

## Technical Memorandum

To: Ms. Olivia Jacobs, REA; President/CEO  
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From: Teri Copeland, DABT, Kurt Fehling, Jim Van de Water, PG, CHG, and Steve Jones, Ph.D.

Date: March 19, 2012

Re: Technical Review of *Proposed Low-Threat UST Closure Policy* (SWRCB Low-Threat UST Closure Policy Task Force, January 31, 2012)

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At your request, we have completed our review of the Proposed Low-Threat UST Closure Policy (LT-UCP) documents (including the associated technical support documents) for general issues regarding consistency with current regulatory policy and risk assessment guidance. Our general comments are outlined in the Executive Summary below, and our specific comments are listed by section of the Closure Policy document afterwards.

### Executive Summary

We have reviewed the following State Water Quality Control Board (SWQCB) documents that present the proposed approach underlying the LT-UCP, which presents an alternative methodology for addressing chemicals released at leaking underground fuel tank (LUFT) sites. Specifically, we have reviewed:

1. *Final Request for External Peer Reviewers of the Scientific Basis of the Technical Justification for the Proposed Low-Threat UST Closure Policy* (Kevin Graves, Manager, UST Program Section, State Water Resources Control Board, December 8, 2011), including Attachments 1-4 and 6-7. (At your direction, we did not review Attachment 5, Technical Justification for Groundwater Media Specific Criteria).
2. *Proposed Low-Threat UST Closure Policy* (SWRCB Low-Threat UST Closure Policy Task Force, reissued January 31, 2012 as Attachment 4 to December 8, 2011);

3. Technical Justification for Soil Screening Levels for Direct Contact and Outdoor Air Exposure Pathways (SWRCB Low-Threat UST Closure Policy Task Force, Final July 16, 2011; reissued as Attachment 7 to December 8, 2011); and
4. Technical Justification for Low-Threat Closure Scenarios for Petroleum Vapor Intrusion Pathway (SWRCB Low-Threat UST Closure Policy Task Force, Final June 30, 2011; reissued November 22, 2011, as Attachment 6).

These documents present an alternative approach for assessing contaminated soil and potential impacts to groundwater at LUFT sites. While we applaud the SWRCB efforts to streamline the current process to address these sites, we find the proposed approach to be, in some manner, incomplete and inconsistent with current California and USEPA guidance.

While many of our previous comments were addressed in the revised documents, the proposed approach continues to fall short of providing clear and unambiguous guidance on the methodology and decision criteria for defining low-threat LUFT sites. As currently presented, the data needs and data collection techniques are not well defined, and the methods and criteria for assessing data adequacy/usability need further clarification. The proposed streamlined approach inherently places a greater burden of transparency and data accuracy on the process, and further clarifications on the methods and decision criteria are necessary to avoid misunderstandings or arbitrary decision-making as the new guidance is implemented.

There are several elements of the proposed methodology that are not adequately documented and also, in some cases, appear to be in conflict with relevant federal or California regulatory agency guidance. For example, the proposed policy also fails to apply standard accepted guidance in regard to the identification of chemicals of potential concern (COPCs) (USEPA, 1989; CalEPA/DTSC, 1992) that should be carried through the risk evaluation process. These issues should be addressed before final guidance is implemented.

We applaud the efforts of SWRCB to identify appropriate methods for more efficient investigation, assessment and closure of less problematic LUFT sites. However, the proposed methodology must be reasonably comprehensive and unambiguous to avoid potential errors during implementation. Thus, we strongly recommend that SWRCB address the specific comments identified below prior to finalizing its Low-Threat UST Closure Policy.

## **1.0 Low-Threat UST Closure Policy (SWRCB Low-Threat UST Closure Policy Task Force, 11-10-11, Attachment 4)**

Our review of this document focused on the following key issues:

## **Clarity of data needs required to implement the draft policy, adequacy of the limited list(s) of indicator chemicals, approach for determining cumulative risk, and deviation from current guidance**

Comment 1.1: For the benefit of all stakeholders, and especially the responsible parties and their consultants, it is recommended that the draft guidance identify the existing standard risk assessment guidance documents that are relevant to the proposed policy (e.g., USEPA, 1989, 1992, 1996, 2002; CalEPA/DTSC, 1992, CalEPA2005a,b). Data needs associated with characterization and remediation should be provided. In addition to providing direction to the stakeholders regarding budgeting and scheduling, this will also allow for a straightforward assessment regarding (a) the definitiveness of the draft policy and (b) the potential benefits/cost savings associated with the draft policy.

Comment 1.2: The indicator chemicals are incomplete. The draft policy is limited to benzene, ethylbenzene, naphthalene, carcinogenic polynuclear aromatic hydrocarbons (PAHs), and methyl tertiary butyl ether (MTBE) (the latter for groundwater only). As the draft policy is intended for fuels (a mixture of numerous chemicals), additional chemicals should be included if detected in site samples. Inclusion of additional chemicals will provide consistency with existing guidance regarding cumulative risk (*i.e.*, consistent with existing USEPA and CalEPA guidance, the contribution of all chemicals to the total risk posed by a site should be quantified).

Comment 1.3: Ecological risk is not addressed. It should be stated in the policy that sites having potential ecological receptors would not qualify for the proposed program.

## **2.0 Attachment 2: Findings, Assumptions and Conclusions to be Reviewed**

Comment 2.1: The peer reviewers were not requested to review the toxicity criteria (e.g., Attachment 7, Table 7) (see also Comment 4.4 below).

