February 4, 2002

Amy Hutzel
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San Francisco Bay Program
1330 Broadway, 11th Floor
Oakland, CA 94612

SUBJECT: Napa River Salt Marsh Restoration Project – Water Quality and Sediment Characterization

Dear Ms. Hutzel:

HydroScience Engineers Inc. (HSe) is pleased to have this opportunity to submit the results of our water quality and sediment characterization of the salt ponds that will be restored as part of the Napa River Salt Marsh Restoration Project. The project site is located North of State Highway 37 and West of the Napa River. The proposed project would divert water from the Napa River, and possibly recycled water from communities in Sonoma and Napa counties, to flush up to 11 existing salt ponds on the west side of the Napa River. The Napa-Sonoma Marsh encompasses approximately 9,850 acres of wetland, marsh and remnants of a former salt pond levee/pond system. The Cargill Salt Company previously operated the salt ponds commercially, but they are now maintained by California Fish and Game. It is anticipated that the flushing process will eventually reduce the salinity in the ponds and restore the eco-system to tidal marshes. Discharge from the flushing will be either to the Napa River or San Pablo Bay.

The potential receiving waters (Napa River and San Pablo Bay) are considered impaired pursuant to the Clean Water Act Section 303(d). It is anticipated that the discharge from this project will be to the Napa River and will be permitted by the California Regional Water Quality Control Board (Region 2). The Discharge Permit for this project may be either a Waste Discharge Requirements (WDR) or possibly a National Pollution Discharge Elimination System (NPDES) Permit depending upon a determination yet to be made by the RWQCB. The water quality data collected in this study will be used to characterize the pond waters for modeling purposes and for conducting a reasonable potential analysis for regulatory permitting purposes.

Methodology

A Sampling and Analysis Plan (SAP) was developed by HSe and submitted to the Corps of Engineers and their contract laboratory (MEC Analytical Laboratories) for review and comment prior to sampling. A copy of the SAP is contained in the appendices for

review. Table 1 summarizes the water quality analyses that were analyzed in the water quality samples collected in each pond.

Table 1. Napa Sonoma Marsh Water Quality Parameters measured and Analytical Methods used.

Parameter	EPA Analysis Method
GENERAL WATER QUALITY:	
Ammonia	350.2
Nitrate as Nitrogen	300.0
Nitrite as Nitrogen	300.0
Fluoride	300.0
TKN	SM 4500
Phosphorus (Total)	365.2
Total Dissolved Solids (TDS)	160.1
Total Suspended Solids (TSS)	160.2
Hardness	SM 2340
VOLATILE ORGANIC COMPOUNDS:	
VOC	8260
SEMI-VOLATILE ORGANIC COMPOUNDS:	
SVOC	8270
METALS:	
13 Metals	6020/7000
Arsenic, Lead, Mercury	1631
Chromium VI	7199
ORGANICS:	
Pesticides & PCBs	8081A/8082
OP Pesticides	8141A
Herbicides	8151
Dioxins	8290

In addition, the following parameters were also measured in the field:

- pH
- Temperature
- Specific Conductivity
- Salinity
- Dissolved Oxygen (DO)
- Sample Location
- Turbidity
- Shear Strength
- RedOX potential.

Sampling was performed under the guidance of the U.S. Army Corps of Engineers (ACE), San Francisco District. Analytical methods, quality control, and quality assurance were performed under the guidelines of the ACE Quality Assurance Project Plan (QAPP). A copy of the QAPP for the project is also contained in the appendices for reference.

Sampling Points

Between October 28 and November 14, 2001, water and sediment samples were collected in the Napa Salt Marsh at 40 sample locations as shown on Figure 1. The latitude and longitude at each sampling location was recorded using a global positioning system (GPS).

Some sampling locations indicated on Figure 1 may differ from sampling points originally proposed in the SAP due to constraints encountered in the field with respect to site access. When site conditions did not allow safe access to an intended sampling station, then samples were collected at the nearest accessible sampling point. Sediment samples were collected in the ponds using a canoe or "John Boat". Water samples were generally collected from the shoreline.

