CALIFORNIA DEPARTMENT OF TOXIC SUBTANCES CONTROL (DTSC)
OFFICE OF HUMAN AND ECOLOGICAL RISK (HERO)

HUMAN HEALTH RISK ASSESSMENT (HHRA) NOTE

HERO HHRA NOTE NUMBER: 3

ISSUE DATE: July 14, 2014

ISSUE: DTSC recommended methodology for use of U.S. EPA Regional Screening Levels (RSLs) in the Human Health Risk Assessment process at hazardous waste sites and permitted facilities.

SUMMARY

In 2008, the U.S. EPA released Regional Screening Levels (RSLs) to replace the Preliminary Remediation Goals (PRGs) formerly available from several U.S. EPA Regional Headquarters. HERO reviewed the differences in methodology and RSL concentrations to develop a methodology to incorporate the RSLs into HERO human health risk assessment consultation and review., In addition to incorporation of more recent toxicity values than those used in the U.S. EPA Region 9 PRGs, several differences in methodology result in a subset of RSLs substantially higher (less protective) than PRGs.

HERO's review to date has been conducted in two phases: Phase I (soil and tapwater RSLs) and Phase II (air RSLs). Initial versions of HHRA Note 3 addressed a Phase I review only. A Phase II review was incorporated into the May 21, 2013 iteration of HHRA Note 3.

HERO's Phase I review addresses the soil and tapwater RSLs only. This revision of HHRA Note 3 incorporates HERO recommendations based on review of the May 2013 RSL tables. For the majority of the approximately 750 listed chemicals, HERO recommends the values listed in the U.S. EPA RSL table. However some values listed in the U.S. EPA RSL table differ significantly (greater than four-fold) from values calculated using CalEPA toxicity criteria and risk assessment procedures. In an effort to provide risk assessment RSL recommendations, HERO has prepared reference Table 1 for compounds with soil and tapwater RSLs for which 1) the 2004 PRG should be used; 2) the 2004 'Cal-modified' PRG should be used; or 3) the DTSC-modified screening levels derived using the RSL on-line screening calculator should be used. In addition, specific recommendations and discussion are provided for several contaminants. Alternatively, in consultation with HERO, the U.S. EPA on-line screening calculator can be used to calculate site-specific values using the more protective of CalEPA and U.S. EPA toxicity values and applying assumptions consistent with HERO recommendations (e.g. route-to-route extrapolation between

the oral and inhalation exposure pathways where no toxicity value is available for the inhalation route of exposure but an oral toxicity value is available).

HERO's Phase II review addresses the residential and industrial air RSLs for a subset of volatile organic compounds (VOCs) frequently found at California hazardous waste sites and permitted facilities. A complete listing of the VOCs reviewed by HERO is presented in reference Table 2. As shown in Table 2, HERO concurs with the use of the U.S. EPA air RSL values for more than half of the VOCs reviewed to date. However, to incorporate CalEPA toxicity criteria and HERO recommendations (e.g. route-to-route extrapolation), HERO has calculated DTSC-modified residential and industrial air screening levels for: 1) VOCs in which use of the CalEPA-recommended inhalation unit risk (IUR) and/or chronic inhalation reference exposure level (REL) is more protective than the values used to derive the RSLs and 2) VOCs present in the RSL table but lacking cancer and/or noncancer air RSLs due to the lack of route-to-route extrapolation when deriving the RSLs. The DTSC-modified air screening levels for such VOCs are presented in reference Table 3. For all constituents other than those listed in Table 2, the DTSC site toxicologist should be consulted prior to using the U.S. EPA air RSLs.

WHAT'S NEW

- Subsequent to our May 21, 2013 iteration of HHRA Note 3, U.S. EPA released a complete set of updated RSL tables dated May 2013. In June 2013, U.S. EPA also revised a subset of the tables based on a target hazard quotient (HQ) equal to 0.1 to correct an error in those corresponding May 2013 tables. Because HHRA Note 3 recommendations are for tables based on a HQ of 1, the May 2013 tables are the most recent versions relevant for this HHRA Note. In general, HERO does not recommend use of screening levels based on a target HQ of 0.1. Instead, screening levels based on a target HQ of 1 should be used, and cumulative noncancer hazard should be summed across all site-related contaminants, media, and exposure pathways.

- As a continuation of our Phase I and II RSL review addressed in previous iterations of HHRA Note 3, HERO has reviewed the RSL table updates from May 2013, as well as other relevant information including updated CalEPA criteria. This revised HHRA Note 3 incorporates our updated recommendations for use of the RSLs.

- HERO continued the development of DTSC-modified air screening levels with the calculation of residential use air screening values for methylene chloride, 1,2,3-trichloropropane (1,2,3-TCP) and vinyl chloride. Age-Dependent Adjustment Factors (ADAFs) were used for the air screening values for methylene chloride and 1,2,3-TCP as these are identified as mutagens by the U.S. EPA in their RSL table. ADAFs were not applied for vinyl chloride in this HHRA Note 3 as vinyl chloride is currently under review.

- In previous versions of HHRA Note 3, HERO calculated DTSC-modified screening levels for cadmium and beryllium in soil. For consistency with DTSC's HHRA Note 1 and the Interim Final – Revised October 2013 Preliminary Endangerment Assessment (PEA) Guidance Manual, the DTSC-modified screening levels have been recalculated herein using DTSC's default dermal exposure parameters and assuming a gastrointestinal absorption fraction (GIABS) of 1 ((http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA_Note1.pdf; http://www.dtsc.ca.gov/SiteCleanup/Brownfields/upload/Preliminary-Endangerment-Assessment-Guidance-Manual.pdf). The revised DTSC-modified screening levels for cadmium in soil based on noncancer endpoints are now 4.6 mg/kg and 6.4 mg/kg for residential and industrial land use scenarios. These values are slightly higher than the previously calculated DTSC-modified screening levels of 4 and 5.1 mg/kg, respectively. The revised DTSC-modified screening levels for beryllium are now 15 mg/kg and 180 mg/kg for residential and industrial land use scenarios. These values are slightly lower than the previously calculated DTSC-modified screening levels of 16 mg/kg and 200 mg/kg.

HERO ISSUE CONTACT PERSONS:	Michael J. Wade, Ph. D., D.A.B.T., Senior Toxicologist 916.255.6653 Voice 916.255.6695 Facsimile Michael.Wade@dtsc.ca.gov
	Edward Fendick, Ph.D., Staff Toxicologist 916.255.6555 Voice 916.255.6695 Facsimile Edward.Fendick@dtsc.ca.gov

BACKGROUND

HERO has a long history of working with the U.S. EPA Region 9 office to integrate California-specific risk assessment concerns into the Preliminary Remediation Goal (PRG) listing and the PRG-screening risk assessment process. One example of the collaboration was the inclusion of 'Cal-modified' values into the U.S. EPA Region 9 PRG list. When the U.S. EPA Region 9 PRG was greater by a factor of 4 or more than the value which would have been obtained with the corresponding California-specific toxicity value, U.S. EPA Region 9 added a 'Cal-modified' PRG to the PRG list based on California-specific cancer toxicity values.

In the past, the U.S. EPA Region 9 PRGs have been used by HERO primarily at open, closing, and formerly-used Department of Defense (DoD) sites. Screening risk assessments at some non-military sites have in the past used a different process. However, the recommendations included in this report are being used and are intended for use at any DTSC site where DTSC has approved the use of PRGs or RSLs.

In 2008, U.S. EPA released Regional Screening Levels (RSLs) (*http://www.epa.gov/region09/superfund/prg/rsl-table.html*) which replaced the U.S. EPA Region 9 PRGs. HERO conducted and anticipates continuing an ongoing process of reviewing the new U.S. EPA RSLs, which are planned for release on a biennial basis (Spring and Fall), and their application in screening risk assessment.

Differences between the methodologies used to develop the 2008 RSLs and the U.S. EPA Region 9 PRGs include the following:

- Incorporation of new inhalation exposure equations per U.S. EPA Risk Assessment Guidance for Superfund (RAGS) Part F (2009);
- Presentation of industrial air screening values in addition to residential screening values;
- Discontinuing the use of route-to-route extrapolations between the oral and inhalation routes of exposure to derive toxicity values where a toxicity value exists for only one route of exposure (route-to-route extrapolations are still conducted for evaluating dermal exposures);
- Discontinuing adjustments for soil saturation with the listing of strictly risk-based RSLs;
- Discontinuing the use of the "ceiling limit" concentration of $1x10^{+5}$ mg/kg (max) with the listing of strictly risk-based RSLs; and,
- Application of age-dependent adjustment factors to address early-life exposures for agents with a mutagenic mode of action for carcinogenesis per U.S. EPA Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Additional modifications to the RSL methodology have been made subsequent to the initial 2008 RSL tables, and we have incorporated these changes in our discussion below. For example, the dermal exposure pathway has been incorporated into the tapwater RSL calculation.