## **3.0 Attachment 3: List of Participants Involved in Developing the Proposed Low-Threat UST Closure Policy Directly or Indirectly**

Comment 3.1: It is not clear how many of the participants have expertise in toxicology or human health risk assessment. Qualifications of the participants should be provided. This comment is also relevant to the peer reviewers

#### **4.0 Technical Justification for Soil Screening Levels for Direct Contact and Outdoor Air Exposure Pathways (SWRCB Low-Threat UST Closure Policy Task Force, reissued in December 2011 as Attachment 7 to December 8, 2011)**

Our review focused on the parameters, equations, and general human health risk assessment concepts relied upon in the draft guidance. Our comments are as follows:

##### **Soil Depth Interval for Exposure**

Comment 4.1: The soil depth intervals for direct contact are not consistent with CalEPA/DTSC (1992) and USEPA (2002) guidance. CalEPA/DTSC guidance (1992) identifies a soil depth interval of 0-2 ft bgs or 0-10 ft bgs, (whichever has higher concentrations of COPCs is to be used) for the residential exposure scenario. USEPA identifies the entire soil depth interval of 0-10 ft bgs for the utility trench/construction worker. It is also not clear if screening levels are to be compared with (1) maximum or (2) upper confidence limit on mean concentrations.

##### **Evaluation of Carcinogenic PAHs**

The approach recommended for assessing carcinogenic PAHs is not consistent with current CalEPA/DTSC guidance, which recommends the use of benzo(a)pyrene potency equivalency factors (CalEPA/DTSC, 1994). The proposed approach, summing the seven carcinogenic PAHs and assuming they are all as potent as benzo(a)pyrene, will overestimate risk and is unnecessarily conservative.

##### **Exposure Parameters (Table 4)**

Comment 4.2: The units on the skin surface area factor (SAS) need to be changed to  $\text{cm}^2/\text{day}$  to be consistent with USEPA guidance for dermal risk assessment (USEPA, 2004). Without this correction, the units do not properly cancel.

Comment 4.3: Where available, California Reference Exposure Levels (RELs) should be used rather than USEPA Reference Concentrations (RfCs).

##### **Toxicity Criteria (Table 7)**

Comment 4.4: The toxicity criteria listed in this table are not consistent with the current CalEPA/OEHHA toxicity criteria (CalEPA, 2012a,b). For example, the RfCs for benzene, ethylbenzene and naphthalene should be  $60 \mu\text{g}/\text{m}^3$ ,  $2000 \mu\text{g}/\text{m}^3$  and  $9 \mu\text{g}/\text{m}^3$  (CalEPA/OEHHA, 2012a), respectively rather than those listed in Table 7.

## **5.0 Technical Justification for Groundwater Plume Lengths, Indicator Constituents, Concentrations, and Buffer Distances [Separation Distances] to Receptors (Tech. Just.-GPL) (SWQCB Low-Threat UST Closure Policy Task Force, 2011c)**

In our review of the Tech. Just.-GPL, we evaluated the following components:

1. Selection of indicator chemicals;
2. Studies cited to support proposed policy;
3. Criteria for defining “low threat groundwater scenarios”;
4. Basis of biodegradation rates;
5. Proposals regarding free product;
6. Confirmation that the potential capture zone(s)/wellhead protection area(s) is/are not greater than the “Service Area of Public Water System”;
7. The manner in which “plume stability” and “plume extent” are quantified;
8. The manner in which the amount of time required for natural attenuation to attain water quality objectives is determined; and
9. Basis of plume concentration value (*e.g.*, MCL or other value) used to establish plume stability and extent.

### **Selection of Indicator Chemicals**

The indicator chemicals selected for groundwater plume lengths in the Tech. Just.-GPL are benzene, methyl tertiary butyl ether (MTBE), and total petroleum hydrocarbons as gasoline (TPHg). The carbon chain range for TPHg is approximately C<sub>5</sub> through C<sub>12</sub>. The reasons stated for choosing these three constituents as the indicator chemicals are as follows:

- Benzene: Has the highest toxicity
- MTBE: Typically has longest plume lengths
- TPHg: Represents additional dissolved hydrocarbons that may be present due to a typical petroleum release.

To further support their selection of benzene and MTBE as indicator chemicals, the Tech. Just.-GPL states that benzene and MTBE are used in research studies as key indicator chemicals for the threat (human health risk and nuisance) posed by groundwater plumes from petroleum releases because:

- Benzene has the highest toxicity of the soluble petroleum constituents, and

- MTBE typically has the longest groundwater plume lengths and has a low secondary maximum contaminant level (secondary MCL; taste and odor threshold of 5 micrograms/liter [ $\mu\text{g/L}$ ]).

Comment 5.1: It is recommended that other carcinogenic constituents of gasoline releases and diesel releases be considered. For leaded gasoline releases, carcinogenic constituents may include 1,2-dichloroethane (1,2-DCA) and ethylene dibromide (EDB). For diesel releases, naphthalene should be considered. Consideration of these additional carcinogenic constituents is consistent with the idea that high toxicity constituents should be used as indicator chemicals for groundwater plume length. The primary MCLs for these constituents are as follows:<sup>[1]</sup>

- 1,2-DCA      0.5  $\mu\text{g/L}$  (California)
- EDB:            0.05  $\mu\text{g/L}$  (Federal)
- Naphthalene: No California or Federal value<sup>[2]</sup>.

1,2-DCA and EDB both have lower MCLs than benzene (1  $\mu\text{g/L}$ ) and MTBE (13  $\mu\text{g/L}$  [primary MCL] and 5  $\mu\text{g/L}$  [secondary MCL]) and, as such, can be considered to be more toxic than these two proposed indicator chemicals. Falta (2004) notes:

*“EDB has proven to be both mobile and persistent in groundwater, and contamination of ground water by EDB was documented in several states beginning in the early 1980s. The majority of this contamination is attributed to agricultural uses of EDB; however, ~90% of the EDB produced was used as a leaded gasoline additive and it was present in virtually all leaded gasoline sold in the United States. 1,2-DCA is commonly found as a groundwater contaminant, and it is both mobile and persistent. Past investigations and remediation efforts at sites contaminated by leaded gasoline have rarely addressed the potential for EDB or 1,2-DCA contamination. For this reason, there is a substantial likelihood that undetected EDB and 1,2-DCA plumes above the MCL may exist at many sites where leaded gasoline leaked or spilled.”*

Comment 5.2: The Tech. Just.-GPL states that the peer-reviewed study by Shih *et al.* (2004) of plume lengths at 500 underground storage tank (UST) sites in the Los Angeles area is widely relied upon as representative of current knowledge of plume lengths at UST sites in California. Based on our review of Shih *et al.* (2004), it is recommended that tertiary butyl alcohol (TBA) be

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<sup>1</sup> California MCLs taken from <http://www.cdph.ca.gov/certlic/drinkingwater/Documents/DWdocuments/EPAandCDPH-11-28-2008.pdf>.

