Exhibit A-36

EXPERT OPINION OF ROBERT SCOFIELD, D.ENV., M.P.H.

ASSESSMENT OF HEALTH RISKS ASSOCIATED WITH DIESEL EXHAUST IN THE VICINITY OF THE MILLENNIUM COAL EXPORT TERMINAL

BEFORE THE COWLITZ COUNTY HEARING EXAMINER

COWLITZ COUNTY SHORELINE SUBSTANTIAL DEVELOPMENT AND SHORELINE CONDITIONAL USE PERMITS

FILE NO. 12-04-0375

SHORELINE PERMIT NO. 17-0992

Issued: 24 October 2017

Prepared for: K & L Gates LLP,
On behalf of Millennium Bulk Terminal – Longview LLC

GSI ENVIRONMENTAL

155 Grand Ave., Suite 704 | Oakland, CA 94612 | 510.463.8484 | www.gsi-net.com
Austin, TX ■ Houston, TX ■ Newport Beach, CA

ASSESSMENT OF HEALTH RISKS ASSOCIATED WITH DIESEL EXHAUST IN THE VICINITY OF THE MILLENNIUM COAL EXPORT TERMINAL

BEFORE THE COWLITZ COUNTY HEARING EXAMINER

COWLITZ COUNTY SHORELINE SUBSTANTIAL DEVELOPMENT AND SHORELINE CONDITIONAL USE PERMITS

FILE NO. 12-04-0375

SHORELINE PERMIT NO. 17-0992

Prepared for:

K & L Gates LLP,
On behalf of Millennium Bulk Terminal – Longview LLC

Prepared by:

GSI Environmental Inc.
155 Grand, Suite 704
Oakland, CA 94612
510.463.8484

GSI Job No. 4704-000
Issued: 24 October 2017

TABLE OF CONTENTS

ASSESSMENT OF HEALTH RISKS ASSOCIATED WITH DIESEL EXHAUST IN THE VICINITY OF THE MILLENNIUM COAL EXPORT TERMINAL

1.0 SUMMARY OF OPINIONS

1. Non-cancer risks for diesel emissions estimated to be present in the air in the vicinity of the terminal are below levels that would be expected to cause any adverse health effects.
2. The Final Environmental Impact Statement (FEIS) for the terminal over-states and mischaracterizes relative risks as a 10 percent (%) increase.
3. The Health Impact Assessment (HIA) for the terminal more accurately characterizes the relative cancer risk as low.
4. Cancer risks for diesel emissions estimated to be present are not significant.

2.0 SUMMARY OF BASIS OF OPINION

The estimated levels of diesel emissions in the air in the vicinity of the proposed Millennium Coal Export Terminal are below levels that would be expected to cause any non-cancer health effects. The cancer risks from diesel exhaust estimated in some areas near the proposed project are presented in the FEIS as being greater than 10 in a million, the risk level the Department of Ecology has considered to be “significant” under the State Environmental Policy Act (SEPA). As noted in both the FEIS and the HIA prepared for the project, however, these risk estimates are based on methods and exposure assumptions deliberately designed to overstate cancer risks (e.g., continuous exposure, 24 hours per day, 7 days per week for 70 years) and are based on a highly uncertain cancer potency factor. Using the same conservative exposure assumptions that were applied to workplace exposures (i.e., 40 years of exposure, 250 days per year, and 8 hours per day) in other risk assessments prepared for facilities in the State of Washington, instead of the assumption of 70 years of continuous exposure, the estimated cancer risks in the commercial/industrial areas in the vicinity of the proposed project would be less than 10 in a million. The highest estimated risk contour of 30 in a million shown to include a small portion of the residential area in the vicinity of the project would be 11 in a million, if standard USEPA exposure assumptions for residential exposures were applied (i.e., 26 years of exposure for 350 days per year). As noted in the FEIS, the United States Environmental Protection Agency (U.S EPA) does not consider the data on which the cancer potency factor that was used for estimating the incremental cancer risks presented in the FEIS and the HIA to be sufficient for risk quantification, and instead, requires application of best available control technology as the approach for managing health risks from diesel emissions.

