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Technical Memorandum

Date:	6 December 2010
To:	Tom Alo, Regional Water Quality Control Board
From:	Brian Hitchens, Geosyntec Consultants
Subject:	Evaluation of Alternate Cleanup goals for Metals

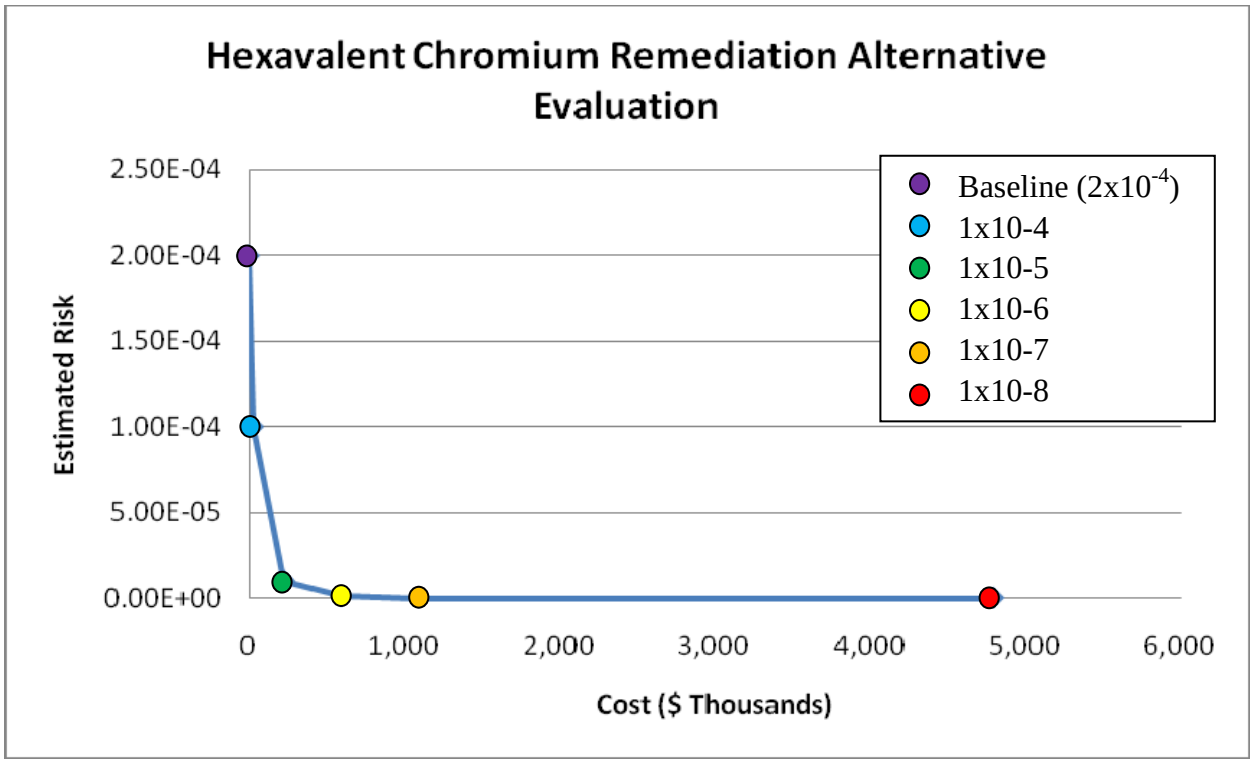
This memorandum has been prepared to document the technical and economic feasibility of the remediation of metals impacts in soil and groundwater. This evaluation is provided as an additional line of evidence for selecting the lowest technically and economically feasible cleanup goal for metals at the site, which is consistent with the maximum benefit to the people of the state.

Soil Cleanup Goal Evaluation

The default risk-based cleanup goals presented in the RI/FS are based on a commercial/industrial exposure scenario and provide goals targeted to meet a $1x10^{-5}$ incremental cancer risk and a health hazard index of 1. The primary driver for hexavalent chromium health impacts from exposure to soil is incremental cancer risk. Other metals detected at the site do not pose a risk of increased cancer, but are evaluated based on their health hazard index.

Hexavalent Chromium Soil Remediation Goal

To evaluate the maximum beneficial cleanup level for hexavalent chromium in soil, the required soil excavation volume was evaluated over a range of target cancer risk levels. These risk levels varied from $2x10^{-4}$ (a no-action alternative based on a maximum concentration of 350 mg/kg), to $1x10^{-8}$ (non-detect>0.035 mg/kg). For each order of magnitude reduction in potential incremental risk, the maximum residual hexavalent chromium concentration is also one order of magnitude lower (i.e. 1x10-5 risk = 35 mg/kg CrVI, 1x10-4 risk = 3.5 mg/kg CrVI). The most significant break point in the excavation volume vs. risk reduction curve is at the $1x10^{-5}$ target. The excavation volume increases exponentially per unit reduction in risk below the $1x10^{-5}$ level.