Federal MCLs taken from <http://water.epa.gov/drink/contaminants/upload/mcl-2.pdf>.

<sup>2</sup> Florida has set an MCL for naphthalene at 100  $\mu\text{g/L}$  ([http://www.doh.state.fl.us/environment/community/health-advisory/HAL\\_list.pdf](http://www.doh.state.fl.us/environment/community/health-advisory/HAL_list.pdf)).

added to the listing of indicator chemicals in the Tech. Just-GPL. Shih *et al.* state because TBA has the greatest site maximum (geometric mean) concentration, "... its presence needs to be confirmed at LUFT sites so that specific cleanup strategies can be developed." The recommendation is further supported by the statement in Shih *et al.* (2004) that, with respect to plume length:

*"The results demonstrate MTBE to pose the greatest problem, followed by TBA and benzene."*

Finally, Shih *et al.* also note that little is known regarding TBA and, therefore, like MTBE, should be carefully considered, along with the other oxygenates (e.g., DIPE, ETBE, TAME) when characterizing LUFT sites:

*"Concerns about potential groundwater contamination from MTBE have led several states to consider or enact MTBE bans (Franklin et al., 2000). Unless the oxygenate requirements are removed through modification of the CAA, state- and federal-level bans of MTBE mean refiners must replace MTBE with another oxygenate. As a result, interest in the use and the environmental fate and transport of alternative oxygenates has increased significantly (Deeb et al., 2001). However, to date, the state of knowledge is still quite limited for oxygenates DIPE, ETBE, TAME, and TBA (which together make up a total of up to 8% of United States oxygenates market). There are virtually no data on the environmental behavior of these other oxygenates (Ellis, 2001), due primarily to difficulties in delineating their extent in the environment, lack of systematic analytical procedures for their determination as a group, and lack of regulatory requirement for their analysis. The extent and magnitude of oxygenate contamination (other than MTBE) in the United States remains unknown. It is imperative that the environmental impacts of alternative oxygenates be properly assessed, since limited evidence available suggests they would pose groundwater contamination threats similar to MTBE (Franklin et al., 2000), if used in similar percent by volume amounts."*

### **Studies cited to support proposed policy**

As noted above, the Tech. Just.-GPL states that the peer-reviewed study by Shih *et al.* (2004) is widely relied upon as representative of current knowledge of plume lengths at UST sites in California.

Comment 5.3: This study was published in the well-respected American Chemical Society (ACS) journal Environmental Science & Technology (ES&T). As noted above in Comment 3.1, it is recommended that Falta (2004) be considered when developing the final policy.

**Criteria (i.e., metrics on which these scenarios are based and the stated values, including plume lengths, concentrations, distances to wells/surface water bodies) for defining “low threat groundwater scenarios”**

The criteria for defining low threat groundwater scenarios include plume lengths, concentrations, distances to wells, distances to surface water bodies, and the presence or (absence) and mitigation of free product.

Comment 5.4: Regarding criteria for defining low threat groundwater scenarios, a detailed discussion is provided in Comment 5.12.

**Basis of biodegradation rates**

The draft policy does not refer to specific biodegradation rates. Biodegradation is recognized in the draft policy as an attenuation process that limits migration of indicator chemicals (*i.e.*, plume lengths).

Comment 5.5: See Comment 5.10 for comments regarding plume lengths.

Comment 5.6: It is recommended that the paragraph regarding silica gel cleanup be revised. The rationale for the recommendation is provided below and followed by a revised, recommended version of the paragraph associated with SGC.

The rationale for our recommended revision is as follows:

- EPA method 8015 is a non-specific method. The detector being used, a flame ionization detector (FID), cannot differentiate one hydrocarbon from another. The draft policy implies that this method can differentiate between polar and nonpolar hydrocarbons if SGC is used. This is not the case. The 8015 cannot differentiate between any compound whether it is cleaned up or not. The use of a Mass Spectrometer type method (such as EPA 8260 or 8270) will differentiate between different hydrocarbon types and should be used for this purpose.
- All compounds that contain carbon and hydrogen in their structures are hydrocarbons. The draft policy implies that polar hydrocarbons are not hydrocarbons at all, which is clearly not the case.

- Polar hydrocarbons have higher water solubilities than non-polar hydrocarbons of the same carbon number. The original statement implies that polar hydrocarbons are not dissolved hydrocarbons. This is not true.
- SGC will remove many dissolved phase hydrocarbons but they remove the polar hydrocarbons not the nonpolar compounds.

It is suggested that the SGC paragraph be rewritten as follows:

