Memorandum

July 16, 2026

To:	J.R. Giska and Apollonia Goeckner, Oregon Department of Environmental Quality; Holly Dixon, PhD, Oregon Health Authority
From:	Deborah Proctor, Chad Thompson, and Camarie Perry, ToxStrategies
Subject:	Technical Comments Following Risk Advisory Committee (RAC) Meetings 2 and 3, and Remarks on the OHA May 2026 Responses to ToxStrategies October 2025 Comment Memos

Oregon Business and Industry (OBI) and ToxStrategies appreciate Oregon Health Authority (OHA)'s response to the October 14, 2025, Technical Memorandum regarding the toxicity reference values (TRVs) for several chemicals of importance to Oregon stakeholders in the regulated community. Herein we provide responses to OHA, as well as additional comments for urgent consideration regarding the current rulemaking.

General Comments

1) Oregon Department of Environmental Quality (ODEQ) and OHA (collectively referred to as ODEQ/OHA throughout these comments), in consultation with Air Toxics Scientific Advisory Committee (ATSAC) as an authoritative source, should conduct further and rigorous reviews of the TRVs for nickel, lead, phosgene and arsenic,[1] hydrogen chloride, and naphthalene. The alternative TRVs for these chemicals have been discussed in earlier comments,[2] and additional comments are presented herein. These are chemicals of high priority to Oregon stakeholders and should be addressed during the current rulemaking. Comments in these documents describe new scientific studies and robust risk assessment methods, including acute values that are more consistent with ODEQ's definition of "acute." Additionally, the relatively simple update of TRVs to include the regionally deposited gas ratio (RDGR) for extrathoracic (ET) respiratory effects, consistent with current United States (U.S.) Environmental Protection Agency (EPA) guidance (EPA, 2012), should be included for all relevant TRVs, including those for hydrogen chloride (chronic non-cancer) and naphthalene (acute). In OHA's response to our October 2025 comments regarding amorphous silica

[1] ToxStrategies recently prepared comments regarding the RBCs, MPAFs, and TRVs for arsenic which are discussed briefly in the chemical-specific comment section here, and in detail in Attachment A.

[2] Earlier comments were included in OBI letters dated October 14, 2025 (OBI, 2025), and March 26, 2026 (OBI, 2026).

(a-silica), OHA (2026) stated that it is "open to developing TRVs for specific forms of amorphous silica if the necessary scientific data becomes available in the future" (p. 17). We appreciate that OHA is open to developing new TRVs for a-silica should new data become available, and request that ODEQ/OHA also be open to developing new TRVs for nickel, lead, phosgene, and arsenic, because the scientific data are currently available to improve upon the proposed and/or current TRVs, and OBI requests that ODEQ/OHA, in consultation with ATSAC, conduct reviews for these chemistries with the current rulemaking.

2) ODEQ/OHA, in consultation with ATSAC, should reconsider and withdraw the chronic noncancer TRVs for a-silica and PFAS as none of the third-party sources recognized in ODEQ's rules as authoritative (EPA; Agency for Toxic Substances and Disease Registry [ATSDR]; or California's Office of Environmental Health Hazard Assessment [OEHHA]) have published inhalation values for these toxic air contaminants (TACs). These TACs have been studied extensively, and following those reviews, the authoritative sources listed above concluded that the available data were insufficient to set inhalation criteria. Specifically, ATSDR concluded that a-silica in ambient air does not pose a hazard at ambient exposures (ATSDR, 2020), and EPA purposely selected not to set reference concentrations (RfCs) for several PFAS. Additional information is provided in the chemical-specific comments sections for a-silica and PFAS below.

3) We recognize that ODEQ/OHA have finite resources to thoroughly review and address the comments offered. **Table 1** provides a summary of the current requests for review and their status since the OHA response issued May 1, 2026 (OHA, 2026).[3] Because these chemicals and TRVs will be used in on-going and future CAO assessments, ODEQ/OHA should consider removing them from the current rulemaking to allow for the necessary thorough review process, engaging ATSAC, similar to the reviews that were conducted for manganese, diesel particulate matter (DPM), and 1-methylnaphthalene.

4) ODEQ/OHA should reevaluate acute TRVs developed from intermediate toxicity criteria because certain health effects that occur upon intermediate exposure are not relevant to 24-hour exposure, and in these cases, use of intermediate minimum risk levels (MRLs) as acute TRVs is not appropriate. For example, the trivalent chromium [Cr(III)] acute TRVs were initially set to be equal to ATSDR's intermediate MRLs. On further review of the underlying study used by ATSDR, OHA changed the Cr(III) TRVs (OHA, 2026). The observations gleaned from these corrections should be used to assess the applicability of all acute TRVs developed from intermediate MRLs because (1) some adverse effects, such as those related to insoluble particle lung

[3] OHA commented that ToxStrategies' comments in October 2025 included several options to address requested TRV comments and that some were internally inconsistent. As we prepared the comments to TRVs released prior to the TRV Support Document in 2026, it was unclear how ODEQ/OHA would receive and respond to comments. We prepared comments specific to the issues relevant to individual chemicals, which might have seemed inconsistent but were based on the chemical-specific data available. We appreciate that OHA responded to our comments.

overload, cannot reasonably be assumed to occur from 24-hour exposures, and (2) points of departure (PODs) for shorter term exposures may be available that are more relevant to Oregon's definition of acute (24 hours) that are not relevant to ATSDR's intermediate MRLs. Thus, similar to the Harber's Law exemption for sensory irritants, subchronic exposures should not be used to set acute TRVs without considering the scientific underpinnings of the POD used for the intermediate MRLs and the availability of more relevant scientific literature and/or other authoritative reviews (e.g., ATSDR Toxicological Profiles).

5) We understand that the tolerance for uncertainty is based on internal policy and decisions; however, regulatory agencies typically apply different tolerances for uncertainty for values that are developed as "guidance" than for values that are unchangeable "rules" or legally binding "standards." TRVs are inflexible standards that cannot be modified to make site-specific risk management decisions in the CAO program, and there is limited opportunity for the stakeholders to evaluate or propose alternative TRVs. Thus, the current rulemaking is an important opportunity to ensure that TRVs are protective of human health and have a robust scientific basis. This process is unlike that for the toxicity criteria developed by the authoritative sources, including EPA toxicity criteria (i.e., Provisional-Peer-Reviewed Toxicity Values (PPRTVs), and reference concentrations (RfCs), OEHHA Reference Exposure Levels (RELs), and ATSDR MRLs, which are all "guidance" values used by risk managers to make risk management decisions. The expectations for scientific certainty, transparency, and rigor should be higher when the outcome is a standard.

   OHA/ODEQ suggested hundreds of proposed TRVs for 377 TACs without adequate time for stakeholders to truly consider these values. Our earlier comments were limited to 11 chemicals (or chemical groups) of high priority to Oregon businesses, and, as an outcome of that review, OHA revised seven of the 11 in May 2026, and also revised TRVs for two additional chemicals for which the same comments applied. This draws into question whether rigorous review of the other TRVs also would result in additional revisions that would be based on the best available science.