For reference, the RSL Users Guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm) lists the following uses (Section 3.0) for the U.S. EPA RSLs:

"*These concentrations can be used for:*

- *Prioritizing multiple sites or operable units or areas of concern within a facility or exposure units*
- *Setting risk-based detection limits for contaminants of potential concern (COPCs)*
- *Focusing future site investigation and risk assessment efforts (e.g., selecting COPCs for the baseline risk assessment)*
- *Identifying contamination which may warrant cleanup*
- *Identifying sites, or portions of sites, which warrant no further action or investigation*
- *Initial cleanup goals when site-specific data are lacking"*

RSLs are NOT to be used to perform a human health Baseline Risk Assessment (BRA), but to assist in the tasks preceding a human health BRA.

There are approximately 750 elements, compounds and mixtures listed in the RSL table posted as the May 2013 version. HERO plans a phased review of the RSLs as resources allow. As discussed in previous revisions of HHRA Note 3, the Phase I review provides recommendations on the use of RSLs for soil (residential use and industrial/commercial use) and tapwater only. Soil and tapwater RSLs were initially selected for priority review because: 1) they are more commonly used in HERO risk assessment review as compared to the air risk-based concentrations; and 2) toxicity values derived via the oral pathway are more prevalent than toxicity values derived via the inhalation pathway, thus, resulting in fewer elements, compounds and mixtures without residential and industrial soil and tapwater RSLs due to lack of toxicity values. Phase II review (first incorporated into the May 2013 revision of HHRA Note 3) provides recommendations on the use of residential and industrial air RSLs for a subset of volatile organic compounds (VOCs). The subset of VOCs selected for priority review are frequently found at California hazardous waste sites and permitted facilities and evaluated for vapor intrusion to indoor air. HERO plans to review the air RSLs for the remaining constituents listed in the RSL tables as time allows. In the interim, the DTSC site toxicologist can be contacted for recommendations on use of air RSLs for constituents which are not addressed in HHRA Note 3.

EPA REGION 9 'CAL-MODIFIED' PRGS

HERO originally agreed to the use of U.S. EPA Region 9 PRGs to expedite human health screening at DoD bases, facilities and sites. This agreement was arrived at after HERO review of the proposed Region 9 PRGs and inclusion of the small number of 'Cal-modified' values, where CalEPA Office of Environmental Health Hazard Assessment (OEHHA) determination of carcinogenicity, pathway-specific carcinogenicity and/or the magnitude of the CalEPA cancer toxicity value resulted in a calculated 'Cal-modified' PRG which was significantly less (i.e., more than a factor of 4 lower) than those listed in the U.S. EPA Region 9 PRG tables.

'Cal-modified' listings have been dropped from the RSL table. As such, in the absence of 'Cal-modified' RSLs, this HHRA Note includes reference Table 1 for compounds with soil and tapwater RSLs for which 1) the 2004 PRG should be used; 2) the 2004 'Cal-modified' PRG should be used; or 3) the DTSC-modified screening levels derived using the RSL on-line screening calculator should be used. Alternatively, Cal-modified PRGs for specific chemicals can be derived using the on-line calculator included as part of the RSL package (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search). This HHRA Note also includes reference Table 2 addressing air RSLs for a subset of VOCs. Table 2 presents a complete listing of the VOCs reviewed by HERO, along with HERO recommendations regarding use of the air RSLs or alternate DTSC-modified screening levels which are located in Table 3. For all constituents other than those listed in Tables 2, the DTSC site toxicologist should be consulted prior to using the air RSLs.

In a memorandum dated October 28, 1994, HERO recommended guidelines for use of the Region 9 PRGs at DoD sites (http://www.dtsc.ca.gov/AssessingRisk/upload/PRG-HERD-Memorandum-OCT-1994.pdf). More recently, HHRA Note Number 4 was released (http://www.dtsc.ca.gov/AssessingRisk/humanrisk2.cfm#guidance), as an update of the 1994 HERO memorandum for consistency with the replacement of PRGs with RSLs and to address more recent screening risk assessment guidance. In general, HERO recommends compliance with the "basic" approach and principles outlined in the referenced memorandum. This includes the provision that PRGs (now RSLs) are used for screening sites as a whole, not for "screening out" individual chemicals. Ratios of the concentration of a particular chemical in a medium (e.g. soil, water, or air) to its risk-based concentration are calculated and the ratio is summed across all chemicals and media to estimate a total risk and hazard for the site. Prior to making risk management decisions based on the results of such an evaluation, it is critical that limitations associated with the use of PRGs (now RSLs) be carefully noted and understood. For example, the derivation of the PRGs and RSLs did not include an evaluation of the intrusion of vapors from the subsurface to indoor air (see below for a more detailed discussion of exposure pathways). The vapor intrusion of volatile chemicals in soil or groundwater to indoor air has become recognized as potentially a major exposure pathway and is receiving increasing attention in risk assessments. It is also important to understand that ecological receptors were not considered in the calculation of the PRGs and RSLs. The PRGs and RSLs apply only to human receptor exposure scenarios only and are NOT necessarily protective of ecological receptors.

In the past, use of the U.S. EPA Region 9 PRG table (with 'Cal-modified' values) at California sites has expedited site assessment and cleanup, resulting in faster cleanups and cost savings. We hope that following incorporation of adjustments such as the application of California toxicity criteria, where appropriate, the RSLs can play a similar role.

CONCEPTUAL SITE MODEL AND INCLUDED EXPOSURE PATHWAYS

Before using the RSLs to conduct a screening level human health risk assessment, development of a site-specific conceptual site model (CSM) is critical to ensure all appropriate receptors and exposure pathways are addressed by the RSLs.

The risk-based residential and industrial soil RSLs consider several exposure pathways: ingestion, inhalation of particles and volatile chemicals in ambient air, and dermal absorption.

The tapwater RSLs are based on assumed residential exposure to water via ingestion from drinking, inhalation of volatile chemicals generated during household use (e.g. showering, dish washing), and dermal exposure.

Although the soil and tapwater RSLs account for many typical exposure pathways, similar to the previous 2004 PRGs, they do not account for the following potential exposure pathways (discussed in the User's Guide and Background Technical Document for U.S. EPA Region 9's PRG Table, http://www.epa.gov/region09/superfund/prg/files/04usersguide.pdf):

- The residential and industrial soil RSLs do not account for exposure to indoor air vapors due to intrusion of subsurface soil gas emissions; ingestion via uptake of plants (home-grown fruits and vegetables), meat, or dairy products; or inhalation of particles (fugitive dust) generated by activities which elevate particulate emissions such as truck traffic and use of heavy equipment.
- Pathways not considered in the calculation of the tapwater RSLs include subsurface vapor intrusion to indoor air from VOCs present in groundwater and transfer of contaminants in the water column to aquatic organisms or terrestrial plants with subsequent ingestion by humans. The RSL on-line calculator and User's Guide do however include equations which can be used to calculate screening level fish concentrations assuming human consumption of fish. These equations do not address impacts to fish; but rather, human consumption of fish which may be contaminated. The RSL on-line calculator and User's Guide also provides equations which can be used to evaluate recreational receptor exposures to soil/sediment and surface water.

If pathways not considered in the derivation of the soil and tapwater RSLs are anticipated at the site (e.g. home-grown produce consumption), an RSL-based screening level risk evaluation may significantly underestimate risk. In addition, if there are exposure scenarios other than residential and industrial land use, a screening level risk evaluation using RSLs may not be appropriate (e.g. sites in which trench workers may be exposed to shallow groundwater). In such cases, the evaluation of risk to human receptors at the site should proceed with the baseline human health risk assessment process. In other instances, the screening risk assessment may overestimate risk. In these cases, preparation of a baseline human health risk assessment is an option. For reference, HERO has compiled a summary of recommended exposure factors which may be used as default values in baseline human health risk assessments for California hazardous waste sites

and permitted facilities (DTSC HHRA Note 1, http://dtsc.ca.gov/AssessingRisk/upload/HHRA_Note1.pdf).

Additional Considerations Regarding the Use of Industrial RSLs

The tapwater RSLs are calculated using residential land use assumptions. As such, these RSLs are not reflective of industrial exposures and may overestimate exposures via the water pathways.

Screening level evaluations using the industrial soil RSLs do not account for the following pathways: all uses of groundwater; exposure via vapor intrusion to indoor air; exposure to contaminated surface and ground water, and inhalation of particulates generated by activities which increase particulate levels such as truck traffic and use of heavy equipment. If these exposure pathways are significant at a site, screening risk assessment using RSLs is generally not appropriate. In some cases it may be possible, with the cooperation of the DTSC toxicologist, to incorporate the risk from the vapor intrusion pathway into the screening risk assessment by adding the risk from this pathway into the risk estimated from the use of the RSL(s).

SITE SCREENING – SOIL AND TAPWATER CONTAMINANTS, AND LIMITED VOC CONTAMINANTS IN AIR

As discussed above, HERO plans to review the soil, tapwater, and air RSLs in a phased approach. The results of our updated Phase I review are summarized below and provide recommendations on the use of RSLs for soil (residential use and industrial/commercial use) and tapwater. The results of our Phase II recommendations on the use of air RSLs for a subset of VOCs which are frequently detected at California hazardous waste sites and permitted facilities and evaluated for vapor intrusion to indoor air are also presented.

