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Technical Support Document for the Third Tier Petition

for

Microsoft Columbia Data Center Expansion Project
Quincy, Washington

August 20, 2010

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1. EXECUTIVE SUMMARY

The Microsoft Corporation (Microsoft) proposes to expand their Columbia Data Center located in Grant County in Quincy, Washington. The expansion project will consist of three buildings to house server equipment and 13 diesel-powered backup engine-generator sets each rated at 2,740 mechanical kilowatts (kWm). The engines will be housed in separate enclosures. A smaller 111 kWm diesel engine will provide power to an emergency fire pump.

Potential emissions of diesel engine exhaust particulate matter (DEEP) from the proposed backup engines exceeded a regulatory trigger level called an Acceptable Source Impact Level (ASIL). The project was therefore required to submit a second tier petition per Chapter 173-460 Washington Administrative Code (WAC).

Due to the relatively close geographic proximity of existing and planned large data centers in Quincy, the Washington State Department of Ecology (Ecology) has determined that a community-wide approach for permitting data centers is warranted for the Quincy urban growth area (UGA). The community-wide approach considers the cumulative impacts of DEEP, which includes consideration of background emissions from existing permitted data centers and other sources of DEEP.

Microsoft retained ICF International (ICF) to prepare a health impact assessment (HIA) to evaluate the potential health risks attributable to operation of the diesel-powered generators and fire pump from the expansion project. The HIA demonstrated that emissions of DEEP from the proposed expansion alone could result in an increased cancer risk of up to 2 in one million (2×10^{-6}). The maximum cumulative health risk after adding Ecology's estimate of existing DEEP risk from on-road, non-road, and existing data center emissions is 30 in one million (3×10^{-5}).

While Microsoft's proposed Columbia Data Center expansion alone results in increased health risks within the range that Ecology may approve for proposed new sources of Toxic Air Pollutants (TAPs) under the second tier review provisions of WAC 173-460-090(7), the cumulative health impact from proposed and existing sources of DEEP necessitate a third tier risk management decision in accordance with WAC 173-460-100. The third tier review process allows Ecology to consider Microsoft's request to reduce allowable DEEP emissions from their existing data center in Quincy, thereby reducing the overall risk from exposure to DEEP emitted by Microsoft's data center operations in Quincy.

After technical review of Microsoft's HIA, the modeled DEEP concentrations, and other supporting information, Ecology has determined that the estimated cumulative health risks from DEEP exposure as a result of Microsoft's proposed expansion are acceptable. Ecology also evaluated a proposal from Microsoft to reduce allowable emissions from their existing data center. Ecology estimated that DEEP concentrations in areas immediately surrounding Microsoft's Quincy northern property boundary could be reduced by a factor of up to 49 percent if Ecology agrees to this enforceable limit. Microsoft's total allowable facility-wide DEEP emissions could also be reduced by approximately 50 percent.

In summary, Ecology determined that the cumulative health risks from DEEP exposure as a result of Microsoft's proposed expansion project are acceptable, and the proposed maximum annual facility-wide fuel usage reduction would result in a greater environmental benefit to the state of Washington. Therefore, Ecology recommends approval of the proposed project.

This document describes the technical review performed by Ecology.

2. MICROSOFT COLUMBIA DATA CENTER

2.1. Microsoft's Exisiting Data Center (Phases CO1 and CO2)

Microsoft submitted a Notice of Construction (NOC) application to Ecology's Eastern Regional Office (ERO) on October 23, 2006, for the installation of the Columbia Data Center (Phases CO1 and CO2) located at 501 Port Industrial Parkway, Quincy, in Grant County. ERO approved the NOC application through Order No. 07AQ-E230, issued on August 8, 2007.

Construction of the data center was completed in 2007-2008. The data center was constructed on a 70+ acre property among industrial-zoned parcels within the city of Quincy's urban growth boundary (Figure 1). The Burlington Northern Santa Fe (BNSF) rail line bounds the property to the south, and D Street NW bounds the property to the north. Land use surrounding the Microsoft property includes agricultural, industrial, commercial, and residential.

Microsoft requires uninterrupted electrical power supply for computer servers inside the data center buildings. While the main power supply to the facility is generally reliable, other sources of electrical power, such as backup diesel engines, are needed in the event of a power interruption.