For purposes of putting the estimated incremental cancer risks from the project into perspective, both the FEIS and HIA noted that the incremental cancer risk of 30 in a million presented as being the highest risk contour in a residential area would represent an increase of approximately 10 percent above the risk associated with the ambient level of diesel particulate in Cowlitz County. The vast majority of people living or working in the vicinity of the project would have a much smaller increase (e.g., less than ten in a million); and an incremental risk of 10 in a million would represent an increase of approximately 2 to 3 percent. An incremental cancer risk of 30 in a million also represents an increase of approximately 0.008% above the background lifetime cancer risk of 400,000 in a million reported by the American Cancer Society for people living in the United States (US).

The estimated cancer risks associated with the project are hypothetical risks based on deliberately overstated exposure assumptions and a conservative estimate of the cancer potency of diesel exhaust. Even so, the estimated risks represent a small increment above the risk posed by background level of diesel particulates present in Cowlitz County and a negligible increase of lifetime cancer risk in the US. The finding presented in the HIA prepared for the project, that the "Significance of the Impact" was "Low," is technically sound.

3.0 SUMMARY OF RISK ASSESSMENT METHODS AND RESULTS

I reviewed two evaluations of health impacts prepared for the proposed Millennium Coal Export Terminal in Longview, Washington. One was a quantitative health risk assessment for air emissions from the project, and this risk assessment was provided as an element of the FEIS prepared for the project. The second evaluation was an HIA, which was a separate evaluation broader in scope than the quantitative risk assessment prepared as part of the FEIS. It is important to note that the HIA was prepared in accordance with guidance from the National Research Council[1] and is a fundamentally different evaluation than the three-tiered process also called a Health Impact Assessment used by the Washington Department of Ecology for the evaluation of health risks posed by new sources of Toxic Air Pollutants under Chapter 173-460 WAC. Apparently, the three-tier Health Impact Assessment process was not applied by the State in this project evaluation because the stationary, but not mobile, source of air emissions are subject to WAC 173-460 (FEIS, 2017, pg. 5.6-19).

3.1 Discussion of Risk Assessment Methods and Results

Working with the Washington State Department of Ecology, Cowlitz County commissioned a quantitative human health risk assessment for the proposed construction and operation of a coal export terminal along the Columbia River in Cowlitz County Washington. The risk assessment was prepared as part of the 2017 Environmental Impact Statement prepared for the proposed Millennium Coal Export Terminal to be built in Longview, Washington. The approach to the risk assessment was reported in the FEIS (p.2-7) to follow, "California's 2003 OEHHA's Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments for a Tier 1 standard point estimate risk assessment approach"[2]. This description of the methodology is confusing because it is not clear if they are referencing the OEHHA or Washington "Tier 1" risk estimate. The reference to a "Tier 1" risk estimate would appear to refer to the Washington three-tier Health Impact Assessment approach applied to new sources of air emissions under WAC 463-160-040. The reference to the "standard point estimate risk assessment approach" is confusing because risks are presented in the FEIS as risk contours and point estimates of risk are not presented or discussed. Although the discussion of approach to health impacts assessment mentions a Tier 1 risk assessment approach, the evaluation presented in the FEIS and the risk assessment review process do not follow the Washington's three tier Health Impact Assessment process. While it does not follow the State's three-tier Health Impact Assessment process, and while the mobile sources making up the

[1] National Research Council (NRC). 2011. Improving Health in the United States: The Role of Health Impact Assessment. September.
[2] The 2003 Hot Spots Guidance Manual is cited even though a 2015 update is the most recent version available.

project are not subject to the State's regulations for new sources of Toxic Air Emissions (i.e., Washington Administrative Code [WAC] 463-160-040), the State is, nonetheless, using the incremental cancer risk limit of 10 in a million specified in the regulations for stationary sources (WAC 173-460-190) as the level at which a cancer risk, whether it comes from a stationary or mobile source, would be considered "significant and adverse" (FEIS, 2017, pg. 5.6-20). It is my understanding that this is the first time that the Department of Ecology has used this criterion to assess health impacts in a FEIS.

As noted above, the HIA prepared for the project addresses a wider range of health concerns than were addressed in the quantitative health risk assessment prepared as part of the FEIS. The evaluation of the "potential increase in lung cancer due to inhalation of diesel exhaust for areas near the train tracks" presented in the HIA was based on the quantitative risk assessment presented in the FEIS. The procedure for evaluating the significance of the potential effect was different in the HIA than in the FEIS. In the HIA the "Magnitude/Consequence of Impact" is evaluated separately from the "Likelihood/Probability of Impact" and the two factors are jointly considered to arrive at a conclusion regarding the "Significance of Impact."

