractor was essentially only required to remove the soil

from Building 3A and safely treat/dispose of it in an acceptable and legal manner within the contract time limit. Thus, the details of the treatment process were considered the contractor's privileged or proprietary information.

PURPOSE AND SCOPE

The purpose of the Phase 2 project was to (1) provide monitoring and technical services during the operation of the full-scale treatment facility, (2) prepare a final report based on the monitoring results, and (3) test the treated soil and the process water that will be discharged to the U.S. Navy Fort Kamehameha Waste Water Treatment Plant. However, only the monitoring aspects per se will be reported herein since the actual treatment parameters are essentially the contractor's proprietary information and not available for public distribution. In addition the treatment site Building 3A was in a high-restricted area, which requires CIA-approved passes to enter; thus, the taking of photographs by the contractors, within this area, was strictly forbidden.

METHODOLOGY

After it was determined that the approximately 2 yd^3 (1.53 m^3) modified dumpsters would be utilized as the soil treatment units, it was directed that three separate soil samples be taken from each dumpster load, following treatment from, as much as possible, the top third, middle third, and the bottom third of the individually dumped piles (Mau 1982*c*). Mainly because of space limitations within Building 3A, the individual 2-yd^3 piles were initially deposited into larger piles; however, when the analysis of

composited samples from these piles proved to be >5 mg/ℓ chromium extract, the entire pile required reprocessing, even though only one of these individual 2-yd^3 piles were possibly in violation. Adding to the space limitations was the 6 ft (1.83 m) maximum height restriction for the soil stored in Building 3A, in order to protect the underlying concrete floor slab.

The U.S. Navy's Resident Officer in Charge of Construction (ROICC) was responsible for collection of the treated soil samples (Mau 1982*c*). The composited treated soil sample was collected in 1- to 2-lb (0.45-0.91 kg) lots and placed in plastic bags provided by the WRRC. The bags containing the samples were picked up daily at the treatment site and transported to the Sanitary Engineering Research Laboratory, Holmes Hall, University of Hawaii at Manoa, Honolulu, for analysis. The analyses were required to be reported back to AEC within 48 hr, with samples containing >5 mg/ℓ chromium extract to be reported also to the ROICC and the Navy's project design engineer. In addition, WRRC also periodically collected random composited samples from the individually treated piles as a double check. The ROICC was responsible for granting permission to the AEC for the disposal of the treated soil by hauling it to the U.S. Navy's Barbers Point landfill.

The analysis for the chromium extract of the treated soil and process water followed the EPA standard EP toxicity test procedures (EPA 1980) and/or their approved procedures as appropriate (APHA, AWWA, and WPCF 1980). The EPA extraction procedure for soil calls for 24 hr of shaking, with the final concentration level being determined by atomic absorption spectrophotometric method.

RESULTS AND DISCUSSIONS

The analytical results of the chromium extract concentration of the

the 5-mg/ℓ value, they directly reprocessed the loads without submitting them to the WRRC for analysis. In the initial part of the treatment operation some sample numbers were not assigned.

Eight dumpster loads (Nos. 596, 621, 629, 630, 638, 641, 649, 1075) between 1 December 1982 and the termination of soil treatment on 23 December 1982 that exceeded the 5 mg/ℓ chromium extract limit, did not again appear with the "R" designation. These eight loads were reported to have been mixed back in the unprocessed pile for reprocessing.*

The 35 values which exceeded the 5 mg/ℓ chromium extract limit had a median value of 5.8 mg/ℓ, a mean of 6.2 mg/ℓ, and a high value of 12.7 mg/ℓ. During the treatment operation the WRRC randomly collected 26 samples and in only one case did the WRRC randomly collected sample give a value higher than the 5-mg/ℓ limit, while the ROICC sample was lower than the limit (composite load Nos. 036, 037, 038; 6.1 vs. 3.3 mg/ℓ), and this was during the first week of operation.

It must be remembered that in any type of sampling procedure, and especially in situations such as the present when a heterogeneous soil mixutre is involved, that samples collected at different locations within the dumpster load may result in notably different constituent concentration values. However, the law of random sampling is assumed to prevail.

From Appendix Table A.1 it appears that, within a ±5 range, 1200 initial dumpster loads (excluding reprocessed loads) were processed between 18 October and 23 December 1982 which represents the entire volume of chromium-contaminated soil stored in Building 3A. At the reported volume of 2 yd^3 (1.53 m^3) per dumpster load (Sain 1982) this amounts to 2400 yd^3 or 64,800 ft^3 (1 835 m^3), which is reasonably close to the original U.S. Navy

*V.K. Yamamoto 1983: personal communication.

estimate of 60,000 ft^3 (1 699 m^3) (Mau 1981*a*). Some change in volume would be expected between the stored soil volume in Building 3A and the volume after being processed within the dumpsters due to difference in packing, the volume of the leached chromium and carry-over solids, and the difference in moisture, which averaged approximately 19% under stored conditions (Dugan, Gee, and Lau 1982) and 26% after being processed in the dumpsters.

The maximum chromium limits of the process water discharge to the U.S. Navy Fort Kamehameha Waste Water Treatment Plant are 2.5 mg/ℓ (average) for total chromium (5.0 mg/ℓ maximum concentration) and 0.25 mg/ℓ as hexavalent chromium (Cr^{+6}) (0.50 mg/ℓ maximum).* Only three process water discharge samples were submitted for analysis, and the values were well within the given limitations (Table 1).

TABLE 1. CHROMIUM CONCENTRATION OF PROCESS WATER PRIOR TO DISPOSAL

1982	CHROMIUM	
	Total	Hexavalent
	(mg/ℓ)	
10/06	0.08	0.00
12/02	1.30	0.01
12/26	0.08	0.00

*V.K. Yamamoto 1981: personal communication.

