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A Sediment Testing "REFERENCE AREA DATABASE" for the San Francisco Deep Ocean Disposal Site (SF-DODS)

The San Francisco Deep Ocean Disposal Site (SF-DODS) is the deepest ocean dredged material disposal site in the United States. It is located off the Continental Shelf in approximately 8,200 to 9,800 feet (2,500 to 3,000 meters) of water, approximately 55 nautical miles (100 kilometers) offshore of San Francisco ([Figure 1](#)).^{*} In order for a dredging project to be authorized to dispose of dredged material at the SF-DODS, sediment evaluations (including appropriate physical, chemical, and biological testing as described in the national sediment testing manual popularly referred to as the Ocean Testing Manual or OTM) must first be conducted. Under these guidelines, EPA and the Corps determine suitability of dredged material for ocean disposal in large part by comparing the results of tests conducted on the material to be dredged against the results of the same tests conducted on a designated reference sediment. Reference sediments are identified by EPA to be substantially free of contaminants, and to be as representative as possible of what conditions at the disposal site would be if no dredged material had ever been disposed there.

The reference area identified by EPA for the SF-DODS is located in approximately 4,200 feet (1,285 meters) of water, at 37°25.00' North Latitude and 123°14.90' West Longitude (NAD 83). This site is approximately 20 nautical miles (35 kilometers) from the SF-DODS itself ([Figure 1](#)).^{*} Just as the SF-DODS is the nation's deepest disposal site, its reference area is the deepest, as well. The great water depth and open-ocean location of the reference site make collection of sediment from the site very expensive and logistically difficult at best. Weather and sea-state conditions can at times force costly delays in project sampling programs, and in extreme conditions can present a concern for human safety. For these reasons EPA believes it is appropriate to establish and maintain a reference area database of previously-collected sediment test data, that may be used in lieu of collecting and testing reference area sediment directly. EPA anticipates that project proponents will typically elect to compare their test result against the database values when timing, cost, or safety considerations present significant obstacles to collecting new reference site sediment; but any project proponent may propose to compare their sediment test data against the most current reference area database values.

The Reference Area Database

Several sets of sediment test data have been successfully collected from the SF-DODS reference area since 1990. Physical, chemical, and biological data from these studies are summarized in Tables 1 through 4. [Table 1](#) depicts the range of bulk sediment chemistry values found at the reference site for all typical contaminants of concern. [Table 2](#) shows solid phase acute toxicity bioassay results for two species of amphipods and two species of polychaetes. Tissue chemistry results are provided for all typical bioaccumulative contaminants of concern, for one clam species in [Table 3](#), and two polychaete species in [Table 4](#). (Suspended particulate phase bioassays are not included in the database, since results from these tests are compared against water quality criteria as opposed to reference sediments.) Thus, all types of reference sediment data necessary for full Tier III OTM evaluations are included in the database.

Cautions for Using the Reference Area Database

Project proponents electing to compare their dredged material test data against the SF-DODS reference area database are cautioned that they must use the same test species reflected in the database.

Project proponents are also cautioned that comparison to the reference area database values can result in disposal suitability determinations by EPA and the Corps that are slightly more conservative (more environmentally protective) than would be the case if the reference sediments were tested directly. This is because direct (not statistical) comparison is made to reference area database values under this approach. Therefore when average amphipod mortality in a sediment sample is more than **20 percent** above the overall average value in the reference area database, the test sediment is automatically considered to be toxic. This will be true even if the test sediment and reference area sediment might not have been statistically different if they had been tested directly at the same time. In the same manner, when polychaete mortality is more than **10 percent** above the corresponding overall average value in the reference area database, it is considered toxic.

Comparison of bioaccumulation test results to the reference area database also will be made directly, as opposed to statistically. For bioaccumulation data, EPA will evaluate test data generally against the range of tissue concentrations in the reference area database, as well as consider available published scientific information concerning tissue residue effects.

Finally, project proponents are advised that before embarking on any sediment testing program in support of proposed ocean dumping at SF-DODS, a draft Sampling and Analysis Plan should be coordinated with and approved in advance by the Region 9 EPA Dredging and Sediment Management Team.



