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Environmental Protection

Department of Toxic Substances Control

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Arnold Schwarzenegger
Governor

June 1, 2009

Linda Hunter
Executive Director
The Watershed Project
1327 South 46th Street
155 Richmond Field Station
Richmond, California 94804

Dear Ms. Hunter:

Thank you for your interest in the activities occurring under the oversight of the Department of Toxic Substances Control (DTSC) in the southeast shoreline area of Richmond. On May 1, 2009, you and members of the Richmond Shoreline Citizens Response Group met with DTSC staff members. During this meeting, the outboard marsh area between Meeker Slough and Meeker Beach, and Shimada Friendship Park were discussed as both groups would like to participate in shoreline cleanup events and restoration activities.

Based upon the description of activities that would occur, DTSC evaluated the potential human health risks associated with those activities. The enclosed memo describes the process that was used to develop the risk calculations, and the assumptions that were used. Cancer risk and non-cancer hazard (the risk of an adverse health effect other than cancer) were calculated for both an adult and child receptor. The total cancer risk to these receptors was found to be the same as from ambient concentrations of chemicals found in sediments elsewhere in San Francisco Bay. The non-cancer hazard was found to be somewhat higher in the area of Stege Marsh than in other parts of the San Francisco Bay. This was mainly due to the higher concentrations of mercury detected near Stege Marsh. However, due to the conservativeness of the assumptions that were made, the actual risks are likely to be much lower, even zero. We would suggest that volunteers and members of your organizations take typical precautions such as wearing gloves when picking up trash or planting, washing their hands before eating, and washing off all mud when done for the day to prevent any potential exposure.

Shimada Friendship Park is located at Marina Bay Parkway and Peninsula Drive and is part of the Marina Bay Project. A Five-Year Review of the remediation activities that occurred at the park is currently underway. A clay barrier was installed to cap hydrocarbon-bearing soils in the southwestern portion of the park and to prevent people from coming in contact with the soils. As part of the Five-Year Review, soil gas samples were collected along the western boundary of the park in the capped area. Chemical concentrations of soil gas above the capped layer were either not detected or were below residential California Human Health Screening Levels. Because the soils are capped and elevated levels of soil gas have not been detected above the cap, persons using the park would not be exposed to contaminants and would not be at risk from the contaminants.

If you have any questions regarding this letter, please contact Lynn Nakashima of my staff at (510) 540-3839.

Sincerely,

Barbara J. Cook, P.E.
Performance Manager
Brownfields and Environmental Remediation Program
Berkeley Office

Enclosure

cc: Dr. Kimiko Klein
Human and Ecological Risk Division
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MEMORANDUM

TO: Lynn Nakashima
Site Mitigation and Brownfields Reuse Program
700 Heinz Avenue, Suite 200
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FROM: Kimiko Klein, Ph.D.
Staff Toxicologist
Human and Ecological Risk Division (HERD)

DATE: May 14, 2009

SUBJECT: Human Health Risk Evaluation for Marsh Volunteers
PCA 95060

Background

Stege Marsh is a tidal salt marsh located on the western margin of central San Francisco Bay near the city of Richmond. Prior to 1959, the area was open water or intertidal mudflat. Around 1959, fill material was placed along the shoreline and breakwaters to build a railroad spur, with bridged breaches to allow flow between Meeker Slough and the bay, and Baxter Creek and the bay. After establishment of the railroad grade, accretion of sediment inboard of the railroad spur formed the Stege Marsh and tidal wetland areas. Historically, this area has been heavily affected by 100 years of industrial manufacturing activities. Stege Marsh is adjacent to historic manufacturing sites, including agrochemicals and blasting caps; and has received stormwater runoff from nearby urban areas and highways. Cleanup activities have occurred at several of these nearby former manufacturing sites, and redevelopment has taken place and is being considered at these sites. A biking/walking trail has replaced the old railroad tracks that bisected the marsh. Most of Stege Marsh inboard of the trail is in the process of being cleaned up and restored.

However, Stege Marsh on the outboard (or bay side) of the trail remains contaminated with chemicals of potential concern, including polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), metals, and an array of chlorinated

pesticides. The concentrations of many specific chemicals in sediment exceed their respective ecological screening concentrations, concentrations at which toxic effects may be expected to be observed in sediment-dwelling organisms (1). Recent studies have shown that the body burden of PCBs and arsenic in the long-jawed mud sucker, a burrowing fish, increases with increasing concentrations in sediment (1), indicating that these chemicals, at least, are readily available for uptake by organisms.

The Human and Ecological Risk Division (HERD) has been requested to assess the potential hazards and risks to volunteers who access Stege Marsh sediments on the bay side of the trail during trash removal or restoration events.

Identification of Chemicals Toxic to Humans and Concentrations

Many chemicals have been detected in sediments in Stege Marsh. These chemicals vary in potential toxicity to humans and are present in variable concentrations in sediments. The chemicals evaluated in this assessment are listed in Table 1. The concentrations listed for Stege Marsh represent the mean concentrations of chemicals in the bay side and nearest the Bay Trail. These concentrations are calculated from data provided by researchers at the University of California, Davis, or consultants for the University of California, Berkeley (3, 4, 6). Ambient concentrations of chemicals in San Francisco Bay were reported by the San Francisco Bay Area Regional Water Quality Control Board (SFRWQCB) in 1997 (5).

Table 1 – Chemicals Detected in Sediments

Chemical	*Stege Marsh – mg/kg*	*Ambient – mg/kg*
PCBs	0.21	0.02
DDE	0.02	0.01*
DDD	0.02	*
Chlordane	0.02	NR
PAHs	4.4	3.4
Arsenic	15	15
Cadmium	0.49	0.33
Chromium	56	112
Copper	66	68
Lead	79	43
Mercury	1.38	0.43
Nickel	52	112
Silver	0.29	0.58
Vanadium	44	NR
Zinc	243	158

*Total DDT isomers reported and included here as DDE, since DDE has the higher cancer slope factor (CSF)
NR – not reported

These concentrations in sediments are combined with exposure intake assumptions as discussed below to calculate potential doses to humans.