6) ODEQ/OHA commented that the "DEQ does not support the use of in vitro bioaccessibility (IVBA) study results to develop [relative bioavailability] RBA values." (OHA, 2026, p. 25). This comment was discussed during office hours, and we concur that use of IVBA for determining the solubility of metals, in applications of TRVs would be problematic, and that water solubility is a reasonable alternative. During office hours, the applicability of IVBA data, *in lieu* of using animal bioassays, for the conservative estimation of RBA in Level 4 risk, was affirmed as preferable. ODEQ should allow for use of inhalation IVBA data as a conservative measure of RBA in the construct of a Level 4 risk assessment.

   OHA (2026) cited the conclusions of Kastury et al. (2017) as a reason for limiting applicability of IVBA. While Kastury et al. (2017) is a well-done review paper, it is dated given the advancements in new approach methods (NAMs), and application of IVBA for metals in many site- and material-specific applications. Although published in 2017, Kastury et al. did not cite the inter- and intra-laboratory IVBA validation study

by Henderson et al. (2014), conducted at five laboratories, including Oregon State. This study found good inter- and intra-reproducibility of IVBA extractions, particularly for artificial lysosomal fluid (ALF), from a wide range of metal containing test materials.

As a few critical points on the findings of Kastury et al. (2017) relative to use of IVBA for Level 4 site-specific risk assessments:

- Kastury et al. (2017) assess atmospheric particulate matter (APM) generally, comparing data from a wide variety of sources typical in ambient air, including road dust, urban dust, slag, vehicle exhaust, etc., from around the world, which is more variable than site-specific, emission-specific measures from a single facility.
- Kastury et al. (2017) recommend using *in vitro-in vivo* extrapolation (IV-IVE) techniques in cell culture. Although the authors recognize limitations with cellular cultures as well, and do not address the practical limitations for dosing metals that are insoluble in culture.
- Kastury et al. (2017) found that IVBA is a conservative measure of RBA for inhalation, and offer several points as to why use of IVBA overestimates of RBA, particularly using ALF.

Chemical Specific Comments

1) Amorphous silica (a-silica)

When authoritative sources review the same literature and reach different conclusions, ODEQ/OHA, in consultation with ATSAC, should review all the analyses in detail to understand the underlying science that forms the basis for these guidelines, including a conclusion that no guideline is required. This is the case for OHA/ODEQ's a-silica TRV.

Following OHA's response our comments (OHA, 2026), we have re-examined the Texas Commission on Environmental Quality (TCEQ) 2013 chronic reference value (ReV), the 2019 ATSDR toxicological profile, OHA's response to our comments issued May 1, and the Groth et al. (1981) animal bioassay, which is the basis of the TRV. Based on this review, rather than changing the designation, we request that ODEQ/OHA, in consultation with ATSAC, review or re-review the ATSDR 2019 toxicological profile of crystalline and amorphous silica and the TCEQ 2013 Development Support Document (DSD) and determine whether the proposed a-silica chronic noncancer TRV should be withdrawn. Of note:

- ATSDR decided not to set inhalation MRLs for any exposure time period for a-silica because the available data were insufficient to determine lowest-observed-adverse-effect levels (LOAELs) and no-observed-adverse-effect levels (NOAELs) as PODs representative of all a-silica polymorphs. There are two points here. First, the available data is insufficient to determine a dose-response relationship, and second, it is unclear if data for one form of a-silica can be used for all polymorphs.

- From the record and OHA's response to our comments, it is unclear if the ATSAC vetted ATSDR's decision regarding the appropriateness of ATSDR's conclusion, relative to the TCEQ a-silica chronic value. The examples provided in Appendix E of the Toxicity Reference Value Support Document, do not address ATSDR's conclusions. We are not questioning the science or validity of the approaches TCEQ selected, or whether a-silica should be categorized separately from crystalline silica, but we request that ODEQ/OHA carefully examine the use of TCEQ's value relative to ATSDR's conclusions.
- In May 2026, OHA responded to our comments regarding a-silica and offered ATSAC's review of the use of screening provisional peer-reviewed toxicity value (PPRTV) as evidence that ATSAC would approve use of the proposed a-silica TRV. We do not see this as relevant to the comment offered regarding a-silica, but it is evident from those comments that the ATSAC may not be aware that TRVs are implemented as inflexible rules, rather than as guidelines. The example regarding choosing TRV values for chloroethane from a 1986 study based on decades old values from OEHHA and EPA over conclusions from a 2025 ATSDR Toxicological Profile (OHA, 2016, p. 13), indicates that ODEQ/OHA will prioritize the availability of an outdated TRV value over consideration of the best available science, even when it comes from an authoritative source.
- Further, in its May 2026 response, OHA bolded the text from one ATSAC member stating, **"In my opinion, not having a value as a guide is considerably more uncertain in evaluating potential risk"** (emphasis not added, OHA, 2026, p. 14). The relevant point here is that TRVs are not 'guides.' Rather, they are inflexible 'standards.' Thus, in situations in which authoritative sources have differing opinions about a TRV of significance to the regulated community undergoing CAO reviews, the proposed TRVs and the associated science should be thoroughly vetted by ODEQ/OHA, in consultation with ATSAC.
- OHA notes that "ATSDR and TCEQ describe animal studies in which a-silica harmed health, and OHA agrees with ATSAC that it is better to protect health from known hazards with a TRV even though there is uncertainty about the degree to which one form of a-silica is representative of others in terms of quantitative toxicity" (OHA, 2026, p. 15). However, toxicity is dose-dependent and given the very high administered doses of insoluble a-silica particles (up to 15,000 $\mu g/m^3$), to which monkeys were chronically exposed for 18 months in the Groth et al. (1981) study, harm to health is anticipated due to the build up of particles in the lung. Whether that observation is relevant at background exposure levels was considered by ATSDR, and they concluded that there was no hazard.

ATSDR stated that there is no hazard at background environmental exposures to a-silica, which range from <2 to 135 $\mu g/m^3$ (ATSDR, 2019, 2020). By comparison, the chronic TRV is 6.6 $\mu g/m^3$, at the lower bound of background.

- As ATSDR noted, the toxicological data for a-silica are limited. The study used by TCEQ exposed monkeys, rats, and guinea pigs to one dose each of the three different synthetic a-silica (SAS) types tested (one dose per SAS form), but the

doses were not the same by SAS type (Groth et al., 1981).[4] For monkeys, the most severe effects were shown at 15,000 µg/m^3 for an 18-month exposure in Macaque monkeys, which was the basis of the POD even though lesser effects were observed at doses of 6,900 µg/m^3 and 9,000 µg/m^3 for 18 months in Cynomolgus monkeys, for the other two SAS forms studied in Groth et al. (1981). The responses observed are likely to be irrelevant at lower background exposures.

- Groth et al. (1981) also noted that rats exposed to 6,900 and 9,900 µg/m^3 did not show effects, but rats exposed to 10,900 µg/m^3 did. Similar to the monkey data, these data were not in the same rat species.[5]
- Given these data, ODEQ/OHA should reconsider setting a TRV for a-silica, and if necessary in consultation with ATSAC, should carefully vet the decision to set a TRV for a-silica in light of the available data. It is unclear that the Groth et al. (1981) animal bioassay data for SAS forms is representative of the potential toxicity associated with all polymorphs of a-silica, including particles of different sizes.
- OHA stated in its May 2026 response that "emission around the state indicate need for a TRV to evaluate risk to health" (OHA, 2026, p. 15). As such, relevant follow-up questions are (1) how were emissions data used to determine which chemicals need TRVs, (2) how were those determinations made, (3) for a-silica, are these emissions specific to the SAS form used as the basis for the TRV, and (4) do monitoring levels indicate exposures above background for a-silica?