The quantitative risk assessment presented in the FEIS evaluated two potential project growth scenarios. Under the "Fixed Emissions Scenario," emissions were assumed to be at the rate when the facility reaches peak capacity in 2028 and included the assumption that all locomotives were the lower emitting Tier 4 models. Under the "Lifetime Average Emissions Scenario," emissions were assumed to begin in 2018, with the facility reaching full capacity in 2028 and Tier 4 locomotives were assumed to gradually enter the fleet between 2018 and 2028.

The risk assessment in the FEIS evaluated inhalation risks only, noting that other exposure routes would be difficult to evaluate and would only add a negligible increment of exposure. The risks were estimated using the very conservative assumption that an exposed individual would be exposed at any given location 24 hour per day, 7 days per week for 70 years and would be breathing at the 80^{th} percentile of human respiration rates (i.e., 302 liters per kilogram of body weight) (FEIS, 2017).

The quantified risk estimates were presented as risk contours mapped over the area surrounding the proposed project for the two scenarios. The contours shown were for lifetime incremental cancer risks of 1, 10, 30, and 50 in a million. While it is not unusual to present results as risk contours, it is unusual not to show or identify risks at maximum impact points. No explanation for why risks were not presented for maximum impact locations was provided in the FEIS. In addition, most of the area inside the mapped contours is not used or available for residential purposes, but is used for industrial, commercial or recreational purposes where individuals would not be exposed for 24 hours per day, 350 days per year for 70 years.

The area estimated for any given risk contour was similar under both the Average Lifetime Emissions Scenario and the Fixed Emissions Scenario, with the contours under the Fixed Emissions Scenario being slightly larger (e.g., compare Figure 7 and Figure 11 in the FEIS Air Quality Technical Report).

- The highest risk contour shown of 50 in a million is essentially limited to a narrow band along the Reynolds spur and an area southeast of the proposed project area. The FEIS notes that this contour "borders" the Highland neighborhood under the Fixed Emissions Scenario (See Figure 6). It does not extend into any residential areas under the Average Lifetime Emissions Scenario.

- The 30 in a million contour is similar in shape to the 50 in a million contour, but it is somewhat larger. Nearly all of the land within this contour is shown as being used for industrial purposes, but it also extends into the Highland neighborhood under the Fixed Emission Scenario. It is stated in the HIA (page 55) that the 30 in a million contour extends about 600 feet into the Highland neighborhood under the Fixed Emission Scenario (See Figure 16 in the HIA or Figure 10 in Chapter 3 of the FEIS). Emission Scenario (See Figure 10).
- The ten in a million contour has a different shape than the 30 or 50 in a million contours and covers a larger area than either of those contours. The 10 in a million contour includes a portion of Longview and a portion Kelso along the Interstate 5 corridor. Larger tracts of residential land are included within this contour than are included within the 30 and 50 in a million contours (See Figures 6 and 10 in Chapter 3 of the FEIS).

The 10 in a million contour is significant because it is the level of risk considered to be "significant and adverse" in the FEIS. Based on this result, Section 5.6.8 of the FEIS concludes that the project would "represent an unavoidable and significant adverse impact". This conclusion appears to stand in contrast to the conclusion regarding cancer risk presented in the HIA in which the "Significance of Impact" for the cancer risk was found to be "Low" and notes that, "no additional mitigation measures have been recommended."

The levels of diesel exhaust in the air do not reach the U.S. EPA Reference Concentration (RfC) of 5 micrograms per cubic meter (HIA 2017,p.58). Accordingly, diesel emissions from the proposed project would not be expected to cause any non-cancer health effects.

3.2 Critical Evaluation of Exposure Estimation

Cancer risks were calculated using exposure assumptions that were very conservative for residential exposure settings and were unduly conservative for the workplace exposures that would typically be used to evaluate health risks for industrial areas. As noted in the FEIS (p.2-7) receptors were assumed to be exposed 24 hours per day for 70 years, and they were assumed to have a breathing rate at the 80th percentile (i.e., 302 liters per kilogram per day) of residential receptors. Both the FEIS and the HIA include acknowledgements that that these assumptions will overstate cancer risks even at residential locations.

These assumptions are conservative because a person would not be expected to stay at any specific location 24 hours per day, 7 days per week for 70 years. People would typically leave the house for a large part of the day to go to work or school and would be expected to leave the house on a typical weekday or weekend for any variety of reasons. Also, people typically leave the house for two weeks or so for vacation. The expectation that a person would live in the same house for 70 years is also highly unrealistic.