The Columbia Data Center currently consists of twenty-two (22) Caterpillar Model 3516C-TA diesel-powered backup generators with a combined 100 percent standby rating of 55 electric megawatts (MWe). Microsoft plans, and already has the approval, to install two more 2.5-MWe Caterpillar Model 3516C-TA diesel-powered backup generators. The data center also has a total of 36 evaporative cooling tower units, and associated support equipment such as fuel tanks, cooling water storage and treatment, and electrical systems. The diesel engines are used to provide emergency backup electrical power to the data center when Grant County PUD's hydroelectric power grid is interrupted. Each engine is permitted to operate for up to 285 hours per year on average, and the total facility diesel fuel usage is limited to 890,021 gallons per year and 77,407 gallons per day of ultra-low sulfur diesel fuel.

2.2. Microsoft Columbia Data Center Proposed Expansion Project (Phases CO3.2 (Phase 1), CO3.1 (Phase II), and CO3.3 (Phase II))

Microsoft proposes to expand their existing data center complex in Quincy, Washington. The proposed Columbia Data Center expansion project, located in the southeast corner of Microsoft's

70+ acre property in Quincy, WA (Figure 2), will consist of three phases, CO3.2 (Phase I), CO3.1 (Phase II), and CO3.3 (Phase II). This proposed expansion will include three buildings to house server equipment, thirteen 2.5 MWe Caterpillar 3516C diesel engines, and a small 149 brake horsepower (111 kWm) diesel-fired emergency fire pump (ICF 2010).

Figure 1. Microsoft Data Center and Proposed Expansion Location, Quincy, WA

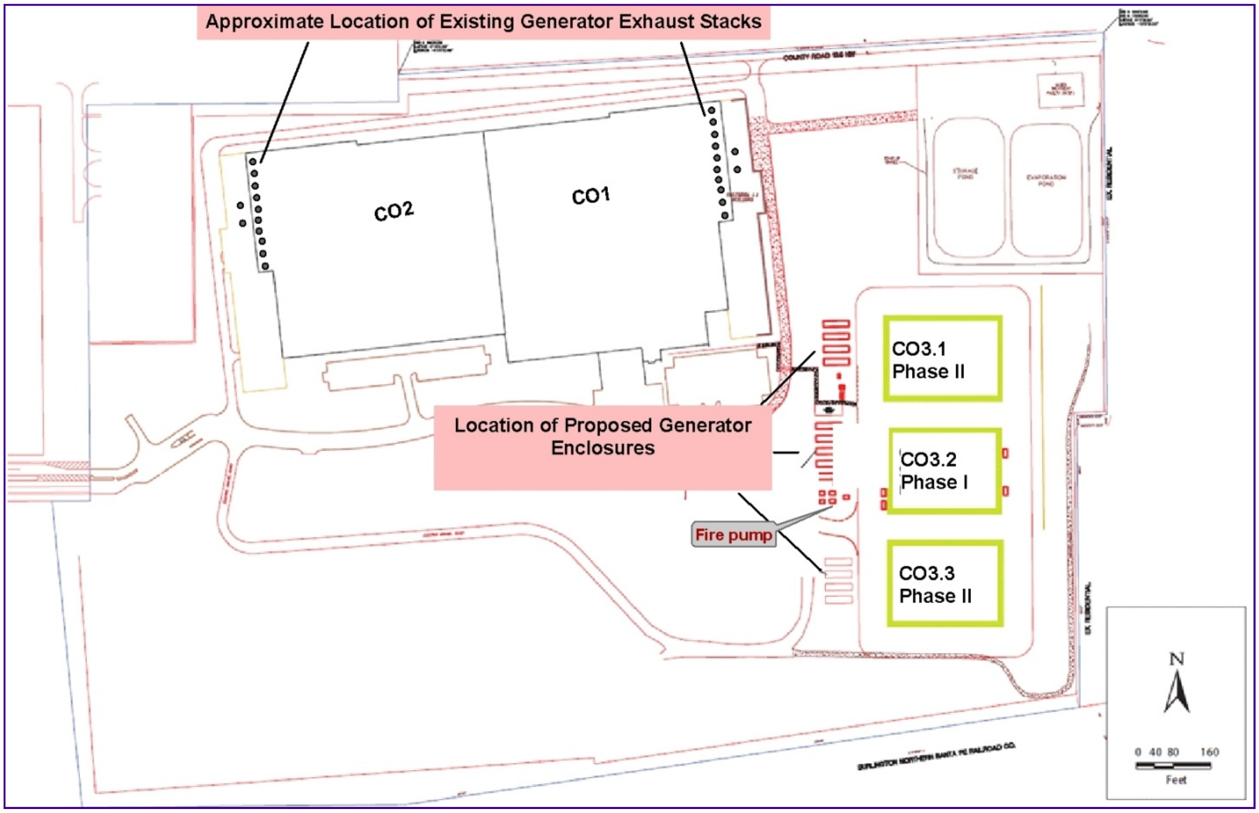

Figure 2. Site plan drawing showing general location of air emission units.

