

Table 12. Total Emissions for Alternative 2.

Activity/Equipment Type/ Disposal Alternative	Total Emissions (tons)						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Dredging							
Clamshell Dredge	17.84	17.13	160.61	614.71	40.06	15.14	9.84
Work Tug	3.53	3.39	5.42	31.45	2.20	2.55	2.45
Barge Equipment	1.08	1.04	2.39	11.08	0.73	0.78	0.75
Hopper Dredge	6.55	6.29	4.84	40.34	2.99	1.16	0.75
Support Boat	5.11	4.91	7.86	45.61	3.19	3.69	3.55
Total	34.11	32.75	181.12	743.19	49.17	23.31	17.33
Ocean Site							
Transport/Disposal							
Tug Boat	12.45	11.95	19.13	111.02	7.76	8.99	8.63
Barge Equipment	0.44	0.42	0.98	4.53	0.30	0.32	0.31
Total	12.89	12.38	20.10	115.55	8.06	9.31	8.94
In-Bay Site							
Transport/Disposal							
Tug Boat	2.19	2.11	3.37	19.56	1.37	1.58	1.52
Barge Equipment	0.17	0.16	0.38	1.75	0.12	0.12	0.12
Hopper Dredge	2.04	1.96	1.51	12.56	0.93	0.36	0.23
Total	4.40	4.23	5.25	33.87	2.41	2.07	1.87
Habitat Restoration Site							
Transport							
Tug Boat	3.00	2.88	4.61	26.73	1.87	2.16	2.08
Barge Equipment	0.23	0.22	0.52	2.39	0.16	0.17	0.16
Disposal							
Tug Boat	0.26	0.25	0.41	2.36	0.16	0.19	0.18
Barge Equipment	0.08	0.07	0.17	0.79	0.05	0.06	0.05
Hydraulic Unloader	1.83	1.76	1.35	11.28	0.84	0.32	0.21
Booster Pump	0.76	0.73	6.88	26.32	1.72	0.65	0.42
Work Tug	0.25	0.24	0.39	2.24	0.16	0.18	0.17
Generator	0.04	0.04	0.15	0.25	0.03	0.03	0.02
Support Boat	0.16	0.15	0.24	1.40	0.10	0.11	0.11
Total	6.61	6.35	14.70	73.76	5.08	3.87	3.42
Levee Site							
Transport							
Tug Boat	2.71	2.60	4.16	24.14	1.69	1.95	1.88
Barge Equipment	0.21	0.20	0.47	2.16	0.14	0.15	0.15
Disposal							
Tug Boat	0.20	0.19	0.30	1.74	0.12	0.14	0.14
Barge Equipment	0.06	0.05	0.13	0.58	0.04	0.04	0.04
Clamshell Crane	0.94	0.90	8.48	32.44	2.11	0.80	0.52
Grader	0.03	0.03	0.11	0.52	0.06	0.05	0.04
Scraper	0.10	0.09	0.28	1.24	0.10	0.10	0.10
Bulldozer	0.20	0.19	0.46	1.65	0.18	0.15	0.14
Total	4.44	4.26	14.38	64.47	4.45	3.38	3.00
Rehandling Facility Site							
Transport							
Tug Boat	0.96	0.92	1.47	8.54	0.60	0.69	0.66
Barge Equipment	0.07	0.07	0.16	0.76	0.05	0.05	0.05
Offload/Dewater							
Tug Boat	0.07	0.06	0.10	0.59	0.04	0.05	0.05
Barge Equipment	0.02	0.02	0.04	0.20	0.01	0.01	0.01
Hydraulic Unloader	0.46	0.44	0.34	2.84	0.21	0.08	0.05
Booster Pump	0.19	0.18	1.73	6.64	0.43	0.16	0.11
Work Tug	0.06	0.06	0.10	0.57	0.04	0.05	0.04
Generator	0.01	0.01	0.04	0.06	0.01	0.01	0.01
Support Boat	0.04	0.04	0.06	0.35	0.02	0.03	0.03
Scraper	0.03	0.03	0.10	0.42	0.04	0.03	0.03
Bulldozer	0.07	0.06	0.16	0.56	0.06	0.05	0.05
Load and Transport to Landfill							
Front-end Loader	0.61	0.58	1.19	3.87	0.38	0.35	0.34
Haul Truck	1.60	1.53	6.36	7.02	0.00	1.39	1.33
Disposal at Landfill							
Haul Truck	0.07	0.07	0.39	0.20	0.00	0.02	0.02
Grader	0.10	0.09	0.31	1.42	0.17	0.12	0.12
Scraper	0.27	0.25	0.78	3.40	0.29	0.28	0.27
Bulldozer	0.54	0.52	1.25	4.55	0.50	0.40	0.39
Total	5.16	4.95	14.59	42.00	2.85	3.79	3.56
Grand Total	67.62	64.92	250.14	1,072.84	72.02	45.73	38.12

Table 13. Total Emissions for Alternative 3.