As noted above, risk contours estimated using the assumption that exposure will take place 24 hours per day for 70 years were drawn over both residential and industrial/commercial areas in the Longview/Kelso area. This presentation of results could easily mislead people who work in these commercial/industrial areas into thinking that they are exposed to cancer at the levels indicated by the risk contours shown in the various maps showing risk contours. Workplace exposures would be approximately 1/8th of the exposures on which the risk contours are based. This difference is based on the standard, conservative assumptions that a person works at the same location for 40 years and is at work 250 days per year and 8 hours per day (i.e., 40 years/70 years × 250 days/365 days × 8 hours/24 hours = 0.13). Applying this adjustment to the highest risk contour of 50 in a million shown in an industrial/ commercial area near the project would reduce the estimated risk of 50 in a million to 6.5 in a million, which is under the State's recommended risk limit of 10 in a million. Adjusting for such work place exposures is an accepted practice under Washington State air permitting practices[3,4]. It is not clear why a separate discussion of risks in residential areas and commercial/industrial areas was not presented in the HIA for the proposed coal terminal.

The Department of Ecology Guidance for their three-tier Health Impact Assessment process for evaluating new sources of air emissions notes that detailed guidance on the subject of exposure assessment can be obtained from a variety of sources including, U.S. EPA's Guidelines for Exposure Assessment[5] and Exposure Factors Handbook[6] and the California's Office of Environmental Health Hazard Assessment (OEHHA) Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, (2015, chapter five)[7]. For the residential exposure duration assumption, there is a big differences in the 70-year duration recommended in the OEHHA document and the 26-year exposure duration currently used by the U.S. EPA for the calculation of Regional Screening Levels for soil and indoor.[8] In addition, the U.S. EPA assumes a resident is at home 350 days per year, rather than 365 days per year. Using these still conservative U.S. EPA exposure assumptions, the estimated cancer risks would reduce the risks presented in the FEIS by a factor of 2.8 (i.e., 70 years/26 years × 365 days/350 days). Based on these conservative assumptions about residential exposure duration, the highest risk contour of 30 in a million shown in a residential area would be 11 in a million, which, because of the imprecision inherent in health risk assessment, is indistinguishable from an estimated risk of ten in a million.

3.3 Critical Evaluation of the Cancer Slope Factor Used in the Risk Assessment

As noted in the discussion of cancer risk in the FEIS and in the HIA, the Washington Department of Ecology adopted the cancer potency value developed by OEHHA in 1998 for purposes of evaluating cancer risk from diesel emission in Washington. Based on factors discussed below, this cancer potency value is highly uncertain and its use is controversial. It is also out of date, based on the availability of more recent studies. The basis of cancer potency value, the specific uncertainties associated with it, and reason it is out of date are discussed below.

In 1998, OEHHA evaluated the available epidemiology studies in the carcinogenicity of diesel exhaust and concluded that diesel exhaust is carcinogenic to humans and that available epidemiological (human) studies on occupational exposures to diesel exhaust were sufficient for

---

[3] Landau Associates. 2016. April 2016 Second-Tier Health Impact Assessment for Diesel Engine Exhaust Particulate Matter and Nitrogen Dioxide (Response to Incompleteness) Microsoft Oxford Data Center Quincy, Washington. April 8.
[4] Washington State Department of Ecology. 2016. 2nd Revised Health Impact Assessment Review Document for Microsoft MWH (formerly Oxford) Data Center, Quincy, Washington. September 27.
[5] United States Environmental Protection Agency (U.S. EPA). 1992. Guidelines for Exposure Assessment. Washington D.C. EPA/600/Z-92/001. May.
[6] United States Environmental Protection Agency (U.S. EPA). 2011. Exposure Factors Handbook. Washington D.C. EPA/600/R-09/052F.
[7] Washington Department of Ecology. Guidance Document - First, Second, and Third Tier Review of Toxic Air Pollution Sources (p. 19 of 34)
[8] https://www.epa.gov/risk/regional-screening-levels-frequent-questions-june-2017#Exposure

dose-response assessment and development of a unit risk factor (URF)[9]. A URF is the upper bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 microgram per cubic meter (µg/m^3) in air and is expressed in the units of inverse concentration, or (µg/m^3)$^{-1}$. For risk assessment purposes, the URF is used to estimate the upper-bound probability that an individual will develop cancer sometime in their lifetime as a result of exposure to a carcinogen. Based on available human studies, OEHHA staff developed URF estimates ranging from 1.3×10^{-4} to 1.5×10^{-3} (µg/m^3)$^{-1}$, and 3×10^{-4} (µg/m^3)$^{-1}$ was identified as "a reasonable estimate of unit risk expressed in terms of diesel particulate"[10]. The California Environmental Protection Agency (Cal/EPA) recommends use of the URF of 3×10^{-4} (µg/m^3)$^{-1}$ when conducting a risk assessment for diesel exhaust[11].