Sample Identification

Sample identification followed the protocol developed in the SAP. The alpha-numeric sample ID consisted of the pond number, an alphabetic sampling point designation, and an alphabetic sampling media designation. Within each pond, the sampling point designation started with “A” and proceeded alphabetically clockwise to each sample location. A “-W”, “-S”, or “-G” designation was used to identify the sampling media (W-Water, S-Sediment, G-Geotechnical soil core). Samples collected in the receiving waters used the following sampling location designations in lieu of pond numbers:

- Napa River: NR
- Napa Slough: NS
- San Pablo Bay: SP

All sample ID and locations were maintained through the Chain-of-Custody Form.

Quality Assurance and Control

Sampling was conducted in accordance with established sampling protocols to maintain quality assurance and control (Ref: QAPP). No field duplicate or trip blanks were collected. Sufficient volume of sample was collected to accommodate laboratory control (i.e., Matrix Spike/Matrix Spike Duplicate) as required in the QAPP. The samples collected for this project were collected and transported in accordance with the guidelines developed in the QAPP to assure the quality of data gathered in the field meet project objectives in an accurate and efficient manner. ACE staff were on-site during field sampling on November 3, 2001 to verify sampling procedures and protocol.

Measures were taken to protect the integrity of the samples and maintain sample consistency between sample locations. MEC Analytical Laboratories provided field sampling oversight of sample handling, preservation, storage, and transportation. Nitrile gloves were worn by technicians between each sample station. The gloves protected the field sampler and prevented cross contamination of samples. All water and sediment samples were placed in an ice chest and cooled to approximately 4^{o} C immediately after collection. The samples remained in the ice chest throughout all sample collection activities and during transportation. Soil core samples were stored up-right in a basket.

Due to the salinity and conductance of the water in the ponds, the pH meter failed after a couple of days of operation. pH strips were used thereafter to estimate water pH. Water samples were collected in two sample buckets, where possible. The buckets were lowered to approximately half the depth of the water column in Pond 2. The other ponds did not contain sufficient depth of water to deeply dip the collection buckets. Where the depth of water did not allow for the bucket to be filled, a dedicated liter bottle was used to dip into the standing water and fill the bucket with sample water. The water from the buckets was poured directly into the requeset bottles for analysis. All bottles were prepackaged together prior to being filled. In addition, all sample bottles requiring preservative had the preservative added prior to transportation to the field. Upon completion of filling out the identification labels for each bottle, they were filled with water directly from the buckets. All sample bottles were placed immediately on ice after filling.

At the conclusion of each day, the sample bottles were packed with ice and bubble wrapped to protect against breakage. The coolers were completely filled with ice prior to transportation to MEC laboratories in Marin, California.

Sediment soil samples were collected from the base level of the ponds and receiving waters at each of the identified sample stations on Figure 1. Where necessary, technicians used a canoe or "John boat" to ferry into the pond for collection of sediment samples. The boat allowed the technicians to advance beyond the borrow ditch along the levees to collect representative sediment samples.

Sediment samples were collected from the top six to eight inches of soil material. These samples were collected using various techniques throughout the course of the sampling. An Art's Manufacturing and Supply, Inc. (AMS) sediment sampler was initially used to collect the samples in 10-inch plastic sleeves. The stainless steel 2-1/4 inch sampler encapsulated a 10-inch plastic sleeve. The sampler was driven into the sediment until the sleeve was filled with sediment sample. This process was continued until six sleeves were filled. However, this process became increasingly inefficient due to site conditions and site constraints in the sampling boat. Sediment samples were collected by a "mud" auger and plastic bags thereafter. MEC evaluated the revised sample method and determined that no adverse impacts to the sample would result from this procedure.

Each bag was labeled in accordance with the same methodology as the water quality samples. Sediment samples were also stored in ice chests, cooled to approximately 4^{o}C, and transported to MEC laboratories in Marin, California under COC procedures for analysis.