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APPENDIX TABLE A.1. CHROMIUM CONCENTRATION SAMPLES AFTER TREATMENT FOR DECONTAMINATION, NAVAL SHIPYARD, PEARL HARBOR, OAHU, HAWAI'I

TREATED SAMPLE 1982	I.D. No.	SAMPLE COLLECTOR ROICC*	WRRC	TOTAL Cr IN SOIL EXTRACT (mg/ℓ)†
10/19	001	✓	-	2.6
10/19	002	✓	-	0.7
10/19	003	✓	-	3.2
10/18	004	✓	-	4.9
10/18	005	✓	-	3.0
10/19	006	✓	-	2.5
10/19	007	✓	-	1.7
10/19	008	✓	-	3.6
10/19	009	✓	-	3.7
10/19	010	✓	-	0.8
10/19	011	✓	-	1.6
10/21	012	✓	-	2.0
10/21	013	✓	-	1.3
10/21	014	✓	-	2.3
10/20	016	✓	-	2.6
10/21	018-019-020[a]	✓	-	1.8
10/21	021-022-023[a]	✓	-	4.1
10/21	024-025-026[a]	✓	-	1.6
10/21	027-028-029[a]	✓	-	6.2‡
10/21	027	✓	-	1.9
10/21	028	✓	-	7.0‡
10/21	029	✓	-	6.0‡
10/21	030-031-032[a]	✓	-	1.9
10/21	033-034-035[a]	✓	-	5.9‡
10/21	033-034-035[b]	-	✓	6.4‡
10/21	033	✓	-	2.5
10/21	034	✓	-	3.1
10/21	035	✓	-	8.6‡
10/21	036-037-038[a]	✓	-	3.3
10/22	036-037-038[b]	-	✓	6.1‡
10/21	039-040-041[a]	✓	-	2.9
10/22	042-043-044[a]	✓	-	1.3
10/22	045-046-047[a]	✓	-	5.8‡
10/22	045	✓	-	1.9
10/22	046	✓	-	12.7‡
10/22	047	✓	-	2.1
10/22	048-049-050[a]	✓	-	3.1
10/22	051-052-053[a]	✓	-	4.3
10/22	054-055-056[a]	✓	-	4.0
10/22	057-058-059[a]	✓	-	2.6

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.

†U.S. EPA, EP Toxicity Test.

‡Exceeded 5-mg/ℓ limit.

[a]Composite of 3 separate samples.

[b]Collected from processed pile on site, containing 3 separate dumpster loads.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE 1982	I.D. No.	SAMPLE COLLECTOR ROICC*	WRRC	TOTAL Cr IN SOIL EXTRACT (mg/ℓ)†
11/03	148	✓	-	3.5
11/03	149	✓	-	1.9
11/03	150	✓	-	2.8
11/03	151	✓	-	2.4
11/03	152	✓	-	2.1
11/03	153	✓	-	6.7‡
11/03	154	✓	-	2.7
11/03	155	✓	-	3.2
11/03	156	✓	-	3.5
11/04	157	✓	-	3.0
11/04	158	✓	-	2.0
11/04	159	✓	-	2.3
11/04	160	✓	-	2.0
11/04	161	✓	-	2.3
11/04	162	✓	-	2.9
11/04	163	✓	-	2.8
11/04	164	✓	-	2.3
11/04	165	✓	-	4.2
11/04	166	✓	-	4.3
11/04	167	✓	-	3.4
11/04	168	✓	-	1.9
11/04	169	✓	-	1.8
11/04	170	✓	-	1.9
11/04	171	✓	-	2.0
11/04	133R[e]	✓	-	3.2
11/04	134R[e]	✓	-	1.9
11/05	153R[e]	✓	-	5.0‡[d]
11/05	172	✓	-	1.0
11/05	173	✓	-	1.7
11/05	174	✓	-	0.8
11/05	175	✓	-	1.4
11/05	176	✓	-	1.1
11/05	177	✓	-	1.0
11/05	178	✓	-	3.3
11/05	179	✓	-	2.4
11/05	180	✓	-	2.9
11/05	181	✓	-	0.9
11/05	182	✓	-	2.1
11/05	183	✓	-	2.0
11/05	184	✓	-	2.2
11/05	185	✓	-	2.8
11/05	186	✓	-	2.3
11/05	187	✓	-	2.2
11/05	188	✓	-	2.3

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
‡Exceeded 5-mg/ℓ limit.
[d]Average of 2 separate analyses.
[e]Reprocessed load.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/05	189	✓	-	3.5
11/05	190	✓	-	2.9
11/06	191	✓	-	2.2
11/06	192	✓	-	1.3
11/06	193	✓	-	1.8
11/08	194	✓	-	2.4
11/08	195	✓	-	2.7
11/08	196	✓	-	2.4
11/08	197	✓	-	1.9
11/08	198	✓	-	1.0
11/08	199	✓	-	0.7
11/08	200	✓	-	1.3
11/08	201	✓	-	2.2
11/08	202	✓	-	2.4
11/08	203	✓	-	2.4
11/08	204	✓	-	1.5
11/08	205	✓	-	2.1
11/08	206	✓	-	1.5
11/08	207	✓	-	2.7
11/08	208	✓	-	3.6
11/08	209	✓	-	1.7
11/08	210	✓	-	1.8
11/08	211	✓	-	1.4
11/08	212	✓	-	1.9
11/08	213	✓	-	1.6
11/08	214	✓	-	5.0‡
11/08	153RR[f]	✓	-	3.7
11/09	215	✓	-	1.7
11/09	216	✓	-	2.5
11/09	217	✓	-	2.3
11/09	218	✓	-	2.9
11/09	219	✓	-	1.7
11/09	220	✓	-	2.7
11/09	221	✓	-	2.9
11/09	222	✓	-	2.7
11/09	223	✓	-	2.9
11/09	224	✓	-	2.2
11/09	225	✓	-	2.1
11/09	226	✓	-	2.3
11/09	227	✓	-	2.2
11/09	228	✓	-	2.3
11/09	229	✓	-	2.1
11/09	230	✓	-	2.5
11/09	231	✓	-	1.9
11/09	232	✓	-	2.1