The URF estimates developed by OEHHA was based primarily on a study of U.S. railroad worker exposures to diesel exhaust and incidence of lung tumors (Garshick et al. 1988). The Garshick et al. (1988) study is a retrospective study of 55,407 white male railroad workers from across the U.S. who, in 1959, were working in one of 39 job groups based on Interstate Commerce Commission job codes, had between 10 and 20 years of railroad service, and were between the ages of 40 and 64. The follow up period in this study was from 1959 to 1980. The lung tumor incidence for these railroad workers was reported in Garshick et al.[12,13] and the estimated exposures were reported in Woskie et al.[14] OEHHA used these studies and others in a statistical analysis (meta-analysis) to calculate relative risks ranging from 1.04 to 1.57. A relative risk of 1 indicates no association between exposure and disease. In spite of the low relative risk, OEHHA concluded that the results of the meta-analysis indicated a consistent positive association between occupations involving diesel exhaust exposure and the development of lung cancer.

To estimate the URF, OEHHA assumed a background lifetime risk of lung cancer of 0.025 (no citation) and a range of exposure concentrations from the studies of between 5 and 500 µg/m^3, with a mean of about 200 µg/m^3. Then using only the highest 95% statistical upper confidence bound on excess relative risk from the meta-analysis (1.57-1.0 = 0.57), OEHHA estimated the corresponding URF by multiplying the background lifetime risk of 0.025 by the excess relative risk of 0.57 and dividing by the exposure-adjusted to a 24-hour lifetime daily average exposure in µg/m^3, assuming 45 years of occupational exposure, five days per week, 48 weeks per year, and that a worker inhales twice as much air in 24 hours while at work as in a single day while at home. Assuming an exposure to 200 µg/m^3, this resulted in a URF of 3×10^{-4} (µg/m^3)$^{-1}$, which is the "reasonable estimate" recommended by OEHHA.

---

9 Cal/EPA. 1998. *Part B: Health Risk Assessment for Diesel Exhaust*. Office of Environmental Health Hazard Assessment. Approved by the Scientific Review Panel on April 22.

10 Cal/EPA. 1998. *Finding of the Scientific Review Panel on The Report on Diesel Exhaust as adopted at the Panel's April 22, 1998, Meeting.*

11 Cal/EPA. 1999. *Air Toxics Hot Spots Program Risk Assessment Guidelines. Part II. Technical Support Document for Describing Available Cancer Potency Factors*. Office of Environmental Health Hazard Assessment. April.

12 Garshick E, Schenker M, Munoz A, Segal M, Smith T, Woskie S, Hammond S and Speizer F. 1987. A case-control study of lung cancer and diesel exhaust exposure in railroad workers. *Am Rev Respir Dis* 135:1242-1248.

13 Garshick E, Schenker MB, Munoz A, Segal M, Smith TJ, Woskie SR, Hammond SK, Speizer FE. 1988. A Retrospective Cohort Study of Lung Cancer and Diesel Exhaust Exposure in Railroad Workers. *Am Rev Respir Dis* 137:820-825.

14 Woskie, SR, Smith, TJ, Hammond, SK, Schenker, MB, Garshick, E, Speizer, FE. 1988. Estimation of the diesel exhaust exposures of railroad workers: I. Current exposures. American Journal of Industrial Medicine. Volume 13, Issue 3: 381-394.

3.3.1 The cancer potency factor used for the risk assessment is highly uncertain

The U.S. EPA[15], Health Effects Institute (HEI)[16], and Crump et al.[17] concluded that the Garshick et al. study, the principal study underlying the Cal/EPA URF, does not provide an adequate basis for quantitative risk assessment. Their conclusion was based on the limitations and uncertainties listed below:

- **Inadequate Exposure Data.** The single most important weakness in the Garshick et al. study is that it lacks data regarding the actual historical exposure of the individual worker to diesel exhaust (i.e., assigning who was exposed and who was not exposed). Instead, exposure estimates are based on reconstructions of historic dose; and these reconstructions of dose are based on job exposure categories, assumptions about exposure patterns, and a limited amount of industrial hygiene measurements. For example, Garshick did not classify shop workers in the exposed group, yet published information, and industrial hygienists familiar with work practices in railroad shops estimated that shop workers, who often worked in enclosed garages containing running trains, were a group exposed to at least twice the level of diesel exhaust as others in job classified as exposed (engineers and conductors).