*“For groundwater samples analyzed for TPHd for comparison to Water Quality Objectives (WQOs), a silica gel cleanup (SGC) should be included for the following reasons: it is well known that the TPHd analysis by EPA method 8015 is used to identify and quantitate different classes of hydrocarbon mixtures. Weathered TPHd can include polar as well as non-polar hydrocarbons. SGC cleanup is used in conjunction with the 8015 method to remove polar hydrocarbons from the mixture. The 8015 method is a non-selective method and cannot identify individual hydrocarbon compounds to determine whether they are polar or nonpolar hydrocarbons. EPA method 8270 should be used for this purpose. In addition to the non-polar hydrocarbons present in TPHd in a water sample, various other polar hydrocarbons sources can be present (e.g. Zemo and Foote 2003). These polar hydrocarbons can be present in TPHd as the result of metabolites from biodegradation of petroleum (primarily organic alcohols and acids, with possibility of phenols, aldehydes and ketones). At sites with biodegrading petroleum hydrocarbons, the majority of the organics being measured in groundwater samples as “TPHd” without SGC can be polar hydrocarbons. The polar hydrocarbons will tend to have higher solubility (dissolved phase) in ground water samples and will dominate. WQOs for diesel range petroleum hydrocarbons for health risk or taste and odor concerns are based on the properties of dissolved non-polar hydrocarbons originally present in the refined fuel and not the polar hydrocarbons present due to oxidative biodegradation. For example, the health-based ESL for TPHd is based on the assumption that 100% of the TPH has a toxicity equivalent to the C11 to C22 aromatics, and the taste and odor value for TPHd is based on the dissolved phase of fresh diesel/kerosene (which would be primarily the C14 and smaller aromatics) (SFRWQCB 2008). The San Francisco Bay RWQCB recognized that reported TPHd concentrations may include polar compounds and issued a guidance memorandum recommending that SGC be routinely used so that “...decisions could be made based on*

*analytical data that represents dissolved petroleum.” (SFRWQCB 1999). Only the nonpolar hydrocarbon component of TPHd should be compared to the TPHd WQOs, and thus SGC is necessary to separate the nonpolar hydrocarbons from the polar hydrocarbons in a groundwater sample prior to analysis. It has been well established that a properly performed SGC cleanup will not remove non-polar hydrocarbons from the sample. (e.g. Lundegard and Sweeney 2004). Further, the removal of polar hydrocarbons by SGC cleanup is always monitored by certified laboratories as part of routine laboratory quality assurance reporting. All approved EPA Gas Chromatography methods used for TPHd analyses utilize a hydrocarbon surrogate standard that is spiked into every sample prior to extraction and cleanup procedures (such as SGC). This surrogate standard concentration is measured during the analysis of TPHd with recoveries of these surrogates required to be maintained within acceptable ranges.”*

### **Proposals regarding free product**

Comment 5.7: The free product criteria/conditions for defining low threat groundwater scenarios requires further definition. An additional discussion of free product is provided in Comment 3.14.

### **Confirmation that the potential capture zone(s)/wellhead protection area(s) is/are not greater than the “Service Area of Public Water System”**

The policy refers to “Service Area of Public Water System” and states that the draft policy is protective of water supply wells. Specifically, the draft policy states:

*“This policy is protective of existing water supply wells. New water supply wells are unlikely to be installed in the shallow groundwater near former UST release sites. However, it is difficult to predict, on a statewide basis, where new wells will be installed, particularly in rural areas that are undergoing new development. This policy is limited to areas with available public drinking water supplies to reduce the likelihood that new wells in developing areas will be inadvertently impacted by residual petroleum in groundwater. Case closure outside of areas with a public water supply should be evaluated based upon this policy and a site specific evaluation of developing water supplies in the area.”*

Comment 5.8: It is unclear whether “service area of public water system” is synonymous with “wellhead protection area” (WHPA). It is recommended that the policy provide a definition of “service area of public water system” and, if not synonymous with WHPA, it is recommended that “service area of public water system” be combined with the concept of “wellhead protection area” (WHPA) in the policy. This will minimize or eliminate the potential that the area considered in a case submitted for closure under the proposed policy is underestimated.

The federal Safe Drinking Water Act (SDWA), as amended in 1986 (USEPA, 1991), established a program for the States to delineate and manage Wellhead Protection Areas WHPAs for protection of groundwater supplies from contamination. Subsection 1428(e) of the Safe Drinking Water Act Amendments of 1986 identify a WHPA as: “the surface and subsurface area surrounding a well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field.” According to the USEPA, the use of WHPAs has been implemented in several states, including all six New England states.<sup>[3]</sup> A preliminary internet search showed WHPA guidance is available on-line for Wisconsin<sup>[4]</sup>, New Jersey<sup>[5]</sup>, Minnesota<sup>[6]</sup>, Massachusetts<sup>[7]</sup>, Michigan<sup>[8]</sup>, Indiana<sup>[9]</sup>, Florida<sup>[10]</sup>, Wyoming<sup>[11]</sup>, New Hampshire<sup>[12]</sup>, Kentucky<sup>[13]</sup>, Washington<sup>[14]</sup>, and likely other states. That is, depending on pumping rate(s), a well/wellfield may capture (pump) contaminated groundwater if the plume/plumes is/are sufficiently close to the pumping well/wellfield.

### **The manner in which “plume stability” and plume extent” are quantified**

One of the criteria listed in the draft policy is that the plume be stable (*i.e.*, concentrations are stable or decreasing within the plume and the plume is not expanding or decreasing in size).

Comment 5.9: See Comment 5.11 and Comment 5.12 for comments regarding methodology to determine plume stability and plume extent. The criteria listed in the draft policy are also provided in Comment 5.13.

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<sup>3</sup> [http://www.epa.gov/region1/eco/drinkwater/pc\\_wellhead\\_protection.html](http://www.epa.gov/region1/eco/drinkwater/pc_wellhead_protection.html).

<sup>4</sup> <http://dnr.wi.gov/org/water/dwg/gw/pubs/delineation.pdf> and <http://dnr.wi.gov/org/water/dwg/wellhead.htm>.

<sup>5</sup> <http://www.state.nj.us/dep/njgs/whpaguide.pdf>.

<sup>6</sup> <http://www.health.state.mn.us/divs/eh/water/swp/whp/index.htm>.

<sup>7</sup> <http://www.mass.gov/mgis/ziis.htm>.

<sup>8</sup> [http://www.michigan.gov/deq/0,1607,7-135-3313\\_3675\\_3695---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695---,00.html).

<sup>9</sup> <http://www.in.gov/idem/4289.htm>.

<sup>10</sup> <http://www.dep.state.fl.us/water/groundwater/wellhead.htm>.

<sup>11</sup> <http://www.wrds.uwyo.edu/wrds/deq/whp/whpsect2.html>.