Activity/Equipment Type/ Disposal Alternative	Total Emissions (tons)						
	TOG	ROG	CO	NO _x	SO ₂	PM	PM ₁₀
Dredging							
Clamshell Dredge	17.84	17.13	160.61	614.71	40.06	15.14	9.84
Work Tug	3.53	3.39	5.42	31.45	2.20	2.55	2.45
Barge Equipment	1.08	1.04	2.39	11.08	0.73	0.78	0.75
Hopper Dredge	6.55	6.29	4.84	40.34	2.99	1.16	0.75
Support Boat	5.11	4.91	7.86	45.61	3.19	3.69	3.55
Total	34.11	32.75	181.12	743.19	49.17	23.31	17.33
Ocean Site							
Transport/Disposal							
Tug Boat	24.90	23.91	38.25	222.04	15.53	17.98	17.26
Barge Equipment	0.88	0.85	1.95	9.07	0.60	0.64	0.61
Total	25.79	24.75	40.20	231.11	16.13	18.62	17.87
In-Bay Site							
Transport/Disposal							
Hopper Dredge	2.04	1.96	1.51	12.56	0.93	0.36	0.23
Total	2.04	1.96	1.51	12.56	0.93	0.36	0.23
Habitat Restoration Site							
Transport							
Tug Boat	3.00	2.88	4.61	26.73	1.87	2.16	2.08
Barge Equipment	0.23	0.22	0.52	2.39	0.16	0.17	0.16
Disposal							
Tug Boat	0.26	0.25	0.41	2.36	0.16	0.19	0.18
Barge Equipment	0.08	0.07	0.17	0.79	0.05	0.06	0.05
Hydraulic Unloader	1.83	1.76	1.35	11.28	0.84	0.32	0.21
Booster Pump	0.76	0.73	6.88	26.32	1.72	0.65	0.42
Work Tug	0.25	0.24	0.39	2.24	0.16	0.18	0.17
Generator	0.04	0.04	0.15	0.25	0.03	0.03	0.02
Support Boat	0.16	0.15	0.24	1.40	0.10	0.11	0.11
Total	6.61	6.35	14.70	73.76	5.08	3.87	3.42
Levee Site							
Transport							
Tug Boat	2.71	2.60	4.16	24.14	1.69	1.95	1.88
Barge Equipment	0.21	0.20	0.47	2.16	0.14	0.15	0.15
Disposal							
Tug Boat	0.20	0.19	0.30	1.74	0.12	0.14	0.14
Barge Equipment	0.06	0.05	0.13	0.58	0.04	0.04	0.04
Clamshell Crane	0.94	0.90	8.48	32.44	2.11	0.80	0.52
Grader	0.03	0.03	0.11	0.52	0.06	0.05	0.04
Scraper	0.10	0.09	0.28	1.24	0.10	0.10	0.10
Bulldozer	0.20	0.19	0.46	1.65	0.18	0.15	0.14
Total	4.44	4.26	14.38	64.47	4.45	3.38	3.00
Rehandling Facility Site							
Transport							
Tug Boat	0.96	0.92	1.47	8.54	0.60	0.69	0.66
Barge Equipment	0.07	0.07	0.16	0.76	0.05	0.05	0.05
Offload/Dewater							
Tug Boat	0.07	0.06	0.10	0.59	0.04	0.05	0.05
Barge Equipment	0.02	0.02	0.04	0.20	0.01	0.01	0.01
Hydraulic Unloader	0.46	0.44	0.34	2.84	0.21	0.08	0.05
Booster Pump	0.19	0.18	1.73	6.64	0.43	0.16	0.11
Work Tug	0.06	0.06	0.10	0.57	0.04	0.05	0.04
Generator	0.01	0.01	0.04	0.06	0.01	0.01	0.01
Support Boat	0.04	0.04	0.06	0.35	0.02	0.03	0.03
Scraper	0.03	0.03	0.10	0.42	0.04	0.03	0.03
Bulldozer	0.07	0.06	0.16	0.56	0.06	0.05	0.05
Load and Transport to Landfill							
Front-end Loader	0.61	0.58	1.19	3.87	0.38	0.35	0.34
Haul Truck	1.60	1.53	6.36	7.02	0.00	1.39	1.33
Disposal at Landfill							
Haul Truck	0.07	0.07	0.39	0.20	0.00	0.02	0.02
Grader	0.10	0.09	0.31	1.42	0.17	0.12	0.12
Scraper	0.27	0.25	0.78	3.40	0.29	0.28	0.27
Bulldozer	0.54	0.52	1.25	4.55	0.50	0.40	0.39
Total	5.16	4.95	14.59	42.00	2.85	3.79	3.56
Grand Total	78.15	75.02	266.49	1,167.08	78.60	53.33	45.41

Table 14. Emission Source Data for Low Volume Analysis.

<i>Activity/Equipment Type/ Disposal Alternative</i>	<i>HorsePower (Hp)</i>	<i>Load Factor</i>	<i>No. Active</i>	<i>Hp-Hours</i>	<i>Fuel Use (Gal/Hr)</i>	<i>Hours Per Day</i>	<i>Work Days</i>	<i>Total Fuel Usage</i>
Ocean Site								
Transport/Disposal								
Tug Boat	2,300	0.75	3	5,175	289.8	22.0	90.0	573,563
Barge Equipment	95	0.50	3	143	8.0	22.0	90.0	15,794
In-Bay Site								
Transport/Disposal								
Tug Boat	1,050	0.75	2	1,575	88.2	0.0	0.0	0
Barge Equipment	95	0.50	2	95	5.3	0.0	0.0	0
Hopper Dredge	2,000	0.75	1	1,500	84.0	5.2	165.6	72,625
Habitat Restoration Site								
Transport								
Tug Boat	1,050	0.75	2	1,575	88.2	16.5	43.1	62,843
Barge Equipment	95	0.50	2	95	5.3	16.5	43.1	3,791
Disposal								
Tug Boat	1,050	0.20	2	420	23.5	5.5	43.1	5,540
Barge Equipment	95	0.50	2	95	5.3	5.5	43.1	1,253
Hydraulic Unloader	1,500	0.75	1	1,125	63.0	10.9	43.1	29,678
Booster Pump	1,500	0.75	2	2,250	126.0	10.9	43.1	59,355
Work Tug	400	0.50	1	200	11.2	10.9	43.1	5,276
Generator	69	0.50	1	35	1.9	10.9	43.1	910
Support Boat	250	0.50	1	125	7.0	10.9	43.1	3,298
Levee Site								
Transport								
Tug Boat	1,050	0.75	4	3,150	176.4	17.3	41.7	127,368
Barge Equipment	95	0.50	4	190	10.6	17.3	41.7	7,683
Disposal								
Tug Boat	1,050	0.20	4	840	47.0	4.7	41.7	9,194
Barge Equipment	95	0.50	4	190	10.6	4.7	41.7	2,080
Clamshell Crane	5,000	0.75	1	3,750	210.0	18.7	41.7	164,182
Grader	200	0.50	1	100	5.6	18.7	41.7	4,378
Scraper	330	0.50	1	165	9.2	18.7	41.7	7,224
Bulldozer	285	0.50	2	285	16.0	18.7	41.7	12,478