  U.S. EPA[18] was particularly concerned about the potential misclassification of job categories exposure and described this factor as, "[t]he greatest uncertainty in estimating DE [diesel exhaust]-induced cancer risk from epidemiologic studies."

- **Lack of Control for Age and Calendar Year Adjustments.** The Garshick study did not adequately control for age and calendar year. The study lacked knowledge on when workers first began working with diesel equipment and the amount of time spent working in a given year (i.e., duration of exposure). Since both diesel exhaust exposure and lung cancer mortality are positively correlated with both age and calendar year, failing to control for these parameters can produce spurious positive correlations between exposure and lung cancer mortality.

  Of particular concern was that the Garshick study found that lung cancer risks among the exposed group actually decreased with increasing length of exposure – the opposite trend from what is expected for carcinogens.

- **Bias in Selection of Control and Associated Difficulty Controlling Smoking.** Use of case-control studies, such as the Garshick study, limit the ability to adequately account for the effect of smoking when trying to quantify a dose-response relationship between diesel exhaust and lung cancer.

---

[15] United States Environmental Protection Agency (U.S.EPA). 2002. *Health Assessment Document for Diesel Engine Exhaust (Final 2002)*. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/8-90/057F.

[16] Health Effects Institute (HEI). 1999. *Diesel Emissions and Lung Cancer: Epidemiology and Quantitative Risk Assessment; A Special Report of the Institute's Diesel Epidemiology Expert Panel*. Cambridge, Massachusetts, June.

[17] Crump KS, Lambert, T, Chen, C. 1991. Assessment of Risk from Exposure to Diesel Engine Exhaust Emissions. USEPA Contract 68-02-4601; Appendix B in USEPA, Health Assessment Document for Diesel Emissions. Volume 2, EPA-600/8-90/057Bb.

[18] United States Environmental Protection Agency (U.S.EPA). 2002. *Health Assessment Document for Diesel Engine Exhaust (Final 2002)*. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/8-90/057F.

The U.S. EPA[19] noted:

> *"Another major uncertainty associated with many of the [diesel exhaust] DE epidemiological studies was the inability to fully control for smoking effects, resulting in possible errors in estimating relative risk increases. Changes in adjustments for smoking could result in considerable changes in relative risk, because smoking has a much larger effect on relative lung cancer risk than is likely for DE. It is difficult to effectively control for a smoking effect in a statistical analysis because cigarette smoke contains an array of biologically active compounds and affects multiple steps of carcinogenesis, thus probably making smoking more susceptible to DE-induced lung cancer than are nonsmoker. A statistical analysis would not be able to adjust for such an effect without having a detailed record of smoking history of individual."*

- **Difficulty Controlling for Other Lifestyle Factors.** In addition to smoking, Garshick et al. did not adequately control for lifestyle factors (e.g., alcohol consumption) that confound attribution of diesel exposure to observed differences in lung cancer mortality between the groups of railroad workers.
- **Extrapolating Workplace Exposures to the General Public.** The degree to which work place exposures and responses can be extrapolated to the general public is a key uncertainty identified by U.S. EPA[20].

> *"A potential uncertainty involves the use of occupational worker data to extrapolate cancer hazard risk to the general population and sensitive subgroups. By sex, age, and general health status, workers are not fully representative of the general population. For example, there is virtually no information to determine whether infants and children, or people in poor health respond differently to [diesel exhaust] DE exposure than do workers."*

The findings of the Garshick et al. study, which examined exposures and responses to relatively high doses of diesel exhaust received by workers may not be relevant for the low levels typically encountered in the general population.

