7.0 CONTAMINANT ASSESSMENT OF SEDIMENTS IN THE NORTHWEST OIL DRAIN "DELTA", FARMINGTON BAY, 2000

7.1 Introduction

The Northwest Oil Drain (NWOD) was built in the early part of the 20th century as part of the Salt Lake City's irrigation and flood water control system and to transport waste waters from heavy industries located in the northwest quadrant of the city. Currently, flows are a combination of return flows from canals originally diverted from the Jordan River, storm waters, treated wastewater effluents from the Salt Lake City Wastewater Treatment Plant (SLC WWTP) and treated wastewaters from several refineries still in operation in the area. Prior to the implementation of controls under water quality regulations beginning with the 1972 Water Pollution Control Act, the NWOD carried untreated wastewaters from a variety of industries in the northwest quadrant, including the refineries, feed lots, tanneries, metal fabricating and plating operations, chemical manufacturing plants, and other "heavy industries." The former name of the NWOD, still currently in use, is "the Sewage Canal."

The NWOD enters the Great Salt Lake within one of the most intensely managed and productive waterfowl habitats on the GSL, the Farmington Bay Waterfowl Management Area (FBWMA) which is owned and operated by the Utah Department of Natural Resources Division of Wildlife Resources (UDNR- DWR). The outlet of the NWOD forms a delta of sediments which reach out several kilometers into the bay, and is located between two of the main waterfowl management impoundments of the FBWMA, the Turpin Unit to the north and the Crystal Unit to the south (**Figure 7-1**). Although the shoreline of the GSL varies considerably depending on lake level, the delta is typically shallowly inundated over much of its area, and is vegetated with emergent and submerged aquatic wetland plants. There are typically a large number and variety of avian species foraging and nesting in the area, with large populations of American avocets, black-necked stilts, white-faced ibis, and American coots foraging in the sediments.

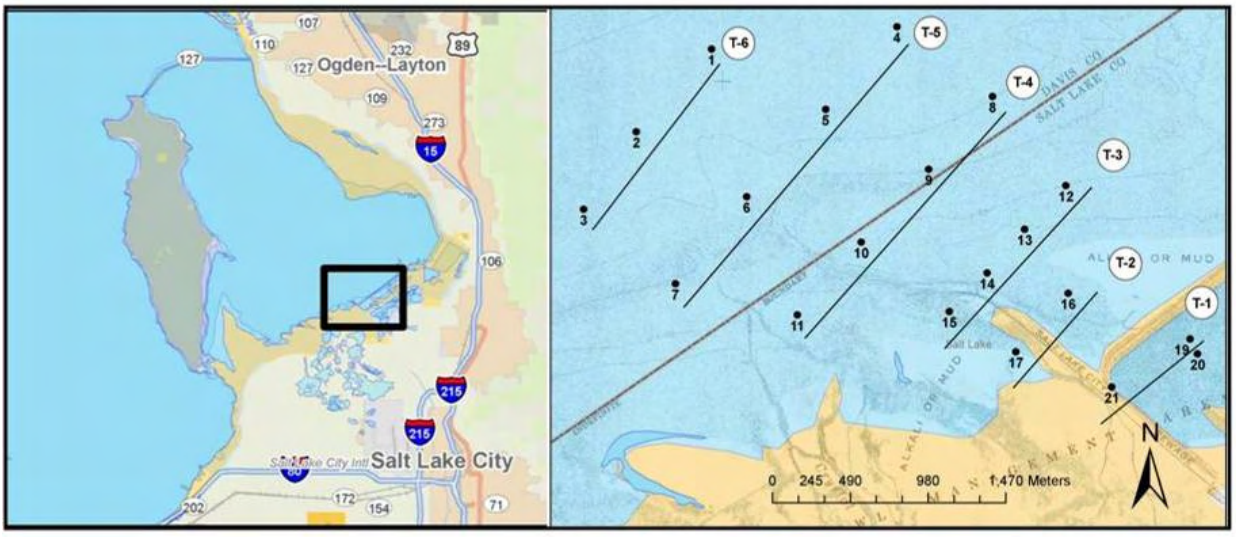

Figure 7-1. Location of the Northwest Oil Drain (NWOD) within Farmington Bay and location of sediment samples (and transects) within the NWOD delta.

Beginning in the late 1990's, the U.S. EPA and the Utah Department of Environmental Quality (UDEQ) began conducting remedial investigations of the NWOD under the Comprehensive Environmental Response, Liability and Compensation Act (CERCLA). These investigations came to the Service's attention after much of the sampling for the 1996-1997 GSL Wetlands Contaminant assessment had been completed. However, based on data that had been collected in relevant locations (summarized below, and shown in **Figure 7-2**), the Service recommended that the NWOD remedial investigation include the submerged portion in Farmington Bay to address avian exposure to contaminants in the delta and characterize risks to avian populations. The study detailed in this section was undertaken by the Service in order to gather data to help in this process. However, the regulatory agencies declined to extend the investigation due to a variety of factors. The upstream segments of the NWOD canal were cleaned up during approximately 2002 – 2005, but the delta of the NWOD remains unaddressed to date.