Table 15. Emission Source Data for Medium Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	HorsePower (Hp)	Load Factor	No. Active	Hp-Hours	Fuel Use (Gal/Hr)	Hours Per Day	Work Days	Total Fuel Usage
Ocean Site								
Transport/Disposal								
Tug Boat	2,300	0.75	3	5,175	289.8	22.0	215.9	1,376,550
Barge Equipment	95	0.50	3	143	8.0	22.0	215.9	37,905
In-Bay Site								
Transport/Disposal								
Tug Boat	1,050	0.75	2	1,575	88.2	22.0	72.9	141,488
Barge Equipment	95	0.50	2	95	5.3	22.0	72.9	8,534
Hopper Dredge	2,000	0.75	1	1,500	84.0	5.2	165.6	72,625
Habitat Restoration Site								
Transport								
Tug Boat	1,050	0.75	2	1,575	88.2	16.5	114.2	166,478
Barge Equipment	95	0.50	2	95	5.3	16.5	114.2	10,042
Disposal								
Tug Boat	1,050	0.20	2	420	23.5	5.5	114.2	14,676
Barge Equipment	95	0.50	2	95	5.3	5.5	114.2	3,320
Hydraulic Unloader	1,500	0.75	1	1,125	63.0	10.9	114.2	78,620
Booster Pump	1,500	0.75	2	2,250	126.0	10.9	114.2	157,240
Work Tug	400	0.50	1	200	11.2	10.9	114.2	13,977
Generator	69	0.50	1	35	1.9	10.9	114.2	2,411
Support Boat	250	0.50	1	125	7.0	10.9	114.2	8,736
Levee Site								
Transport								
Tug Boat	1,050	0.75	4	3,150	176.4	17.3	50.4	154,027
Barge Equipment	95	0.50	4	190	10.6	17.3	50.4	9,290
Disposal								
Tug Boat	1,050	0.20	4	840	47.0	4.7	50.4	11,119
Barge Equipment	95	0.50	4	190	10.6	4.7	50.4	2,515
Clamshell Crane	5,000	0.75	1	3,750	210.0	18.7	50.4	198,545
Grader	200	0.50	1	100	5.6	18.7	50.4	5,295
Scraper	330	0.50	1	165	9.2	18.7	50.4	8,736
Bulldozer	285	0.50	2	285	16.0	18.7	50.4	15,089
Rehandling Facility Site								
Transport								
Tug Boat	1,050	0.75	3	2,363	132.3	17.4	23.0	53,067
Barge Equipment	95	0.50	3	143	8.0	17.4	23.0	3,201
Offload/Dewater								
Tug Boat	1,050	0.20	3	630	35.3	4.6	23.0	3,693
Barge Equipment	95	0.50	3	143	8.0	4.6	23.0	835
Hydraulic Unloader	1,500	0.75	1	1,125	63.0	13.7	23.0	19,785
Booster Pump	1,500	0.75	2	2,250	126.0	13.7	23.0	39,570
Work Tug	400	0.50	1	200	11.2	13.7	23.0	3,517
Generator	69	0.50	1	35	1.9	13.7	23.0	607
Support Boat	250	0.50	1	125	7.0	13.7	23.0	2,198
Scraper	330	0.50	1	165	9.2	13.7	23.0	2,902
Bulldozer	285	0.50	2	285	16.0	13.7	23.0	5,012
Load and Transport to Landfill								
Front-end Loader	215	0.50	2	215	12.0	22.0	115.2	30,502
Haul Truck (a)	24	18.86	14	NA	NA	15.1	6,335.9	729,600
Disposal at Landfill								
Haul Truck (b)	NA	NA	14	NA	NA	1.6	22.0	2,532
Grader	200	0.50	1	100	5.6	22.0	115.2	14,187
Scraper	330	0.50	1	165	9.2	22.0	115.2	23,408
Bulldozer	285	0.50	2	285	16.0	22.0	115.2	40,433

- (a) For this source, Horsepower is equal to roundtrip distance, Load Factor is the number of roundtrips per truck per day, Work Days is the total daily mileage, and Total Fuel Usage is total miles.
- (b) For this source, Work Days is the total number of hours per day at idle and Total Fuel Usage is total number of hours at idle.