The U.S. EPA RSL "What's New" summary posted online in May 2013 states that new tables are now provided by U.S. EPA with target hazard quotients (THQ) of 1.0 and 0.1. The RSL website states that the rationale for using a THQ of 0.1 for screening is that if 10 chemicals were at a site and all narrowly passed a screening at THQ=1.0, the resulting total HI could actually be 10.

In general, HERO does not recommend use of screening levels based on a target HQ of 0.1. Instead, screening levels based on a target HQ of 1 should be used, and cumulative noncancer hazard should be summed across all site-related contaminants, media, and exposure pathways. For these reasons, the following HHRA Note 3 recommendations are specifically for screening levels based on a HQ of 1.

Soil and Tapwater

While it is possible to use the on-line screening calculator (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search) supplied as part of the U.S. EPA RSL process and employ the California-recommended toxicity values for each exposure pathway, this would be a laborious process for DTSC Project Managers and contractors for Responsible Parties. To address this difficulty, during our initial Phase I review HERO prepared a copy of the U.S. EPA RSL worksheet in which the U.S. EPA Region 9 2004 soil and tapwater PRGs (including 'Cal-modified' PRGs) and California criteria were inserted. HERO then identified elements, compounds and mixtures in which the soil and tapwater RSLs differed significantly (i.e. greater by a factor of 4-fold or more) from the 2004 PRGs (including Cal-modified PRGs) and California values. In most cases, the differences for soil were due to the deletion of the adjustment for saturation or ceiling limit, updates in toxicity values, the lack of extrapolation between the oral and inhalation pathways in deriving the RSLs, or changes in physical/chemical parameters, including molecular weight. Most of the differences for tapwater were due to updates in toxicity values and the lack of extrapolation between the oral and inhalation exposure pathways in deriving the RSLs.

HERO reviewed each analyte in which the soil and tapwater RSLs differed significantly from the 2004 PRGs and California values to determine whether we agree that use of the newer RSLs for site screening is health protective. In general, with the exception of the chemicals listed Table 1, HERO finds it acceptable to use the soil and tapwater RSLs for compounds in which the differences are due to the deletion of the adjustment for saturation or ceiling limit (applicable to soil values only), updates in toxicity values, and changes in physical/chemical parameters. However, the DTSC Project Managers should be aware that the RSL soil values are strictly risk-based. The RSLs do not consider physical limitations such as soil saturation and the RSLs for some chemicals exceed 10% (i.e., >100,000 ppm). In addition, HERO is concerned with the lack of route to route extrapolation between the oral and inhalation exposure pathways, particularly for compounds in which CalEPA OEHHA lists both an oral cancer slope factor and inhalation unit risk factor. Generally, we recommend that such extrapolations be conducted, particularly for organic compounds in which systemic effects are known to occur and significant portal of entry effects are not anticipated.

Subsequent to our May 2013 revision of this HHRA Note, HERO has reviewed the changes made to the current May 2013 version of the RSL tables. In Table 1 below, HERO lists recommended alternate values that should be used in lieu of the soil and tapwater RSLs. Please note that HERO recommendations, as contained in Table 1, are evolving and may change in the future with additional compounds either being added or deleted.

Although we have identified a sizable number of compounds, as listed in Table 1, only a small number of these are frequently found at California hazardous waste sites and permitted facilities.

The HERO recommendations outlined here (with the exception of the elements and compounds discussed in the following section) reflect that for the greater number of compounds listed in the RSL tables, the soil and tapwater RSLs may be used. It is also important to note that many of the compounds listed in Table 1 are VOCs. If VOCs are present at a site, soil gas data are required to evaluate the vapor intrusion to indoor air pathway. This allows a more comprehensive evaluation because the derivation of the soil and tapwater RSLs and PRGs do not consider the vapor intrusion pathway, which is often the risk driver.

Air.

Subsurface vapor intrusion to indoor air from volatile chemicals in soil or groundwater has become recognized as a potentially major exposure pathway. The air RSLs address residential and industrial ambient air exposure scenarios, and may be used for screening VOC concentrations in indoor air. The air RSLs for VOCs also have potential applications for screening soil gas data when used in concert with an appropriate attenuation factor as described in DTSC's 2011 Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (http://www.dtsc.ca.gov/AssessingRisk/upload/Final_VIG_Oct_2011.pdf). (DTSC-recommended default attenuation factors for preliminary screening evaluations can be found in DTSC's 2011 Vapor Intrusion guidance). For detailed recommendations on the vapor intrusion to indoor air pathway and evaluation of soil gas and indoor air data, please consult DTSC's 2011 Vapor Intrusion guidance, or contact the DTSC site toxicologist to ensure use of the air RSLs on a site-specific basis is appropriate.

To facilitate site screening, HERO's Phase II review provides recommendations on use of air RSLs for a subset of the VOCs that are often present at California hazardous waste sites and permitted facilities. A complete listing of the VOCs reviewed by HERO, and HERO recommendations for these chemicals are presented in reference Table 2. For all constituents other than those listed in Table 2, the DTSC site toxicologist should be consulted prior to using the air RSLs.

HERO's Phase II review is based on a comparison of the inhalation toxicity criteria used to derive the air RSLs relative to CalEPA toxicity criteria and HERO recommendations (e.g. route-to-route extrapolation). For chemicals in which use of CalEPA-recommended criteria is more protective, HERO used the RSL on-line screening calculator to derive alternate values which should be used in lieu of the U.S. EPA air RSLs. These DTSC-modified values are presented in reference Table 3, and were calculated using the more health protective of toxicity criteria from CalEPA and the RSL tables. As shown in Table 3, HERO also used the RSL on-line screening calculator to derive DTSC-modified air screening levels for VOCs where cancer and/or noncancer RSLs are unavailable due to a lack of route-to-route extrapolation when deriving the U.S. EPA RSLs. Again, HERO recommendations, as contained in Tables 2 and 3 below, are evolving and may change in

the future with additional compounds being added and potential revisions to the recommended screening levels for individual compounds.

One exception to the general HERO methodology used to derive DTSC-modified air screening levels is vinyl chloride under the residential land use scenario. Because the on-line RSL screening calculator utilizes a special equation for residential exposures to vinyl chloride in air, HERO did not use the on-line RSL calculator to derive the DTSC-modified residential air screening level for this volatile. Instead, HERO calculated the vinyl chloride risk-based residential air screening level using Equation 4.8.2 (Carcinogenic, Resident Air) from the RSL User's Guide. The on-line RSL calculator was used to develop the DTSC-modified residential air screening concentration for methylene chloride, 1,2,3-TCP

DISCUSSION AND RECOMMENDATIONS FOR SPECIFIC CONTAMINANTS

1. **Lead (Soil).** In 2007, CalEPA OEHHA developed a new toxicity evaluation of lead replacing the 10 µg/dL threshold blood lead concentration with a source-specific "benchmark change" of 1 µg/dL (http://oehha.ca.gov/public_info/public/kids/pdf/PbHGV041307.pdf). One µg/dL is the estimated incremental increase in children's blood lead that would reduce Intelligence Quotient (IQ) by up to 1 point. In light of the updated CalEPA lead toxicity criterion, as well as the need for revision to ensure that the model is adequately protective of women of child-bearing age, a new version of the DTSC LEAD RISK ASSESSMENT SPREADSHEET (LeadSpread 8; 2011) has been developed (http://www.dtsc.ca.gov/AssessingRisk/LeadSpread8.cfm).

   Worksheets 1 and 2 of the LeadSpread 8 file include PRG90 calculations for residential and industrial land use scenarios, respectively. The PRG90s represent concentrations in soil that will result in a 90th percentile estimate of a 1ug/dl increase in blood lead in a child or the fetus of a pregnant adult worker equal. While DTSC has historically used the 99th percentile estimate of blood lead, HERO considers the 90th percentile of the distribution appropriate for use in evaluating lead exposures given that the target blood lead (PbB) level of concern was updated to the more recent health-protective criterion of 1 ug/dL.

   Use of PRG90s is a departure from the previously utilized Cal-modified USEPA Region 9 PRG values of 150 mg/kg for residential land use and 800 mg/kg for industrial land use. HERO implements the risk-based soil concentrations as a residential use (i.e., unrestricted use) scenario Exposure Point Concentration (EPC), calculated as the 95 percent upper confidence limit on the arithmetic mean (95% UCL) of 80 mg/kg or less soil lead and an industrial/commercial use 95% UCL of 320 mg/kg or less soil lead. With regard to assessment of lead risk and evaluating cleanup options, if sufficient data are available, HERO recommends calculating the 95% UCL lead concentration for each exposure area. If individual samples exceed the PRG90, it would not mean that the exposure area itself is in exceedance of the PRG90 as long as the 95% UCL itself is below ~80 mg/kg for residential and ~320 mg/kg for

industrial/commercial, assuming hot spots are not present. If "hot spots" (i.e., geographically collocated areas of elevated concentration), or "outliers" (i.e., individual samples with elevated concentrations) are present, they must be addressed separately.