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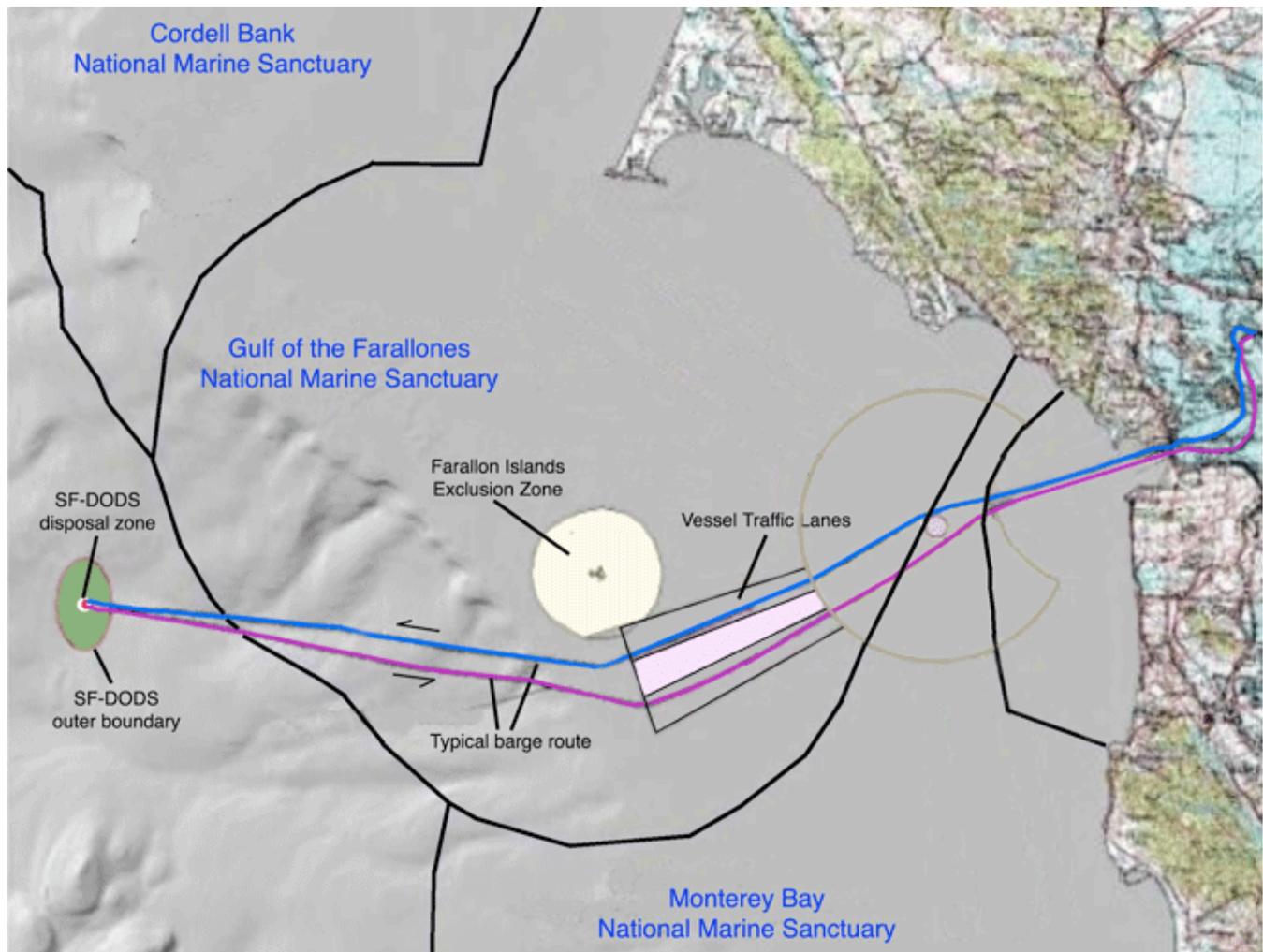
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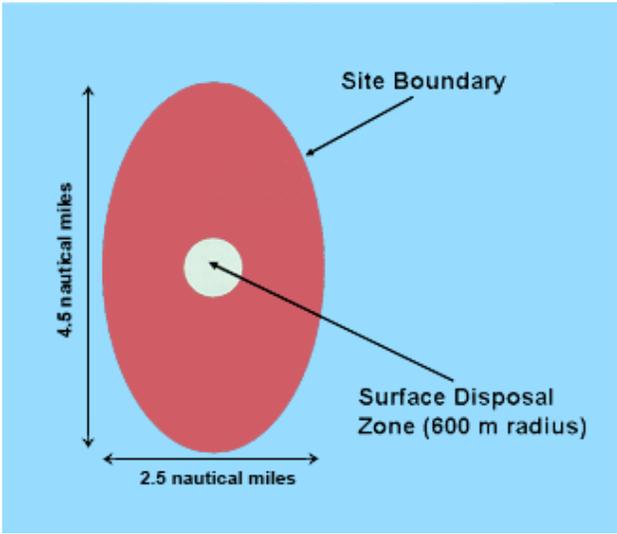
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SF Deep Ocean Disposal Site (SF-DODS) Vessel Route

This map shows the route of a typical disposal vessel trip to the SF-DODS. The vessel remains within the established shipping lanes in the vicinity of the Farallon Islands as required.