<sup>12</sup> <http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-12-2.pdf>.

<sup>13</sup> <http://water.ky.gov/groundwater/Pages/WellheadProtection.aspx>.

<sup>14</sup> [http://www.doh.wa.gov/ehp/dw/Publications/331-106\\_2-28-06.pdf](http://www.doh.wa.gov/ehp/dw/Publications/331-106_2-28-06.pdf).

### **The manner in which the amount of time required for natural attenuation to attain water quality objectives is determined**

The draft policy states that water quality objectives be attained within a “reasonable time frame”.

Comment 5.10: See Comment 5.12 for comments regarding methodology to determine time required for natural attenuation to attain water quality objectives.

### **Basis of plume concentration value (e.g., MCL or other value) used to establish plume stability and extent.**

Comment 5.11: It is recommended that the final guidance specify which concentration value is to be used to establish plume stability and extent. For example, in the case of MTBE, it is unclear if the plume extent is to be based on the secondary (more stringent) MCL of 5 µg/L or 1000 µg /L.

This section provides comments to excerpts from the Tech. Just.-GPL. The excerpts are shown in italics and are followed by our comments.

#### **Excerpt 1**

*Resolution No. 92-49 does not require that the requisite level of water quality be met at the time of case closure; it specifies compliance with cleanup goals and objectives within a reasonable time frame.*

*“Water quality control plans (Basin Plans) generally establish “background” water quality as a restorative endpoint. This policy recognizes the regulatory authority of the Basin Plans but underscores the flexibility contained in Resolution 92-49.”*

*“It is a fundamental tenet of this low-threat closure policy that if the closure criteria described in this policy are satisfied at a release site, water quality objectives will be attained through natural attenuation within a reasonable time, prior to the need for use of any affected groundwater. If groundwater with a designated beneficial use is affected by an unauthorized release, to satisfy the media-specific criteria for groundwater, the contaminant plume that exceeds water quality objectives must be stable or decreasing in areal extent, and meet all of the additional characteristics of one of the five classes of sites listed below. A plume that is “stable or decreasing” is a contaminant mass*

*that has expanded to its maximum extent: the distance from the release where attenuation exceeds migration.”*

Comment 5.12: It is recommended that the final policy define “reasonable time frame” or provide guidance as to how it is to be established.

Comment 5.13: It is recommended that the final policy provide guidance regarding the methodology: (a) for establishing whether a plume has “expanded to its maximum extent”, (b) how one is to establish whether a contaminant plume is “stable or decreasing in areal extent” and (c) for establishing “where attenuation exceeds migration”.

## **Excerpt 2**

This excerpt presents the six groundwater plume cases considered by the draft policy. The first five cases involve sites where groundwater has been impacted. The last (sixth) case involves sites where groundwater has not been impacted.

*(1) a. The contaminant plume that exceeds water quality objectives is less than 100 feet in length.*

*b. There is no free product.*

*c. The nearest existing water supply well and/or surface water body is greater than 250 feet from the defined plume boundary.*

*(2) a. The contaminant plume that exceeds water quality objectives is less than 250 feet in length.*

*b. The nearest existing water supply well and/or surface water body is greater than 1000 feet from the defined plume boundary.*

*c. The dissolved concentration of benzene is less than 3000 µg/L and the dissolved concentration of MTBE is less than 1000 µg/L.*

*(3) a. The contaminant plume that exceeds water quality objectives is less than 250 feet in length.*

*b. Free product may be present below the site but does not extend off-site.*

*c. The plume has been stable or decreasing for a minimum of five years.*

*d. The nearest existing water supply well and/or surface water body is greater than 1000 feet from the defined plume boundary.*

*e. The property owner is willing to accept a deed restriction if the regulatory agency requires a deed restriction as a condition of closure.*

*(4) a. The contaminant plume that exceeds water quality objectives is less than 1000 feet in length.*

*b. The nearest existing water supply well and/or surface water body is greater than 1000 feet from the defined plume boundary.*

*c. The dissolved concentration of benzene is less than 1000 µg/L and the dissolved concentration of MTBE is less than 1000 µg/L.*

*(5) a. An analysis of site specific conditions determines that the site under current and reasonably anticipated near-term future scenarios poses a low threat to human health and safety and to the environment and water quality objectives will be achieved within a reasonable time frame.*

*(6) Sites with Releases That Have Not Affected Groundwater - Sites with soil that does not contain sufficient mobile constituents (leachate, vapors, or LNAPL) to cause groundwater to exceed the groundwater criteria in this policy shall be considered low-threat sites for the groundwater medium. Provided the general criteria and criteria for other media are also met, those sites are eligible for case closure. For older releases, the absence of current groundwater impact is often a good indication that residual concentrations present in the soil are not a source for groundwater pollution.*

Comment 5.14: Regarding Case 1: It is recommended that the phrase “there is no free product present” be removed and “General Criteria – Item d” should read “there is no free product present or free product has been removed to the extent practical”.<sup>[15]</sup>

Comment 5.15: Regarding Case 2: A benzene plume at 1000 µg/L and 250 feet in length is highly unusual when considered in light of Shih *et al.* (2004) and, as such, should require additional characterization at a minimum and likely remediation. It is recommended that such a plume not be considered for closure as set forth in the final policy.

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<sup>15</sup> The “General Criteria” set forth in the draft policy are: (a) *The unauthorized release is located within the service area of a public water system;* (b) *The unauthorized release consists only of petroleum;* (c) *The unauthorized (“primary”) release from the UST system has been stopped;* (d) *Free product has been removed to the maximum extent practicable;* (e) *A conceptual site model has been developed;* (f) *Secondary source removal has been addressed and* (g) *Soil or groundwater has been tested for MTBE and results reported in accordance with Health and Safety Code section 25296.15.*

Comment 5.16: Regarding Case 4: A benzene plume at 1000 µg /L and 1000 feet in length is highly unusual when considered in light of Shih *et al.* (2004) and, as such, should require additional characterization at a minimum and likely, remediation. It is recommended that such a plume not be considered for closure as set forth in the final policy. Also, it is not clear whether free product is permissible in this case.