2) Arsenic

ToxStrategies has prepared comments regarding the arsenic carcinogenic and acute TRVs, the proposed Multipathway Assessment Factors (MPAFs), and proposed Risk-Based Concentrations (RBCs), which are included in **Attachment A**. In summary, ODEQ/OHA, in consultation with ATSAC, should review and revise the TRVs to be consistent with the recent and more rigorous TCEQ risk assessments for acute 24-hour exposures and cancer (TCEQ, 2012, 2021). These changes would result in a cancer TRV of 0.0067 µg/m^3 and an acute 24-hour TRV of 5.4 µg/m^3. In addition, applying MPAFs to arsenic TRVs is unwarranted because, based on the currently proposed adjustments to the arsenic MPAF calculations, the predicted soil concentration associated with deposition of particles containing arsenic is well below and indistinguishable from naturally occurring background levels of arsenic in Oregon soil. Deposition of arsenic at levels protective of

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[4] OHA (2026, p. 16) states that all three forms of a-silica tested caused effects "at the same dose," but that is incorrect (ATSDR, 2019). The doses tested were not the same for each form of SAS tested. Only one dose was tested for each form, but it was not the same concentration for each. The lowest LOAEL reported by ATSDR from this study is 6.9 mg/m^3 for pyrogenic silica, but the effects were mild compared to those from precipitated silica tested only at 15 mg/m^3. TCEQ selected 15 mg/m^3 as the POD.

[5] OHA correctly noted that in our October 2025 comments, we confused the rat and monkey data in the Groth et al. (1981) study. Effects were observed for all three forms of SAS among the monkey species tested.

inhalation exposure does not present a health risk greater than background. Please see **Attachment A** for a detailed discussion.

3) Hydrogen chloride (HCl) (chronic noncancer) and Naphthalene (acute)

ODEQ/OHA, in consultation with ATSAC if necessary, should apply EPA's more current Regional Gas Dose Ratio (RGDR) guidance (EPA, 2012) when setting TRVs for HCl, naphthalene, and other gases where the TRV is based on extrathoracic (ET) respiratory effects. EPA has made it clear that the older 1994 RfC guidance (EPA, 1994) has been superseded by new guidance, entitled *Advances in Inhalation Gas Dosimetry for Derivation of a Reference Concentration (RfC) and Use In Risk Assessment* (EPA 2012, https://assessments.epa.gov/risk/document/&deid%3D244650).



The EPA's stated Impact/Purpose for the 2012 update says, "This report was written to evaluate the state of the science and advances in gas dosimetry that have occurred since the publication of the 1994 RfC Methods. In addition, the state of the science considering children's inhalation dosimetry is also addressed. It was also written in response to concerns and questions about the methods that NCEA has received from external peer reviewers of IRIS documents, and other client program offices as well as regional and state agencies." (EPA website, last updated December 14, 2012, accessed July 12, 2026).

In its May 2026 response (OHA, 2026), OHA stated that the policy is not to change parameters used to set TRVs, except the exposure time adjustment. OHA also indicated it would wait for an authoritative source to revise its value. Although it is unclear why ATSDR (2025) did not use the updated guidance when the MRL for naphthalene was set, it is clearly the most current EPA guidance on the matter, as evidenced by the fact that EPA used it for the IRIS assessment of formaldehyde (EPA, 2024a). Setting TRVs now using outdated scientific methods is inappropriate given that EPA has updated and improved its old 1994 guidance, and has recently used it. As reiterated earlier, EPA RfCs and ATSDR MRLs are guidance values, and site-specific risk assessment and risk management

decisions can be used to modify chemical-specific toxicity values for risk assessment in situations where newer guidance exists. Because TRVs are inflexible standards, OHA/ODEQ, in consultation with ATSAC if necessary, should use the EPA's most current guidance regarding inhalation gas dosimetry and revise the RDGR values for ET effects.

Recommended TRVs for HCl and naphthalene are provided in **Table 1**. Note that we understand OHA's position regarding not updating the benchmark dose modeling for naphthalene (OHA, 2026) but continue to request that ODEQ/OHA include the most recent EPA (2012) values. Correcting the RDGR results in an acute TRV for naphthalene of 0.75 $\mu g/m^3$.

4) Lead

ODEQ/OHA, in consultation with ATSAC and the EPA lead Technical Review Workgroup (TRW), should investigate the modeling approach that ToxStrategies performed to calculate a 24-hour acute TRV for lead of 3.9 $\mu g/m^3$. OHA's response to our request to use the EPA 2025 All Ages Lead Model (AALM) (EPA, 2025b) is similar to that for nickel in that, according to OHA, "it would mean reviewing and potentially performing primary research to validate [ToxStrategies'] proposed, novel approach." OHA also stated that "OHA is not aware of any government regulatory agency that has adopted ToxStrategies' approach." However, no authoritative source has adopted ODEQ's current approach of applying a 3-month average as representative for 24-hour exposures. Moreover, the approach we proposed is based on the current, but only recently available, 2025 version of the AALM. Applying the 3-month average National Ambient Air Quality Standards (NAAQS) as a 24-hour standard today is not appropriate, because AALM, which was developed by an authoritative source, allows for modeling time periods as short as 24 hours.

We also suggest that ODEQ/OHA invite EPA's lead TRW to participate with ATSAC and advise ODEQ/OHA on this proposal because ToxStrategies has already presented this work to the TWG and received positive feedback. In summary and with an update since our SOT presentation (Price et al., 2026; attached to the OBI, 2026, comments):

- We used AALM to model 24-hour exposures to predict an acute TRV for lead for 24-hour exposures, associated with a predicted 1 µg/dL increase in blood lead level (BLL), which is the guideline developed by OEHHA (OEHHA, 2007), another authoritative source, to protect children. OEHHA's guideline is for chronic exposures, so application of a 1 µg/dL increase for acute exposures is additionally conservative.
- We presented the analysis at the Society of Toxicology (SOT) conference and as a result, were invited to present the study to the EPA lead TWG, which developed the AALM. We received encouraging feedback both at SOT from scientists and other state toxicologists attending the meeting as well as from the TRW.
- The EPA lead TRW were interested in alternative uses of AALM and also had several recommendations for refining the modeling methods.