For initial site screening where data are insufficient to calculate a 95% UCL, comparison of the maximum detected concentration to the PRG90s would be appropriate. If individual sample results exceed the PRG90s, depending on site-specific conditions and sampling results, additional investigation, evaluation, and potentially remediation may be warranted to address concerns about lead exposure.

It is important to note that background exposures to lead, and media other than soil which may be impacted by lead are not considered in LeadSpread8. If lead is present at levels above background in media other than soil (e.g. water, air), or if the home grown produce pathway is anticipated at the site, please contact the HERO toxicologist. DTSC's LeadSpread model is currently undergoing additional revision, and we hope to incorporate additional exposure pathways and environmental media in the near future.

2. **Cadmium (Soil).** The cadmium soil and tapwater RSLs based on noncancer effects were calculated using the U.S. EPA Integrated Risk Information System (IRIS) oral reference dose (RfDo) for food (1 µg/kg-day) and water (0.5 µg/kg-day), respectively. However, the 2006 Cal/EPA OEHHA public health goal (PHG) for cadmium is based on a more health protective oral acceptable daily intake level than the current U.S. EPA RfDs. Specifically, the acceptable daily dose (ADD) used by OEHHA to derive their PHG was 0.0063 µg/kg-day.

   To address the more health protective CalEPA toxicity criterion for cadmium, HERO used the on-line calculator to estimate DTSC-modified soil screening levels for this constituent. Please consult Appendix A for a listing of key inputs used to derive the DTSC screening levels.
   For residential scenarios, risk-based soil concentrations based on noncancer effects are generally calculated for the first six years of childhood based on an assumption that children have higher estimated exposure rates than adults because of factors such as a lower body weight and higher soil ingestion rate. For cadmium, HERO has reviewed the CalEPA OEHHA PHG document; and at this time, we consider a 30-year adult residential scenario appropriate for calculating a risk-based soil concentration to address noncancer effects. As discussed in the PHG document, cadmium accumulates rapidly in the kidney during the first decades of life and then approaches a plateau around age 40 to 50. The PHG is derived from a daily cadmium intake based on toxicokinetic studies in adults and assumes accumulation of cadmium over approximately 50 years. The no observed adverse effect level (NOAEL) identified by OEHHA is also based on a very sensitive indicator of renal toxicity, and the ADD incorporates an overall uncertainty factor of 50. First, an uncertainty factor of 5 was used to address sensitive individuals (principally uncertainties due to limited information on the toxicokinetics of cadmium,

particularly in women). An additional uncertainty factor of 10 was used to address potential cancer risk due to oral exposure to cadmium since no oral studies were considered suitable for estimating the oral cancer potency for cadmium.

Applying the CalEPA ADD (6.3E-6 mg/kg-day) and May 2013 RSL table inhalation RfC (1E-5 mg/m^3; Source ATSDR) with a 30-year adult residential exposure scenario, DTSC default dermal exposure parameters, and an assumed GIABS of 1, the DTSC-modified screening level for residential soil based on noncancer effects was calculated to be approximately 4.6 mg/kg. The DTSC-modified screening level for industrial soil based on noncancer effects was calculated to be 6.4 mg/kg. Applying the CalEPA inhalation unit risk factor of 4.2E-3 per µg/m^3, the DTSC-modified screening levels for residential and industrial soil based on cancer are 790 mg/kg and 4000 mg/kg, respectively. Therefore, the noncancer-based values of 4.6 mg/kg and 6.4 mg/kg were selected as screening levels for residential and industrial soil, respectively.

Please note that the DTSC-modified soil screening levels presented herein represent HERO's current thinking on screening level criteria for cadmium in soil. Based on newer data and potential updates to cadmium toxicity criteria, HERO's review of relevant information for this contaminant is ongoing and we may derive updated DTSC-modified screening levels in the future. At this time we have not derived tapwater screening levels for cadmium, however, we may do so as part of a future revision. In the interim, please consult with the DTSC toxicologist for sites where cadmium is a site-related contaminant in water.

3. **Beryllium (Soil).** While the 2004 PRGs and Fall 2012 RSLs for beryllium and compounds in soil and tapwater are less than 4-fold different, CalEPA toxicity criteria for beryllium differ from current U.S. EPA values in some regards. For cancer, the U.S. EPA inhalation unit risk (2.4E-3 per µg/m^3) is the same as CalEPA's inhalation unit risk for beryllium and beryllium oxide. However, CalEPA also has a separate inhalation unit risk specifically for beryllium sulfate (8.6E-1 per µg/m^3). For noncancer, the U.S. EPA RfDo (2E-3 mg/kg-day) is 10-fold higher than the noncancer toxicity criterion used by CalEPA OEHHA to derive the PHG for beryllium and beryllium compounds (2E-4 mg/kg-day). In addition, the U.S. EPA inhalation reference concentration (RfC) for beryllium and compounds (2E-5 mg/m^3) is higher than the OEHHA chronic inhalation reference level (REL) for beryllium and compounds (7E-6 mg/m^3).

   To address the more health protective CalEPA OEHHA toxicity criteria for beryllium, HERO used the on-line calculator with DTSC default dermal exposure parameters and an assumed GIABS of 1to estimate DTSC-modified soil screening levels for beryllium and compounds (including beryllium oxide). Separate DTSC-modified screening levels based on cancer were also derived for beryllium sulfate due to difference in the inhalation unit risk for this form of beryllium. Please consult Appendix A for a listing of key inputs used to derive the DTSC screening levels.

For beryllium and compounds, applying the CalEPA OEHHA inhalation unit risk (2.4E-3 per µg/m^3), RfDo-equivalent from the PHG document (2E-4 mg/kg-day), and chronic REL (7E-6 mg/m^3), the DTSC-modified screening levels for soil based on noncancer effects were calculated to be approximately 15 mg/kg and 180 mg/kg for residential and industrial land use, respectively. For cancer, the DTSC-modified screening levels for beryllium and compounds in soil were calculated to be 1400 mg/kg and 7000 mg/kg under the residential and industrial land use scenarios, respectively.

For beryllium sulfate, applying the CalEPA inhalation unit risk (8.6E-1 per µg/m^3) results in DTSC-modified screening levels for soil based on cancer of 3.9 mg/kg and 19 mg/kg (residential and industrial land uses, respectively). For noncancer endpoints, the DTSC-modified screening levels for beryllium and compounds in soil (discussed above) can be used since the only CalEPA criterion specific for beryllium sulfate is the inhalation unit risk. Similar to cadmium above, at this time we have not derived tapwater screening levels for beryllium. Please consult with the DTSC toxicologist for sites where beryllium is a site-related contaminant in water.

ACCOMPANYING TABLE 1

For expediency, HERO has not calculated “Cal-modified” RSLs for all compounds included in Table 1. In the interim, HERO recommends that evaluations of compounds in soil and tapwater apply the 2004 PRGs, the 2004 ‘Cal-modified’ PRGs, and DTSC-modified screening levels for elements, compounds and mixtures listed in Table 1. Alternatively, in consultation with HERO, the on-line screening calculator can be used to calculate site-specific values using the more protective of CalEPA and U.S. EPA toxicity values and applying assumptions consistent with HERO recommendations (e.g. route-to-route extrapolation between the oral and inhalation exposure pathways where no toxicity value is available for the inhalation route of exposure but an oral toxicity value is available).

Also included in Table 1 are elements, compounds and mixtures that were included in the 2004 PRG tables, but had no corresponding RSLs available. In the absence of newer screening levels, HERO recommends that the 2004 soil and tapwater PRGs be used for evaluating these compounds if present at a site.

[Remainder of page intentionally blank]

Table 1, Page 1. Alternate soil and tapwater screening values currently recommended in lieu of the Spring 2013 RSLs.