[Larger version for download](#) (.gif image format, 500K — click to display, then right-click to copy)



SF-DODS center coordinates:
37° 39.0 min N, 123° 29.0 min W (NAD 83)



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Sediment Chemistry for the SF-DODS Reference Area

PARAMETER	Results from Separate Assessments								Overall Range
CONVENTIONALS									
Grain Size (%)									
sand/gravel	34	60	59	45	16	37	39		16-60
silt	45	27	25	35	62	39	44		25-62
clay	21	13	16	20	22	24	17		13-24
Total Organic Carbon (%)	1.35	0.63	0.74	0.79	1.44	1.45	1.8		0.63-1.45
Total Volatile Solids (%)	2.49	4.28	4.38	2.34	5.74	N/A	N/A		2.34-5.74
TRPH (ppm dw)	nd<29	6.7	d<16	nd<16	17.1	1.8	nd>2.0		nd-17.1
TRACE METALS (ppm dw)									
Arsenic	2.2	3.9	4.25	5.33	4	2.6	nd		2.2-5.33
Cadmium	0.5	0.3	0.3	0.4	0.6	0.3	nd		0.3-0.6
Chromium	171	225	247	197	172	283	69.2		69.2-283
Copper	23.5	20.3	21.8	21.8	30.7	86.3	18.3		18.3-86.3
Lead	10.8	9.1	6.8	8.2	9.2	26	5.1		5.1-26
Mercury	0.1	0.2	0.1	0.1	0.2	0.1	0.1		0.1-0.2
Nickel	68.1	63.5	70	69.4	82.8	238	50.9		50.9-238
Selenium	1.3	0.6	1.2	0.8	2.6	0.7	1.5		0.6-2.6
Silver	0.6	0.2	0.4	0.3	0.5	1	0.4		0.2-1.0
Zinc	84.3	82.5	82.3	76.3	91	288	60.8		60.8-288
ORGANICS (ppb dw)									
Total LPAH (a)	48	11	14	65	77	nd	nd		nd-77
Total HPAH (b)	68	6	23	57	115	nd	31		nd-115
Total PAHs	116	17	37	122	192	nd	31		nd-192
Chlorinated Pesticides (ppb dw)									
Aldrin	nd	nd	nd	nd	nd	nd	nd		nd
Dieldrin	nd	nd	nd	nd	nd	nd	nd		nd
Chlordane	nd	nd	nd	nd	nd	nd	nd		nd
DDE/DDD/DDT	nd	nd	nd	1.2	nd	nd	2.1		nd-2.1
Endosulfan I	nd	nd	nd	nd	nd	nd	nd		nd
Endosulfan II	nd	nd	nd	nd	nd	nd	nd		nd
Endosulfan Sulfate	nd	nd	nd	nd	nd	nd	nd		nd
Endrin	nd	nd	nd	nd	nd	nd	nd		nd
Heptachlor	nd	nd	nd	nd	nd	nd	nd		nd
Heptachlor Epoxide	nd	nd	nd	nd	nd	nd	nd		nd
Alpha- BHC	nd	nd	nd	nd	nd	nd	nd		nd

Beta-BHC	nd	nd	nd	nd	nd	nd	nd	nd
Delta-BHC	nd	nd	nd	nd	nd	nd	nd	nd
Gamma-BHC	nd	nd	nd	nd	nd	nd	nd	nd
Toxaphene	nd	nd	nd	nd	nd	nd	nd	nd
Total PCB (ppb dw) (c)	nd	nd	nd	nd	nd	nd	nd	nd
Total Butyltins (ppb dw) (d)	nd	nd	nd	nd	nd	1.3	nd	nd-1.3

NOTES:

- Reported as total of 6 LPAHs: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene
- Reported as total of 9 HPAHs: fluoranthene, pyrene, benzo(a)anthracene, chrysene, Benzo(b,k)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene
- Reported as total of Aroclor equivalents 1242, 1248, 1254, and 1260
- Reported as total of Mono-, Di-, and Tri- and Tetrabutyltin



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 Reference Area Sediments

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Percent Survival in Toxicity Bioassays of SF-DODS Reference Area Sediments

SPECIES	Average Survival in Separate Bioassays (percent)					Overall Average Survival (a)
AMPHIPODS						
Rhepoxinius abronius	89	94	86	97	83	89.8 (n=5)
Ampelisca abdita	92	98	84	88		90.5 (n=4)
POLYCHAETES						
Nephtys caecoides	96	99	93	97	95	95.4 (n=6)
Neanthes arenaceodentata	96	100				98.0 (n=2)
NOTE: (a) Direct (not statistical) comparison is made between these values and test sediment average survival results.						