- Refinements to the modeling work are ongoing, but it demonstrates the model's utility for estimating results down to a single day's exposure, while accounting for background exposures and assessing sensitive life stages.
- EPA has no requirement for a 24-hour standard, nor does ATSDR or OEHHA, so it is not reasonable to expect that these authoritative sources will develop such a value. TCEQ develops 24-hour toxicity criteria, but implements the 3-month average NAAQS rather than setting a guideline for 24-hour exposures.
- This approach allows for consistency with OEHHA's target increase in BLL of 1 µg/dL, and also allows for assurance that BLLs are maintained below the Centers for Disease Control and Prevention's (CDC's) BLL Reference Value of 3.5 µg/dL (CDC, 2021)

5) Nickel (acute non-cancer)

ODEQ/OHA, in consultation with ATSAC, should review the Buxton et al. (2021) paper regarding immunological effects following 24-hour exposure to nickel and the SOT poster regarding derivation of an acute nickel TRV (Proctor et al., 2026), submitted in March 2026 by OBI (OBI, 2026). Based on this review, ODEQ/OHA should set an alternative acute nickel TRV for 24-hour exposures. OHA's May 2026 response to our request to change the acute nickel TRV (OBI, 2025) states that "there are no instances where OHA calculated a new candidate TRV from primary research studies." As outlined in earlier comments and the SOT presentation, the Buxton et al. (2021) study is ideal for setting an acute TRV because it was specifically designed for setting guidelines for 24-hour nickel exposures. Further:

- Buxton et al. (2021) is a high-quality Guideline study, conducted under good laboratory practice (GLP).
- Buxton et al. (2021) is a 24-hour continuous whole-body chamber study designed to minimize uncertainties related to the time duration adjustments, unlike the study used by ATSDR to set its acute MRL (Efremenko et al., 2017), which involved 6-hour exposures in rats for 5 consecutive days. The Efremenko et al. (2017) study is a toxicogenomics study and not ideally designed for setting 24-hour exposure guidelines.
- Toxicogenomic data from the study ATSDR selected as the basis for the acute TRV POD (Efremenko et al., 2017) demonstrates that immune effects are more sensitive for short-term exposures than respiratory effects. Further, OEHHA's acute (1-hour) REL is based on immunotoxicity.
- The Buxton et al. (2021) study provides data to calculate a dose-adjustment factor and human equivalent concentration (HEC), reducing the need for uncertainty factors.
- We request that ODEQ/OHA, in consultation ATSAC, vet the methodology and proposed TRV of 11 µg/m^3 for acute nickel exposure in a manner similar to the manganese (Mn) acute TRV, which was reviewed by ATSAC and changed based on application of a more appropriate POD. For nickel, the data from Buxton et al.

(2021) is ideal for a 24-hour acute TRV, so the methods and data for deriving such should be easier to evaluate than that for Mn.

6) Nickel (exempt in alloys)

OHA/ODEQ should specifically exempt nickel in alloy form from inclusion in the nickel TRVs. Nickel (Ni) toxicity has been well established to depend on the availability of Ni ions to interact with cellular components (Goodman et al., 2011) and Ni in alloy form does not dissolve in biological fluids, similar to cobalt and Cr(III) in alloy form. Further,

- Nickel in alloys has been exempted as carcinogenic by the National Toxicology Program (NTP, 2013).
- Significant *in vitro* data demonstrate nickel insolubility in alloys in simulated lung fluids (e.g., Heim et al., 2020; Wang, 2020; Karlsson, 2023; Suh et al., 2020).
- In a recent review of stainless steel and nickel-based alloys, Karlsson et al. (2023) concluded that this material shows low toxicity. Further, based on various aspects, such as the low release of nickel from stainless steels in artificial lysosomal fluid (ALF, a fluid representative of the potential for lysosomes to dissolve metals within cells), and the lack of nickel-induced inflammatory lung effects in a 28-day inhalation study, the study also concluded that the data "do not support nickel-related carcinogenicity of stainless steels" (Karlsson et al., 2023, p.11).

7) Per- and polyfluoroalkyl substances (PFAS)

OHA/ODEQ should rely on the EPA, ATSDR, and/or OEHHA, all of which have the technical resources necessary to set inhalation guidelines for PFAS, before applying route-to-route extrapolation from oral values. ATSDR and EPA have both performed extensive reviews of PFAS and not set inhalation guidelines. OEHHA (2024) has also reviewed PFOA and PFOS and only set oral toxicity criteria.

Route-to-route extrapolation is simply a computational equivalence to the oral toxicity value which may have no relation to the toxicity observed from oral exposure and provides no insight into any specific toxicological response via inhalation exposure. The route-to-route extrapolation is a crude approximation, which is likely why the IRIS files for PFAS do not include RfC values (examples):

> EPA (2022), PFBA: "No studies are available that examine toxicity in humans or experimental animals following inhalation exposure, and no physiologically based pharmacokinetic (PBPK) models exist to allow a route-to-route extrapolation; therefore, no inhalation reference concentration (RfC) was derived (see Section 5.2.3)."

> EPA (2023), PFHxA: "Animal studies of PFHxA exposure exclusively examined the oral exposure route, and therefore, no inhalation assessment was conducted nor was an RfC derived (see Section 5.2.2)."
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> EPA (2024b), PFDA: "No studies that examine toxicity in humans or experimental animals following inhalation exposure were available and no acceptable physiologically based pharmacokinetic (PBPK) models are available to support route-to-route extrapolation; therefore, no RfC was derived."
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> EPA (2025a), PFHxS: "Animal studies of PFHxS exposure exclusively examined the oral exposure route; therefore, no inhalation assessment was conducted nor was an inhalation reference concentration (RfC) derived (see Section 5.2.3)."

The fact that EPA has not conducted route-to-route extrapolation to derive inhalation toxicity values for any of the PFAS listed in Table 3 of the OHA memo (except for PFNA) is a clear signal that EPA believes that without inhalation-specific toxicity data or a PBPK model to conduct route-to-route extrapolation, such extrapolation-based RfCs (and thus TRVs) would not be scientifically defensible.

In May 2026, OHA made multiple changes to the proposed TRVs for PFAS, which speaks to the rapidly evolving nature of the science and changing guidelines for these chemistries, including changes to EPA oral reference doses between the first and second draft TRV proposals, and uncertainties associated with setting PFAS inhalation guidelines. ToxStrategies' comments (OBI, 2025) requested that ODEQ/OHA consider the quality and/or uncertainty associated with the studies used as the basis of the 2024 EPA RfD, highlighted by work by Wikoff et al. (2025) and Burgoon et al. (2023). OHA's response quoted Vandenberg, but the point of the quote is not clear. Stating that the studies include data on infants and children does not address questions regarding the quality of the studies or the uncertainties highlighted in the cited literature, and these statements do not diminish or address the issues raised by other experts.

The final point in OHA (2026)'s response (p. 44) is that PFAS gas emissions at landfills exceed those in the leachate. Although ODEQ/OHA did not cite any publications, based on a brief review of the literature, those emissions seem to be primarily 8:2 FTOH (De la Cruz et al., 2025), which is not a PFAS chemical for which ODEQ is proposing TRVs. So, as ODEQ/OHA is concerned about PFAS in air, TRVs should be developed for the more volatile compounds. Understanding the inhalation risk of PFAS from landfills may be important for public health, but the PFAS compounds that are being regulated in the current proposal are primarily of low volatility, and not an inhalation exposure concern relative to oral exposures.

We request that OHA pause on setting TRVs for PFAS until external authoritative sources have done so. Not setting a value is a conscious decision by authoritative sources, and these agencies are obligated to set guidelines to protect public health when the science is sufficient to do so. As TRVs are inflexible standards that cannot be modified during a site-specific risk assessment, the regulated sources and the surrounding community deserve a careful vetting of the decision to set inhalation values when the external authoritative

sources have not done so. We request that ODEQ wait for the scientific data from external authoritative sources before proposing TRVs for chronic PFAS inhalation. In addition, there are currently no approved EPA test methods for PFAS in air.