Analyte	CAS Number	U.S. EPA Region 9 PRGs (2004)						'Cal-modified' 2004 U.S. EPA Region 9 PRGs (2004)						RSL Calculator Risk-based Concentration						
		Residential Soil		Industrial Soil		Tapwater		Residential Soil		Industrial Soil		Tapwater		Residential Soil		Industrial Soil		Tapwater		
		Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (µg/L)	Noncancer PRG (µg/L)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (µg/L)	Noncancer PRG (µg/L)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (µg/L)	Noncancer PRG (µg/L)	FOOTNOTE
Acrylonitrile	107-13-1							5.50E-02	NA	1.20E-01	NA									2
Aminodinitrotoluenes	1321-12-6		1.20E+01		1.20E+02		7.30E+00													6
Aminopyridine, 4-	504-24-5		1.20E+00		1.20E+01		7.30E-01													6
Arsenic, Inorganic	7440-38-2							6.20E-02	NA	2.50E-01	NA	7.10E-03	NA*							2, 5
Benzo[k]fluoranthene	207-08-9							3.80E-01	NA	1.30E+00	NA	5.60E-02	NA*							2, 5
Beryllium and compounds	7440-41-7													1.38E+03	1.52E+01	6.95E+03	1.83E+02			3, 7
Butadiene, 1,3-	106-99-0							1.10E-02	8.40E+00	2.30E-02	2.80E+01									2
Butylbenzene, n-	104-51-8		2.4E+02 (sat) 5.80E+02		2.4E+02 (sat) 2.20E+03															1
Butylbenzene, sec	135-9-88		2.2E+02 (sat) 4.50E+02		2.2E+02 (sat) 1.60E+03		2.40E+02													6
Butylbenzene, tert-	98-06-6		3.9E+02 (sat) 5.30E+02		3.9E+02 (sat) 2.00E+03															1
Cadmium	7440-43-9													7.88E+02	4.58+00	3.97E+03	6.37E+00			3
Carbazole	86-74-8	2.40E+01	NA	8.60E+01	NA	3.40E+00	NA													6
Carbon Tetrachloride	56-23-5			5.50E-01																1
Chloroacetophenone, 2-	532-27-4		3.30E-02		1.10E-01		5.20E-02													1, 6
Chlorobutane, 1-	109-69-3		4.8E+02 (sat) 7.10E+02		4.8E+02 (sat) 2.40E+03															1
Chloronitrobenzene, p-	100-00-5					1.70E+00	1.20E+00													4
Chlorophenol, 2-	95-57-8		6.30E+01		2.40E+02															1
Chloropropane, 2-	75-29-6		1.70E+02		5.90E+02		1.70E+02													6
Chlorotoluene, o-	95-49-8		1.60E+02		5.60E+02															1
Chrysene	218-01-9							3.80E+00	NA	1.30E+01	NA	5.60E-01	NA*							2, 5
Crotonaldehyde, trans-	123-73-9	5.30E-03	NA	1.10E-02	NA	5.90E-03	NA													1, 4
Cyanogen Bromide	506-68-3		2.90E+02		9.70E+02															1
Cyanogen Chloride	506-77-4		1.60E+02		5.40E+02															1
Dichlorobenzene, 1,3-	541-73-1		5.30E+02		6.0E+02 (sat) 2.10E+03		1.80E+02													6
Dichloromethane (Methylene chloride)	75-09-2	9.1E+00		2.1E+01		4.3E+00														1, 4
Dicofol	115-32-2	1.10E+00	NA	3.90E+00	NA	1.50E-01	NA													6
Diisononyl phthalate	28553-12-0		1.20E+03		1.20E+04		7.30E+02													6
Dimethyl phthalate	131-11-3		1.0E+05 (max) 6.10E+05		1.0E+05 (max) 6.20E+06		3.60E+05													6
Dimethylamine	124-40-3		6.70E-02		2.50E-01		3.50E-02													6
di-n-Octyl phthalate	117-84-0		2.40E+03		2.50E+04		1.50E+03													1
Dysprosium	7429-91-6		7.80E+03		1.0E+05 (max) 1.00E+05		3.60E+03													6
Epichlorohydrin	106-89-8							1.30E+00	NA	2.90E+00	NA	1.40E-01	NA*							2, 5
Ethyl Acetate	141-78-6		1.90E+04		3.7E+04 (sat) 7.60E+04		5.5+03													1, 4
Ethyl Acrylate	140-88-5	2.10E-01	NA	4.50E-01	NA	2.30E-01	NA													1, 4
Ethyl Ether	60-29-7		1.8E+03 (sat) 6.80E+03		1.8E+03 (sat) 3.30E+04															1

Table 1, Page 2. Alternate soil and tapwater screening values currently recommended in lieu of the Spring 2013 RSLs.

Analyte	CAS Number	U.S. EPA Region 9 PRGs (2004)						'Cal-modified' 2004 U.S. EPA Region 9 PRGs (2004)						RSL Calculator Risk-based Concentration						
		Residential Soil		Industrial Soil		Tapwater		Residential Soil		Industrial Soil		Tapwater		Residential Soil		Industrial Soil		Tapwater		
		Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (µg/L)	Noncancer PRG (µg/L)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (µg/L)	Noncancer PRG (µg/L)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (mg/kg)	Noncancer PRG (mg/kg)	Cancer PRG (µg/L)	Noncancer PRG (µg/L)	FOOTNOTE
Furan	110-00-9		2.50E+00		8.50E+00															1
Hexamethylene Diisocyanate, 1,6-	822-06-0		1.70E-01		1.80E+00															1
Hydrazine, 1,1-dimethyl	57-14-7	1.60E-01	NA	5.70E-01	NA	2.20E-02	NA													1, 4
Hydrogen Sulfide	7783-06-4						1.10E+02													4
Lead and Compounds	7439-92-1							See text for discussion												
Maleic Hydrazide	123-33-1		1.70E+03		2.4E+03 (sat) 5.60E+03															1
Maneb	12427-38-2	8.10E+00	3.10E+02	2.90E+01	3.10E+03	1.10E+00	1.80E+02													1, 4
Mercaptobenzothiazole, 2-	149-30-4	1.70E+01	6.10E+03	5.90E+01	6.20E+04	2.30E+00	3.60E+03													6
Methomyl	16752-77-5		4.40E+01		1.50E+02															1
Methyl Acetate	79-20-9				9.20E+04															1
Methyl Acrylate	96-33-3		7.00E+01		2.30E+02															1
Methyl Mercaptan	74-93-1		3.50E+01		3.50E+02		2.10E+01													6
2-(2-Methyl-1,4-chlorophenoxy) propionic acid	16484-77-8		6.10E+01		6.20E+02		3.60E+01													6
Methylcyclohexane	108-87-2		2.60E+03		8.70E+03		5.20E+03													6
Methylenediphenyl Diisocyanate	101-68-8		1.00E+01		1.00E+02		6.20E+00													1, 6
Methylstyrene, Alpha-	98-83-9		6.8E+02 (sat) 9.20E+02		6.8E+02 (sat) 3.40E+03															1
Nitroanaline, 3-	99-09-2		1.8E+01	8.2E+01		3.2E+00														6
Nitroso-di-N-butylamine, N-	924-16-3			5.80E-02	NA															1
Nitrotoluene, o-	88-72-2			2.2E+00		4.90E-02	6.10E+01													1, 4
Nitrotoluene, p-	99-99-0					6.60E-01	6.10E+01													4
Selenourea	630-10-4		3.1E+02		3.1E+03		1.8E+02													6
Tetrachloroethylene	127-18-4	4.8E-01		1.3E+00		1.0E-01														1, 4
Thiocyanate	N/A		3.10E+03		1.0E+05 (max) 3.10E+04		1.80E+03													6
Titanium	7440-32-6		1.0E+05 (max) 3.10E+05		1.0E+05 (max) 3.80E+06		1.50E+05													6
Trichlorophenol, 2,4,6-	88-06-2							6.90E+00	NA	2.50E+01	NA									2
Trichloropropane, 1,1,2-	598-77-6		7.10E+01		2.70E+02															1
Trimethylbenzene, 1,3,5-	108-67-8		2.13E+01		6.97E+01		1.23E+01													1, 4
Trimellitic Anhydride (TMAN)	552-30-7		8.60E+00		8.60E+01		5.10E+00													6

FOOTNOTES:

* NA = Not Available. Non-carcinogenic PRG not available for carcinogen.

1. Contaminants for which HERO recommends use of 2004 U.S. EPA Region 9 PRGs for soil. 2004 U.S. EPA Region 9 PRG for soil significantly more protecitve than Spring 2013 RSL.
2. Contaminants for which HERO recommends use of 2004 U.S. EPA Region 9 'Cal-modified' PRGs for soil. 'Cal-modified' PRG significantly more protective than 2004 Region 9 PRG and Spring 2013 RSL.
3. Contaminants for which HERO recommends use of the listed RSL calculator risk-based calculated concentrations. These risk-based concentrations, using the RSL calculator are significantly more protective than Spring 2013 RSLs. If beryllium or cadmium is detected in groundwater above background and determined to be a site-related contaminant contact HERO Toxicologist.
4. Contaminants for which HERO recommends use of 2004 U.S. EPA Region 9 PRGs for tapwater. EPA Region 9 2004 tapwater PRG signficantly more protective than Spring 2013 tapwater RSL.
5. Contaminants for which HERO recommends use of 2004 U.S. EPA Region 9 'Cal-modified' PRGs for tapwater. 'Cal-modified' tapwater PRG significantly more protective than EPA Region 9 tapwater PRG and Spring 2013 tapwater RSL.
6. Contaminants for which Spring 2013 RSLs are not available, but EPA Region 9 2004 PRGs are available.
7. HERO recommends use of RSL calculator risk-based concentrations above for beryllium compounds except for anhydrous beryllium sulfate (CASN 13510-49-1). See the text for beryllium sulfate.