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
‡Exceeded 5-mg/ℓ limit.
[f]Reprocessed twice.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/09	233	✓	-	2.0
11/09	234	✓	-	1.9
11/09	235	✓	-	2.7
11/10	236	✓	-	1.5
11/10	237	✓	-	1.5
11/10	238	✓	-	1.4
11/10	239	✓	-	1.3
11/10	240	✓	-	2.9
11/10	241	✓	-	2.2
11/10	242	✓	-	1.7
11/10	243	✓	-	1.5
11/10	244	✓	-	2.8
11/10	245	✓	-	2.3
11/10	246	✓	-	1.7
11/10	247	✓	-	1.5
11/10	248	✓	-	1.7
11/10	249	✓	-	1.8
11/10	250	✓	-	1.6
11/10	251	✓	-	1.7
11/10	252	✓	-	1.6
11/10	253	✓	-	1.9
11/10	254	✓	-	2.0
11/10	255	✓	-	1.6
11/11	256	✓	-	2.4
11/11	257	✓	-	1.8
11/10	214R[e]	✓	-	3.5
11/11	258	✓	-	1.8
11/11	259	✓	-	0.9
11/11	260	✓	-	0.7
11/11	261	✓	-	1.9
11/11	262	✓	-	1.9
11/11	263	✓	-	1.4
11/11	264	✓	-	2.0
11/11	265	✓	-	2.6
11/11	266	✓	-	1.4
11/11	267	✓	-	2.3
11/11	268	✓	-	2.8
11/11	269	✓	-	1.5
11/11	270	✓	-	0.1
11/11	271	✓	-	1.4
11/11	272	✓	-	1.4
11/11	273	✓	-	2.0
11/11	274	✓	-	1.3
11/11	275	✓	-	1.4
11/11	276	✓	-	1.1
11/12	277	✓	-	1.0

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
[e]Reprocessed load.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/12	278	✓	-	1.9
11/12	279	✓	-	1.2
11/12	280	✓	-	1.9
11/12	281	✓	-	1.7
11/12	282	✓	-	1.2
11/12	283	✓	-	2.1
11/12	284	✓	-	1.2
11/12	285	✓	-	1.6
11/12	286	✓	-	2.0
11/12	287	✓	-	1.5
11/12	288	✓	-	3.1
11/12	289	✓	-	2.0
11/12	290	✓	-	1.9
11/12	291	✓	-	1.5
11/12	292	✓	-	1.5
11/12	293	✓	-	1.9
11/12	294	✓	-	1.4
11/12	295	✓	-	2.6
11/13	296	✓	-	1.6
11/13	297	✓	-	1.7
11/13	298	✓	-	1.2
11/13	299	✓	-	2.1
11/13	300	✓	-	3.1
11/13	301	✓	-	2.2
11/13	302	✓	-	2.8
11/13	303	✓	-	2.2
11/13	304	✓	-	2.7
11/13	305	✓	-	3.5
11/13	306	✓	-	1.9
11/13	307	✓	-	1.8
11/13	308	✓	-	1.8
11/13	309	✓	-	1.8
11/13	310	✓	-	2.1
11/13	311	✓	-	2.0
11/13	312	✓	-	1.7
11/13	313	✓	-	2.0
11/13	314	✓	-	1.9
11/13	315	✓	-	2.1
11/13	316	✓	-	1.8
11/13	317	✓	-	2.5
11/13	318	✓	-	1.8
11/15	319	✓	-	0.4
11/15	320	✓	-	0.7
11/15	321	✓	-	0.6
11/15	322	✓	-	1.4
11/15	323	✓	-	1.4
11/15	324	✓	-	2.6

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/15	325	✓	-	1.7
11/15	326	✓	-	1.5
11/15	327	✓	-	1.9
11/15	328	✓	-	0.8
11/15	329	✓	-	0.2
11/15	330	✓	-	0.0
11/15	331	✓	-	0.7
11/15	332	✓	-	2.2
11/15	333	✓	-	2.1
11/15	334	✓	-	0.3
11/15	335	✓	-	0.3
11/15	336	✓	-	1.5
11/15	337	✓	-	1.3
11/15	338	✓	-	1.0
11/15	339	✓	-	1.0
11/15	340	✓	-	1.0
11/16	341	✓	-	1.1
11/16	342	✓	-	0.4
11/16	343	✓	-	1.3
11/16	344	✓	-	1.1
11/16	345	✓	-	0.9
11/16	346	✓	-	0.8
11/16	347	✓	-	0.9
11/16	348	✓	-	0.6
11/16	349	✓	-	1.6
11/16	350	✓	-	0.8
11/16	351	✓	-	1.7
11/16	352	✓	-	1.9
11/16	353	✓	-	1.2
11/16	354	✓	-	1.4
11/16	355	✓	-	2.1
11/16	356	✓	-	1.4
11/16	357	✓	-	1.8
11/16	358	✓	-	0.7
11/16	359	✓	-	1.1
11/16	360	✓	-	0.9
11/16	361	✓	-	1.2
11/16	362	✓	-	1.2
11/16	363	✓	-	1.3
11/16	364	✓	-	2.6
11/16	365	✓	-	1.0
11/16	366	✓	-	0.8
11/17	367	✓	-	0.8
11/17	368	✓	-	0.8
11/17	369	✓	-	1.3
11/17	370	✓	-	1.0
11/17	371	✓	-	1.5

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.

†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/17	372	✓	-	0.5
11/17	373	✓	-	1.6
11/17	374	✓	-	1.3
11/17	375	✓	-	0.8
11/17	376	✓	-	1.5
11/18	376	-	✓	1.8
11/17	377	✓	-	1.4
11/17	378	✓	-	1.6
11/17	379	✓	-	1.4
11/17	380	✓	-	1.1
11/17	381	✓	-	1.5
11/17	382	✓	-	1.6
11/17	383	✓	-	1.6
11/17	384	✓	-	2.4
11/17	385	✓	-	2.0
11/17	386	✓	-	2.0
11/17	387	✓	-	1.5
11/17	388	✓	-	2.5
11/17	389	✓	-	2.1
11/17	390	✓	-	1.8
11/18	391	✓	-	1.0
11/18	392	✓	-	1.0
11/18	393	✓	-	1.3
11/18	394	✓	-	1.9
11/18	395	✓	-	1.6
11/18	396	✓	-	2.0
11/18	397	✓	-	2.1
11/18	398	✓	-	3.1
11/18	399	✓	-	2.3
11/18	400	✓	-	2.2
11/18	401	✓	-	2.2
11/18	402	✓	-	3.3
11/18	403	✓	-	1.5
11/18	404	✓	-	2.8
11/18	405	✓	-	3.5
11/18	406	✓	-	2.5
11/18	407	✓	-	3.9
11/18	408	✓	-	2.6
11/18	409	✓	-	2.7
11/18	410	✓	-	2.8
11/19	411	✓	-	3.6
11/19	412	✓	-	2.5
11/19	412	-	✓	4.6
11/19	413	✓	-	2.4
11/19	414	✓	-	1.6
11/19	415	✓	-	2.2
11/19	416	✓	-	1.8