The 13 engines will be installed in stages: five engines in 2010 (CO3.2 (Phase I)), four engines in 2011 (CO3.1 (Phase II)), and the remaining four engines in 2011 or 2012 (CO3.3 (Phase II)). The engines will be located in separate generator enclosures. Exhaust from each engine will be routed through a 31-foot vertical exhaust stack, penetrating through the roof of the generator enclosure.

In order to minimize air quality impacts from the proposed project, Microsoft agreed to limit the duration of engine testing, maintenance and other usage. Each of the thirteen 2.5 MWe Caterpillar 3516C diesel engines will be tested for an average of 12 hours per year (Table 1). Additionally, Microsoft will run each engine for up to 44 hours per year for storm avoidance and “electrical bypass,” to minimize electrical upset conditions, and no more than 48 hours per year during power outage emergencies. The fire pump will be tested for 12 hours per year and up to 48 hours per year for emergencies. In total, Microsoft estimates that a fuel usage limit of up to 139,493 gallons of diesel per year will provide enough fuel for operating durations shown in Table 1.

Table 1. Operating Time Limits for Microsoft's Proposed Columbia Data Center Expansion Project Diesel-Powered Emergency Generators

Generator	Event	Frequency	Hours/Event	Engine Load (kWm)	Total Maximum kWm-hr/yr	Total Maximum kWm-hr/yr
Each of the 13 Caterpillar Model 3516C (2,740 kWm) Diesel-Powered Generators	Routine Testing	1 x per month	1	370	12	57,720
	Storm	As needed	As needed	1,153	44	659,516
	Outage	As needed	As needed	12 eng. @ 2,300; 1 eng. @ 370	48	1,342,560
	Combined Testing, Storm Advance + Outage				104	2,059,796
Fire Pump 111 kWm	Routine Testing	1 x per month	1	11	12	133
	Outage	As needed	As needed	89	48	4,262
	Combined Testing + Outage				60	4,395
Total kWm-hr/yr						**2,064,191**

2.3. Reductions of Emissions From the Existing Columbia Data Center CO1 and CO2 Emission Units

During the NOC permit review process for Microsoft's Columbia Data Center expansion project, Microsoft offered to reduce the allowable emissions from their existing data center's twenty-four (24) Caterpillar Model 3516C-TA diesel-powered generators. The diesel engines were originally permitted to operate at full standby for up to 285 hours per year per engine on average, and a facility-wide diesel fuel consumption limit of 890,021 gallons per year (Table 2). As part of the Columbia Data Center expansion project proposal, Microsoft agreed to reduce their existing data center's maximum annual diesel fuel consumption from 890,021 to 300,000 gallons per year.

Even with 13 additional engines in the proposed expansion CO3.2 (Phase I), CO3.1 (Phase II), and CO3.3 (Phase II)), Microsoft's allowable facility-wide fuel consumption will decrease from 890,021 gallons per year to 439,493 gallons per year. This reduction in allowable fuel consumption translates into a 50 percent net decrease in the amount of DEEP emissions allowed from the facility.

Table 2. Microsoft's Maximum Annual Fuel Usage

Project	Historical Allowed Fuel Usage (gallons per year)	Proposed Allowed Fuel Usage (gallons per year)	Percent Reduction (total)
CO 1 & 2	890,021	300,000	66.3%
CO3.2 (Phase I), CO3.1 (Phase II), & CO3.3 (Phase II)	-	139,493	
Total	890,021	439,493	50.6%

3. PERMITTING NEW SOURCES OF TOXIC AIR POLLUTANTS

3.1. Overview of the Regulatory Process

The requirements for performing a toxics screening are established in Chapter 173-460 WAC. This rule requires a review of any non-de minimis[1] increase in toxic air pollutant emissions for all new or modified stationary sources in the state of Washington. Sources subject to review under this rule must apply best available control technology for toxics (tBACT) to control emissions of all toxic air pollutants subject to review.

There are three levels of review when processing a Notice of Construction application for a new or modified emissions unit emitting TAPs in excess of the de minimis levels: (1) first tier (toxic screening), (2) second tier (health impact assessment), and (3) third tier (risk management decision).

All projects with emissions exceeding the de minimis levels are required to undergo a toxics screening (first tier review) as required by WAC 173-460-080. The objective of the toxics screening is to establish the systematic control of new sources emitting toxic air pollutants in order to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality to protect human health and safety. If modeled emissions exceed the trigger levels called acceptable source impact levels (ASILs), a second tier review is required.