ACCOMPANYING TABLE 2

For expediency, HERO has reviewed the air RSLs for a subset of VOCs commonly found at California hazardous waste sites and permitted facilities and evaluated for the vapor intrusion to indoor air pathway. A complete listing of the VOCs reviewed to date, and HERO recommendations are presented in Table 2 below. HERO concurs with the use of the U.S. EPA RSL values for more than half of the VOCs listed in Table 2. Exceptions for which HERO recommends use of alternate DTSC-modified screening levels (in lieu of RSLs) are noted within the table, and the DTSC-modified screening levels are presented in Table 3. For all constituents other than those listed in Table 2, the DTSC site toxicologist should be consulted prior to using the U.S. EPA air RSLs.

[Remainder of page intentionally blank]

Table 2. Page 1. Complete Listing of VOC U.S. EPA Air RSLs Reviewed to Date.

CAS No.	Volatile Organic Compound	Recommendation
75-07-0	**Acetaldehyde**	**See Table 3**
67-6411	Acetone	Use RSLs
75-05-8	Acetonitrile	Use RSLs
107-02-8	Acrolein	Use RSLs
107-13-1	**Acrylonitrile**	**See Table 3**
71-43-2	**Benzene**	**See Table 3**
100-44-7	Benzyl Chloride	Use RSLs
111-44-4	**Bis(2-chloroethyl)ether**	**See Table 3**
75-27-4	**Bromodichloromethane**	**See Table 3**
75-25-2	**Bromoform**	**See Table 3**
74-83-9	Bromomethane (Methyl Bromide)	Use RSLs
106-99-0	**1,3-Butadiene**	**See Table 3**
104-51-8	**n-Butylbenzene**	**See Table 3**
135-98-8	**sec-Butylbenzene**	**See Table 3**
98-06-6	**tert-Butylbenzene**	**See Table 3**
75-15-0	Carbon Disulfide	Use RSLs
56-23-5	**Carbon Tetrachloride**	**See Table 3**
126-99-8	2-Chloro-1,3-butadiene (Chloroprene)	Use RSLs
108-90-7	Chlorobenzene	Use RSLs
109-69-3	**1-Chlorobutane**	**See Table 3**
75-45-6	Chlorodifluoromethane	Use RSLs
67-66-3	Chloroform	Use RSLs
74-87-3	Chloromethane (Methyl Chloride)	Use RSLs
124-48-1	**Dibromochloromethane**	**See Table 3**
74-95-3	Dibromomethane (Methylene Bromide)	Use RSLs
95-50-1	1,2-Dichlorobenzene	Use RSLs
106-46-7	1,4-Dichlorobenzene	Use RSLs
75-71-8	Dichlorodifluoromethane	Use RSLs
75-34-3	**1,1-Dichloroethane**	**See Table 3**
107-06-2	1,2-Dichloroethane	Use RSLs
75-35-4	**1,1-Dichloroethylene (1,1-DCE)**	**See Table 3**
156-59-2	**cis-1,2-Dichloroethylene (cis-1,2-DCE)**	**See Table 3**
156-60-5	trans-1,2-Dichloroethylene (trans-1,2-DCE)	Use RSLs
78-87-5	1,2-Dichloropropane	Use RSLs
542-75-6	**1,3-Dichloropropene**	**See Table 3**
100-41-4	Ethylbenzene	Use RSLs
75-21-8	Ethylene oxide	Use RSLs
118-74-1	**Hexachlorobenzene**	**See Table 3**

Table 2. Page 2. Complete Listing of VOC U.S. EPA Air RSLs Reviewed to Date.

87-68-3	**Hexachlorobutadiene**	**See Table 3**
77-47-4	Hexachlorocyclopentadiene	Use RSLs
67-72-1	Hexachloroethane	Use RSLs
110-54-3	n-Hexane	Use RSLs
74-90-8	Hydrogen cyanide	Use RSLs
75-09-2	**Methylene Chloride**	**See Table 3**
78-93-3	Methyl ethyl ketone (2-butanone)	Use RSLs
108-10-1	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	Use RSLs
91-57-6	**2-Methylnaphthalene**	**See Table 3**
1634-04-4	Methyl tert-Butyl Ether (MTBE)	Use RSLs
91-20-3	Naphthalene	Use RSLs
98-95-3	Nitrobenzene	Use RSLs
88-72-2	**o-Nitrotoluene**	**See Table 3**
103-65-1	Propyl benzene	Use RSLs
100-42-5	**Styrene**	**See Table 3**
630-20-6	**1,1,1,2-Tetrachloroethane**	**See Table 3**
79-34-5	**1,1,2,2-Tetrachloroethane**	**See Table 3**
127-18-4	**Tetrachloroethylene (PCE)**	**See Table 3**
108-88-3	**Toluene**	**See Table 3**
120-82-1	1,2,4-Trichlorobenzene	Use RSLs
71-55-6	**1,1,1-Trichloroethane**	**See Table 3**
79-00-5	1,1,2-Trichloroethane	Use RSLs
79-01-6	Trichloroethylene (TCE)	Use RSLs
75-69-4	Trichlorofluoromethane	Use RSLs
96-18-4	**1,2,3-Trichloropropane**	**See Table 3**
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	Use RSLs
95-63-6	1,2,4-Trimethylbenzene	Use RSLs
108-67-8	**1,3,5-Trimethylbenzene**	**See Table 3**
75-01-4	**Vinyl chloride**	**See Table 3**
95-47-6, 106-42-3, 1330-20-7, 108-38-3	Xylene(s), p-, m-, o-	Use RSLs

Table 3. Page 1. Alternate air screening levels currently recommended in lieu of the Spring 2013 RSLs.

				DTSC Recommended Values			
		More Protective of CalEPA and Nov 2012 U.S. EPA RSL Table Criteria		DTSC-Modified Residential Air Screening Level Calculated using RSL Calculator		DTSC-Modified Industrial Air Screening Level Calculated using RSL Calculator	
CAS No.	**Volatile Organic Compound**	**IUR (per µg/m^3)**	**RfC or REL (mg/m^3)**	**Cancer (µg/m^3)**	**Noncancer (µg/m^3)**	**Cancer (µg/m^3)**	**Noncancer (µg/m^3)**
75-07-0	**Acetaldehyde**	2.7E-06 (C)	0.009 (S)	**0.9**	Use RSL	**4.5**	Use RSL
107-13-1	**Acrylonitrile**	2.9E-04 (C)	0.002 (S)	**0.0084**	Use RSL	**0.042**	Use RSL
71-43-2	**Benzene**	2.9E-05 (C)	0.03 (S)	**0.084**	Use RSL	**0.42**	Use RSL
111-44-4	**Bis(2-chloroethyl)ether**	7.1E-04 (C)	-	**0.0034**	-	**0.017**	-
75-27-4	**Bromodichloromethane**	3.70E-05 (C)	0.07 (R)	Use RSL	**73**	Use RSL	**310**
75-25-2	**Bromoform**	1.10E-06	0.07 (R)	Use RSL	**73**	Use RSL	**310**
106-99-0	**1,3-Butadiene**	1.7E-04 (C)	0.002 (C*)	**0.014**	Use RSL	**0.072**	Use RSL
104-51-8	**n-Butylbenzene**	-	0.175 (R)	-	**180**	-	**770**
135-98-8	**sec-Butylbenzene**	-	0.4 (SUR)	**-**	**420**	**-**	**1800**
98-06-6	**tert-Butylbenzene**	-	0.4 (SUR)	**-**	**420**	**-**	**1800**
56-23-5	**Carbon tetrachloride**	4.2E-05 (C)	0.04 (C)	**0.058**	**42**	**0.29**	**180**
109-69-3	**1-Chlorobutane**	-	0.14 (R)	-	**150**	-	**610**
124-48-1	**Dibromochloromethane**	2.7E-05 (C)	0.07 (R)	Use RSL	**73**	Use RSL	**310**
75-34-3	**1,1-Dichloroethane**	1.6E-06 (C)	0.7 (R)	Use RSL	**730**	Use RSL	**3100**
75-35-4	**1,1-Dichloroethylene (1,1-DCE)**	-	0.07 (C)	-	**73**	-	**310**
156-59-2	**cis-1,2-Dichloroethylene (cis-1,2-DCE)**	-	0.007 (R)	-	**7.3**	-	**31**
542-75-6	**1,3-Dichloropropene**	1.6E-05 (C)	0.02	**0.15**	Use RSL	**0.77**	Use RSL
118-74-1	**Hexachlorobenzene**	5.1E-04 (C)	0.0028 (R)	**0.0048**	**2.9**	**0.024**	**12**
87-68-3	**Hexachlorobutadiene**	2.20E-05	0.0035 (R)	Use RSL	**3.7**	Use RSL	**15**
75-09-2	**Methylene Chloride**	1E-06 (C)	0.4 (C)	**0.96**	**420**	**12**	**1800**
91-57-6	**2-Methylnaphthalene**	-	0.014 (R)	-	**15**	-	**61**
88-72-2	**o-Nitrotoluene**	6.3E-5 (R)	0.00315 (R)	0.039	**3.3**	0.195	**14**
100-42-5	**Styrene**	**-**	0.9 (C)	-	**940**	-	**3900**
630-20-6	**1,1,1,2-Tetrachloroethane**	7.40E-06	0.11 (R)	Use RSL	**120**	Use RSL	**480**
79-34-5	**1,1,2,2-Tetrachloroethane**	5.8E-05 (C)	0.07 (R)	Use RSL	**73**	Use RSL	**310**
127-18-4	**Tetrachloroethylene (PCE)**	5.9E-06 (C)	0.035 (C)	**0.41**	**37**	**2.08**	**150**
108-88-3	**Toluene**	-	0.3 (C)	-	**310**	-	**1300**
71-55-6	**1,1,1-Trichloroethane**	-	1 (C)	**-**	**1040**	**-**	**4400**
96-18-4	**1,2,3-Trichloropropane**	8.6E-03 (R)	0.0003	**0.0001**	Use RSL	**0.0014**	Use RSL
108-67-8	**1,3,5-Trimethylbenzene**	-	0.035 (R)	**-**	**37**	**-**	**150**
75-01-4	**Vinyl chloride**	7.8E-05 (C)	0.1	**0.031***	Use RSL	**0.16**	Use RSL

Table 3. Page 2. Alternate air screening levels currently recommended in lieu of the Spring 2013 RSLs.