Table 16. Emission Source Data for High Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	HorsePower (Hp)	Load Factor	No. Active	Hp-Hours	Fuel Use (Gal/Hr)	Hours Per Day	Work Days	Total Fuel Usage
Ocean Site								
Transport/Disposal								
Tug Boat	2,300	0.75	3	5,175	289.8	22.0	341.9	2,179,538
Barge Equipment	95	0.50	3	143	8.0	22.0	341.9	60,016
In-Bay Site								
Transport/Disposal								
Tug Boat	1,050	0.75	2	1,575	88.2	22.0	145.8	282,975
Barge Equipment	95	0.50	2	95	5.3	22.0	145.8	17,068
Hopper Dredge	2,000	0.75	1	1,500	84.0	5.2	165.6	72,625
Habitat Restoration Site								
Transport								
Tug Boat	1,050	0.75	2	1,575	88.2	16.5	189.8	276,728
Barge Equipment	95	0.50	2	95	5.3	16.5	189.8	16,692
Disposal								
Tug Boat	1,050	0.20	2	420	23.5	5.5	189.8	24,395
Barge Equipment	95	0.50	2	95	5.3	5.5	189.8	5,518
Hydraulic Unloader	1,500	0.75	1	1,125	63.0	10.9	189.8	130,686
Booster Pump	1,500	0.75	2	2,250	126.0	10.9	189.8	261,372
Work Tug	400	0.50	1	200	11.2	10.9	189.8	23,233
Generator	69	0.50	1	35	1.9	10.9	189.8	4,008
Support Boat	250	0.50	1	125	7.0	10.9	189.8	14,521
Levee Site								
Transport								
Tug Boat	1,050	0.75	4	3,150	176.4	17.3	50.4	154,027
Barge Equipment	95	0.50	4	190	10.6	17.3	50.4	9,290
Disposal								
Tug Boat	1,050	0.20	4	840	47.0	4.7	50.4	11,119
Barge Equipment	95	0.50	4	190	10.6	4.7	50.4	2,515
Clamshell Crane	5,000	0.75	1	3,750	210.0	18.7	50.4	198,545
Grader	200	0.50	1	100	5.6	18.7	50.4	5,295
Scraper	330	0.50	1	165	9.2	18.7	50.4	8,736
Bulldozer	285	0.50	2	285	16.0	18.7	50.4	15,089
Rehandling Facility Site								
Transport								
Tug Boat	1,050	0.75	3	2,363	132.3	17.4	47.2	108,927
Barge Equipment	95	0.50	3	143	8.0	17.4	47.2	6,570
Offload/Dewater								
Tug Boat	1,050	0.20	3	630	35.3	4.6	47.2	7,581
Barge Equipment	95	0.50	3	143	8.0	4.6	47.2	1,715
Hydraulic Unloader	1,500	0.75	1	1,125	63.0	13.7	47.2	40,612
Booster Pump	1,500	0.75	2	2,250	126.0	13.7	47.2	81,223
Work Tug	400	0.50	1	200	11.2	13.7	47.2	7,220
Generator	69	0.50	1	35	1.9	13.7	47.2	1,245
Support Boat	250	0.50	1	125	7.0	13.7	47.2	4,512
Scraper	330	0.50	1	165	9.2	13.7	47.2	5,956
Bulldozer	285	0.50	2	285	16.0	13.7	47.2	10,288
Load and Transport to Landfill								
Front-end Loader	215	0.50	2	215	12.0	22.0	236.4	62,609
Haul Truck (a)	24	18.86	14	NA	NA	15.1	6,335.9	1,497,600
Disposal at Landfill								
Haul Truck (b)	NA	NA	14	NA	NA	1.6	22.0	5,198
Grader	200	0.50	1	100	5.6	22.0	236.4	29,121
Scraper	330	0.50	1	165	9.2	22.0	236.4	48,049
Bulldozer	285	0.50	2	285	16.0	22.0	236.4	82,994

(a) For this source, Horsepower is equal to roundtrip distance, Load Factor is the number of roundtrips per truck per day, Work Days is the total daily mileage, and Total Fuel Usage is total miles.

(b) For this source, Work Days is the total number of hours per day at idle and Total Fuel Usage is total number of hours at idle.

Table 17. Daily Emissions for the Low Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	Daily Emissions (Pounds/Day)						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Ocean Site							
Transport/Disposal							
Tug Boat	291	280	448	2,598	182	210	202
Barge Equipment	10	10	23	106	7	7	7
Total	302	290	470	2,704	189	218	209
In-Bay Site							
Transport/Disposal							
Hopper Dredge	26	25	19	160	12	5	3
Total	26	25	19	160	12	5	3
Habitat Restoration Site							
Transport							
Tug Boat	67	64	102	594	42	48	46
Barge Equipment	5	5	11	53	3	4	4
Disposal							
Tug Boat	6	6	9	52	4	4	4
Barge Equipment	2	2	4	18	1	1	1
Hydraulic Unloader	41	39	30	251	19	7	5
Booster Pump	17	16	153	585	38	14	9
Work Tug	6	5	9	50	3	4	4
Generator	1	1	3	5	1	1	1
Support Boat	3	3	5	31	2	3	2
Total	147	141	327	1,640	113	86	76
Levee Site							
Transport							
Tug Boat	140	134	214	1,245	87	101	97
Barge Equipment	11	10	24	111	7	8	8
Disposal							
Tug Boat	10	10	15	90	6	7	7
Barge Equipment	3	3	6	30	2	2	2
Clamshell Crane	49	47	437	1,672	109	41	27
Grader	2	2	6	27	3	2	2
Scraper	5	5	15	64	5	5	5
Bulldozer	10	10	23	85	9	8	7
Total	229	220	741	3,324	230	174	155