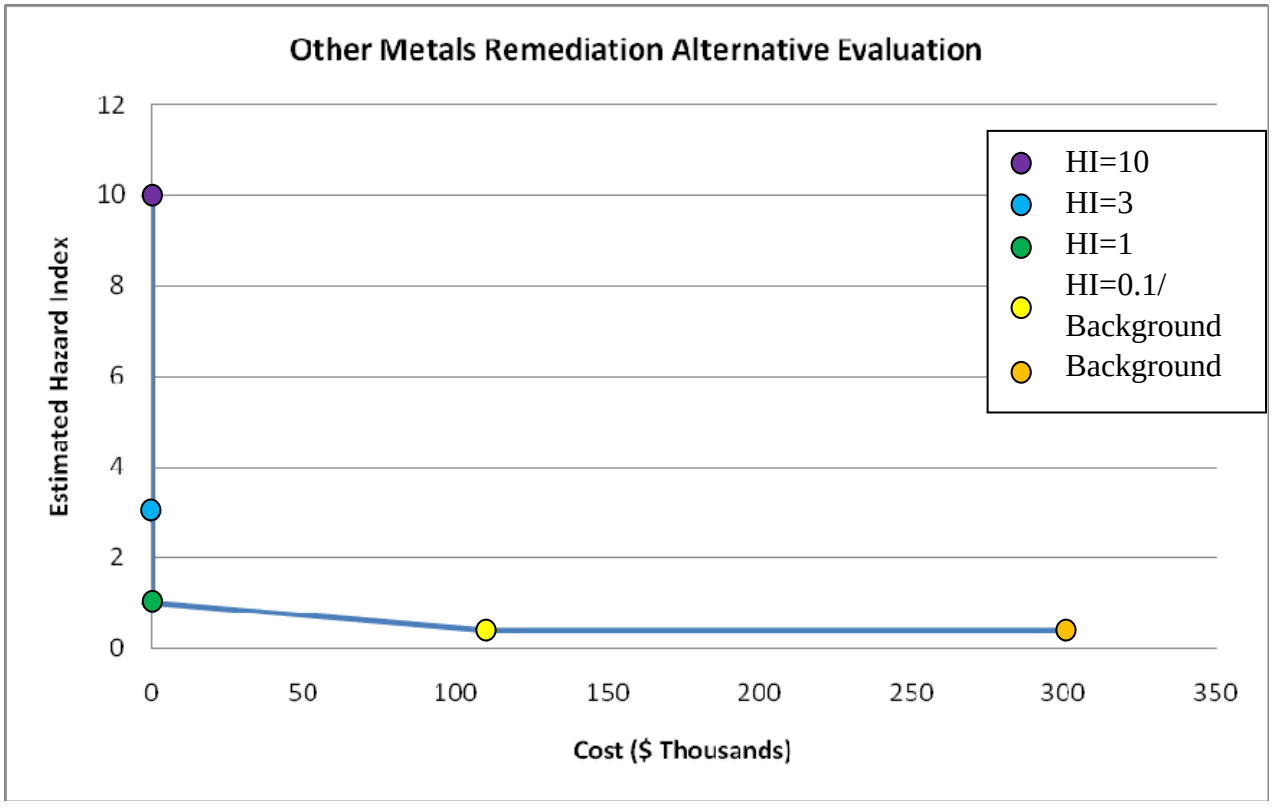


The additional non-economic costs for performing large scale excavations also need to be considered, including project related greenhouse gas emissions, increased demand on finite landfill capacity, and increased truck trips and associated risk of traffic accidents. The break point of $1x10^{-5}$ represents a point of diminishing returns where increasingly large excavations would be required to realize ever smaller incremental reductions in risk. Therefore, a target risk of $1x10^{-5}$ (corresponding to a soil concentration of 35 mg/kg) is proposed as the most appropriate hexavalent chromium remediation goal.

Other Metals Soil Remediation Goal

With the exception of hexavalent chromium, the only metals detected on-site which individually exceed a hazard index of 0.1 are cobalt and nickel (Table 1). Antimony, cadmium, mercury, molybdenum, selenium, and zinc have also been detected above background concentrations in soil but at low concentrations which contribute little to the cumulative hazard index. Copper, cyanide, and silver have also been detected on site, however these constituents were not detected frequently enough to determine a Site-specific background concentration for the Site (Table 1). The graph below presents the estimated excavation volumes to meet a hazard index of 10, 3, 1, 0.1 (or background where background is greater than 0.1), and to remediate all metals impacts to

background. The most significant break point in the excavation volume vs. hazard reduction curve is at the hazard index of 1. Below that hazard index value, the excavation volume increases exponentially with relatively little further reduction in hazard.