Key:

Unless noted otherwise, criteria listed in Table 3 above are from the May 2013 RSL tables; S = see footnote for CalEPA criteria which are less protective than the RSL table values listed in Table 3; C = CalEPA criterion; R = route-extrapolated value, see footnote for details; SUR = surrogate value, see footnote for details; * See explanation below

Age-dependent adjustment factors (ADAFs) for mutagens were used in On-line RSL Calculator to derive DTSC-Modified Air Screening Levels for methylene chloride and 1,2,3-trichloropropane which the RSL Table identifies as mutagens.

Footnotes:

Acetaldehyde - CalEPA REL 0.140 mg/m^3; less protective than RSL table value

Acrylonitrile - CalEPA REL 0.005 mg/m^3; less protective than RSL table value

Benzene - CalEPA REL 0.06 mg/m^3; less protective than RSL table value

Bromodichloromethane - RfC-equivalent based on route-extrapolated RfDo value from RSL table

Bromoform - RfC-equivalent based on route-extrapolated RfDo value from RSL table

1,3-Butadiene - CalEPA REL 0.02 mg/m^3 equal to RSL table value

n-Butylbenzene - RfC-equivalent based on route-extrapolated RfDo value from RSL table

sec-Butylbenzene – Appendix A of the 2012 USEPA PPRTV for sec-Butylbenzene recommends Isopropylbenzene (cumene) as surrogate for oral noncancer effects. Route-extrapolation of the cumene oral RfD, 0.1 mg/kg-day, is 0.35 mg/m^3. HERO selected the cumene RfC, 0.4 mg/m^3, based on inhalation exposure data, as the surrogate toxicity value for screening.

tert-Butylbenzene - Appendix A of the 2012 USEPA PPRTV for tert-Butylbenzene recommends Isopropylbenzene (cumene) as surrogate for oral noncancer effects. Route-extrapolation of the cumene oral RfD, 0.1 mg/kg-day, is 0.35 mg/m^3. HERO selected the cumene RfC, 0.4 mg/m^3, based on inhalation exposure data, as the surrogate toxicity value for screening.

Dibromochloromethane - RfC-equivalent based on route-extrapolated RfDo value from RSL table

1-Chlorobutane - RfC-equivalent based on route-extrapolated RfDo value from RSL table

1,1-Dichloroethane - RfC-equivalent based on route-extrapolated RfDo from RSL table

cis-1,2-Dichloroethylene - RfC-equivalent based on route-extrapolated RfDo value from RSL table

Hexachlorobenzene – RfC-equivalent based on route-extrapolated RfDo value from RSL table

Hexachlorobutadiene - RfC-equivalent based on route-extrapolated RfDo value from RSL table

2-Methylnaphthalene - RfC-equivalent based on route-extrapolated RfDo value from RSL table
o-Nitrotoluene – IUR is route-extrapolated oral cancer slope factor from RSL table; RfC-equivalent based on route-extrapolated RfDo value from RSL table

1,1,1,2-Tetrachloroethane - RfC-equivalent based on route-extrapolated RfDo value from RSL table

1,1,2,2-Tetrachloroethane - RfC-equivalent based on route-extrapolated RfDo value from RSL table

1,2,3-Trichloropropane - IUR is route-extrapolated oral cancer slope factor from RSL table

1,3,5-Trimethylbenzene - RfC-equivalent based on route-extrapolated RfDo value from RSL table

Vinyl Chloride – RSL Calculator not used; Instead, DTSC-modified screening levels calculated using Equation 4.8.2 from RSL User's Guide

Human Health Risk Assessment Note Number 3
Appendix A- Key Inputs used to Derive DTSC Screening Levels

Soil - Cadmium and Compounds

30 Year Adult Residential Scenario Risk-Based Screening Levels for Soil

* To allow for a 30-year adult residential scenario, the "composite worker" scenario was selected in the RSL calculator and the following exposure parameters were modified to reflect default adult residential assumptions: exposure duration 30 years, exposure frequency of 350 days/year, dermal adherence factor 0.07 mg/cm^2, exposure time 24 hours, and skin surface area 5700 cm^2/day.

Chemical	Inhalation Unit Risk (ug/m^3)$^{-1}$	Chronic RfD (mg/kg-day)	Chronic RfC (mg/m^3)	GIABS	ABS	Particulate Emission Factor (m^3/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL HQ=1 (mg/kg)	Dermal SL HQ=1 (mg/kg)	Inhalation SL HQ=1 (mg/kg)	Noncarcinogenic SL HI=1 (mg/kg)	Screening Level (mg/kg)
Cadmium (Diet)	4.20E-03	6.30E-06	1.00E-05	1	0.001	1.36E+09	7.88E+02	7.88E+02	4.60E+00	1.15E+03	1.42E+04	4.58E+00	4.58E+00 nc

Industrial Scenario Risk-Based Screening Levels for Soil

Chemical	Inhalation Unit Risk (ug/m^3)$^{-1}$	Chronic RfD (mg/kg-day)	Chronic RfC (mg/m^3)	GIABS	ABS	Particulate Emission Factor (m^3/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL HQ=1 (mg/kg)	Dermal SL HQ=1 (mg/kg)	Inhalation SL HQ=1 (mg/kg)	Noncarcinogenic SL HI=1 (mg/kg)	Screening Level (mg/kg)
Cadmium (Diet)	4.20E-03	6.30E-06	1.00E-05	1	0.001	1.36E+09	3.97E+03	3.97E+03	6.44E+00	5.65E+02	5.95E+04	6.37E+00	6.37E+00 nc

Human Health Risk Assessment Note Number 3
Appendix A- Key Inputs used to Derive DTSC Screening Levels

Soil - Beryllium and Compounds (Including Beryllium Oxide)

Residential Scenario Risk-Based Screening Levels for Soil

Chemical	Inhalation Unit Risk $(ug/m^3)^{-1}$	Chronic RfD (mg/kg-day)	Chronic RfC (mg/m^3)	GIABS	ABS	Particulate Emission Factor (m^3/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL Child HQ=1 (mg/kg)	Dermal SL Child HQ=1 (mg/kg)	Inhalation SL Child HQ=1 (mg/kg)	Noncarcinogenic SL Child HI=1 (mg/kg)	Screening Level (mg/kg)
Beryllium and compounds	2.40E-03	2.00E-04	7.00E-06	1	0.01	1.36E+09	1.38E+03	1.38E+03	1.56E+01	5.39E+02	9.92E+03	1.52E+01	1.52E+01 nc

Industrial Scenario Risk-Based Screening Levels for Soil

Chemical	Inhalation Unit Risk $(ug/m^3)^{-1}$	Chronic RfD (mg/kg-day)	Chronic RfC (mg/m^3)	GIABS	ABS	Particulate Emission Factor (m^3/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL HQ=1 (mg/kg)	Dermal SL HQ=1 (mg/kg)	Inhalation SL HQ=1 (mg/kg)	Noncarcinogenic SL HI=1 (mg/kg)	Screening Level (mg/kg)
Beryllium and compounds	2.40E-03	2.00E-04	7.00E-06	1	0.01	1.36E+09	6.95E+03	6.95E+03	2.04E+02	1.79E+03	4.17E+04	1.83E+02	1.83E+02 nc

Human Health Risk Assessment Note Number 3
Appendix A- Key Inputs used to Derive DTSC Screening Levels

Soil - Beryllium Sulfate

Residential Scenario Risk-Based Screening Levels for Soil

* See Beryllium and Compounds above for risk-based screening levels for soil based on noncancer effects

Chemical	Inhalation Unit Risk $(ug/m^3)^{-1}$	Particulate Emission Factor (m^3/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)
Beryllium sulfate	8.60E-01	1.36E+09	3.85E+00	3.85E+00