Comment 5.17: Regarding Case 5: Under current guidance, human health risk assessment guidance requires that future scenarios consider exposure 30 years and 25 years into the future for residential and commercial/industrial exposure scenarios, respectively. It is therefore recommended that the final policy define the time frame associated with “reasonably anticipated near-term future scenarios”.

Comment 5.18: The SWRCB has developed this draft policy in an attempt to inject reason into the manner in which sites are characterized, remediated, and closed. Case 5 and Case 6 capture the essence of what the draft policy is attempting to promulgate. However, the other four cases are unnecessary and presenting them confuses the characterization/remediation/closure process.

## **6.0 Technical Justification for Low Threat Closure Scenarios for Petroleum Vapor Intrusion Pathway (Tech. Just.-PVIP) (SWRCB Low-Threat UST Closure Policy Task Force, 2011d)**

The draft policy for the petroleum vapor intrusion pathway addresses four contaminant source scenarios as follows:

- Scenario 1: Unweathered LNAPL on groundwater overlain by a minimum 30-foot-thick vertical source/building separation (exclusion) distance for unweathered (residual or free-phase) LNAPL on groundwater containing less than 100 milligrams per kilogram (mg/kg) of total petroleum hydrocarbons (TPH)<sup>[16]</sup>;
  - Scenario 2: Unweathered LNAPL in soil with at least a 30 foot lateral and vertical separation (exclusion) distance between a building foundation and an unweathered LNAPL (residual or free-phase) source in soil containing less than 100 mg/kg TPH;
  - Scenario 3: Dissolved phase benzene concentration in groundwater with: 5 foot vertical separation distance between a dissolved-phase source < 100 ug/L benzene and a building foundation (no oxygen [O<sub>2</sub>] measurement) containing less than 100 mg/kg TPH in soil; 10 foot vertical exclusion distance for a dissolved-phase source <1,000 ug/L benzene (no
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O<sub>2</sub> measurement) containing less than 100 mg/kg TPH in soil; 5 foot vertical separation distance between a dissolved-phase source <1,000 ug/L and a building foundation (measured O<sub>2</sub> in soil gas  $\geq$ 4%) containing less than 100 mg/kg in soil; and

- Scenario 4: Direct measurement of soil gas concentrations: application of an additional attenuation factor of 1000x to risk-based soil-gas criteria (*i.e.*, vapor sources) located 5 feet from a building foundation containing less than 100 mg/kg TPH in soil.

Petroleum release sites shall satisfy the criteria for petroleum vapor intrusion to indoor air and be considered low-threat for the vapor intrusion-to-indoor-air pathway if:

- a. Site-specific conditions at the release site satisfy all of the characteristics and screening criteria of Scenarios 1 through 3 as applicable, *or* all of the characteristics and screening criteria of Scenario 4 as applicable; or

A site-specific risk assessment for the vapor intrusion pathway is conducted and demonstrates that human health is protected to the satisfaction of the regulatory agency.

### **Selection of indicator chemicals (for model parameters and for risk characterization)**

Comment 6.1: It is recommended that additional indicator constituents of gasoline releases and diesel releases be considered in a site-specific manner. For example, for leaded gasoline releases, carcinogenic constituents may include 1,2-dichloroethane (1,2-DCA) and ethylene dibromide (EDB). For diesel releases, naphthalene should be considered for Scenarios 1 through 3, in addition to Scenario 4. Consideration of additional indicator constituents is consistent with the characterization of cumulative risk consistent with the recently finalized CalEPA Vapor Intrusion Guidance (CalEPA, 2011).

1,2-DCA and EDB both have lower MCLs than benzene (1  $\mu$ g/L) and MTBE (13  $\mu$ g/L [primary MCL] and 5  $\mu$ g/L [secondary MCL]) and, as such, can be considered to be more toxic than these two proposed indicator chemicals. Falta (2004) notes:

*“EDB has proven to be both mobile and persistent in groundwater, and contamination of ground water by EDB was documented in several states beginning in the early 1980s. The majority of this contamination is attributed to agricultural uses of EDB; however, ~90% of the EDB produced was used as a leaded gasoline additive and it was present in virtually all leaded gasoline sold in the United States. 1,2-DCA is commonly found as a groundwater contaminant, and it is both mobile*

*and persistent. Past investigations and remediation efforts at sites contaminated by leaded gasoline have rarely addressed the potential for EDB or 1,2-DCA contamination. For this reason, there is a substantial likelihood that undetected EDB and 1,2-DCA plumes above the MCL may exist at many sites where leaded gasoline leaked or spilled.”*

### **Consistency with current USEPA and CalEPA guidance**

The indicator chemicals and media of concern selected for the vapor intrusion pathway are as follows:

- Scenario 1: Unweathered LNAPL on groundwater
- Scenario 2: LNAPL in soil
- Scenario 3: Dissolved phase benzene concentrations in groundwater
- Scenario 4: Direct measurement of soil gas concentrations.

Comment 6.2: By relying on concentrations in a single medium, the proposed approach is inconsistent with the multimedia approach set forth in the final CalEPA guidance (CalEPA, 2011), which states:

*“Multiple lines of evidence, such as soil gas, soil matrix and groundwater data, should be used.”*

Comment 6.3: With the exception of Scenario 4, the media of concern are inconsistent with CalEPA guidance (CalEPA, 2005), which exclusively lists soil gas (and indoor air) risk-based concentrations for the vapor intrusion pathway for volatile organic compounds (VOCs) (*e.g.*, benzene). That is, this guidance does not list risk-based soil or groundwater concentrations for VOCs.