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/19	417	✓	-	1.0
11/19	418	✓	-	2.0
11/19	419	✓	-	2.1
11/19	420	✓	-	1.5
11/19	421	✓	-	2.2
11/19	422	✓	-	3.7
11/19	423	✓	-	2.5
11/19	424	✓	-	4.2
11/19	425	✓	-	2.4
11/19	426	✓	-	2.0
11/19	427	✓	-	1.0
11/19	428	✓	-	1.8
11/19	429	✓	-	1.0
11/19	430	✓	-	2.0
11/19	431	✓	-	2.1
11/19	432	✓	-	2.1
11/19	433	✓	-	1.3
11/19	434	✓	-	1.3
11/22	435	✓	-	1.5
11/22	436	✓	-	2.7
11/22	437	✓	-	1.5
11/22	438	✓	-	1.6
11/22	439	✓	-	1.8
11/22	440	✓	-	2.4
11/22	441	✓	-	3.0
11/22	442	✓	-	1.2
11/22	443	✓	-	1.5
11/22	444	✓	-	1.9
11/22	445	✓	-	1.6
11/22	446	✓	-	1.8
11/23	446	-	✓	1.4
11/22	447	✓	-	2.4
11/22	448	✓	-	2.4
11/22	449	✓	-	1.7
11/23	450	✓	-	2.7
11/23	451	✓	-	1.6
11/23	452	✓	-	1.0
11/23	453	✓	-	1.2
11/23	454	✓	-	1.6
11/23	455	✓	-	1.3
11/23	456	✓	-	1.2
11/23	457	✓	-	1.6
11/23	458	✓	-	1.2
11/23	459	✓	-	2.1
11/23	460	✓	-	1.9
11/23	461	✓	-	2.3
11/23	462	✓	-	2.7

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.

†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/23	463	✓	-	2.5
11/23	464	✓	-	1.9
11/24	465	✓	-	2.1
11/24	466	✓	-	2.4
11/24	467	✓	-	1.6
11/24	468	✓	-	1.5
11/24	469	✓	-	1.6
11/24	470	✓	-	1.8
11/24	471	✓	-	3.8
11/24	472	✓	-	1.6
11/24	473	✓	-	2.7
11/24	474	✓	-	3.3
11/24	475	✓	-	2.4
11/24	476	✓	-	2.8
11/26	476	-	✓	2.7
11/24	477	✓	-	2.7
11/24	478	✓	-	3.0
11/24	479	✓	-	3.4
11/24	480	✓	-	2.8
11/24	481	✓	-	1.4
11/24	482	✓	-	1.6
11/25	483	✓	-	1.8
11/25	484	✓	-	1.9
11/25	485	✓	-	1.7
11/25	486	✓	-	2.5
11/25	487	✓	-	1.8
11/26	488	✓	-	1.4
11/26	489	✓	-	1.3
11/26	490	✓	-	1.2
11/26	491	✓	-	1.6
11/26	492	✓	-	1.3
11/26	493	✓	-	2.2
11/26	494	✓	-	1.3
11/26	495	✓	-	1.7
11/26	496	✓	-	1.7
11/26	497	✓	-	2.3
11/26	498	✓	-	2.0
11/26	499	✓	-	2.1
11/26	500	✓	-	2.0
11/26	501	✓	-	3.3
11/26	502	✓	-	3.6
11/26	503	✓	-	2.8
11/26	504	✓	-	2.9
11/26	505	✓	-	1.4
11/26	506	✓	-	2.2
11/26	507	✓	-	2.8
11/26	508	✓	-	2.4

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/26	509	✓	-	2.6
11/26	510	✓	-	1.5
11/26	511	✓	-	2.0
11/26	512	✓	-	1.9
11/26	513	✓	-	2.2
11/26	514	✓	-	1.6
11/26	515	✓	-	3.5
11/26	516	✓	-	2.3
11/26	517	✓	-	1.8
11/26	518	✓	-	1.8
11/26	519	✓	-	0.8
11/26	520	✓	-	1.8
11/26	521	✓	-	2.1
11/26	522	✓	-	1.4
11/26	523	✓	-	1.3
11/26	524	✓	-	1.5
11/27	525	✓	-	2.7
11/27	526	✓	-	3.6
11/27	527	✓	-	3.9
11/27	528	✓	-	6.0‡
11/27	529	✓	-	2.8
11/27	530	✓	-	4.6
11/27	531	✓	-	4.4
11/27	532	✓	-	5.4‡
11/27	533	✓	-	3.0
11/27	534	✓	-	3.0
11/27	535	✓	-	5.0‡
11/27	536	✓	-	3.1
11/27	537	✓	-	5.3‡
11/27	538	✓	-	5.4‡
11/27	539	✓	-	4.1
11/27	540	✓	-	5.9‡
11/29	541	✓	-	4.0
11/29	542	✓	-	4.2
11/29	543	✓	-	5.0‡
11/29	544	✓	-	4.5
11/29	545	✓	-	3.2
11/29	546	✓	-	2.9
11/29	547	✓	-	3.3
11/30	547	-	✓	2.9
11/29	548	✓	-	1.9
11/29	549	✓	-	3.4
11/29	550	✓	-	2.9
11/29	551	✓	-	2.9
11/29	552	✓	-	1.7
11/29	553	✓	-	2.8