7.2 Study Location and Methods

Twenty sediment sampling locations were chosen for this investigation and sampled in 2000. Eighteen of the sampling points were located at the mouth of the NWOD where it empties out into Farmington bay near the southwest end of the impoundment dike between the Crystal Unit (to the south) and the Turpin Unit (to the north) in the FBWMA (**Figure 7-1**). Two additional samples were located upgradient of the shoreline of Farmington Bay as it existed in 2000, within the Turpin Unit. These samples were located to

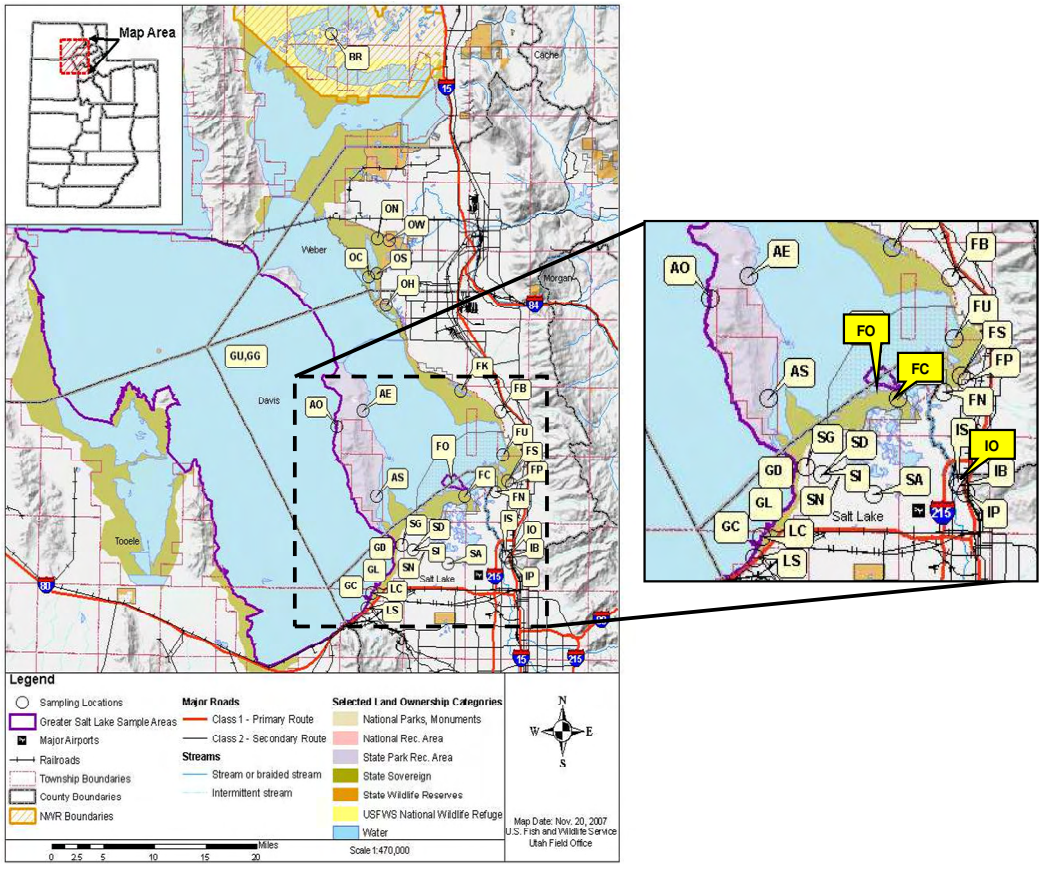

Figure 7-2. Sampling locations of 1996-1997 Great Salt Lake Wetlands Contaminants Assessment; sites relevant to the Northwest Oil Drain highlighted in yellow.

characterize contamination that may have been deposited in the Turpin Unit during the early 1980's, when several years of historically high precipitation had resulted in flooding of the GSL shoreline. The samples were arranged in transects that ran parallel to the shoreline and extended out into Farmington Bay. The first transect (T-1) included the two points within the Turpin Unit, and the second (T-2) was the first transect located within Farmington Bay. A total of six transects, spaced approximately 500 meters apart, extended about 2.5 km into Farmington Bay. Sediments in the four shore-most transects (T-1 through T-4) were located under less than 30 cm of water; these were sampled with decontaminated stainless steel scoops according to procedures outlined in Section 3. The last two transects (T-5 and T-6) were under approximately 1.0 – 1.5 meters of water, and were sampled with a stainless steel ponar dredge from a canoe. All samples were collected into chemically clean borosilicate glass jars, and handled, transported and stored as described in Section 3. Samples were analyzed for 19 metals, 25 organochlorine compounds (including total PCBs); and 25 polynuclear aromatic hydrocarbons (PAHs) including both non-alkylated and alkylated PAHs. Two isomers of tetrachlorobenzene (TCB; 1,2,3,4- and 1,2,4,5- isomers), were also included in the analysis. Analytical laboratories and methods are described in Section 3.