8) Phosgene

ODEQ/OHA should convene ATSAC to review the technical comments prepared by ToxStrategies regarding the phosgene acute and chronic TRVs submitted in May 2026 (OBI, 2026) and develop new values consistent with the current state of the science (**Table 1**). The underlying toxicity data for phosgene has advanced since any authoritative source has offered a new guideline, and the current EPA RfCs are outdated, having been based on data from the 1980s and 1990s. ODEQ/OHA, in consultation with ATSAC, should consider the new scientific information. As TRVs are only revised periodically, the phosgene acute and non-cancer chronic TRVs should be reevaluated with this rulemaking.

In summary,

- Over the past 10 years, world-renowned inhalation toxicology expert Dr. Jorgan Pauluhn has published extensively on phosgene inhalation toxicity and conducted several newer animal bioassays that expand the available data and thinking regarding phosgene toxicity.
- Pauluhn developed a 95% lower confidence limit benchmark dose (BMDL) by combining new animal bioassay data and modeling the results, which provides a POD for TRV calculations (Paulhun, 2021).
- Pauluhn also published an expert panel review paper regarding his approach to assessing risk from phosgene (Pauluhn, et al., 2018). One of the panel experts included Dr. Urmila Kodavanti, who was the EPA inhalation toxicity expert and primary author of the study used to set EPA's chronic RfC, which is the OHA chronic noncancer TRV.

A summary of our updated comments is provided in **Table 1**.

Table 1. Summary of current comments regarding chemical-specific TRV and RBC values including chemicals pending ODEQ/OHA review

Chemical-Specific TRV/RBC Values Reviewed by ODEQ/OHA			
Chemical (TRV type)	**ODEQ's 2025 Initially Proposed TRV (µg/m^3)[a]**	**ODEQ's May 2026 Updated Proposed TRV (µg/m^3)[b]**	**Status of Comments**
Hydrogen chloride (Acute)	88	2100	No further comment
Hydrogen chloride (Chronic noncancer)	9	9	Request revision. ODEQ/OHA, in consultation with ATSAC, should further update this TRV using EPA's current RDGR for ET effects,

Chemical-Specific TRV/RBC Values Reviewed by ODEQ/OHA			
Chemical (TRV type)	**ODEQ's 2025 Initially Proposed TRV (µg/m³)[a]**	**ODEQ's May 2026 Updated Proposed TRV (µg/m³)[b]**	**Status of Comments**
			which should result in an updated proposed TRV of 30 µg/m³.
Amorphous silica (Chronic noncancer)	6.6	6.6	Request revision. ODEQ/OHA, in consultation with ATSAC, should review ATSDR's Toxicological Profile and withdraw the proposed TRV.
Floride and inorganic compounds (Acute)	16	16 Revised to be specific to hydrogen fluoride	No further comments
PFAS (Acute)	Values for 8 PFAS	Withdrawn	No further comments
PFDoA (Chronic noncancer)	0.042	Withdrawn	No further comments
6:2FTS, GenX, PFBA, PFBE, PFDA, PFNA, PFOSA, PFOS, PFOA (Chronic noncancer)	Varied	No or essentially no change	Request revision. ODEQ/OHA should withdraw all proposed chronic noncancer PFAS values until an authoritative source other than ODEQ sets inhalation values.
PFBS, PFHxS, PFNA (Chronic noncancer)	None	1.1, 0.0000014, 0.000025	Request revision. ODEQ/OHA should withdraw all proposed chronic noncancer PFAS values until an authoritative source other than ODEQ sets inhalation values.
PFHxA (Chronic noncancer)	0.5	1.8	Request revision. ODEQ/OHA should withdraw all proposed chronic noncancer PFAS values until an authoritative source other than ODEQ sets inhalation values.
Soluble Chromium III (CrIII) (Acute) (Chronic noncancer)	0.14 1.4	1.2 1.4 CrIII in alloy and metalloid forms are excluded	No further comments
Insoluble Chromium III (CrIII) (Acute) (Chronic noncancer)	7 1.4	Withdrawn 1.4	No further comments

Chemical-Specific TRV/RBC Values Reviewed by ODEQ/OHA			
Chemical (TRV type)	**ODEQ's 2025 Initially Proposed TRV (µg/m³)[a]**	**ODEQ's May 2026 Updated Proposed TRV (µg/m³)[b]**	**Status of Comments**
		CrIII in alloy and metalloid forms are excluded	
Insoluble Cobalt (Co) (Acute) (Chronic noncancer) (Cancer)	 0.3 0.1 0.00013	 0.3 0.1 0.00013 Co in alloy and metalloid forms are excluded	No further comments
Nickel (Ni) compounds and nickel oxide (Acute)	0.1	0.1	Request revision. ODEQ should exclude Ni in alloy and metalloid forms, just as with Co and CrIII. In addition, ODEQ/OHA, in consultation with ATSAC, should develop a different acute TRV, based on the Buxton et al. (2021) study, which should result in an updated proposed TRV of 11 µg/m³.
Vanadium and compounds (Acute) (Chronic noncancer) (Cancer)	 0.8 0.1 0.00012	 0.8 0.1 0.00012 OHA specified vanadium as vanadium pentoxide and there are no TRVs for other vanadium compounds.	No further comments
Lead (Acute)	0.15	0.15	Request revision. ODEQ/OHA, in consultation with ATSAC and the EPA lead working group, should develop a different acute lead TRV using the EPA All Ages Lead Model (AALM), which should result in an updated acute lead TRV of 3.9 µg/m³.
Naphthalene (Acute)	0.3	0.3	Request revision. ODEQ and OHA in consultation with ATSAC, should develop an updated proposed acute TRV using EPA's current RDGR for ET effects, which should result in in an updated proposed acute TRV of 0.75 µg/m³.

Chemical-Specific TRV/RBC Values Pending ODEQ/OHA Review			
Chemical (TRV type)	**ODEQ's 2025 Initially Proposed TRV (µg/m³)[a]**	**ToxStrategies' Proposed TRVs and RBCs (µg/m³)[b]**	**Status of Comments**
Phosgene			
(Acute TRV)	0.17	16	Comments submitted March 2026
(Chronic TRV)	0.3	5	
Arsenic			Comments submitted July 2026
(Cancer TRV)	0.00023	0.0067	
(Acute TRV)	0.2	5.4	
(Residential Cancer RBC)	0.0000049	0.0067	ODEQ should set all chronic RBCs for arsenic equal to the chronic TRVs, with adjustments for exposure time (e.g., 8 hours per day for workers). MPAFs for arsenic are unwarranted and should be excluded from RBC calculations.

[a] The initially or currently proposed TRVs were issued in 2025 (footnoted as ver.1-15-2025), but in a Technical Memorandum issued May 1, 2026 (but not dated), these values are referred to as TRVs issued 1/12/2026. We refer to these TRVs as 2025 TRVs because they were available on-line in 2025.

[b] In the Technical Memorandum issued May 1, 2026 (but not dated), these values are referred to as TRVs as of 4/1/26 and as of 3/16/26 for PFAS compounds. We refer to these TRVs as 2026 TRVs because they were first available publicly May 2026.