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
‡Exceeded 5-mg/ℓ limit.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
11/30	553	-	✓	2.6
11/29	554	✓	-	2.1
11/29	555	✓	-	3.1
11/29	556	✓	-	2.8
11/29	557	✓	-	4.1
11/29	558	✓	-	2.8
11/29	559	✓	-	2.8
11/29	560	✓	-	3.4
11/29	561	✓	-	3.2
11/29	562	✓	-	3.3
11/29	563	✓	-	3.8
11/29	564	✓	-	3.6
11/29	565	✓	-	2.8
11/29	566	✓	-	3.0
11/29	528R[e]	✓	-	4.95
11/29	532R[e]	✓	-	2.9
11/29	535R[e]	✓	-	4.8
11/29	537R[e]	✓	-	4.4
11/29	538R[e]	✓	-	6.6‡
11/29	540R[e]	✓	-	3.4
11/30	567	✓	-	2.6
11/30	568	✓	-	3.0
11/30	569	✓	-	2.4
11/30	570	✓	-	2.8
11/30	571	✓	-	2.6
11/30	572	✓	-	4.3
11/30	573	✓	-	3.2
11/30	574	✓	-	5.3‡
11/30	575	✓	-	4.1
11/30	576	✓	-	6.2‡
11/30	577	✓	-	5.3‡
11/30	578	✓	-	5.8‡
11/30	579	✓	-	5.3‡
11/30	580	✓	-	5.2‡
11/30	581	✓	-	4.3
11/30	582	✓	-	4.1
11/30	583	✓	-	3.2
11/30	584	✓	-	3.6
11/30	585	✓	-	4.3
11/30	543R[e]	✓	-	4.8
12/01	586	✓	-	4.2
12/01	587	✓	-	3.6
12/01	588	✓	-	3.6
12/01	589	✓	-	2.6
12/01	590	✓	-	4.2

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
‡Exceeded 5-mg/ℓ limit.
[e]Reprocessed load.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/01	591	✓	-	9.0‡
12/01	592	✓	-	5.0‡
12/01	593	✓	-	1.8
12/01	594	✓	-	2.1
12/01	595	✓	-	2.6
12/01	596	✓	-	5.7‡
12/01	597	✓	-	2.7
12/01	598	✓	-	2.7
12/01	599	✓	-	3.4
12/01	600	✓	-	2.8
12/01	601	✓	-	2.4
12/01	602	✓	-	1.7
12/01	603	✓	-	2.3
12/01	604	✓	-	2.8
12/01	605	✓	-	2.6
12/01	606	✓	-	3.0
12/01	607	✓	-	3.9
12/01	608	✓	-	4.9
12/01	609	✓	-	4.1
12/01	610	✓	-	2.0
12/01	611	✓	-	2.1
12/01	612	✓	-	2.0
12/01	538RR[f]	✓	-	3.3
12/02	613	✓	-	1.6
12/02	614	✓	-	2.8
12/02	615	✓	-	2.9
12/02	616	✓	-	3.1
12/02	617	✓	-	2.1
12/02	618	✓	-	2.0
12/02	619	✓	-	3.2
12/02	620	✓	-	3.2
12/02	620	-	✓	4.6
12/02	621	✓	-	5.7‡
12/02	622	✓	-	3.3
12/02	623	✓	-	3.6
12/02	624	✓	-	3.8
12/02	625	✓	-	1.1
12/02	626	✓	-	3.1
12/02	627	✓	-	3.3
12/02	628	✓	-	2.0
12/02	629	✓	-	6.8‡
12/02	630	✓	-	5.1‡
12/02	631	✓	-	4.8
12/02	632	✓	-	2.0
12/02	633	✓	-	2.4

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
‡Exceeded 5-mg/ℓ limit.
[f]Reprocessed twice.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE 1982	I.D. No.	SAMPLE COLLECTOR ROICC*	WRRC	TOTAL Cr IN SOIL EXTRACT (mg/ℓ)†
12/02	634	✓	-	2.4
12/02	635	✓	-	1.7
12/02	636	✓	-	2.4
12/02	637	✓	-	2.2
12/02	638	✓	-	8.7‡
12/02	574R[e]	✓	-	4.4
12/02	576R[e]	✓	-	3.7
12/02	577R[e]	✓	-	3.3
12/02	578R[e]	✓	-	3.4
12/02	579R[e]	✓	-	4.2
12/02	580R[e]	✓	-	3.6
12/02	591R[e]	✓	-	3.5
12/02	592R[e]	✓	-	4.7
12/03	639	✓	-	2.2
12/03	640	✓	-	2.5
12/03	641	✓	-	7.4‡
12/03	642	✓	-	1.4
12/03	643	✓	-	2.8
12/03	644	✓	-	2.1
12/03	645	✓	-	3.4
12/03	646	✓	-	3.2
12/03	647	✓	-	4.8
12/03	648	✓	-	2.1
12/03	649	✓	-	5.4‡
12/03	650	✓	-	2.8
	651 (Sample number missing)			
12/03	652	✓	-	0.7
12/03	653	✓	-	1.2
12/03	654	✓	-	1.1
12/03	655	✓	-	0.8
12/03	656	✓	-	2.1
12/03	657	✓	-	2.7
12/03	658	✓	-	1.9
12/03	659	✓	-	3.4
12/03	660	✓	-	3.5
12/03	661	✓	-	2.4
12/04	662	✓	-	1.4
12/04	663	✓	-	1.1
12/04	664	✓	-	2.2
12/04	665	✓	-	1.5
12/04	666	✓	-	2.2
12/04	667	✓	-	2.4
12/04	668	✓	-	2.8
12/04	669	✓	-	2.3
12/06	670	✓	-	0.9

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
‡Exceeded 5-mg/ℓ limit.
[e]Reprocessed load.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/06	718	✓	-	0.9
12/07	718	-	✓	0.1
12/06	719	✓	-	1.3
12/06	720	✓	-	1.2
12/06	721	✓	-	0.0
12/06	722	✓	-	0.7
12/06	723	✓	-	0.4
12/06	724	✓	-	0.8
12/06	725	✓	-	1.1
12/06	726	✓	-	0.1
12/06	727	✓	-	0.6
12/06	728	✓	-	1.2
12/06	729	✓	-	0.6
12/06	730	✓	-	0.5
12/06	731	✓	-	1.0
12/06	732	✓	-	0.7
12/08	732	-	✓	1.1
12/06	733	✓	-	1.6
12/06	734	✓	-	1.5
12/06	735	✓	-	0.7
12/06	736-737[g]	✓	-	0.9
12/06	738-739[g]	✓	-	2.0
12/07	740	✓	-	2.9
12/08	741	✓	-	0.2
12/08	742	✓	-	0.2
12/08	743	✓	-	0.5
12/08	744	✓	-	1.0
12/08	745	✓	-	0.2
12/08	746	✓	-	0.1
12/08	747	✓	-	0.5
12/08	748-749[g]	✓	-	1.2
12/08	750-751[g]	✓	-	0.4
12/08	752-753[g]	✓	-	0.4
12/08	754	✓	-	0.6
12/08	755	✓	-	0.7
12/08	756	✓	-	1.2
12/08	757	✓	-	0.7
12/08	758	✓	-	1.7
12/08	759	✓	-	0.9
12/08	760	✓	-	0.4
12/08	761	✓	-	1.2
12/08	762	✓	-	1.2
12/08	763	✓	-	1.4
12/08	764	✓	-	3.2
12/09	765	✓	-	0.8
12/09	766	✓	-	1.3