As part of a second tier petition, described in WAC 173-460-090, the applicant submits a site-specific HIA. The objective of a HIA is to quantify the increase in lifetime cancer risk for persons exposed to the increased concentration of any carcinogen, and to quantify the increased health hazard from any non-carcinogen that would result from the proposed project. Once quantified, the cancer risk is compared to the maximum risk allowed for a second tier petition,

[1] If the estimated increase of emissions of a TAP or TAPs from a new or modified project is below the de minimis emissions threshold(s) found in WAC 173-460-150, the project is exempt from review under Chapter 173-460 WAC.

which is 10 in one million[2], and the concentration of any non-carcinogen that would result from the proposed project is compared to its effect threshold concentration.

In evaluating a second tier petition, background concentrations of the applicable pollutants must be considered. If the emissions of a toxic air pollutant result in an increased cancer risk of greater than 10 in one million (equivalent to one in one hundred thousand), then an applicant may request Ecology perform a third tier review. For non-carcinogens, a similar path exists, but there is no bright line associated with when a third tier review is triggered.

A third tier review is a risk management decision in which Ecology makes a decision that the risk of the project is acceptable based on a determination that emissions will be maximally reduced through available preventive measures, assessment of environmental benefit, disclosure of risk at a public hearing and related factors associated with the facility and the surrounding community.

Microsoft's proposed Columbia Data Center expansion was required to submit a third tier petition to Ecology because the cumulative health impact from the proposed data center and other existing sources of DEEP necessitated a third tier risk management decision in accordance with WAC 173-460-100.

3.2. tBACT for the Microsoft Columbia Data Center Expansion Project

For this project, Ecology's ERO determined that tBACT for DEEP is restricted operation of the EPA Tier-2 certified engines and compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII.

The project review team for the third tier review concurs with this tBACT determination.

3.3. First Tier Review Toxics Screening for the Microsoft Columbia Data Center Expansion Project

Microsoft's consultant, ICF International (ICF) used EPA emission factors and EPA Tier-2 engine emission limits to estimate emission rates of toxic air pollutants from Microsoft's diesel-powered generators (ICF 2010). Table 3 shows each TAPs proposed emissions compared to its respective small quantity emission rate (SQER).[3] DEEP, nitrogen dioxide, benzene, and acrolein emission rates exceed their respective SQER.

[2] WAC 173-460-090(7)
[3] An SQER is an emission rate that is not expected to result in off-site concentration that exceeds an ASIL.

Table 3. Comparison of Emission Rates to SQER

Pollutant	Averaging Period	Total Emissions	SQER	Emissions Above SQER
		See Averaging Period for Units	See Averaging Period for Units	Yes or No
Acetaldehyde	lb/yr	0.5	71	No
Acrolein	lb/24-hr	0.05	0.00789	**Yes**
Benzene	lb/yr	15.5	6.62	**Yes**
Benzo(a)pyrene	lb/yr	0.003 0.01 (TEQ)	0.174	No
1,3-Butadiene	lb/yr	0.4	1.13	No
DEEP	lb/yr	910	0.639	**Yes**
Formaldehyde	lb/yr	1.6	32	No
Nitrogen Dioxide	lb/hr	37.8	1.03	**Yes**
Toluene	lb/24-hr	1.7	657	No
Xylenes	lb/24-hr	1.2	29	No

TEQ – toxic equivalent (sum of releative toxicity of several polycyclic aromatic hydrocarbons similar to benzo(a)pyrene.

ICF used refined dispersion modeling (briefly described in Section 4.2.2) to model ambient concentrations of those TAPs that exceed their SQER. Table 4 shows a comparison of the modeled concentrations of pollutants that exceeded SQERs to their respective ASILs. DEEP exceeded its ASIL, therefore, Microsoft was required to prepare a HIA (second tier analysis).

3.4. Second Tier Review of the Columbia Data Center Expansion Project

As stated above, potential DEEP emissions from the proposed expansion exceeded its ASIL. As a result, Microsoft prepared and submitted to Ecology a HIA (second tier analysis). Based on Ecology's review of the second tier analysis and evaluation of prevailing background DEEP concentrations in the Quincy area, Ecology determined that Microsoft's second tier analysis for the expansion project could not be approved without a third tier risk management decision in accordance with WAC 173-460-100. Therefore, Ecology decided to review Microsoft's second tier analysis as a third tier review petition, which involves a detailed assessment of proposed emissions controls and environmental benefits of the project, as well as disclosure of expected health risks from the project at a public hearing.