Table 18. Daily Emissions for the Medium Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	Daily Emissions (Pounds/Day)						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Ocean Site							
Transport/Disposal							
Tug Boat	291	280	448	2,598	182	210	202
Barge Equipment	10	10	23	106	7	7	7
Total	302	290	470	2,704	189	218	209
In-Bay Site							
Transport/Disposal							
Tug Boat	89	85	136	791	55	64	61
Barge Equipment	7	7	15	71	5	5	5
Hopper Dredge	26	25	19	160	12	5	3
Total	121	117	171	1,021	72	74	69
Habitat Restoration Site							
Transport							
Tug Boat	67	64	102	594	42	48	46
Barge Equipment	5	5	11	53	3	4	4
Disposal							
Tug Boat	6	6	9	52	4	4	4
Barge Equipment	2	2	4	18	1	1	1
Hydraulic Unloader	41	39	30	251	19	7	5
Booster Pump	17	16	153	585	38	14	9
Work Tug	6	5	9	50	3	4	4
Generator	1	1	3	5	1	1	1
Support Boat	3	3	5	31	2	3	2
Total	147	141	327	1,640	113	86	76
Levee Site							
Transport							
Tug Boat	140	134	214	1,245	87	101	97
Barge Equipment	11	10	24	111	7	8	8
Disposal							
Tug Boat	10	10	15	90	6	7	7
Barge Equipment	3	3	6	30	2	2	2
Clamshell Crane	49	47	437	1,672	109	41	27
Grader	2	2	6	27	3	2	2
Scraper	5	5	15	64	5	5	5
Bulldozer	10	10	23	85	9	8	7
Total	229	220	741	3,324	230	174	155
Rehandling Facility Site							
Transport							
Tug Boat	105	101	162	941	66	76	73
Barge Equipment	8	8	18	84	6	6	6
Offload/Dewater							
Tug Boat	7	7	11	65	5	5	5
Barge Equipment	2	2	5	22	1	2	1
Hydraulic Unloader	51	49	38	313	23	9	6
Booster Pump	21	20	191	731	48	18	12
Work Tug	7	7	11	62	4	5	5
Generator	1	1	4	7	1	1	1
Support Boat	4	4	7	39	3	3	3
Scraper	4	3	11	46	4	4	4
Bulldozer	7	7	17	62	7	6	5
Load and Transport to Landfill							
Front-end Loader	13	13	26	85	8	8	7
Haul Truck	35	34	140	154	0	30	29
Disposal at Landfill							
Haul Truck	2	1	9	5	0	1	0
Grader	2	2	7	31	4	3	3
Scraper	6	6	17	75	6	6	6
Bulldozer	12	11	28	100	11	9	9
Total	288	277	700	2,823	196	191	175

Table 19. Daily Emissions for the High Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	Daily Emissions (Pounds/Day)						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Ocean Site							
Transport/Disposal							
Tug Boat	291	280	448	2,598	182	210	202
Barge Equipment	10	10	23	106	7	7	7
Total	302	290	470	2,704	189	218	209
In-Bay Site							
Transport/Disposal							
Tug Boat	89	85	136	791	55	64	61
Barge Equipment	7	7	15	71	5	5	5
Hopper Dredge	26	25	19	160	12	5	3
Total	121	117	171	1,021	72	74	69
Habitat Restoration Site							
Transport							
Tug Boat	67	64	102	594	42	48	46
Barge Equipment	5	5	11	53	3	4	4
Disposal							
Tug Boat	6	6	9	52	4	4	4
Barge Equipment	2	2	4	18	1	1	1
Hydraulic Unloader	41	39	30	251	19	7	5
Booster Pump	17	16	153	585	38	14	9
Work Tug	6	5	9	50	3	4	4
Generator	1	1	3	5	1	1	1
Support Boat	3	3	5	31	2	3	2
Total	147	141	327	1,640	113	86	76
Levee Site							
Transport							
Tug Boat	140	134	214	1,245	87	101	97
Barge Equipment	11	10	24	111	7	8	8
Disposal							
Tug Boat	10	10	15	90	6	7	7
Barge Equipment	3	3	6	30	2	2	2
Clamshell Crane	49	47	437	1,672	109	41	27
Grader	2	2	6	27	3	2	2
Scraper	5	5	15	64	5	5	5
Bulldozer	10	10	23	85	9	8	7
Total	229	220	741	3,324	230	174	155
Rehandling Facility Site							
Transport							
Tug Boat	105	101	162	941	66	76	73
Barge Equipment	8	8	18	84	6	6	6
Offload/Dewater							
Tug Boat	7	7	11	65	5	5	5
Barge Equipment	2	2	5	22	1	2	1
Hydraulic Unloader	51	49	38	313	23	9	6
Booster Pump	21	20	191	731	48	18	12
Work Tug	7	7	11	62	4	5	5
Generator	1	1	4	7	1	1	1
Support Boat	4	4	7	39	3	3	3
Scraper	4	3	11	46	4	4	4
Bulldozer	7	7	17	62	7	6	5
Load and Transport to Landfill							
Front-end Loader	13	13	26	85	8	8	7
Haul Truck	35	34	140	154	0	30	29
Disposal at Landfill							
Haul Truck	2	1	9	5	0	1	0
Grader	2	2	7	31	4	3	3
Scraper	6	6	17	75	6	6	6
Bulldozer	12	11	28	100	11	9	9
Total	288	277	700	2,823	196	191	175