Analytical results were compared with the freshwater Consensus-based Sediment Screening Guidelines (CBSSG) threshold effect concentrations (TECs) and probable effect concentrations (PECs) used to evaluate the GSL wetland sediments. (MacDonald et al. 2000) and see Section 4.1). Concentrations of selenium were evaluated against the sediment guidelines in (National Irrigation Water Quality Program 1998) because these guidelines directly address adverse effects to avian species. Concentrations of Al, Ba, Mn, and V were compared with concentrations identified in "SQuiRT" (Screening Quick Reference Tables) produced by the National Oceanic and Atmospheric Administration (NOAA;(Buchman 1999). Ecologically-based screening concentrations could not be identified for Be and B, so concentrations of these elements were compared with mean "background" concentrations in western U.S soils (Shacklette & Boerngen 1984) as a way of roughly identifying elevated concentrations compared with these "background" values. No reference values were identified for Fe, Mg, Mo and Sr. For organics, available TEC and PEC concentrations (MacDonald et al., 2000 and NOAA, 1999) were used as screening benchmarks. Although these benchmarks are not available for all of the compounds that were analyzed, they are available for constituents that are typically of greatest concern for ecological toxicity. Since organic constituents tend to co-occur with each other, we believed that elevated concentrations of compounds with screening concentrations would tend to "drive" the evaluation, so no attempt was made to identify additional benchmarks for compounds not addressed by the CBSG or SQuiRT references.

7.3 Results and Discussion

Trace Elements-
All data from the metals analysis in the Oil Drain Delta sediments are presented in **Appendix Table D-1**. All elements but Hg, Mo and Se were detected in every sample, with Mo the least frequently detected, in less 50% of the samples.

The geometric means of 14 metals exceeded their respective TECs, out of the 15 metals for which TECs could be identified (**Table 7-1**). Only the geometric mean concentrations of Cr, Mn and Vn did not exceed these lower benchmarks. All 20 samples exceeded the TECs for a number of metals of concern including As, and Pb; 19 of the 20 samples exceeded the TEC for mercury (Table 7-1). The geometric mean concentration of lead (Pb) exceeded the higher threshold PEC, and a high frequency of samples exceeded the PECs for Pb and Cu. Seven of the 20 sediment samples exceeded the PEC for Hg.

In addition to the number of exceedences of the sediment benchmarks, the spatial distribution of contaminant concentrations was also of interest. Copper, Pb and Zn collectively tended to have the highest concentrations from Transect 3 (T-3) outward (**Figure 7-3**); Hg exhibited the same trend (**Figure 7-4**).

Table 7-1 Summary of trace elements (mg/kg, dry weight) and exceedences of reference values in sediments of the Northwest Oil Drain Delta(*n* = 20) in Farmington Bay, Great Salt Lake, 2000.

Constituent	Gmean[a]	max	Reference Values[c]	# > TEC	# > PEC
Aluminum	*10,882*	*16,989*	[2,600 / 25,550]¹	20	0
Arsenic	*25.8*	**43.0**	[9.8 / 33]²	20	5
Barium	*220*	305	[48 / --]³	20	--
Beryllium	*0.71*	1.96	[0.68 / --][4]	15	--
Boron	*100*	141	[23 / --][4]	20	--
Cadmium	*1.56*	**10.9**	[0.99 / 4.98]²	13	3
Chromium	36.3	**310**	[43.4 / 111]²	8	3
Copper	*137*	**268**	[31.6 / 149]²	19	12
Iron	12,023	18,703	[--]	--	--
Lead	**193**	**453**	[35.8 / 128]²	20	16
Magnesium	28,981	38,311	[--]	--	--
Manganese	*322*	443	[400 / 630]¹	3	0
Mercury	*0.97*	**6.17**	[0.18 / 1.06]²	19	7
Molybdenum	NC[b]	17.4	[--]	--	--
Nickel	17.0	36.5	[22.7 / 48.6]²	4	0
Selenium	*1.22*	2.48	[1 / 4][5]	14	0
Strontium	745	2710	[--]	--	--
Vanadium	*30.7*	112	[50 / --]¹	1	--
Zinc	*275*	**932**	[121 / 459]²	17	5