Table 4. Comparison of Modeled Off-Site TAP Concentrations to ASILs

Pollutant	CAS #	Averaging Time	Highest Modeled Off-Site Concentration (µg/m^3)	ASIL (µg/m^3)
DEEP	--	Annual (70-yr)	0.016	0.00333
Nitrogen Dioxide	10102-44-0	1-hr	359	470
Benzene	71-43-2	Annual	0.0013	0.0345
Acrolein	107-02-8	24-hr	0.007	0.06

3.5. The Third Tier Review and the Community-Wide Approach

Between 2006 and 2008, Ecology permitted the construction of three data centers in Quincy, WA. Each data center installed multiple large backup diesel-powered generators to be used during power failures. In total, the three existing data centers currently operate a total of 46 diesel-powered generators each rated at 2.0 MW electrical generating capacity or higher.

When Ecology permitted these facilities in 2006-2007, DEEP was not regulated as a toxic air pollutant under Chapter 173-460 WAC, Controls for Toxic Air Pollutants. In June 2009, Ecology revised Chapter 173-460 WAC, and began regulating DEEP as a toxic air pollutant along with a number of other new pollutants. The revised rule established an ambient trigger level or ASIL for DEEP of 0.00333 µg/m^3 above which predicted ambient concentrations of DEEP are subject to second tier review. Primarily because DEEP was not previously regulated, the existing data center permits allowed more hours of operation and fuel use than would likely be permitted under this revised rule.

On March 25, 2010, the governor signed into law a bill (ESSB 6789)[4] passed by the Washington legislature to promote the development of additional data centers in rural Washington. The final law gives anyone who starts constructing a data center between April 1, 2010 and July 1, 2011, an exemption from the sales tax for server equipment and power infrastructure. Among other requirements, eligible data centers have to be located in a rural county; cover at least 20,000 square feet dedicated to servers, and completed by April 1, 2018.

The passage of this *Computer Data Centers – Sales and Use Tax Exemption* Act of 2010 prompted much interest from companies wanting to build new data centers in Quincy and other parts of central and eastern Washington.

Given the serious interest in building several more data centers clustered within the Quincy, WA UGA, and the potential for overlapping DEEP plumes, Ecology's Air Quality Program (AQP) recognized the need to consider the cumulative impacts of new and existing data centers on a

[4] http://apps.leg.wa.gov/documents/WSLdocs/2009-10/Pdf/Bills/Session%20Law%202010/6789-S.SL.pdf

community-wide basis.[5] Therefore, a third tier decision will be used by Ecology to consider the approval of Microsoft and each subsequent company's proposal to construct data centers in the Quincy UGA.

Under the community-wide risk evaluation approach, Ecology estimated background DEEP concentrations by modeling contributions from:

- The existing data centers assuming each of the data centers was operating at their allowed maximum rate; and
- Other known sources of DEEP in the Quincy area.

Section 4 of this document summarizes Ecology's review of Microsoft's HIA, and presents results of our evaluation of background DEEP concentrations in Quincy.

3.5.1. Third Tier Review Processing Requirements

In order for Ecology to review the health impact assessment (HIA) for third tier decision and review, each of the following regulatory requirements under Chapter 173-460-090 and Chapter 173-460-100 must be satisfied:

(a) The local permitting authority, Ecology's ERO, has determined that other conditions for processing the Notice of Construction Order of Approval (NOC) have been met, and has issued a preliminary approval order.

(b) Emission controls contained in the preliminary NOC approval order represent at least tBACT.

(c) The applicant has developed a HIA protocol that has been approved by Ecology.

(d) The ambient impact of the emissions increase of each TAP that exceeds acceptable source impact levels has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol.

(e) The third tier review petition contains a HIA conducted in accordance with the approved HIA protocol.

ERO submitted items (a) and (b) above to Ecology on August 4, 2010. Ecology waived the requirement for developing a HIA protocol for this project (item (c)) because the applicant's consultant had recently developed HIAs for other similar data centers in Washington. Ecology

[5] Basis for estimating cumulative diesel engine exhaust particulate emissions health risk impacts in Quincy, WA, under the third tier petition procedure specified in WAC 173-460-100. Department of Ecology's Air Quality Program Position Paper, August 2010.

received the HIA (item (e)) on May 19, 2010. The project review team found the refined modeling conducted by Microsoft to be acceptable. The applicant has therefore satisfied all of the five requirements above.