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ATTACHMENT A

Comments regarding the Arsenic TRVs, MPAFs and RBCs

Memorandum

July 7, 2026

To:	Sharla Moffet, Senior Policy Director, Oregon Business and Industry
From:	Deborah Proctor and Camarie Perry, ToxStrategies LLC
Subject:	**Evaluation of Draft Proposed Updates toMPAFs, RBCs and Current TRVs for Arsenic and Inorganic Compounds for Cleaner Air Oregon**

To support the current review of the inhalation toxicity reference values (TRVs) used in the Cleaner Air Oregon (CAO) program, we have evaluated the current TRV and draft proposed risk-based concentrations (RBCs) that Oregon Department of Environmental Quality (ODEQ) and Oregon Health Authority (OHA) have presented for consideration in the current rulemaking for arsenic and inorganic compounds. ODEQ and OHA have not proposed changes to the existing TRVs for arsenic and inorganic compounds; however, the agencies have proposed modifications to the multipathway adjustment factors (MPAFs), which result in new proposed RBCs. This memorandum provides comments regarding the current TRVs and proposed MPAFs and resulting RBCs for arsenic and inorganic compounds.

Table 1. Summary of recommendations for current arsenic TRVs and proposed MPAFs/RBCs

Proposed MPAFs range from 210 to 2.9, resulting in RBCs for arsenic ranging from 0.0000049 to 0.023 µg/m^3	Application of the arsenic MPAFs substantially reduces the RBCs relative to TRVs, but MPAFs are unnecessary for arsenic because the predicted soil concentration associated with deposition of particles containing arsenic does not represent a meaningful contribution of arsenic in soil relative to naturally occurring background concentrations. As such, using the MPAF for arsenic results in an unwarranted level of conservatism in the RBC (e.g., 47-fold change in the RBC for the residential cancer RBC with inclusion of the MPAF) that does not meaningfully reduce cancer risk. In all cases, the arsenic RBCs should be equal to the TRVs, without application of MPAFs.[1]

[1] Note: We recognize that the nonresidential and worker RBC equations also contain nonresident adjustment factors (NRAF), and the acute TRV is the acute RBC and no MPAF is applied.

Current Cancer TRV 0.00023 µg/m^3	The current cancer TRV is based on the 1995 EPA IRIS inhalation unit risk (IUR), which was initially set in 1985. Since then, the epidemiology data used for this value has been updated in follow-up studies, adding newly identified lung cancer cases to the studies used by EPA to set its IUR and increasing statistical power in the analysis. An additional larger epidemiology study of workers exposed to arsenic also has been published, which improves the data available to develop an IUR. TCEQ has used these updated occupational epidemiology analyses to develop an updated IUR, including a meta-analysis combining the data for all three cohorts, resulting in a far more robust analysis and IUR that applies the most current and best-available science. We recommend that ODEQ, in consultation with ATSAC, review the TCEQ documentation and update the cancer TRV to be consistent with the TCEQ IUR analysis. The TCEQ IUR is 0.00015 $(\mu g/m^3)^{-1}$ and at ODEQ's $1x10^{-6}$ risk level, the new cancer TRV would be 0.0067 µg/m^3.
Current Acute Noncancer TRV 0.2 µg/m^3	The current acute arsenic TRV is based on the OEHHA acute value, which is very dated and based on a study with signification limitations. We recommend that ODEQ, in consultation with ATSAC, review the more current TCEQ documentation for the acute TRV, and then revise the current acute noncancer TRV to TCEQ's 24-hour air monitoring comparison value (AMCV) of 5.4 µg/m^3. TCEQ's value is based on a newer, higher quality toxicity study and incorporates dosimetric adjustments to reduce uncertainty. Further, the TCEQ value is intended for use with data of the same exposure duration considered for ODEQ's acute TRVs, as the acute TRV and AMCV are both for 24-hour exposures.

Proposed Multipathway Adjustment Factor for Arsenic

ODEQ has developed conservative MPAFs to be applied to the cancer and chronic noncancer arsenic TRVs for calculating RBCs. Please note that while the TRV has not changed, ODEQ has developed an MPAF tool and applied the results of this tool to update the RBCs for arsenic. Focusing on the most conservative values, which are for residential exposure and cancer endpoints, the current RBC for residential cancer was 2.4×10^{-5} µg/m^3, and the proposed new value is 4.9×10^{-6} µg/m^3. The new inhalation RBC is largely driven by the new EPA oral cancer potency factor (CPF); relatively, changes to the exposure parameters in the MPAF calculation tool result in only minor differences in the RBC.

The MPAF is intended to account for oral and dermal exposure due to deposition of particles on soil and garden vegetables. The default MPAF tool uses a contaminant air concentration (C_{air}) of 1 µg/m^3, which we recognize as a unit value used for convenience in calculating MPAFs. If C_{air} parameter for arsenic in the MPAF tool is changed to the current cancer TRV of 0.00023 µg/m^3, the model-predicted soil concentrations from deposition of arsenic are 0.38 mg/kg for the playground scenario and 0.025 mg/kg for the agricultural scenario. Similarly, if C_{air} parameter for arsenic in the MPAF tool is changed to the residential cancer RBC of 0.0000049 µg/m^3, the model-predicted soil concentrations from deposition of arsenic are 0.00811 mg/kg for the playground scenario and 0.00054 mg/kg for the agricultural scenario. These soil concentrations at both the TRV and RBC are negligible as compared to, and indistinguishable from naturally occurring levels of arsenic in Oregon soils, which range from 6.8 to 19 mg/kg (ODEQ 2018). Given this negligible theoretical additional contribution from deposition of particles containing arsenic, it is not

appropriate to apply the MPAF to the arsenic TRVs, as doing so decreases the RBCs many fold without any corresponding or equivalent health protective benefit.

We note that there is additional support to indicate that an MPAF for arsenic is unnecessary in OHA's Public Health Assessment (PHA) for Bullseye Glass (OHA 2023). In that assessment, the concentrations of arsenic in ambient air were estimated to be far higher than the current TRV of 0.00023 µg/m^3. The PHA assumed 78 years of exposure at 0.0997 µg/m^3, [2] which is 433-times higher than the current TRV. Even at these much higher levels of arsenic in air, OHA concluded:

> "Levels of metals measured in the soil in 2016 were too low cause health effects" (p. 11).
>
> "Metals concentrations measured in the soil around Bullseye were similar to those measured in urban areas around Portland and around the country" (p. 71).
>
> "Metals concentrations are too low to harm the health of people who consume soil particles on homegrown produce." (p. 71).

The same rationale was provided for excluding soil and homegrown produce exposure pathway in the Uroboros Glass PHA, stating, "Metal concentrations measured in soil around Uroboros are similar to those measured in urban areas around Portland and around the country"(OHA 2019, p. 8).

The same, or an even stronger, conclusion can be reached regarding the contribution of deposited arsenic assuming concentrations in air at the TRV, as estimated using the MPAF tool, compared to local background soil conditions. Assuming arsenic concentrations in air at the TRV, there would be no measurable increase in arsenic soil concentration, and therefore no increase that could cause adverse health effects. Accordingly, there is no basis to apply an MPAF for arsenic that would have such a substantial effect on the RBCs (e.g., 47-fold difference for the cancer RBC).