Industrial Scenario Risk-Based Screening Levels for Soil

Chemical	Inhalation Unit Risk $(ug/m^3)^{-1}$	Particulate Emission Factor (m^3/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)
Beryllium sulfate	8.60E-01	1.36E+09	1.94E+01	1.94E+01

Human Health Risk Assessment Note Number 3
Appendix A- Key Inputs used to Derive DTSC Screening Levels

Air – Residential

Chemical	CAS Number	Inhalation Unit Risk $(ug/m^3)^{-1}$	Chronic RfC (mg/m^3)	Carcinogenic SL TR=1.0E-6 (ug/m^3)	Noncarcinogenic SL HI=1 (ug/m^3)	Screening Level (ug/m^3)
Acetaldehyde	75-07-0	2.70E-06	9.00E-03	9.01E-01	9.39E+00	9.01E-01 ca*
Acrylonitrile	107-13-1	2.90E-04	2.00E-03	8.39E-03	2.09E+00	8.39E-03 ca
Benzene	71-43-2	2.90E-05	3.00E-02	8.39E-02	3.13E+01	8.39E-02 ca
Bis(2-chloroethyl)ether	111-44-4	7.10E-04	-	3.43E-03	-	3.43E-03 ca**
Bromodichloromethane	75-27-4	3.70E-05	7.00E-02	6.58E-02	7.30E+01	6.58E-02 ca
Bromoform	75-25-2	1.10E-06	7.00E-02	2.21E+00	7.30E+01	2.21E+00 ca*
Butadiene, 1,3-	106-99-0	1.70E-04	2.00E-03	1.43E-02	2.09E+00	1.43E-02 ca
Butylbenzene, n-	104-51-8	-	1.75E-01	-	1.83E+02	1.83E+02 nc
Butylbenzene, sec-	135-98-8	-	4.00E-01	-	4.17E+02	4.17E+02 nc
Butylbenzene, tert-	98-06-6	-	4.00E-01	-	4.17E+02	4.17E+02 nc
Carbon Tetrachloride	56-23-5	4.20E-05	4.00E-02	5.79E-02	4.17E+01	5.79E-02 ca
Chlorobutane, 1-	109-69-3	-	1.40E-01	-	1.46E+02	1.46E+02 nc
Dibromochloromethane	124-48-1	2.70E-05	7.00E-02	9.01E-02	7.30E+01	9.01E-02 ca
Dichloroethane, 1,1-	75-34-3	1.60E-06	7.00E-01	1.52E+00	7.30E+02	1.52E+00 ca
Dichloroethylene, 1,1-	75-35-4	-	7.00E-02	-	7.30E+01	7.30E+01 nc
Dichloroethylene, 1,2-cis-	156-59-2	-	7.00E-03	-	7.30E+00	7.30E+00 nc
Dichloropropene, 1,3-	542-75-6	1.60E-05	2.00E-02	1.52E-01	2.09E+01	1.52E-01 ca
Hexachlorobenzene	118-74-1	5.10E-04	2.80E-03	4.77E-03	2.92E+00	4.77E-03 ca**
Hexachlorobutadiene	87-68-3	2.20E-05	3.50E-03	1.11E-01	3.65E+00	1.11E-01 ca*
Methylene Chloride	75-09-2	1.00E-06	4.00E-01	6.91E-01	4.17E+02	6.91E-01 ca
Methylnaphthalene, 2-	91-57-6	-	1.40E-02	-	1.46E+01	1.46E+01 nc
Nitrotoluene, o-	88-72-2	6.30E-05	3.15E-03	3.86E-02	3.29E+00	3.86E-01 ca
Styrene	100-42-5	-	9.00E-01	-	9.39E+02	9.39E+02 nc
Tetrachloroethane, 1,1,1,2-	630-20-6	7.40E-06	1.10E-01	3.29E-01	1.15E+02	3.29E-01 ca
Tetrachloroethane, 1,1,2,2-	79-34-5	5.80E-05	7.00E-02	4.20E-02	7.30E+01	4.20E-02 ca
Tetrachloroethylene	127-18-4	5.90E-06	3.50E-02	4.12E-01	3.65E+01	4.12E-01 ca*
Toluene	108-88-3	-	3.00E-01	-	3.13E+02	3.13E+02 nc
Trichloroethane, 1,1,1-	71-55-6	-	1.00E+00	-	1.04E+03	1.04E+03 nc
Trichloropropane, 1,2,3-	96-18-4	8.60E-03	3.00E-04	1.112E-04	3.13E-01	1.112E-04 ca
Trimethylbenzene, 1,3,5-	108-67-8	-	3.50E-02	-	3.65E+01	3.65E+01 nc

Human Health Risk Assessment Note Number 3
Appendix A- Key Inputs used to Derive DTSC Screening Levels
Air – Industrial

Chemical	CAS Number	Inhalation Unit Risk $(ug/m^3)^{-1}$	Chronic RfC (mg/m^3)	Carcinogenic SL TR=1.0E-6 (ug/m^3)	Noncarcinogenic SL HI=1 (ug/m^3)	Screening Level (ug/m^3)
Acetaldehyde	75-07-0	2.70E-06	9.00E-03	4.54E+00	3.94E+01	4.54E+00 ca**
Acrylonitrile	107-13-1	2.90E-04	2.00E-03	4.23E-02	8.76E+00	4.23E-02 ca
Benzene	71-43-2	2.90E-05	3.00E-02	4.23E-01	1.31E+02	4.23E-01 ca
Bis(2-chloroethyl)ether	111-44-4	7.10E-04	-	1.73E-02	-	1.73E-02 ca**
Bromodichloromethane	75-27-4	3.70E-05	7.00E-02	3.31E-01	3.07E+02	3.31E-01 ca
Bromoform	75-25-2	1.10E-06	7.00E-02	1.11E+01	3.07E+02	1.11E+01 ca*
Butadiene, 1,3-	106-99-0	1.70E-04	2.00E-03	7.21E-02	8.76E+00	7.21E-02 ca
Butylbenzene, n-	104-51-8	-	1.75E-01	-	7.67E+02	7.67E+02 nc
Butylbenzene, sec-	135-98-8	-	4.00E-01	-	1.75E+03	1.75E+03 nc
Butylbenzene, tert-	98-06-6	-	4.00E-01	-	1.75E+03	1.75E+03 nc
Carbon Tetrachloride	56-23-5	4.20E-05	4.00E-02	2.92E-01	1.75E+02	2.92E-01 ca
Chlorobutane, 1-	109-69-3	-	1.40E-01	-	6.13E+02	6.13E+02 nc
Dibromochloromethane	124-48-1	2.70E-05	7.00E-02	4.54E-01	3.07E+02	4.54E-01 ca
Dichloroethane, 1,1-	75-34-3	1.60E-06	7.00E-01	7.67E+00	3.07E+03	7.67E+00 ca
Dichloroethylene, 1,1-	75-35-4	-	7.00E-02	-	3.07E+02	3.07E+02 nc
Dichloroethylene, 1,2-cis-	156-59-2	-	7.00E-03	-	3.07E+01	3.07E+01 nc
Dichloropropene, 1,3-	542-75-6	1.60E-05	2.00E-02	7.67E-01	8.76E+01	7.67E-01 ca
Hexachlorobenzene	118-74-1	5.10E-04	2.80E-03	2.40E-02	1.23E+01	2.40E-02 ca**
Hexachlorobutadiene	87-68-3	2.20E-05	3.50E-03	5.57E-01	1.53E+01	5.57E-01 ca*
Methylene Chloride	75-09-2	1.00E-06	4.00E-01	1.23E+01	1.75E+03	1.23E+01 ca
Methylnaphthalene, 2-	91-57-6	-	1.40E-02	-	6.13E+01	6.13E+01 nc
Nitrotoluene, o-	88-72-2	6.3E-05	3.15E-03	1.95E-01	1.38E+01	1.95E-01 ca
Styrene	100-42-5	-	9.00E-01	-	3.94E+03	3.94E+03 nc
Tetrachloroethane, 1,1,1,2-	630-20-6	7.40E-06	1.10E-01	1.66E+00	4.82E+02	1.66E+00 ca
Tetrachloroethane, 1,1,2,2-	79-34-5	5.80E-05	7.00E-02	2.11E-01	3.07E+02	2.11E-01 ca
Tetrachloroethylene	127-18-4	5.90E-06	3.50E-02	2.08E+00	1.53E+02	2.08E+00 ca*
Toluene	108-88-3	-	3.00E-01	-	1.31E+03	1.31E+03 nc
Trichloroethane, 1,1,1-	71-55-6	-	1.00E+00	-	4.38E+03	4.38E+03 nc
Trichloropropane, 1,2,3-	96-18-4	8.60E-03	3.00E-04	1.43E-03	1.31E+00	1.43E-03 ca
Trimethylbenzene, 1,3,5-	108-67-8	-	3.50E-02	-	1.53E+02	1.53E+02 nc
Vinyl Chloride	75-01-4	7.80E-05	1.00E-01	1.57E-01	4.38E+02	1.57E-01 ca