3.5.2. Third Tier Review Approval Criteria

Ecology's director approves all third tier petitions. As specified in WAC 173-460-100(3), Ecology's director must find that the following conditions are met before approving a third tier petition:

(a) Proposed emission controls represent at least tBACT.

(b) A health impact assessment has been completed as described in WAC 173-460-090(3).

(c) Approval of the project will result in a greater environmental benefit to the state of Washington.

The remainder of this document discusses the HIA review performed by Ecology.

4. HEALTH IMPACT ASSESSMENT

The HIA reviewed by Ecology was conducted according to the requirements of WAC 173-460-090. It addressed the public health risk associated with exposure to DEEP emissions from Microsoft's proposed diesel-powered emergency generators and existing sources of DEEP in Quincy, Washington. A consultant (ICF International) for Microsoft prepared the HIA.

While the HIA is not a complete risk assessment, it loosely follows the four steps of the standard HIA approach proposed by the National Academy of Sciences (NAS, 1983, 1994). These four steps are: (1) hazard identification, (2) exposure assessment, (3) dose-response assessment, and (4) risk characterization.

4.1. Hazard Identification

Hazard identification involves gathering and evaluating toxicity data on the types of health injury or disease that may be produced by a chemical and on the conditions of exposure under which injury or disease is produced. It may also involve characterization of the behavior of a chemical within the body and the interactions it undergoes with organs, cells, or even parts of cells. This information may be of value in determining whether the forms of toxicity known to be produced by a chemical agent in one population group or in experimental settings are also likely to be produced in human population groups of interest. Note that risk is not assessed at this stage. Hazard identification is conducted to determine whether and to what degree it is scientifically correct to infer that toxic effects observed in one setting will occur in other settings (e.g., are chemicals found to be carcinogenic or teratogenic in experimental animals also likely to be so in adequately exposed humans?).

Diesel engines emit very small fine (<2.5 micrometers [µm]) and ultrafine (<0.1 µm) particles. These particles can easily enter deep into the lung when inhaled. Mounting evidence indicates that inhaling fine particles can cause numerous adverse health effects.

Studies of humans and animals specifically exposed to DEEP show that diesel particles can cause both acute and chronic health effects including cancer. Ecology has summarized these health effects in "Concerns about Adverse Health Effects of Diesel Engine Emissions" available at http://www.ecy.wa.gov/pubs/0802032.pdf.

The following health effects have been associated with exposure to diesel particles:

- Inflammation and irritation of the respiratory tract
- Eye, nose, and throat irritation along with coughing, labored breathing, chest tightness, and wheezing
- Decreased lung function
- Worsening of allergic reactions to inhaled allergens
- Asthma attacks and worsening of asthma symptoms
- Heart attack and stroke in people with existing heart disease
- Lung cancer and other forms of cancer
- Increased likelihood of respiratory infections
- Male infertility
- Birth defects
- Impaired lung growth in children

It is important to note that the estimated levels of Microsoft-related DEEP emissions that will potentially impact people will be much lower than levels associated with many of the health effects listed above. For the purpose of determining whether or not Microsoft's project-related and community-wide DEEP impacts are acceptable, Ecology calculates and presents numerical estimates of exposure and risk in the remaining sections of this document.

4.2. Exposure Assessment

Exposure assessment involves estimating the extent that the public is exposed to a chemical substance emitted from a facility. This includes:

- Identifying routes of exposure.
- Estimating off-site pollutant long-term and/or short-term concentrations.

- Identifying exposed receptors.
- Estimating the duration and frequency of receptors' exposure.

4.2.1. Identifying Routes of Potential Exposure

Humans can be exposed to chemicals in the environment through inhalation, ingestion, or dermal contact. The primary route of exposure to most air pollutants is inhalation; however, some air pollutants may also be absorbed through ingestion or dermal contact. Ecology uses guidance provided in California's Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments to determine which routes and pathways of exposure to assess for chemicals emitted from a facility (CalEPA, 2003). Table 5 shows a table of chemicals for which Ecology assesses multiple routes and pathway of exposure. In the case of Microsoft's emergency generators, Ecology will evaluate only inhalation exposure to DEEP.