Results

Detailed results of all water quality and soil sediment analyses can be found in the appendices of this report. The data is approximately 95% complete. It is not anticipated that MEC Laboratories will provide any additional water quality data. Spreadsheets with detailed summaries of results for all sampling (Water quality and sediment) are contained in the appendices of this report. These spreadsheets contain the results of comprehensive analyses for all 126 priority pollutants as identified by the RWQCB (California RWQCB Memo, San Francisco Bay Region, dated August 6, 2001, SUBJECT: Requirements for Monitoring of Pollutants in Effluent and Receiving Water to Implement New Statewide Regulations and Policy). The spreadsheets also identify approximate discharge criterion as identified by the RWQCB. An overview of the results are summarized below.

Volatile and Semi-Volatile Organics. The water and sediment samples were relatively free of volatile and semi-volatile organics. Organics levels were consistently below detection limits in almost all samples. No organic chemicals were measured in detectable amounts in all of the samples collected in any single pond.

Pesticides. The water and sediment samples were also relatively free of chlorinated pesticides and organophosphate pesticides. None of the water samples had pesticide concentrations at detectable levels. Sediment samples occasionally contained trace amounts of a few organophosphate pesticides in isolated samples collected in ponds 1, 2A, 3, 4, 5, 6, and 7A. Organophosphate pesticides were not detected in any of the ponds.

PCBs. PCB's were not detected in any of the water quality or sediment samples collected in this study.

Heavy Metals. Tables 2 and 3 summarize the results of the analyses for heavy metals in the water quality samples. Most metals were generally present at non-detectable levels in the water quality samples. Arsenic, copper, and zinc were the most commonly detected metals. A preliminary comparison of the levels of metals detected in each pond with anticipated discharge criteria for an NPDES permit suggests that only copper and zinc are present in the water at levels that could potentially exceed discharge criteria. It is anticipated however, that the discharge outfall for the project will be able to achieve sufficient dilution (10:1) to mitigate most of this potential.

Table 2. Metals concentrations in water quality samples collected in ponds 1 through 4 of the Napa River Salt Marsh Ponds.

Parameter	Average for All Sampling Points in each Pond					
	Pond 1	Pond 1A	Pond 2	Pond 2A	Pond 3	Pond 4
Arsenic (mg/L)	0.0195[a]	0.012	0.0105	ND	ND	ND
Cadmium (mg/L)	ND[a]	ND	ND	ND	ND	ND
Chromium (mg/L)	ND[a]	ND	ND	ND	ND	ND
Copper (mg/L)	0.031[a]	0.053	0.03375	0.0195	0.053	0.2875
Lead (mg/L)	0.010[a]	ND	ND	ND	ND	ND
Nickel (mg/L)	ND[a]	ND	0.011	ND	ND	ND
Selenium (mg/L)	ND[a]	ND	ND	ND	ND	ND
Silver (mg/L)	ND[a]	ND	ND	ND	ND	ND
Zinc (mg/L)	0.013[a]	0.047	0.0263	ND	0.0587	0.725
Mercury (mg/L)	ND[a]	ND	ND	ND	ND	ND

ND = None Detected
[a]Dissolved Metals (Total Metal Data not Provided)

Table 3. Metals concentrations in water quality samples collected in ponds 5 through 8 of the Napa River Salt Marsh Ponds.

Parameter	Average for All Sampling Points in each Pond					
	Pond 5	Pond 6	Pond 6A	Pond 7	Pond 7A	Pond 8
Arsenic (mg/L)	0.087	ND	ND	0.125	ND	ND
Cadmium (mg/L)	ND	ND	ND	ND	ND	ND
Chromium (mg/L)	ND	0.0287	ND	ND	ND	ND
Copper (mg/L)	0.253	ND	ND	1.519	0.065	0.373
Lead (mg/L)	ND	ND	ND	ND	ND	ND
Nickel (mg/L)	ND	ND	ND	0.090	ND	ND
Selenium (mg/L)	ND	ND	ND	0.174	ND	ND
Silver (mg/L)	ND	ND	ND	0.025	ND	ND
Zinc (mg/L)	1.0267	0.0747	ND	3.379	ND	1.84
Mercury (mg/L)	ND	ND	ND	ND	ND	ND

ND = None Detected

Trace concentrations of most metals were detected in the sediments of all of the ponds. It is believed that these metals have concentrated over time in the sediments as the water in the ponds has evaporated. It is anticipated that these metals are probably in non-soluble form and may pose a potential risk for resuspension during flushing of the ponds.