In summary, it is not necessary or appropriate to include an MPAF for arsenic when calculating RBCs from the TRV because the resulting soil concentrations (assuming deposition of arsenic from air containing concentrations at the TRV) are 50–270 times below naturally occurring arsenic levels in Oregon soils, the impact on public health associated with soil and produce ingestion has been recognized as negligible even for the higher concentrations of arsenic in air associated with Bullseye and Uroboros Glass manufacturing sites, and there is no meaningful change in risk or improvement in public health protection associated with use of the MPAFs for arsenic. Thus, the arsenic RBCs should be equal to the TRVs.

Background on TRVs for Arsenic

The current TRVs for arsenic and inorganic compounds are the same values as the 2018 TRVs.

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[2] The 95% UCL of arsenic measured at the SE Powell and 22nd Avenue Portland Monitor in October 2015 (OHA 2023).

- ODEQ's current cancer TRV is 0.00023 µg/m^3 and references US Environmental Protection Agency's (EPA) Integrated Risk Information System (IRIS). The current cancer TRV is based on the 1995 EPA IRIS inhalation unit risk factor (IUR) of 0.0043 (µg/m^3)$^{-1}$. The current cancer TRV is the same value as the 2018 cancer TRV, but the 2018 TRV references ODEQ's Air Toxics Science Advisory Committee (ATSAC) as the authoritative source for that value. ODEQ indicates there is more than one authoritative source for the current cancer TRV.
    - We did not identify information regarding ATSAC's 2018 review of the arsenic cancer TRV. We would appreciate and specifically request any information on ATSAC's review of the value.
- ODEQ's current acute noncancer TRV is 0.2 µg/m^3 and is the OEHHA acute REL. The current acute noncancer TRV is the same value as the 2018 acute noncancer TRV, but the 2018 TRV referenced ODEQ short-term guidance concentration (SGC) instead of OEHHA.[3]

Additional toxicological information and regulatory analyses concerning arsenic have become available since the EPA and OEHHA values above were determined. This information is discussed below and is the basis for the changes we recommend to the current arsenic TRVs.

Cancer TRV

The current cancer TRV of 0.00023 µg/m^3 is based on the 1995 EPA IRIS IUR and a cancer risk level of 1x10^{-6} (i.e., 1x10^{-6} /0.0043 [µg/m^3]$^{-1}$ = 0.00023 µg/m^3). The IUR was originally calculated by EPA in 1984 and is based on study of lung cancer among male workers at the Anaconda Copper Smelter in Montana and the ASARCO Copper Smelter in Tacoma, Washington (EPA 1995).

Using data from these worker studies[4] and the absolute risk linear model, EPA (1995) calculated a unit risk for each study, then calculated a geometric mean of the unit risk values specific to each smelter. The final IUR of 0.0043 (µg/m^3)$^{-1}$ is the geometric mean of these two individual geometric mean unit risks. The range of the unit risk estimates from the two smelters was within a factor of six. Exposure information included air measurements at the Anaconda smelter, and both air and urinary arsenic measurements for the Asarco smelter. Lung cancer incidences were significantly higher than expected (EPA 1995).

In 2025, EPA released a new *IRIS Toxicological Review of Inorganic Arsenic.* However, this document did not include an updated inhalation assessment for cancer or noncancer effects, only oral toxicity evaluations. The new IRIS review states that, "inhalation exposures would not have a significant impact on lifetime extra risk estimates. Therefore, risk estimates for oral exposures are calculated assuming zero inhalation exposure." EPA calculated an oral cancer slope factor with and without including background inhalation exposures and found the difference to be negligible

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[3] ODEQ and OHA quickly developed SGCs after an acute industrial air pollution incident in Portland, Oregon.

[4] A total of five studies were used by EPA (1995) to calculate the IUR: Anaconda: Brown and Chu, 1983a,b,c; Lee-Feldstein, 1983; Higgins, 1982; ASARCO: Enterline and Marsh, 1982.

and therefore excluded the inhalation component (EPA 2025). EPA (2025) concluded that under typical conditions, inhalation has a negligible impact on cancer risk relative to oral exposures.

OEHHA (2011) calculated an IUR of 0.0033 $(\mu g/m^3)^{-1}$ which was first derived by California Department of Health Services (CDHS) in 1990. This IUR converts to an air concentration of 0.00033 $\mu g/m^3$ at $1x10^{-6}$ risk, which is ~1.3-fold less conservative than the EPA value. Like the EPA (1995) IUR, OEHHA used older occupational epidemiology studies from the Anaconda and ASARCO smelters. OEHHA calculated the IUR using the maximum likelihood estimate slope and upper 95% confidence bound based on the four lowest exposure groups in the ASARCO study by Enterline et al. (1987).

In 2012, the Texas Commission on Environmental Quality (TCEQ) derived a final IUR of 0.00015 $(\mu g/m^3)^{-1}$, which is the basis of the chronic/long-term air monitoring comparison values (AMCV, used to evaluate air monitoring data) and chronic/long-term effects screening level (ESL, used in air permitting). In addition to using the IUR to calculate AMCVs and ESLs[5] for use in air toxics evaluations, the IUR is also used in the agency's remediation program. TCEQ's long-term AMCV/ESL for arsenic are air concentrations calculated using the IUR and $1x10^{-5}$ risk (i.e., $1x10^{-5}$ /0.00015 $[\mu g/m^3]^{-1}$ = 0.067 $\mu g/m^3$) (TCEQ 2012). While the TCEQ IUR is also based on occupational exposure data from smelting, it is more comprehensive, updated with additional cancer cases, and has greater statistical power.

ToxStrategies recommends the cancer TRV be revised in consideration of the TCEQ analysis and IUR of 0.00015 $(\mu g/m^3)^{-1}$ at ODEQ's $1x10^{-6}$ risk level, to 0.0067 $\mu g/m^3$. This value is more strongly supported than the current TRV based on the following:

- Like EPA IRIS, TCEQ's IUR evaluation cancer TRV underwent public comment and peer review (https://tera.org/Peer/ArsenicCarc/index.html), but TCEQ's IUR derivation is more recent (finalized in 2012) than the EPA IRIS derivation (1984, reviewed in 1995).
- TCEQ used updated, more realistic estimates of arsenic exposure (Enterline et al. 1987, 1995; Lubin et al. 2000, 2008). For example, in the Anaconda study, the newer data sets accounted for respirator use by workers in high-exposure areas, substantially refining exposure estimation. Including the use of respirator protection results in more conservative IUR and TRV values because there is less exposure causing the increased risk.
- According to TCEQ (2012), EPA's (1995) determination relied on old, outdated exposure estimates which incorrectly depict the relationship between the amount of arsenic inhaled and urinary arsenic levels.
- In addition to updated data from the Asarco and Anaconda smelters, TCEQ (2012) included a third large study of smelter workers from the Ronnskar Copper Smelter in Sweden (Järup et al. 1989; Viren and Silvers 1994).

[5] AMCVs (air monitoring comparison values) are used by TCEQ in evaluating air monitoring data. ESLs (effects screening levels) are similar and are used by TCEQ in the air permitting process.