HI - Hazard Index

The additional non-economic costs for performing large scale excavations also need to be considered, including project related greenhouse gas emissions, increased demand on finite landfill capacity, and increased truck trips and associated risk of traffic accidents. The break point of HI = 1 represents a point beyond which substantial excavations would be required to realize relatively small incremental reductions in hazard. Therefore, a target hazard index of 1 is proposed as the most appropriate remediation goal.

Groundwater Cleanup Goal Evaluation

Alternate groundwater cleanup goals were evaluated on the basis of technical feasibility. Due to extremely low hydraulic gradient, groundwater velocities are estimated to be less than 1 foot per year, with most constituent transport occurring through dispersion and diffusion. These factors

cause the footprint impacted groundwater to be very stable and unlikely to migrate to Convair Lagoon at concentrations in excess of the California Toxics Rule (CTR). The proposed remedial action for hexavalent chromium in groundwater in the Building 158 area (Excavation and In-Situ Reduction with Emulsified Vegetable Oil) will rapidly reduce available hexavalent chromium to trivalent chromium which has much lower solubility and toxicity. The trivalent chromium will precipitate due to its reduced solubility, further reducing the potential for future migration of impacts to Convair Lagoon.

The residual concentrations for other metals detected above background in groundwater at the site are consistent with maximum benefit to the people of the State in that further reduction of the anticipated residual constituent concentration would provide marginal benefit, while incurring potentially significant social and environmental costs associated with extended pumping, treatment, and disposal of large quantities of water for little to no measureable benefit to human health or the environment. The proposed risk based remedial goals do not unreasonably affect present and anticipated beneficial use of water and do not result in water quality less than those prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards.

Although background conditions will not be achieved for all metals in groundwater, the residual concentrations proposed are protective for the current and future use of the Site, which is restricted to commercial/industrial use for tidelands properties.

Attachments:

Table 1: Alternate RBC Analysis Comparison Table

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Alternate RBC Analysis Comparison Table

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		Alternate RBC Analysis for Soil Pathways[a] (mg/kg)									
		Higher RBC Alternative		Baseline RBCs		Lower RBC Alternative					
COPCs	**Unit Hazard Index [b]**	**RBC_{cancer} 10-4**	**$RBC_{noncancer}$ 3**	**RBC_{cancer} 10-5**	**$RBC_{noncancer}$ 1**	**RBC_{cancer} 10-6**	**$RBC_{noncancer}$ 0.1**	**background**	**background HI**	**maximum detected on-Site**	**Site Baseline HI**
Inorganics											
Antimony	**0.0083**	-	360	-	120	-	12	3.9	**0.03**	**8.5**	**0.07**
Arsenic	**0.016**	28	180	2.8	61	0.28	6.1	23	**0.4**	**23**	**0.4**
Barium	**0.00032**	-	9300	-	3100	-	310	440	**0.1**	**440**	**0.1**
Beryllium	**0.021**	21000	140	2100	47	210	4.7	**NE**	-	**ND**	-
Cadmium	**0.01**	12000	300	1200	99	120	10	3.6	**0.04**	**6.8**	**0.07**
Cobalt	**0.007**	-	400	-	140	-	14	23	**0.2**	**100**	**0.7**
Copper	**0.000083**	-	36000	-	12000	-	1200	55	**0.005**	**200**	**0.02**
Cyanide (Amenable)	**0.00021**	-	14000	-	4800	-	480	**NE**	-	**1**	**0.0002**
Cyanide (Total)	**0.00021**	-	14000	-	4800	-	480	**NE**	-	**1.7**	**0.0004**
Mercury	**0.013**	-	240	-	79	-	7.9	0.065	**0.0008**	**0.23**	**0.003**
Molybdenum	**0.00067**	-	4500	-	1500	-	150	2.3	**0.002**	**10**	**0.007**
Nickel	**0.0029**	200000	1000	19654	340	1965	34	14.3	**0.04**	**170**	**0.5**
Selenium	**0.00067**	-	4500	-	1500	-	150	23.7	**0.02**	**30**	**0.02**
Silver	**0.00067**	-	4500	-	1500	-	150	**NE**	-	**2.3**	**0.002**
Thallium	**0.05**	-	60	-	20	-	2.0	**NE**	-	**ND**	-
Vanadium	**0.0033**	-	900	-	300	-	30	70	**0.2**	**70**	**0.2**
Zinc	**0.000011**	-	270000	-	90000	-	9000	53	**0.0006**	**710**	**0.008**

[a] Soil pathways include: incidental soil ingestion, dermal contact, and outdoor inhalation of particulates/vapors

[b] - Unit Hazard Index equals the estimated health hazard risk based on a concentration of 1 mg/kg

RBC goal less than background

Not detected above background

Detected above background

Detected above a HI of 0.1

NE-Too few detections on-site to establish site specific background

ND - Not detected on-site