3.3.2 U.S. EPA has developed an approach to managing diessel exhaust risks

Consistent with Cal/EPA, the U.S. EPA[21] concluded that diesel exhaust is "likely to be carcinogenic to humans by inhalation." However, in contrast to Cal/EPA, U.S. EPA concluded that neither the animal nor epidemiology data available at the time was adequate to support a quantitative risk assessment (i.e., for the development of a unit risk factor [URF]). In the absence of a URF for quantitative risk assessment, U.S. EPA has applied a qualitative approach to evaluating potential exposures to diesel exhaust and promotes use of technology to reduce diesel emissions. The qualitative approach applied by U.S. EPA is intended to support technology-based reductions of diesel exhaust by providing a perspective of the range of

---

[19] United States Environmental Protection Agency (U.S.EPA). 2002. *Health Assessment Document for Diesel Engine Exhaust (Final 2002)*. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/8-90/057F.

[20] United States Environmental Protection Agency (U.S.EPA). 2002. *Health Assessment Document for Diesel Engine Exhaust (Final 2002)*. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/8-90/057F.

[21] Ibid

possible lung cancer risks from environmental exposures to diesel exhaust by considering environmental levels and exposures relative to occupational settings.

3.3.3 The cancer slope factor used by the Department of Ecology is out of date

In November 2015, the Health Effects Institute (HEI) released Special Report 19, *Diesel Emissions and Lung Cancer: An Evaluation of Recent Epidemiological Evidence for Quantitative Risk Assessment*. This documents reports the findings of the HEI review and analysis of two recent epidemiological studies of mine and trucking worker exposures to diesel exhaust. The two studies examined by HEI included: the Diesel Exhaust *in Miners Study (DEMS) conducted by the National Cancer Institute (NCI) and the National Inst*itute for Occupational Safety and Health (NIOSH) and the Trucking Industry Particle Study (Truckers) led by a team of researchers at Boston VA Healthcare System, Brigham and Women's Hospital, and Harvard T.H. Chan School of Public Health. The DEMS studied a cohort of more than 12,000 male U.S. nonmetal miners and the Truckers study examined a cohort of about 31,000 male workers employed in the unionized U.S. trucking industry.

Following the 2012 decision by the International Agency for Research on Cancer (IARC) to categorize diesel exhaust as a known human carcinogen, U.S. EPA and industry asked HEI to assess whether the DEMS and Trucker studies, which played a central role in IARC's decision, could be used for quantitative risk assessment. In their report, HEI concluded that the studies "made considerable progress toward addressing the deficiencies that HEI had identified in the utility of earlier epidemiological research studies of diesel exhaust for quantitative risk assessment" and could "lay the groundwork for a systematic characterization of the exposure-response relationship and associated uncertainties in a quantitative risk assessment." However, HEI also recognized a number of limitations, or sources of uncertainty, in each of the studies that warrant consideration in their use for quantitative risk assessment. For example, given the limited availability of actual measurements of exposures in both studies, the actual exposures experienced cannot be known with certainty. HEI further noted that efforts to apply these studies to estimate human risk from exposure to current environmental diesel exhaust levels should consider these limitations, and that current levels of diesel exhaust are expected to be lower than those reported in the studies due to newer diesel technology engines.

Since the 2015 publication of the HEI report, the U.S. EPA has not developed an updated cancer potency factor (or URF) for diesel exhaust; and California has not updated their potency factor.

3.4 Evaluating the Significance of the Estimated Risks

The significance of the potential health risks estimated for diesel exhaust can be evaluated and put into perspective in a variety of ways. One way is to compare estimated risks to regulatory limits and criteria. A second way is to compare estimated risks from a chemical or mixture emitted from a particular source to the estimated risk associated with background levels of the same chemical or mixture to understand the relative increase in risk posed by the particular source. A third approach applicable to evaluating increased cancer risk is to compare the estimated cancer risk from a particular source to the background cancer incidence in the population. Finally, a way to help put the health risks estimated for a new or unfamiliar source of emission is to compare the estimated risks to the health risks associated with a familiar source of emissions. All four of these approaches have been applied to the health risks estimated for the proposed Coal Export Terminal.