- TCEQ (2012) used a meta-analysis approach, inverse-variance weighting, to combine the results of the three separate studies and IURs estimated from published primary epidemiological study data into a single, final IUR. This method resulted in a more statistically robust data set by combining different data sets and expanding the information developed by EPA in 1984/1995.
- TCEQ's (2012) IUR is based on a longer follow-up period (Lubin et al. 2000; 2008) and therefore, a higher number of recorded deaths and more person-years at risk than EPA (1995), yielding a higher statistical power.
- Like EPA (1995), TCEQ (2012) used a conservative linear model, as inhaled arsenic's cancer mode of action is not fully understood.
- Similar to EPA, the OEHHA (2011) IUR was originally derived at an earlier date (1990) and relied on older literature and analyses. The evaluation included data from only two smelters and the final IUR is based on data from only the ASARCO smelter.

Notably, ODEQ's current cancer TRV (0.00023 $\mu g/m^3$) is below even the lowest range of mean ambient background concentrations of 0.001 to 2 $\mu g/m^3$ cited by EPA in its 2025 *IRIS Toxicological Review of Inorganic Arsenic.* EPA (1995) states that the IUR of 0.0043 $(\mu g/m^3)^{-1}$ should not be used for air concentrations >2 $\mu g/m^3$, as the value may not be appropriate at such concentrations. Therefore, the EPA IUR used as the basis for ODEQ's current cancer TRV has been indicated by EPA as inappropriate for evaluating concentrations just above natural background concentrations in air. As TRVs may be applied in areas with elevated arsenic concentrations, ODEQ should consider this potential issue.

OHA (2026) states:

> "While TCEQ itself is not an authoritative source under Oregon Administrative Rule (OAR), 'DEQ in consultation with the Air Toxics Science Advisory Committee (ATSAC)' is an authoritative source in DEQ rule (OAR 340-247-0030). This means that DEQ, in consultation with ATSAC, can propose candidate TRVs from sources other than the EPA, ATSDR, or California EPA (CalEPA) under DEQ's own authority."

For the reasons listed above, ToxStrategies recommends ODEQ, in consultation with ATSAC, revise the cancer TRV to use the TCEQ IUR of 0.00015 $(\mu g/m^3)^{-1}$; at ODEQ's $1x10^{-6}$ risk level, the cancer TRV would be 0.0067 $\mu g/m^3$.

Acute Noncancer TRV

The current acute (24-hour) noncancer TRV of 0.2 $\mu g/m^3$ is the OEHHA (2014) acute (1-hour) REL. The acute REL is based on a developmental inhalation study in pregnant mice (Nagymajtenyi et al. 1985).

Nagymajtenyi and coworkers (1985) exposed pregnant CFLP mice to aerosolized arsenic trioxide (As_2O_3) at 0, 0.26, 2.9, or 28.5 mg/m^3 (~0, 0.2, 2.2, or 21.6 mg As/m^3) for 4 hours per day on gestation days (GD) 9–12. Observed effects in fetuses included skeletal malformations,

intrauterine growth retardation, and hepatocellular chromosomal aberrations, with decreased fetal weight as the critical effect. A no-observed-adverse-effect level (NOAEL) was not observed; a lowest-observed-adverse-effect level (LOAEL) of 0.26 mg/m³ As_2O_3 (0.197 mg As/m³) was established for reduced fetal weight (OEHHA 2014).

The total study duration was 16 hours (4 days, 4 hours/day). OEHHA (2014) did not make a time adjustment in determining the 1-hour REL since the critical exposure timepoint for developmental effects may be very brief relative to the length of the study (OEHHA 2007). The LOAEL of 0.197 mg As/m³ was adjusted by a total UF of 1,000 (LOAEL to NOAEL UF = 10, interspecies UF = 10, intraspecies UF = 10) to calculate an acute REL of 0.2 µg/m³ (OEHHA 2014).

Limitations of the OEHHA acute REL include the following:

- The Nagymajtenyi et al. (1985) study is considered low quality and has a relatively small sample size, few exposure groups, and does not provide nominal concentrations, particle size, nor critical maternal observations (e.g., body weight, respiratory distress) (TCEQ 2012).
- The LOAEL used as the POD has additional uncertainty since a NOAEL was not identified in the Nagymajtenyi et al. (1985) study.
- OEHHA did not apply a human equivalent concentration (HEC) adjustment. Instead, the agency used a simple default approach for interspecies extrapolation, which is a less precise scientific method than multiple-path particle dosimetry (MPPD) modeling.

TCEQ more recently (2021) derived a 24-hour AMCV of 5.4 µg/m³ for arsenic and inorganic arsenic compounds. The 24-hour AMCV is based on the same study (Holson et al. 1999) used to derive the acute 1-hour AMCV/ESL in TCEQ's final DSD document (TCEQ 2012). In this developmental/reproductive inhalation study, groups of 24 female Crl:CD(SD)BR rats were exposed to 0, 0.3, 3, or 10 mg/m³ arsenic trioxide (ATO) for 6 hours per day for 14 days prior to mating until GD 19. Measured mean exposure concentrations and aerosol sizes as the median mass aerodynamic diameter (MMAD) were reported (Holson et al. 1999, TCEQ 2021, TCEQ 2012).

Holson et al. (1999) documented maternal toxicity as rales (labored respiration and gasping) during pre-mating and gestation exposures. No dose-dependent effects were found in the fetuses. The study NOAEL was 3 mg ATO/m³ and LOAEL was 10 mg ATO/m³, both based on maternal effects. TCEQ determined that no duration adjustment was necessary, since the total exposure time associated with the observations exceeded the 24-hour duration of interest. The agency used parameters provided in Holson et al. (1999) and MPPD modeling to estimate the ATO deposition fraction in the target respiratory region. A Regional Deposited Dose Ratio (RDDR) of 0.714 was calculated for the pulmonary region and used to determine the POD_{HEC}: NOAEL of 3 mg ATO/m³ × 0.714 = 2.142 mg ATO/m³. The POD_{HEC} was multiplied by 76/100 since ATO is 76% by weight arsenic, yielding a POD_{HEC} of 1.622 mg As/m³. The POD_{HEC} of 1.622 mg As/m³ was adjusted by a total UF of 300 (interspecies UF = 3, intraspecies UF = 10, database UF = 10) to yield the 24-hour AMCV of 5.4 µg/m³ (TCEQ 2021).

ToxStrategies recommends the acute noncancer TRV be revised to the TCEQ 24-hour AMCV of 5.4 µg/m^3. This value is more strongly supported than the current TRV based on the following:

- TCEQ's AMCV is intended for evaluation of 24-hour exposures to arsenic, same as the ODEQ acute noncancer TRV, while the OEHHA REL is set for 1-hour exposures.
- TCEQ's value is based on a more recent study (Holson et al. 1999) than OEHHA's (Nagymajtenyi et al. 1985). Holson et al. (1999) is a higher quality study with additional information (e.g., nominal concentrations, detailed aerosol characterization, particle size, maternal observations).
- TCEQ (2021, 2012) identified both a LOAEL and NOAEL from the Holson et al. (1999) study, while OEHHA was able to identify only a LOAEL from the Nagymajtenyi et al. (1985) study. Having both types of values allows for a more certain POD.
- TCEQ used the MPPD model to apply more refined dosimetric adjustments to account for deposition of arsenic particles in the human lung and estimate a HEC, whereas OEHHA did not.

For the reasons listed above, ToxStrategies recommends that ODEQ, in consultation with ATSAC, revise the acute noncancer TRV to the TCEQ 24-hour AMCV of 5.4 µg/m^3.

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