Comment 6.4: The draft policy is inconsistent with USEPA guidance (USEPA, 1989) and CalEPA guidance (CalEPA, 2011) in that all detected compounds (*i.e.*, as opposed to only TPH and LNAPL in soil and groundwater, only benzene in groundwater, or only benzene and naphthalene in soil gas) should be considered when evaluating the risk associated with a given site.

## **Basis and use of “Rules of Thumb” (e.g., presence of LNAPL; weathered versus unweathered)**

The draft policy sets forth “rules of thumb” regarding the presence and nature of LNAPL. Characterizing LNAPL is necessary for Scenarios 1 and 2.

Direct evidence for the presence of LNAPL as listed in the draft policy are:

- “current or historical evidence of LNAPL in soil (known release area) or at the water table (visible/reported in nearby groundwater monitoring wells)”

Indirect evidence for the presence of LNAPL as listed in the draft policy are:

- “hydrocarbon VOC concentrations in groundwater approaching ( $> 0.2$ ) effective solubilities (Bruce et al., 1991) (e.g., benzene  $> 3$  mg/L; BTEX or TPH gasoline range organics (GRO)  $> 20$  mg/L; TPH diesel range organics (DRO)  $> 5$  mg/L)”
- “total hydrocarbon VOC concentrations in soil of TPH GRO  $> 100 - 200$  mg/kg; TPH DRO  $> 10 - 50$  mg/kg (see ASTM, 2006, Alaska DEC, 2011)”
- “TPH vapor readings from a photo-ionization detector (PID) of  $> 1,000$  ppm (recent gasoline release sites),  $> 100$  ppm (recent diesel/historic gasoline release sites), and  $> 10$  ppm (historic diesel sites) (Alaska DEC, 2011).”

To differentiate between weathered and unweathered LNAPL, the draft policy proposes:

- “For groundwater impacted by LNAPL or where groundwater is in proximity to LNAPL, effective solubility is a key indicator for whether the LNAPL is depleted of VOCs. For example, benzene’s effective solubility is approximately 18 mg/L, if it constitutes 1% of gasoline. Therefore benzene concentrations  $< 1$  mg/L are reasonable indicators that the LNAPL is weathered (depleted of VOCs).”
- For soil sources, TPH (GRO)  $< 100$  mg/kg is a good indication that there is a small or low concentration (VOC) source.

Comment 6.5: The rules of thumb in the draft policy are consistent with generally accepted practices for identifying the presence and nature of LNAPL.

It should be noted that direct evidence requires the installation of monitoring wells properly screened across the water table to allow LNAPL (if present) to enter the well. Similarly, the first method listed as offering indirect evidence (the effective solubility approach) requires collection and analysis of groundwater samples for BTEX and TPH and/or analysis of soil samples for TPH. Differentiation between weathered and unweathered LNAPL also requires the collection and analysis of groundwater and/or soil samples.

### **Basis for the “Low-Threat Vapor Intrusion Screening Scenarios”**

Aerobic biodegradation of fuel hydrocarbons is the primary factor on which the low threat scenarios are based. The draft policy relies on modeling studies and soil gas data collected at retail, distribution, and manufacturing sites across several states, including California, for evidence that aerobic biodegradation is the primary factor affecting the vapor intrusion pathway.

Comment 6.6: The reviewer agrees with the idea that aerobic biodegradation can play a significant role in attenuating fuel hydrocarbon vapors under favorable conditions. However, it is recommended that soil gas samples collected from 5 feet and/or in close proximity to the subsurface source be used in conjunction with subslab or, in cases where no slab is present, near-surface (*e.g.*, at a depth of 1 or 2 feet) soil gas samples to establish that attenuation is indeed occurring at a given site. Leak tests and sample collection should be conducted consistent with CalEPA/LARWQCB guidance (CalEPA/LARWQCB, 2003) to ensure that high quality soil gas data are obtained. Use of site-specific soil gas data should significantly reduce uncertainty in comparison to reliance on modeling studies and non-site-specific data and is consistent with CalEPA guidance (CalEPA, 2011).

Comment 6.7: The data requirements for the four scenarios set forth in the draft policy involve collection and analysis of soil data and/or groundwater data and/or soil gas data and characterization of LNAPL and, as such, appear to be less time- and cost-effective than simply collecting soil gas samples, as is being done under current CalEPA guidance. That is, the data requirements are inconsistent with the stated goal that the draft policy “... seeks to increase UST cleanup process efficiency”.

Comment 6.8: The computer model must consider VOC concentrations that may prove toxic to microbes. This should be discussed in the guidance.

Comment 6.9: Assuming first order degradation, the rate constant assumed in the model gives a half-life of about 1 hour, which does seem high. This half-life must consider the presence of other fuel hydrocarbons (FHCs) that may be preferentially degraded over benzene. It is recommended that field-derived degradation rates be used in the model.

Comment 6.10: The policy should specify the reporting limit used to establish “full attenuation”.

Comment 6.11: It appears that Figure 5 on page 18 of the June 30, 2011 technical justification, which showed that the model is particularly sensitive to half-life (*e.g.*, a one order-of-magnitude change in rate constant yields a four order-of-magnitude change in attenuation factor), has been replaced with Figure 19 on page 9 of the revised technical justification (which also shows model results with and without biodegradation for sand and silty clay soils) The

removal of Figure 5 does not remove our concern regarding the sensitivity of the model to half-life. While this reviewer agrees with the idea biodegradation of fuel hydrocarbons (especially benzene) is significant and important to consider, the existence of a bioattenuation zone can be readily determined using 5 foot and subslab vapor probes. Such probes are relatively time- and cost-effective to install, sample, and analyze.

### **Role of subslab soil gas samples (and associated risk-based concentrations)**

Comment 6.12: As stated previously, the reviewer agrees with the idea that aerobic biodegradation can play a significant role in attenuating fuel hydrocarbon vapors under favorable conditions. However, it is recommended that soil gas samples collected from 5 feet and/or in close proximity to the subsurface source be used in conjunction with subslab or, in cases where no slab is present, near-surface (*e.g.*, at a depth of 1 or 2 feet) soil gas samples to establish that attenuation is indeed occurring at a given site. Leak tests and sample collection should be conducted consistent with DTSC/LARWQCB guidance (DTSC/LARWCB, 2003) to ensure that high quality soil gas data are obtained. Use of site-specific soil gas data should significantly reduce uncertainty in comparison to reliance on modeling studies and non-site-specific data and is consistent with CalEPA guidance.