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
[g]Composite by ROICC.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/09	767	✓	-	0.4
12/09	768	✓	-	0.0
12/09	769	✓	-	1.4
12/09	770	✓	-	1.1
12/09	771	✓	-	1.0
12/09	772	✓	-	1.5
12/09	773	✓	-	1.5
12/09	774	✓	-	1.5
12/09	775	✓	-	0.4
12/09	776	✓	-	0.6
12/09	777	✓	-	0.6
12/09	778	✓	-	0.8
12/09	779	✓	-	0.6
12/09	780	✓	-	1.2
12/09	781	✓	-	1.2
12/09	782	✓	-	2.2
12/09	783	✓	-	0.4
12/09	784	✓	-	0.3
12/09	785	✓	-	0.3
12/09	786	✓	-	1.4
12/09	787	✓	-	1.2
12/09	788	✓	-	0.2
12/09	789	✓	-	0.2
12/09	790	✓	-	0.3
12/09	791	✓	-	0.3
12/09	792	✓	-	0.6
12/09	793	✓	-	0.4
12/09	794	✓	-	0.5
12/09	795	✓	-	1.9
12/09	796	✓	-	1.7
12/09	797	✓	-	1.2
12/09	798	✓	-	0.4
12/09	799	✓	-	1.1
12/09	800	✓	-	0.6
12/09	801	✓	-	0.4
12/09	802	✓	-	1.0
12/09	803	✓	-	0.9
12/09	804	✓	-	0.6
12/09	805	✓	-	0.5
12/09	806	✓	-	1.3
12/09	807	✓	-	0.9
12/10	808	✓	-	0.7
12/10	809	✓	-	1.4
12/10	810	✓	-	1.6
12/10	811	✓	-	1.3
12/10	812	✓	-	0.8
12/10	813	✓	-	0.9

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/10	814	✓	-	1.0
12/10	815	✓	-	1.0
12/10	816	✓	-	1.1
12/10	817	✓	-	1.1
12/10	818	✓	-	1.4
12/10	819	✓	-	1.2
12/10	820	✓	-	1.2
12/10	821	✓	-	1.1
12/10	822	✓	-	1.2
12/10	823	✓	-	0.6
12/10	824	✓	-	0.8
12/10	825	✓	-	0.4
12/10	826	✓	-	0.4
12/10	827	✓	-	0.5
12/10	828	✓	-	1.2
12/10	829	✓	-	1.7
12/10	830	✓	-	2.1
12/10	831	✓	-	1.6
12/10	832	✓	-	1.6
12/10	833	✓	-	0.7
12/10	834	✓	-	1.7
12/10	835	✓	-	1.3
12/10	836	✓	-	2.0
12/10	837	✓	-	0.8
12/10	838	✓	-	0.6
12/10	839	✓	-	1.2
12/10	840	✓	-	0.6
12/10	841	✓	-	0.9
12/10	842	✓	-	1.0
12/10	843	✓	-	(trace) 0.01
12/10	844	✓	-	0.7
12/10	845	✓	-	0.9
12/11	845	-	✓	0.7
12/10	846	✓	-	1.6
12/10	847	✓	-	0.8
12/10	848	✓	-	0.4
12/10	849	✓	-	0.6
12/10	850	✓	-	0.5
12/11	850	-	✓	0.3
12/10	851	✓	-	0.7
12/10	852	✓	-	0.4
12/11	853	✓	-	1.0
12/11	854	✓	-	0.9
12/11	855	✓	-	0.9
12/11	855	-	✓	0.8
12/11	856	✓	-	1.2
12/11	857	✓	-	1.2

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii

†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/11	858	✓	-	0.9
12/11	859	✓	-	1.2
12/11	860	✓	-	0.8
12/11	861	✓	-	0.4
12/11	862	✓	-	1.3
12/11	863	✓	-	3.1
12/11	864	✓	-	0.2
12/11	865	✓	-	1.1
12/11	866	✓	-	1.4
12/11	867	✓	-	1.5
12/11	868	✓	-	1.4
12/11	869	✓	-	1.0
12/11	870	✓	-	1.3
12/11	871	✓	-	1.4
12/11	872	✓	-	0.5
12/11	873	✓	-	0.5
12/11	874	✓	-	1.1
12/11	875	✓	-	3.2
12/11	876	✓	-	1.9
12/11	877	✓	-	1.1
12/11	878	✓	-	1.0
12/11	879	✓	-	1.4
12/11	880	✓	-	1.4
12/11	881	✓	-	1.0
12/11	882	✓	-	1.0
12/11	883	✓	-	0.7
12/11	884	✓	-	1.6
12/11	885	✓	-	0.7
12/11	886	✓	-	0.9
12/11	887	✓	-	0.5
12/11	888	✓	-	0.7
12/11	889	✓	-	1.1
12/11	890	✓	-	0.3
12/11	891	✓	-	0.7
12/11	892	✓	-	0.4
12/11	893	✓	-	0.7
12/11	894	✓	-	0.4
12/11	895	✓	-	0.7
12/11	896	✓	-	0.6
12/11	897	✓	-	0.9
12/11	898	✓	-	0.7
12/11	899	✓	-	1.2
12/12	900	✓	-	0.4
12/12	901	✓	-	0.5
12/12	902	✓	-	0.6
12/12	903	✓	-	0.8
12/12	904	✓	-	0.6