Table 5. California's Air Toxics Hotspots Risk Assessment Guidance on Specific Pathways to be Analyzed for Each Multi-Pathway Substance

Substance	Ingestion Pathway									
	Soil	Dermal	Meat, Milk & Egg	Fish	Exposed Vegetable	Leafy Vegetable	Protected Vegetable	Root Vegetable	Water	Breast Milk
4,4'-Methylene dianiline	X	X		X	X	X	X	X	X	
Creosotes	X	X	X	X	X	X			X	
Diethylhexylphthalate	X	X		X	X	X	X	X	X	
Hexachlorocyclohexanes	X	X		X	X	X			X	
PAHs	X	X	X	X	X	X			X	
PCBs	X	X	X	X	X	X	X	X	X	X
Cadmium & compounds	X	X	X	X	X	X	X	X	X	
Chromium VI & compounds	X	X	X	X	X	X	X	X	X	
Inorganic arsenic & compounds	X	X	X	X	X	X	X	X	X	
Beryllium & compounds	X	X	X	X	X	X	X	X	X	
Lead & compounds	X	X	X	X	X	X	X	X	X	
Mercury & compounds	X	X		X	X	X	X	X	X	
Nickel	X	X	X		X	X	X	X	X	
Fluorides (including hydrogen fluoride)	To be determined									
Dioxins & furans	X	X	X	X	X	X	X		X	X

4.2.2. Estimating Pollutant Concentrations

Microsoft's DEEP emissions will be carried by the wind and possibly impact people living and working in the immediate area. The level of DEEP in off-site air depend in part on how much DEEP is emitted, the wind direction, and other weather-related variables at the time the pollutants are emitted. To estimate where DEEP will disperse after it is emitted from

Microsoft's generators, ICF conducted air dispersion modeling. Air dispersion modeling incorporates emissions, meteorological, geographical and terrain information to estimate pollutant concentrations downwind from a source.

ICF used the following model and inputs to estimate ambient impacts:

- American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD, Version 09292) with Plume Rise Model Enhancements (PRIME) algorithm for building downwash.
- Five years sequential hourly meteorological data from Moses Lake Airport (2001-2005).
- Twice-daily upper air data from Spokane (2001-2005) to define mixing heights.
- Quincy area digital elevation model (DEM) files (which describe local topography and terrain).
- Quincy area digital land classification files (which describe surface characteristics).
- Each generator was modeled with a stack height of 31feet above local ground level and a stack inside diameter of 18 inches (0.457 meters). Engine load-specific exhaust gas temperature and velocity were used.
- The receptor grid for the AERMOD modeling domain was established using a 10-meter grid spacing along the facility boundary extending to a distance of 300 meters from each facility boundary. A grid spacing of 25 to 50 meters was used for distances more than 300 meters from the boundary.

4.2.3. Identifying Potentially Exposed Receptors

As described in Section 3.2, the proposed Microsoft campus is located among industrial-zoned properties, but several different land uses are located within the vicinity of Microsoft's property. ICF identified locations where people could be exposed to project-related DEEP. Typically, Ecology considers exposures occurring at maximally exposed boundary, residential, and commercial areas to capture worst-case exposure scenarios. In this case, ICF identified these locations and other nearby receptors to include school and church receptors. While Ecology does not consider exposures at the school and church to represent worst-case scenarios, Ecology considers their exposures to reflect the evaluation performed by ICF.

Table 6 shows maximally exposed receptors of different types and the distance from Microsoft's proposed expansion.[6] These receptors represent the worst-case scenarios associated with

[6] Distances were approximated from the 3rd (middle) engine associated with Columbia Data Center Phase 3.1.

different types of land uses in the area. This table also shows the estimated average exposure concentration at each maximally exposed receptor.

Table 6. Maximally Exposed Receptors

Receptor Type	Direction From Nearest Project-Specific DEEP Emission Source	Estimated Distance From Nearest Project-Specific DEEP Emission Source		Estimated Average Annual DEEP Concentration ($\mu g/m^3$) at Receptor Location
		Feet	Meters	
Point of Maximum Impact	SSE	320	98	0.016
Maximum Impacted Residence	E	600	183	0.008
Maximum Impacted Business/Office	SE	650	198	0.010
Maximum Impacted Elementary School	NE	1100	335	0.007
Maximum Impacted Church	NE	2000	610	0.003

Figure 3 shows a color-coded map of estimated average DEEP concentrations attributable to Microsoft's expansion DEEP emissions. This figure represents the ambient impacts of Microsoft's Columbia Data Center expansion project and each of the maximally exposed receptors representing different land uses. Ecology estimates that Microsoft's DEEP emissions impact approximately 130 residentially zoned parcels at levels exceeding the ASIL.

The "green" shaded area in Figure 3 indicates that the estimated impact from Microsoft's diesel engines is below the ASIL. For the purpose of evaluating worst-case exposures and health risk, Ecology identifies maximally exposed receptors associated with varying land use around the site. For example, the maximally impacted residence, workplace, school, and church were chosen as places where people participating in a variety of activities can be exposed.