## **7.0 Office of Environmental Health Hazard Assessment Comments on the Proposed Low-Threat UST Closure Policy, 7-14-11**

We note that these comments were made to the draft policy dated 7-14-11. As previously noted, the technical justification documents have been updated to correct many of our previous comments, as well as the comments provided by OEHHA. We are in concurrence with the OEHHA comments that were not addressed in the revised policy.

## **8.0 References Cited**

California Environmental Protection Agency (CalEPA/LARWQCB, 2003. Advisory – Active Soil Gas Investigations, January 13.  
[http://www.dtsc.ca.gov/LawsRegsPolicies/Policies/SiteCleanup/upload/SMBR\\_ADV\\_activesoilgasinvst.pdf](http://www.dtsc.ca.gov/LawsRegsPolicies/Policies/SiteCleanup/upload/SMBR_ADV_activesoilgasinvst.pdf)

CalEPA/DTSC, 1992. Supplemental Guidance for Human Health Multimedia Risk Assessment of Hazardous Waste Sites and Permitted Facilities. Department of Toxic Substances Control, October 7. Reprinted 1993, 1996.  
[http://www.dtsc.ca.gov/AssessingRisk/Supplemental\\_Guidance.cfm](http://www.dtsc.ca.gov/AssessingRisk/Supplemental_Guidance.cfm)

CalEPA/DTSC, 1994. Preliminary Endangerment Assessment Guidance Manual. Department of Toxic Substances Control, January (second printing: June, 1999).  
<http://www.dtsc.ca.gov/SiteCleanup/Brownfields/> (under Cleanup Guidance).

CalEPA/DTSC, 2005a. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air. Department of Toxic Substances Control February 2.  
[http://www.dtsc.ca.gov/AssessingRisk/upload/HERD\\_POL\\_Eval\\_Subsurface\\_Vapor\\_Intrusion\\_interim\\_final.pdf](http://www.dtsc.ca.gov/AssessingRisk/upload/HERD_POL_Eval_Subsurface_Vapor_Intrusion_interim_final.pdf)

CalEPA, 2005b. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties.  
<http://www.calepa.ca.gov/brownfields/documents/2005/CHHSLsGuide.pdf>

CalEPA/DTSC, 2011. FINAL - Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air. Department of Toxic Substances Control. October.  
[http://www.dtsc.ca.gov/AssessingRisk/upload/Final\\_VIG\\_Oct\\_2011.pdf](http://www.dtsc.ca.gov/AssessingRisk/upload/Final_VIG_Oct_2011.pdf)

CalEPA/Office of Environmental Health Hazard Assessment (OEHHA), 2012a. Chronic Reference Exposure levels. <http://www.oehha.ca.gov/air/allrels.html> CalEPA/OEHHA, 2012b. Toxicity Criteria Database, Office of Environmental Health Hazard Assessment  
[www.oehha.ca.gov/risk/chemicalDB/](http://www.oehha.ca.gov/risk/chemicalDB/)

Falta, R.W., 2004. The Potential for Ground Water Contamination by the Gasoline Lead Scavengers Ethylene Dibromide and 1,2-Dichloroethane. Ground Water Monitoring & Remediation 24, no. 3/ Summer 2004/ pages 76–87.

Deeb, R. A.; McMillan, B.; Kavanaugh, M, C., 2001. *Environmental Fate and Transport of Fuel Oxygenates*; Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Groundwater, Houston, Texas.

Ellis, P. 2001. *A Circle Vicious: what do we know about the other oxygenates?* New England Interstate Water Pollution Control Commission, L.U.S.T. LINE, Bulletin 37, March.

Franklin, P. M.; Koshland, C. P.; Lucas, D.; Sawyer, R. F. *Environ. Sci. Technol.* 2000, 34(18), 3857-3863.

Lundegard, P.D. and R.E. Sweeney, 2004. Total petroleum hydrocarbons in groundwater: Evaluation of nondissolved and nonhydrocarbon fractions. *Environmental Forensics*, Vol 5: 85-95.

Shih, T., Y. Rong, T. Harmon, and M. Suffet, 2004. Evaluation of the impact of fuel hydrocarbons and oxygenates on groundwater resources. *Environmental Science & Technology*. Vol. 38, No. 1: 42-48.

Ms. Olivia Jacobs, REA

March 19, 2012

Page 22

San Francisco Regional Water Quality Control Board (SFRWQCB), 2008. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater. Interim Final, May.

U.S. Environmental Protection Agency (USEPA), 1989. Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. <http://www.epa.gov/oswer/riskassessment/ragsa/>

USEPA. 1991. Safe Drinking Water Act as Amended by the Safe Drinking Water Act Amendments of 1986. Office of Water. June. EPA 570/B-91-041.

USEPA, 1992. Guidance for Data Usability in Risk Assessment (Part A), Final. Office of Emergency and Remedial Response, April.  
<http://www.epa.gov/oswer/riskassessment/datause/parta.htm>

USEPA, 1996. Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response, May.  
<http://www.epa.gov/superfund/health/conmedia/soil/index.htm>

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, December.  
<http://www.epa.gov/superfund/health/conmedia/soil/index.htm>

USEPA, 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. Office of Superfund Remediation and Technology Innovation.  
<http://www.epa.gov/oswer/riskassessment/ragse/>

Zemo, D.A. and G.R. Foote, 2003. The technical case for eliminating the use of the TPH analysis in assessing and regulating dissolved petroleum hydrocarbons in ground water. Ground Water Monitoring & Remediation, Vol. 23, No. 3: 95-104.