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/12	905	✓	-	0.0
12/12	906	✓	-	0.0
12/12	907	✓	-	0.7
12/12	908	✓	-	1.3
12/12	909	✓	-	2.2
12/13	910	✓	-	1.0
12/13	911	✓	-	0.8
12/13	912	✓	-	0.4
12/13	913	✓	-	1.0
12/13	914	✓	-	0.2
12/13	915	✓	-	1.5
12/13	916	✓	-	0.4
12/13	917	✓	-	0.2
12/13	918	✓	-	0.3
12/13	919	✓	-	0.3
12/13	920	✓	-	0.4
12/13	921	✓	-	0.1
12/13	922	✓	-	0.2
12/13	923	✓	-	0.2
12/13	924	✓	-	0.2
12/13	925	✓	-	0.1
12/13	926	✓	-	0.2
12/13	927	✓	-	0.4
12/13	928	✓	-	0.6
12/13	929	✓	-	0.9
12/13	930	✓	-	0.9
12/13	931	✓	-	0.3
12/13	932	✓	-	0.4
12/13	933	✓	-	0.2
12/13	934	✓	-	0.5
12/13	935	✓	-	0.6
12/13	936	✓	-	0.6
12/13	937	✓	-	0.1
12/13	938	✓	-	0.6
12/13	939	✓	-	1.2
12/13	940	✓	-	1.3
12/13	941	✓	-	0.8
12/13	942	✓	-	0.6
12/13	943	✓	-	1.4
12/14	944	✓	-	2.1
12/14	945	✓	-	0.5
12/14	946	✓	-	1.2
12/14	947	✓	-	1.2
12/14	948	✓	-	1.5
12/14	949	✓	-	2.0
12/14	950	✓	-	1.9
12/14	951	✓	-	0.8

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/14	952	✓	-	1.0
12/14	953	✓	-	1.4
12/14	954	✓	-	1.0
12/14	955	✓	-	1.4
12/14	956	✓	-	1.1
12/14	957	✓	-	0.9
12/14	958	✓	-	0.2
12/14	959	✓	-	0.8
12/14	960	✓	-	1.0
12/14	961	✓	-	4.3
12/14	962	✓	-	0.4
12/14	963	✓	-	1.0
12/14	964	✓	-	0.7
12/14	965	✓	-	1.1
12/14	966	✓	-	0.5
12/14	967	✓	-	0.4
12/14	968	✓	-	0.4
12/14	969	✓	-	0.8
12/14	970	✓	-	0.4
12/14	971	✓	-	0.7
12/14	972	✓	-	0.6
12/14	973	✓	-	0.4
12/14	974	✓	-	0.6
12/14	975	✓	-	0.4
12/14	976	✓	-	0.8
12/14	977	✓	-	0.3
12/14	978	✓	-	0.5
12/14	979	✓	-	0.6
12/14	980	✓	-	0.8
12/14	981	✓	-	0.6
12/14	982	✓	-	0.6
12/14	983	✓	-	1.2
12/14	984	✓	-	0.4
12/14	985	✓	-	0.5
12/14	986	✓	-	0.4
12/14	987	✓	-	0.5
12/14	988	✓	-	0.2
12/14	989	✓	-	0.4
12/14	990	✓	-	0.6
12/14	991	✓	-	1.6
12/14	992	✓	-	1.6
12/14	993	✓	-	1.0
12/14	994	✓	-	1.7
12/14	995	✓	-	1.3
12/14	996	✓	-	0.7
12/14	997	✓	-	1.8
12/14	998	✓	-	0.9

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.

†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/14	999	✓	-	0.9
12/14	1000	✓	-	0.4
12/15	1001	✓	-	0.6
12/15	1002	✓	-	0.6
12/15	1003	✓	-	0.6
12/15	1004	✓	-	0.8
12/15	1005	✓	-	0.6
12/15	1006	✓	-	0.8
12/15	1007	✓	-	0.5
12/15	1008	✓	-	0.5
12/15	1009	✓	-	1.0
12/15	1010	✓	-	1.2
12/15	1011	✓	-	1.3
12/15	1012	✓	-	1.0
12/15	1013	✓	-	0.9
12/15	1014	✓	-	0.8
12/15	1015	✓	-	1.4
12/15	1016	✓	-	1.0
12/15	1017	✓	-	0.9
12/15	1018	✓	-	0.8
12/15	1019	✓	-	1.1
12/15	1020	✓	-	0.8
12/15	1021	✓	-	0.6
12/15	1022	✓	-	0.9
12/15	1023	✓	-	1.4
12/15	1024	✓	-	0.8
12/15	1025	✓	-	0.4
12/15	1026	✓	-	0.4
12/15	1027	✓	-	0.2
12/15	1028	✓	-	0.0
12/15	1029	✓	-	0.3
12/15	1030	✓	-	1.1
12/15	1031	✓	-	0.2
12/15	1032	✓	-	0.5
12/15	1033	✓	-	0.1
12/15	1034	✓	-	0.6
12/15	Comp. Pile Front	-	✓	2.6
12/15	Comp. Pile Back	-	✓	2.2
12/15	Comp. Pile Side	-	✓	1.8
12/16	1035	✓	-	0.4
12/16	1036	✓	-	0.5
12/16	1037	✓	-	0.2
12/16	1038	✓	-	0.4
12/16	1039	✓	-	0.4
12/16	1040	✓	-	0.4
12/16	1041	✓	-	0.3
12/16	1042	✓	-	0.6

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/16	1043	✓	-	0.4
12/16	1044	✓	-	0.5
12/16	1045	✓	-	0.2
12/16	1046	✓	-	0.0
12/16	1047	✓	-	0.0
12/16	1048	✓	-	0.3
12/16	1049	✓	-	0.0
12/16	1050	✓	-	0.0
12/16	1051	✓	-	0.2
12/16	1052	✓	-	0.1
12/16	1053	✓	-	0.1
12/16	1054	✓	-	0.0
12/16	1055	✓	-	0.3
12/16	1056	✓	-	0.4
12/16	1057	✓	-	0.3
12/16	1058	✓	-	0.0
12/16	1059	✓	-	0.5
12/16	1060	✓	-	0.4
12/16	1061	✓	-	0.4
12/16	1062	✓	-	0.2
12/16	1063	✓	-	0.5
12/16	1064	✓	-	0.6
12/16	1065	✓	-	0.5
12/16	1066	✓	-	0.5
12/16	1067	✓	-	0.7
12/16	1068	✓	-	1.0
12/16	1069	✓	-	4.4
12/16	1070	✓	-	2.5
12/16	1071	✓	-	4.4
12/16	1072	✓	-	1.3
12/16	1073	✓	-	1.3
12/16	1074	✓	-	2.3
12/16	1075	✓	-	5.7‡
12/16	1076	✓	-	2.3
12/16	1077	✓	-	1.5
12/16	1078	✓	-	2.7
12/16	1079	✓	-	2.2
12/16	1080	✓	-	1.4
12/16	1081	✓	-	2.9
12/17	1082	✓	-	2.0
12/17	1083	✓	-	2.4
12/17	1084	✓	-	2.6
12/17	1085	✓	-	1.6
12/17	1086	✓	-	1.3
12/17	1087	✓	-	1.1
12/17	1088	✓	-	0.5