KEY:

Value	Value exceeds TEC
Value	Value exceeds PEC

NOTES:

(a)One half the detection limit was used to calculate geometric means for Hg and Se
(b)NC = Geometric mean not calculated
(c)[--] = No reference values identified

KEY TO EFFECTS LEVELS:

1) "Background" and lowest Threshold Effect Level (Buchman 1999)
2) Threshold Effects and Probable Effects concentrations (MacDonald et al. 2000)
3) Apparent Effects Threshold in marine sediments (Buchman 1999)
4) Mean concentrations in U.S. soils (Shacklette & Boerngen 1984); not a threshold value.
5) "Background" and toxicity threshold (National Irrigation Water Quality Program 1998)

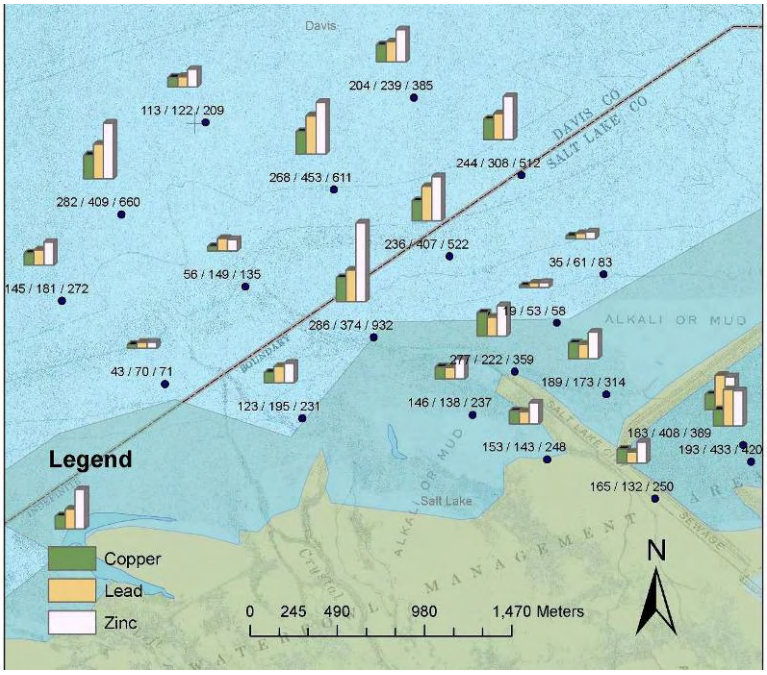

Figure 7-3. Spatial distribution of copper, lead and zinc (mg/kg dry weight) in sediments, Northwest Oil Drain Delta of the Great Salt Lake, 2000. Probable effects concentrations (PECs) = 149 mg/kg (Cu), 128 mg/kg (Pb) and 459 mg/kg (Zn).

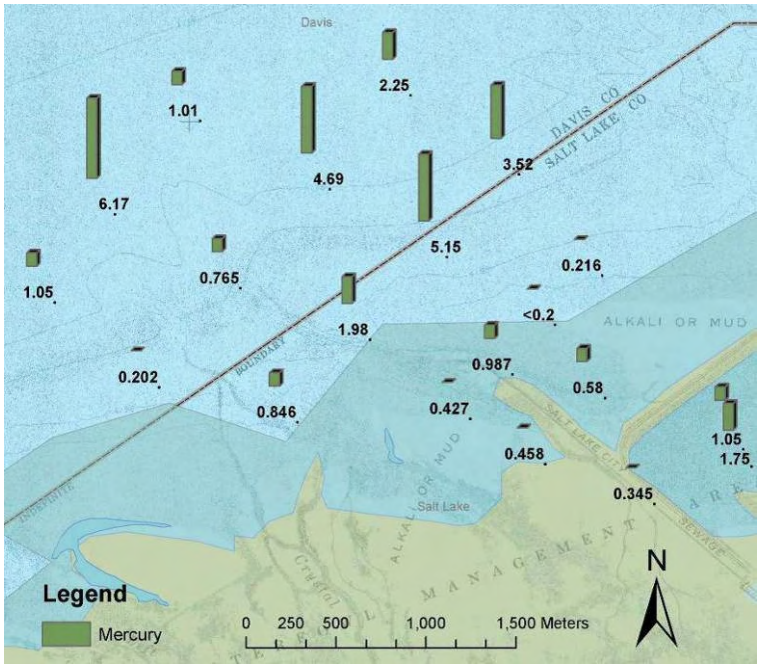

Figure 7-4. Spatial distribution of mercury (mg/kg dry weight) in sediments, Northwest Oil Drain Delta of the Great Salt Lake, 2000. Probable effects concentration (PEC) = 1.06 mg/kg.