Table 20. Total Emissions for the Low Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	Total Emissions (tons)						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Ocean Site							
Transport/Disposal							
Tug Boat	13.11	12.58	20.13	116.86	8.17	9.46	9.09
Barge Equipment	0.47	0.45	1.03	4.77	0.31	0.34	0.32
Total	13.57	13.03	21.16	121.64	8.49	9.80	9.41
In-Bay Site							
Transport/Disposal							
Hopper Dredge	2.15	2.06	1.59	13.22	0.98	0.38	0.25
Total	2.15	2.06	1.59	13.22	0.98	0.38	0.25
Habitat Restoration Site							
Transport							
Tug Boat	1.44	1.38	2.21	12.80	0.90	1.04	1.00
Barge Equipment	0.11	0.11	0.25	1.15	0.08	0.08	0.08
Disposal							
Tug Boat	0.13	0.12	0.19	1.13	0.08	0.09	0.09
Barge Equipment	0.04	0.04	0.08	0.38	0.02	0.03	0.03
Hydraulic Unloader	0.88	0.84	0.65	5.40	0.40	0.16	0.10
Booster Pump	0.37	0.35	3.29	12.61	0.82	0.31	0.20
Work Tug	0.12	0.12	0.19	1.07	0.08	0.09	0.08
Generator	0.02	0.02	0.07	0.12	0.01	0.01	0.01
Support Boat	0.08	0.07	0.12	0.67	0.05	0.05	0.05
Total	3.17	3.04	7.04	35.33	2.43	1.85	1.64
Levee Site							
Transport							
Tug Boat	2.91	2.79	4.47	25.95	1.81	2.10	2.02
Barge Equipment	0.23	0.22	0.50	2.32	0.15	0.16	0.16
Disposal							
Tug Boat	0.21	0.20	0.32	1.87	0.13	0.15	0.15
Barge Equipment	0.06	0.06	0.14	0.63	0.04	0.04	0.04
Clamshell Crane	1.01	0.97	9.11	34.87	2.27	0.86	0.56
Grader	0.04	0.04	0.12	0.56	0.07	0.05	0.05
Scraper	0.10	0.10	0.31	1.33	0.11	0.11	0.10
Bulldozer	0.21	0.20	0.49	1.78	0.19	0.16	0.15
Total	4.77	4.58	15.45	69.31	4.79	3.63	3.22

Table 21. Total Emissions for the Medium Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	Total Emissions (tons)						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Ocean Site							
Transport/Disposal							
Tug Boat	31.45	30.20	48.32	280.47	19.62	22.71	21.80
Barge Equipment	1.12	1.07	2.47	11.45	0.75	0.81	0.77
Total	32.57	31.27	50.78	291.93	20.37	23.52	22.58
In-Bay Site							
Transport/Disposal							
Tug Boat	3.23	3.10	4.97	28.83	2.02	2.33	2.24
Barge Equipment	0.25	0.24	0.56	2.58	0.17	0.18	0.17
Hopper Dredge	2.15	2.06	1.59	13.22	0.98	0.38	0.25
Total	5.63	5.41	7.11	44.62	3.17	2.90	2.66
Habitat Restoration Site							
Transport							
Tug Boat	3.80	3.65	5.84	33.92	2.37	2.75	2.64
Barge Equipment	0.30	0.28	0.65	3.03	0.20	0.21	0.20
Disposal							
Tug Boat	0.34	0.32	0.52	2.99	0.21	0.24	0.23
Barge Equipment	0.10	0.09	0.22	1.00	0.07	0.07	0.07
Hydraulic Unloader	2.32	2.23	1.72	14.31	1.06	0.41	0.27
Booster Pump	0.97	0.93	8.73	33.40	2.18	0.82	0.53
Work Tug	0.32	0.31	0.49	2.85	0.20	0.23	0.22
Generator	0.05	0.05	0.19	0.31	0.04	0.03	0.03
Support Boat	0.20	0.19	0.31	1.78	0.12	0.14	0.14
Total	8.39	8.06	18.65	93.59	6.45	4.91	4.34
Levee Site							
Transport							
Tug Boat	3.52	3.38	5.41	31.38	2.19	2.54	2.44
Barge Equipment	0.27	0.26	0.60	2.81	0.18	0.20	0.19
Disposal							
Tug Boat	0.25	0.24	0.39	2.27	0.16	0.18	0.18
Barge Equipment	0.07	0.07	0.16	0.76	0.05	0.05	0.05
Clamshell Crane	1.22	1.18	11.02	42.17	2.75	1.04	0.68
Grader	0.05	0.04	0.14	0.67	0.08	0.06	0.06
Scraper	0.13	0.12	0.37	1.61	0.14	0.13	0.13
Bulldozer	0.26	0.24	0.59	2.15	0.23	0.19	0.18
Total	5.77	5.54	18.69	83.81	5.79	4.40	3.90
Rehandling Facility Site							
Transport							
Tug Boat	1.21	1.16	1.86	10.81	0.76	0.88	0.84
Barge Equipment	0.09	0.09	0.21	0.97	0.06	0.07	0.07
Offload/Dewater							
Tug Boat	0.08	0.08	0.13	0.75	0.05	0.06	0.06
Barge Equipment	0.02	0.02	0.05	0.25	0.02	0.02	0.02
Hydraulic Unloader	0.58	0.56	0.43	3.60	0.27	0.10	0.07
Booster Pump	0.24	0.23	2.20	8.40	0.55	0.21	0.13
Work Tug	0.08	0.08	0.12	0.72	0.05	0.06	0.06
Generator	0.01	0.01	0.05	0.08	0.01	0.01	0.01
Support Boat	0.05	0.05	0.08	0.45	0.03	0.04	0.03
Scraper	0.04	0.04	0.12	0.53	0.05	0.04	0.04
Bulldozer	0.08	0.08	0.20	0.71	0.08	0.06	0.06
Load and Transport to Landfill							
Front-end Loader	0.77	0.74	1.50	4.90	0.48	0.45	0.43
Haul Truck	2.02	1.94	8.06	8.89	0.00	1.76	1.69
Disposal at Landfill							
Haul Truck	0.09	0.08	0.50	0.26	0.00	0.03	0.03
Grader	0.12	0.12	0.39	1.80	0.22	0.16	0.15
Scraper	0.34	0.32	0.99	4.31	0.36	0.35	0.34
Bulldozer	0.68	0.66	1.59	5.76	0.63	0.51	0.49
Total	6.53	6.27	18.48	53.20	3.61	4.80	4.51

Table 22. Total Emissions for the High Volume Analysis.