General Water Quality Parameters. A review of the results of the general water quality parameters for the ponds show that salt levels in the ponds are very high as expected. Total Dissolved Solids (TDS) levels ranged from approximately 22,000 mg/L in ponds 1 and 2 to levels in excess of 300,000 mg/L in ponds 4, 5, 7, and 8. Approximately half of the TDS in the ponds was comprised of chlorides as would be expected. Ponds 7 and 8 were slightly acidic. Turbidity varied significantly in the ponds and may be a concern with respect to discharge requirements. Average turbidity ranged from a low of 9.5 in Pond 1 to a high of 145 in Pond 7. Average total Suspended Solids (TSS) also varied significantly between ponds ranging from non-detectable levels in ponds 2 and 2A to a high of over 400 mg/L in Pond 4. Nitrogen levels were relatively low in all ponds except Pond 7 where average Total Kjeldahl Nitrogen (TKN) levels exceeded 100 mg/L. Average Biochemical Oxygen Demand (BOD) was also relatively high in ponds 7 and 7A (> 40 mg/L). Tables 4 and 5 summarize the results of the general water quality analyses conducted on the water quality samples collected in the ponds in the Napa River Salt Marsh.

Table 4. General Water Quality Parameters samples collected in ponds 1 through 4 of the Napa River Salt Marsh Ponds.

	Average for All Sampling Points in each Pond					
Parameter	**Pond 1**	**Pond 1A**	**Pond 2**	**Pond 2A**	**Pond 3**	**Pond 4**
Ammonia as N (mg/L)	0.25	0.32	0.25	0.4	0.232	3.38
Nitrate as N (mg/L)	0.7	0.6	0.5	0.3	1.975	5.98
TKN (mg/L)	2.8	4.2	4.4	1.3	12.36	55.15
pH	8.4	9.1	8.9	7.9	8.3	7.7
BOD (mg/L)	4.87	26.7	11.5	1.5	28.67	15.9
Turbidity (NTU)	9.5	23.6	29.2	7.24	59.45	92.05
TSS (mg/L)	62	47	ND	ND	167.5	443.75
TDS (mg/L)	40,050	163,950	38,425	21,850	66,475	323,000
Chloride (mg/L)	22,900	33,600	22,250	12,000	38,900	174,500

ND = None Detected

Table 5. General Water Quality Parameters samples collected in ponds 5 through 48of the Napa River Salt Marsh Ponds.

Parameter	Average for All Sampling Points in each Pond					
	Pond 5	**Pond 6**	**Pond 6A**	**Pond 7**	**Pond 7A**	**Pond 8**
Ammonia as N (mg/L)	3.63	0.32	0.243	39.47	0.337	128
Nitrate as N (mg/L)	6.17	3.43	1.2	6.43	2.0	0.967
TKN (mg/L)	59.93	7.0	5.4	111.25	12.2	129.7
pH	7.63	8.4	8.77	4.95	8.60	3.33
BOD (mg/L)	4.07	8.73	8.83	44.55	48.40	29.31
Turbidity (NTU)	83.2	12.17	19.57	144.75	46.47	36.30
TSS (mg/L)	533.3	31.0	52.67	353.75	84.0	102.33
TDS (mg/L)	323,667	92,100	57,533	353,500	96,400	293,667
Chloride (mg/L)	173,667	54,200	32,200	226,000	53,333	150,667

ND = None Detected

Dioxins. The results of the dioxin analyses for this study are contained in the appendices. Dioxins were not found in detectable levels in any of the ponds except for trace amounts in Pond 2A.

If you have any questions or require any additional information regarding the water quality analyses presented in this report, please give me a call.

Sincerely,

HydroScience Engineers, Inc.

George D. Harris
Principal