



CALIFORNIA HUMAN HEALTH SCREENING LEVELS FOR PERCHLORATE

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Office of Environmental Health Hazard Assessment
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Draft California Human Health Screening Levels for Perchlorate

Introduction

In 2005, the California Office of Environmental Health Hazard Assessment (OEHHA) released a final document on the development of a list of soil screening numbers based on “protection of public health and safety” as required by Health and Safety Code Section 57008 (OEHHA, 2005 revision). The screening numbers are not intended for use by regulatory agencies that have authority to require remediation of contaminated soil, but are solely advisory numbers. The numbers have no regulatory effect, and are published solely as reference values that may be used by citizen groups, community organizations, property owners, developers, and local government officials to estimate the degree of effort that may be necessary to remediate a contaminated property. How these soil screening levels should be applied is explained in “Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties,” (Cal/EPA, 2005).

At the time the OEHHA document was released, a quantitative health risk assessment for perchlorate was underway by OEHHA. OEHHA postponed the development of a CHHSL for perchlorate until the risk assessment was completed. The assessment has been completed and was used to develop a Public Health Goal (PHG) for drinking water (OEHHA, 2004). The PHG developed for perchlorate is 0.006 mg/L (6 parts per billion, 6 ppb) in drinking water. The PHG was calculated as follows:



where:

BMDL = The lower limit of a one-sided 95 percent confidence interval of a perchlorate dose that reduces mean thyroidal iodide uptake by five percent based on the study by Geer *et al.* (2002) and explained in detail in the report by OEHHA (2004);

RSC = The relative source contribution; the value used is based on the assumption that, 60 percent of human to exposure to perchlorate comes from drinking water and the rest from food, such as farm produce and cow’s milk;

BW/WC = The ratio of body weight (kg) and tap water consumption rate (L/day); the ratio for the 95th percentile of the pregnant woman population is estimated to be 0.0252 kg-day/mL or 25.2 kg-day/L (OEHHA, 2000); and

UF = An uncertainty factor of 10 is used to account for interindividual human variability.

In the above calculation, the BMDL divided by the UF is a toxicity criterion for perchlorate, 0.00037 mg/kg, which is a daily dose that is unlikely to cause an adverse health effect. The other components of the calculation, BW/WC and RSC, are used to determine the drinking water concentration of perchlorate based on: 1) daily water intake; and 2) other sources of daily perchlorate exposure, such as food.

To calculate the CHHSL for perchlorate, the toxicity criterion for perchlorate, 0.00037 mg/kg, is needed but not the other components for the equation to calculate the PHG. This CHHSL is for exposure to a nonvolatile chemical, like perchlorate, from contaminated soil. In this case the perchlorate exposure is assumed to only come from the contaminated soil. However, perchlorate exposure from the soil can occur from incidental ingestion, dermal absorption from soil on the skin, and inhalation of soil dust. Two CHHSLs are calculated. One is for exposure in a residential setting and one for exposure in a commercial/industrial setting. The methods used are discussed in the following section.

Methods

To estimate exposure to soil-bound contaminants other than lead and lead compounds, standard U.S. EPA “Superfund” algorithms were used in the OEHHA, 2005 revision, document. For an unrestricted land use scenario (possibly residential), screening numbers were calculated using Equation 4.2 from the U.S. EPA Region 9 Preliminary Remediation Goal (PRG) document (Smucker, 2002). To calculate screening numbers for a commercial/industrial land use scenario, Equation 4.4 from the PRG document was used. These equations are reproduced in Appendix C of the OEHHA document. The parameters used for the residential and the commercial/industrial scenarios are also given in Appendix C of the OEHHA document and those relevant for perchlorate are provided below. To generate the CHHSLs for perchlorate toxicity criterion, 0.00037 mg/kg, discussed above was used and is designated RfDo in the equations below.

Residential

Commercial/Industrial

where:

Parameter	Abbreviation	Value	Units
Body weight (adult)	BWa	70	kg
Body weight (child)	BWc-	15	kg
Averaging time: carcinogens	ATc	25550	days
Averaging time: noncarcinogens	ATn	ED x 365	days
Exposed skin area for soil/dust (adult resident)	SAr-	5700	cm ² /day
Exposed skin area for soil/dust (adult worker)	SAo	3300	cm ² /day
Target Hazard Quotient	THQ	1	unitless
Oral Risk Reference Dose	RfDo	3.70E-04	mg/kg-d
Inhalation Risk Reference Dose ¹	RfDi	1.30E-03	mg/m ³ -d
Particulate Emission Factor	PEF	1.32E+09	m ³ air/kg soil
Exposed skin area for soil/dust (child)	SAc	2800	cm ² /day
Skin absorption factor	ABS	0.01	unitless
Adherence Factor (child)	AFc	0.2	mg/cm ²
Adherence Factor (worker)	AFo	0.2	mg/cm ²
Inhalation rate (adult)	IRAA	20	m ³ /day
Inhalation rate (child)	IRAc	10	m ³ /day
Soil ingestion (adult)	IRSa	100	mg/day
Soil ingestion (child)	IRSc	200	mg/day
Soil ingestion: occupational	IRSo	100	mg/day
Exposure frequency: residential	EFr	350	d/y
Exposure frequency: occupational	EFo	250	d/y
Exposure duration: residential	EDr	30	years
Exposure duration: childhood	EDc	6	years
Exposure duration: occupational	EDo	25	years

¹ Estimated from the RfDo by simple unit conversion. Overall, the RfDi did not have an impact on the final CHHSLs.

Results

For the residential CHHSL, both the adult and child scenarios were evaluated. It was found that the CHHSL based on the child scenario was the most health protective and it was used as shown in the table below.

CHHSLs for Perchlorate

Property Type	CHHSL (mg/kg or ppm)
Residential	28
Commercial/Industrial	350

While these CHHSLs are considered safe for exposure to perchlorate in soil, the potential for significant groundwater contamination from soil contaminated with perchlorate at the CHHSLs levels may exist, since the PHG level for drinking water is 6 ppb or 6 µg/L.

Updating of the CHHSL

As of this writing, OEHHA is preparing an updated risk assessment of perchlorate as part of its review of the 2004 Public Health Goal for perchlorate in drinking water. If the risk assessment identifies a different toxicity criterion or comparable number, OEHHA will update the CHHSL accordingly.

References

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