Activity/Equipment Type/ Disposal Alternative	Total Emissions (tons)						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Ocean Site							
Transport/Disposal							
Tug Boat	49.80	47.81	76.50	444.08	31.06	35.96	34.52
Barge Equipment	1.77	1.70	3.91	18.13	1.19	1.27	1.22
Total	51.57	49.51	80.41	462.21	32.25	37.24	35.75
In-Bay Site							
Transport/Disposal							
Tug Boat	6.47	6.21	9.93	57.66	4.03	4.67	4.48
Barge Equipment	0.50	0.48	1.11	5.16	0.34	0.36	0.35
Hopper Dredge	2.15	2.06	1.59	13.22	0.98	0.38	0.25
Total	9.11	8.75	12.63	76.03	5.35	5.41	5.08
Habitat Restoration Site							
Transport							
Tug Boat	6.32	6.07	9.71	56.38	3.94	4.57	4.38
Barge Equipment	0.49	0.47	1.09	5.04	0.33	0.35	0.34
Disposal							
Tug Boat	0.56	0.54	0.86	4.97	0.35	0.40	0.39
Barge Equipment	0.16	0.16	0.36	1.67	0.11	0.12	0.11
Hydraulic Unloader	3.86	3.71	2.86	23.78	1.76	0.68	0.44
Booster Pump	1.61	1.55	14.50	55.51	3.62	1.37	0.89
Work Tug	0.53	0.51	0.82	4.73	0.33	0.38	0.37
Generator	0.08	0.08	0.31	0.52	0.06	0.05	0.05
Support Boat	0.33	0.32	0.51	2.96	0.21	0.24	0.23
Total	13.95	13.39	31.01	155.57	10.71	8.17	7.21
Levee Site							
Transport							
Tug Boat	3.52	3.38	5.41	31.38	2.19	2.54	2.44
Barge Equipment	0.27	0.26	0.60	2.81	0.18	0.20	0.19
Disposal							
Tug Boat	0.25	0.24	0.39	2.27	0.16	0.18	0.18
Barge Equipment	0.07	0.07	0.16	0.76	0.05	0.05	0.05
Clamshell Crane	1.22	1.18	11.02	42.17	2.75	1.04	0.68
Grader	0.05	0.04	0.14	0.67	0.08	0.06	0.06
Scraper	0.13	0.12	0.37	1.61	0.14	0.13	0.13
Bulldozer	0.26	0.24	0.59	2.15	0.23	0.19	0.18
Total	5.77	5.54	18.69	83.81	5.79	4.40	3.90
Rehandling Facility Site							
Transport							
Tug Boat	2.49	2.39	3.82	22.19	1.55	1.80	1.73
Barge Equipment	0.19	0.19	0.43	1.99	0.13	0.14	0.13
Offload/Dewater							
Tug Boat	0.17	0.17	0.27	1.54	0.11	0.13	0.12
Barge Equipment	0.05	0.05	0.11	0.52	0.03	0.04	0.03
Hydraulic Unloader	1.20	1.15	0.89	7.39	0.55	0.21	0.14
Booster Pump	0.50	0.48	4.51	17.25	1.12	0.42	0.28
Work Tug	0.16	0.16	0.25	1.47	0.10	0.12	0.11
Generator	0.03	0.02	0.10	0.16	0.02	0.02	0.02
Support Boat	0.10	0.10	0.16	0.92	0.06	0.07	0.07
Scraper	0.09	0.08	0.25	1.10	0.09	0.09	0.09
Bulldozer	0.17	0.17	0.40	1.47	0.16	0.13	0.12
Load and Transport to Landfill							
Front-end Loader	1.58	1.51	3.09	10.06	0.98	0.92	0.88
Haul Truck	4.15	3.99	16.54	18.25	0.00	3.60	3.46
Disposal at Landfill							
Haul Truck	0.18	0.17	1.02	0.53	0.00	0.06	0.06
Grader	0.25	0.24	0.80	3.70	0.45	0.32	0.31
Scraper	0.69	0.66	2.03	8.84	0.75	0.72	0.69
Bulldozer	1.40	1.35	3.26	11.82	1.29	1.05	1.01
Total	13.41	12.87	37.93	109.20	7.40	9.84	9.25

APPENDIX P

Derivation of Dredging and Disposal Costs

DERIVATION OF DREDGING AND DISPOSAL COSTS

Prepared by U.S. EPA with technical assistance from Jones & Stokes Assoc.
November 1995

DERIVATION OF DREDGING AND DISPOSAL COSTS

INTRODUCTION

This Report summarizes the process used to develop unit cost estimates for dredging and disposal activities, and estimate total costs for dredging and disposal under the four alternatives developed in the environmental impact statement/report (EIS/R) developed for the Long Term Management Strategy (LTMS). The LTMS is evaluating the policy options related to disposing material in San Francisco Bay or a designated ocean site, and promoting upland and wetland reuse (UWR).

In summary, estimates of total costs for dredging and disposal over the 50-year planning period were developed by applying unit cost estimates for dredging and disposal activities to the dredge volumes assumed for each disposal placement environment under each alternative. Unit costs represent the cost of dredging and disposal activities expressed per cubic yard of dredged material. A high-cost and low-cost scenario were developed for the unit costs to establish a range of likely costs. To establish total costs, the estimated unit costs were multiplied by the likely volumes of dredged material to be disposed in each placement environment under the various alternatives.