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Tissue Chemistry for the Clam *Macoma nasuta* Exposed to SF-DODS Reference Area Sediments

PARAMETER	Results from Separate Bioassays						Overall Range
TRACE METALS (ppm ww)							
Arsenic	2.3-4.0	2.8-4.0	2.4-3.0	3.3-3.7	3.0-3.9	2.2-2.5	2.2-4.0
Cadmium	nd-0.03	0.03-0.05	0.01-0.04	0.03-0.05	0.02-0.04	0.01-0.02	nd-0.05
Chromium	0.2-0.4	0.3-0.6	0.3-0.4	0.2-0.3	0.3-0.5	0.4-0.5	0.2-0.6
Copper	1.2-2.5	2.1-8.7	1.8-2.9	1.4-2.0	1.6-2.0	2.3-3.1	1.2-8.7
Lead	0.1-0.2	0.1-0.8	0.1-0.2	0.1	0.1-0.2	0.1-0.3	0.1-0.8
Mercury	0.01	0.01-0.02	0.01	0.01	0.01	0.1	0.01-0.1
Nickel	0.5-0.8	0.6-4.3	0.4-0.5	0.5-0.7	0.6-0.9	0.2-1.0	0.2-4.3
Selenium	0.2-0.3	0.3-0.4	0.2	0.2-0.4	0.2-0.3	0.3	0.2-0.4
Silver	0.02-0.06	0.06-0.26	0.05-0.1	0.03-0.04	0.02-0.12	0.1	0.02-0.26
Zinc	11.0-14.0	13.6-18.2	12.6-16.6	8.8-13.6	9.0-14.0	15-18	8.8-18.2
ORGANICS (ppb ww)							
Total LPAH (a)	2-3	nd	1-2	6-10	2-5	nd	nd-10
Total HPAH (b)	12-17	nd-26	3-8	21-25	2-7	nd<40	nd-26
Total PAHs	12-17	nd-26	4-9	27-33	4-11	nd<40	nd-33
Chlorinated Pesticides (ppb ww)							
Aldrin	nd	nd	0.7	nd	nd	nd	nd-0.7
Dieldrin	nd	nd	nd	nd	nd	nd	nd
Chlordane	nd	nd	nd	nd	nd	nd	nd
DDE/DDD/DDT	nd	nd	0.9	1.4-1.8	0.4-0.6	nd	nd-1.8
Endosulfan I	nd	nd	nd	nd	nd	nd	nd
Endosulfan II	nd	nd	nd	nd	nd	nd	nd
Endosulfan Sulfate	nd	nd	nd	nd	nd	nd	nd
Endrin	nd	nd	nd	nd	nd	nd	nd
Heptachlor	nd	nd	0.18	nd	nd	nd	nd-0.18
Heptachlor Epoxide	nd	nd	nd	nd	nd	nd	nd
Alpha- BHC	nd	nd	0.1-0.4	nd	0.2	nd	nd-0.4
Beta-BHC	nd	nd	nd	nd	nd	nd	nd
Delta-BHC	nd	nd	nd	nd	nd	nd	nd
Gamma-BHC	0.13	nd	nd	nd	nd	N/A	nd-0.13
Toxaphene	nd	nd<100	nd	nd	nd	nd	nd
Total PCB (ppb ww) (c)	nd<20	nd<20	2.6-4.2	nd	2.5-3.5	nd<20	nd-4.2
Butyltins (ppb ww) (d)	1.7-3.6	3.1-10.2	2.2-3.4	nd-1.6	4.0-11.0	N/A	nd-11.0

NOTES:

1. Reported as total of 6 LPAHs: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene
2. Reported as total of 9 HPAHs: fluoranthene, pyrene, benzo(a)anthracene, chrysene, Benzo(b,k)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene
3. Reported as total of Aroclor equivalents 1242, 1248, 1254, and 1260
4. Reported as total of Mono-, Di-, and Tri- and Tetrabutyltin

**Butyltins (ppb
ww) (d)**

2.7

nd-9.3

5.2-206

nd

30-40

N/A

nd-206

NOTES:

- a. Reported as total of 6 LPAHs: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene
- b. Reported as total of 9 HPAHs: fluoranthene, pyrene, benzo(a)anthracene, chrysene, Benzo(b,k)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene
- c. Reported as total of Aroclor equivalents 1242, 1248, 1254, and 1260
- d. Reported as total of Mono-, Di-, and Tri- and Tetrabutyltin