Exposure Intake Parameters

Volunteers who access the marsh may be exposed by inhalation of dusts resuspended from sediments, dermal contact with sediments, and incidental ingestion of sediments. Even though the inhalation route is insignificant, as marsh sediments would not be dry enough to generate dust, this exposure route is included in this evaluation in order to have a complete evaluation of all exposure routes. A study of reed gatherers in tidal marshes was consulted to determine that the head, lower legs, and forearms could be exposed for dermal contact and that sediments could readily adhere to the skin (6). For this evaluation, all persons going into the marsh are assumed to be wearing gloves and shoes or boots because of the nature of the activities being performed (trash collecting or planting). Children as young as 11 years old are assumed to go regularly into the marsh. The standard incidental soil ingestion parameters of 200 mg/day for children and 100 mg/day for adults are decreased, because volunteers and children would spend only up to four hours out of a 16-hour day in the marsh for each event. Table 2 lists the exposure intake parameters for children and adults visiting the marsh.

Table 2 Exposure Intake Parameters

Exposure Parameter	*Units*	*Adult Volunteer*	*Child*
Soil Ingestion Rate	mg soil/day	25[a]	50[b]
Skin Surface Area	cm^2	4300[c]	3700[d]
Soil Adherence Factor	mg soil/cm^2 skin	0.3[e]	0.3[e]
Inhalation Rate	m^3/day	6[f]	5[g]
Particulate Emission Factor	m^3/kg	1.32×10^9	1.32×10^9
Body Weight	mg	70	41
Exposure Frequency	days/year	24	24
Exposure Duration	years	20	10

a 100 mg/16 hour day multiplied by 4 hours
b 200 mg/16 hour day multiplied by 4 hours
c head, forearms, lower legs (7)
d professional judgement
e from reed gatherers study (8)
f 1.5 m^3/hour of moderate activity times 4 hours (7)
g 1.2 m^3/hour of moderate activity times 4 hours (7)

The general equation to calculate the dose to a human is:

- Dose equals soil concentration multiplied by an intake rate and duration/frequency of exposure.

Toxicity Criteria

The calculated doses of chemicals are compared to chemical specific toxicity criteria. For estimating the risk of a chemical to cause cancer, the toxicity criterion is that chemical's cancer slope factor (CSF). The larger the cancer slope factor, the more potent the chemical for causing cancer. For estimating the hazard of the chemical to cause a non-cancer adverse health effect, the toxicity criterion is a reference dose (RfD). Chemicals with low RfDs are considered more likely to cause adverse health effects. These toxicity criteria are established either by the California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) or the U.S. Environmental Protection Agency (US EPA).

Risk Characterization

The doses calculated from the concentrations given in Table 1 and assuming the exposure parameters in Table 2 and toxicity criteria from the Cal/EPA or US EPA are used to calculate risks and hazard. The general equations for calculating risks and hazards are:

- The *cancer risk* is equal to the dose of a chemical multiplied by a cancer slope factor established for that chemical.

- The *Hazard Index* is equal to the dose of a chemical divided by a reference dose established for that chemical as a concentration that will not cause any adverse health effects.

The cumulative cancer risks and hazards represent the risks from exposure to all contaminants and from all exposure routes (inhalation, ingestion and dermal contact) and are tabulated in Table 3. The cancer risks are dominated by the presence of arsenic in sediments. Thus, the cumulative risks from potential exposure to sediments at Stege Marsh or anywhere in San Francisco Bay are virtually the same, because the average arsenic concentrations in both areas are virtually the same. At an arsenic concentration of 15 mg/kg, the cancer risks to both adult volunteers and children are slightly above one-in-a-million. The hazard indices are most affected by the presence of arsenic and mercury. Potential exposure to these chemicals in sediments by children in the marsh or other areas of San Francisco Bay result in hazard indices above one, indicating that such exposure could result in adverse health effects.

Table 3 – Cancer Risks and Noncancer Hazards

Receptor	*Location*	*Cumulative Cancer Risk*	*Noncancer Hazard Index*
Adult	Stege Marsh	3×10^{-6}	1.4
Child	Stege Marsh	3×10^{-6}	2.2
Adult	Ambient	3×10^{-6}	0.7
Child	Ambient	3×10^{-6}	1.2

Discussion and Conclusions

Risks and hazards to adults and children are elevated by potential intermittent exposure to contaminated sediments on the outboard, bay side of the Bay Trail. The cancer risks are the same as the risks from potential exposure to ambient concentrations of chemicals, particularly arsenic, in sediments elsewhere in San Francisco Bay. The non-cancer hazards are somewhat higher in Stege Marsh than in other parts of the bay because of the higher concentrations of mercury detected in the marsh.

Exposure to the contaminants in sediments may result in risks and hazards as high as those listed in Table 3 but are likely to be much lower, even zero. This is because conservative assumptions are made in estimating exposure to sediments, including assuming that volunteers will go out to the marsh twice a month for 10 years as children and 20 years as adults, that volunteers will be dressed lightly, will accidentally ingest small amounts of sediment on each visit, and will not wash off mud that has accumulated on the skin after visiting the marsh.

If you have further questions on this memorandum, please contact me at Kklein@dtsc.ca.gov or by telephone at 916 255 6643 or 510 540 3762.

Kimiko Klein for:

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cc: J. Michael Eichelberger, Ph.D.
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Mark Vest
Geologic Services Unit

References

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