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.
‡Exceeded 5-mg/ℓ limit.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/17	1089	✓	-	3.0
12/17	1090	✓	-	1.9
12/17	1091	✓	-	3.1
12/17	1092	✓	-	3.2
12/17	1093	✓	-	2.4
12/17	1094	✓	-	0.9
12/17	1095	✓	-	1.4
12/17	1096	✓	-	0.7
12/17	1097	✓	-	1.9
12/17	1098	✓	-	1.6
12/17	1099	✓	-	2.6
12/17	1100	✓	-	2.4
12/17	1101	✓	-	2.1
12/17	1102	✓	-	2.1
12/17	1103	✓	-	2.1
12/17	1104	✓	-	2.3
12/17	1105	✓	-	2.5
12/17	1106	✓	-	2.0
12/17	1107	✓	-	2.2
12/17	1108	✓	-	1.4
12/17	1109	✓	-	1.7
12/17	1110	✓	-	0.7
12/17	1111	✓	-	0.6
12/17	1112	✓	-	1.5
12/17	1113	✓	-	1.7
12/17	1114	✓	-	2.9
12/17	1115	✓	-	2.8
12/18	1116	✓	-	0.6
12/18	1117	✓	-	1.4
12/18	1118	✓	-	0.8
12/18	1119	✓	-	2.5
12/18	1120	✓	-	0.6
12/18	1121	✓	-	1.4
12/18	1122	✓	-	1.2
12/18	1123	✓	-	4.7
12/18	1124	✓	-	2.7
12/18	1125	✓	-	1.3
12/18	1126	✓	-	3.0
12/18	1127	✓	-	3.4
12/18	1128	✓	-	2.4
12/18	1129	✓	-	2.6
12/18	1130	✓	-	1.3
12/18	1131	✓	-	1.3
12/18	1132	✓	-	2.3
12/18	1133	✓	-	2.5
12/18	1134	✓	-	2.9
12/18	1135	✓	-	1.9

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii

†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/18	1136	✓	-	2.1
12/18	1137	✓	-	1.7
12/18	1138	✓	-	1.4
12/18	1139	✓	-	1.2
12/18	1140	✓	-	1.7
12/18	1141	✓	-	1.1
12/18	1142	✓	-	1.3
12/18	1143	✓	-	1.9
12/18	1144	✓	-	1.0
12/18	1145	✓	-	1.1
12/18	1146	✓	-	0.6
12/18	1147	✓	-	1.8
12/18	1148	✓	-	0.5
12/18	1149	✓	-	0.8
12/18	1150	✓	-	0.7
12/18	1151	✓	-	0.8
12/18	1152	✓	-	1.7
12/20	1153	✓	-	1.1
12/20	1154	✓	-	0.7
12/20	1155	✓	-	0.7
12/20	1156	✓	-	1.0
12/20	1157	✓	-	1.6
12/20	1158	✓	-	0.4
12/20	1159	✓	-	0.3
12/20	1160	✓	-	2.0
12/20	1161	✓	-	1.6
12/20	1162	✓	-	1.1
12/20	1163	✓	-	1.4
12/20	1164	✓	-	1.0
12/20	1165	✓	-	1.8
12/20	1166	✓	-	1.6
12/20	1167	✓	-	1.4
12/20	1168	✓	-	1.2
12/20	1169	✓	-	1.5
12/20	1170	✓	-	0.6
12/20	1171	✓	-	1.9
12/20	1172	✓	-	1.4
12/20	1173	✓	-	1.5
12/20	1174	✓	-	1.1
12/20	1175	✓	-	1.3
12/20	1176	✓	-	1.4
12/20	1177	✓	-	1.3
12/20	1178	✓	-	1.4
12/20	1179	✓	-	1.4
12/20	1180	✓	-	1.7
12/20	1181	✓	-	1.3
12/20	1182	✓	-	1.3

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.

APPENDIX TABLE A.1—*Continued*

TREATED SAMPLE		SAMPLE COLLECTOR		TOTAL Cr IN SOIL
1982	I.D. No.	ROICC*	WRRC	EXTRACT (mg/ℓ)†
12/20	1183	✓	-	0.7
12/20	1184	✓	-	1.4
12/20	1185	✓	-	1.5
12/20	1186	✓	-	1.8
12/20	1187	✓	-	2.1
12/20	1188	✓	-	1.6
12/21	1189	✓	-	1.5
12/21	1190	✓	-	1.4
12/21	1191	✓	-	1.5
12/21	1192	✓	-	2.5
12/21	1193	✓	-	2.3
12/21	1194	✓	-	2.3
12/21	1195	✓	-	2.4
12/21	1196	✓	-	1.6
12/21	1197	✓	-	1.8
12/21	1198	✓	-	1.8
12/21	1199	✓	-	1.6
12/21	1200	✓	-	4.1
12/21	1200	-	✓	2.0
12/21	1201	✓	-	1.6
12/21	1202	✓	-	1.2
12/21	1202	-	✓	1.8
12/21	1203	✓	-	1.0
12/21	1204	✓	-	1.3
12/21	1205	✓	-	2.2
12/21	1206	✓	-	1.5
12/21	1207	✓	-	1.2
12/21	1208	✓	-	1.1
12/23	1209	✓	-	1.0
12/23	1210	✓	-	1.5
12/23	1211	✓	-	1.5
12/23	1212	✓	-	1.1
12/23	1213	✓	-	2.2

*Resident Officer in Charge of Construction, U.S. Naval Shipyard, Pearl Harbor, Oahu, Hawaii.
†U.S. EPA, EP Toxicity Test.