The cost estimates prepared for this task report are planning-level estimates that will be used to compare the relative dredging and disposal costs of the four alternatives and to provide an indication of the level of funding required over the 50-year planning period. Other reports prepared for the LTMS evaluate tools and mechanisms that may be required to finance this costs.

The planning-level estimates prepared for this report do not specifically reflect the range of dredging and disposal costs associated with all projects or project sponsors. As planning-level estimates of costs over a 50-year period, many simplifying assumptions were required for the analysis. Furthermore, limited resources necessitated using existing data sources for much of the cost analysis. The incorporation of numerous simplifying assumptions, the limitations of existing data, and the consideration of costs over a lengthy planning period necessarily introduce considerable variability and uncertainty into the estimates. Nevertheless, these cost estimates provide a consistent means to describe and compare the alternatives considered in this programmatic EIS/R.

Many of the assumptions incorporated into the analysis are described in the subsequent sections of this report. Where appropriate, this analysis has incorporated conservative assumptions in order to capture all possible costs associated with the wide range of dredging and disposal activities. Overall, however, the following major assumptions and limitations of the analysis should be considered when evaluating the findings of this report.

- Dredging volumes are assumed to be the same for each of the four alternatives under consideration. Approximately 296.5 million cubic yards (mcy) of material are assumed to be dredged over the 50-year planning period, with material not suitable for unconfined aquatic disposal (NUAD) accounting for 20% of this total. This represents a high estimate, and actual dredge volumes may vary substantially from this

cumulative total, affecting cost totals. Significant changes in dredging or disposal costs may lead to a decline in dredging, resulting in lower total costs.

- Total cost estimates were produced by assuming that the percentage of dredged material going to the three placement environments (ocean, in-bay and UWR) would be constant over the 50 year planning period and would equal the cumulative percentage. These distributions are assumed to be evenly distributed over time: that is, the percentage of material going to a placement environment in year 1 will be the same as in year 50. In reality, the cumulative percentage will be lower than assumed, as UWR projects and sites are phased in early years. Total costs would likely be lower than projected.
- Average annual cost estimates were produced by assuming an even distribution of dredging over the 50-year planning period. In reality, dredging may be heavy in some years and light in others, with annual dredging and disposal costs varying greatly over the planning period.
- The cost estimates presented in this report do not include the costs for dredging and disposing of the 20% of material assumed to be NUAD. It is assumed that some volume of NUAD material would be dredged under each alternative, that it would be disposed at appropriate sites, and that the overall costs for NUAD material disposal would not vary significantly among the alternatives.
- Costs associated with dredging and disposal activities are assumed to change at the same rate as inflation over the 50-year planning period. Costs are assumed to represent 1995 costs, even though unit costs developed for specific activities were developed from data representing prior years. Costs throughout the report are presented in constant 1995 dollars.
- Cost estimates were based on the development of a high and low unit cost range established for various dredging and disposal activities. No information was readily available to determine where costs would actually fall within these ranges. Because the unit cost ranges are wide and actual unit costs may vary greatly within these ranges, the estimates of total costs are expected to bracket actual costs associated with specific activities over the 50-year planning period.
- The cost estimates attempt to capture market-based costs and do not incorporate nonmarket benefits and costs such as those associated with providing environmental and social benefits (e.g., placement benefiting habitat restoration projects) or avoiding environmental degradation (e.g., benefits of avoiding disposal that may harm aquatic environments). It also does not attempt to capture economic benefits of increased regulatory certainty regarding dredge material disposal, which is a common goal to all the LTMS alternatives.
- The cost estimates attempt to summarize direct costs to all parties involved in dredging and disposal activities, including costs to local project sponsors, and, where

possible, direct costs to local, state, and federal agencies. These estimates, except where noted, do not include staff time for government employees charged with regulating dredging and dredged material placement. If included, total costs would likely be higher.

- The cost estimates are based on the current regulatory and financial framework for dredging activities. Other portions of the EIS/R will consider policy and financing options that may reduce the total costs or the costs borne by particular sectors of the dredging economy.

PLACEMENT ENVIRONMENT ALTERNATIVES

The placement environment distributions developed for the financial analysis reflect the four alternatives being evaluated for the EIR/S. Costs associated with disposal activities will be affected by amounts of "clean" and NUAD materials dredged in the future. For the purposes of this assessment, NUAD materials are assumed to account for 20% of all materials dredged over the 50-year study period.

In summary, each EIR/S alternative is associated with percentage ranges for amounts of clean dredged material to be disposed of in the three primary available placement environments (i.e., in-bay disposal, ocean disposal, and uplands/wetlands reuse). See Table 1.

Table 1. Percent Ranges of Clean Material Allocated to Each Placement Environment by Alternative

No-Action (Current Conditions)	
In-Bay (High)	65-80%
Ocean (Low)	5-20%
Upland/wetland/reuse (Low)	5-20%
Alternative 1: Medium In-Bay, Medium Ocean, Low UWR	
In-Bay (Medium)	35-50%
Ocean (Medium)	35-50%
Upland/wetland/reuse (Low)	5-20%
Alternative 2: Medium In-Bay, Low Ocean, Medium UWR	
In-Bay (Medium)	35-50%
Ocean (Low)	5-20%
Upland/wetland/reuse (Medium)	35-50%
Alternative 3: Low In-Bay, Medium Ocean, and Medium UWR	
In-Bay (Low)	5-20%
Ocean (Medium)	35-50%
Upland/wetland/reuse (Medium)	35-50%

Source: LTMS