Because the health risk assessment is being performed in support of the EIS for the project, the critical evaluation of health risks appears to be an evaluation of the significance of impact under the Washington State Environmental Policy Act (SEPA); and under SEPA, an impact is considered significant if there is a "... reasonable likelihood of more than a moderate adverse impact on environmental quality" (WAC 197-11-794). As noted above, the Department of Ecology Stated in the FEIS that a cancer risk impact will be considered significant if the lifetime incremental cancer risk is estimated to be greater than 10 in a million; and the 10 in a million limit is adopted from the risk limits for new stationary sources (WAC 173-460-190). Although, under the State's three-tier HIA process, projects that do not meet the 10 in a million criterion may still be approved if the Director of the Department of Ecology makes certain findings, such as Best Available Control Technology for Air Toxics (tBACT), have been applied. Another consideration is whether the project may offer counterbalancing health benefits, an evaluation that would be based on data and results presented in the HIA. In addition, it may be possible to propose emission reductions from off-site emissions[22]. Understanding the conservative nature and degree of uncertainty associated with the cancer risk estimate would be a critical consideration in the balancing of health benefits and health risks associated with a project and in identifying any counterbalancing emission reduction options.

The authors of the FEIS put the estimated risk associated with diesel emissions from the project into perspective by comparing them to the estimated risk associated with background levels of diesel emissions in Cowlitz County. They estimated the cancer risk associated with background levels of diesel exhaust by using the cancer slope factor and conservative exposure assumptions discussed above. (The cancer slope factor of 1.1 $[\text{mg/kg-d}]^{-1}$ can also be expressed as a unit risk factor of 3×10^{-4} $[\mu\text{g/m}^3]^{-1}$). Applying the OEHHA 2003 methods reportedly used in the FEIS[23], and the average diesel exhaust concentration of 1.14 $\mu\text{g/m}^3$ in Cowlitz county cited in the FEIS, GSI estimated a cancer risk of 379 in a million, which would be reported as 400 in a million following rounding to one significant figure. While the statements in the FEIS and HIA that an incremental risk of 30 in a million from project emissions would represent an 8 percent increase above the background risk of 300 in a million, it is also true that such an increment is so small as to be within rounding error of the background risk estimate.

Comparing the incremental risk associated with diesel emissions from the project background levels in Cowlitz County provides a valuable reference point for understanding the relative risk posed by the project. Another point of comparison is the diesel exhaust levels in the more urban Snohomish and King Counties where average reported diesel exhaust levels are 2.2 and 2.28 $\mu\text{g/m}^3$, respectively[24]. Using the same cancer potency factor and exposure assumptions as were used as the basis for the estimated background cancer risk for Cowlitz County results in estimated background cancer risks of 730 and 758 in a million for Snohomish and Kings Counties, respectively.

---

[22] *Washington Department of Ecology. 2015. Guidance Document. First, Second, and Third Tier Review of* Toxic Air Pollution Sources (Chapter 173-460 WAC). September 2010 (Revised August 2015).

[23] The FEIS cited following OEHHA's (2003) Air Toxics Hot Spots Program Guidance Manual and assumed a breathing rate of 302 L/kg/day, exposure time of 24 hours per day, and exposure duration of 70 years. Based on these methods and assumptions, the FEIS reported that the average Cowlitz County diesel concentration of 1.14 $\mu\text{g/m}^3$ corresponds to a cancer risk of 300 in a million. The difference between the cancer risks reported in the FEIS and the risk estimated by GSI using the same methodology may be attributable to a modification that was not disclosed in the FEIS report.

[24] United States Environmental Protection Agency (U.S. EPA). 2015. National Air Toxics Assessment (NATA) Database. Based on 2011 data.

Another useful point of reference can be made by comparing the incremental cancer risk associated with the project to the lifetime risk of being diagnosed with cancer. As reported by the American Cancer Society[25], 40% of Americans will be diagnosed with some form of cancer in their lifetime. This can also be expressed as a lifetime cancer risk of 400,000 in a million. A lifetime incremental cancer risk of 30 in a million would result in an estimated lifetime cancer risk of 400,030 in a million. As noted in the HIA, such a comparison must be evaluated with caution because the lifetime cancer risk of 400,000 in a million is based on actual report of cancer, while the estimated incremental risk of 30 in a million is an upper-bound estimate of risk based on conservative estimates of risk and the cancer potency of diesel particulates discussed above.

4.0 SUMMARY OF OPINIONS

1. Non-cancer risks for diesel emissions estimated to be present in the air in the vicinity of the terminal are below levels that would be expected to cause any adverse health effects.
2. The Final Environmental Impact Statement (FEIS) for the terminal over-states and mischaracterizes relative risks as a 10 percent (%) increase.
3. The Health Impact Assessment (HIA) for the terminal more accurately characterizes the relative cancer risk as low.
4. Cancer risks for diesel emissions estimated to be present are not significant.

[25] American Cancer Society. 2017. Lifetime Risk of Developing or Dying from Cancer.