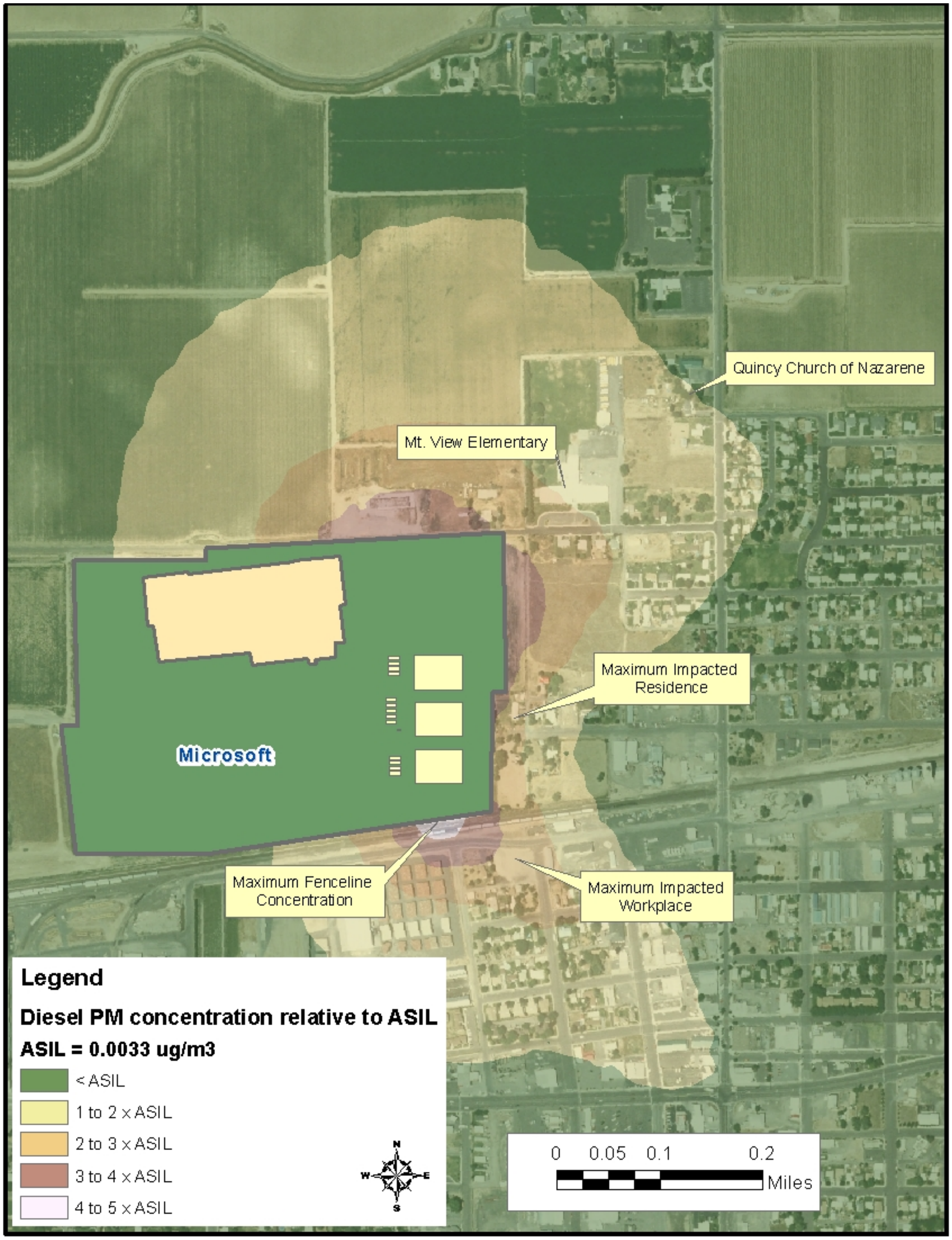

Figure 3. Estimated annual average off-site DEEP concentrations attributable to proposed Microsoft emissions (expansion project only).

4.2.4. Exposure Frequency and Duration

The likelihood that someone is exposed to DEEP from Microsoft's backup diesel engines depends on local wind patterns (meteorology), how frequently engines operate, and how much time people spend in the immediate area. As discussed previously, the air dispersion model uses emissions and meteorology information (and other assumptions) to determine ambient DEEP concentrations in the vicinity of the proposed Microsoft expansion.

Ecology considers the land use surrounding the Microsoft facility to estimate the amount of time a given receptor could be exposed. For example, people are more likely to be exposed frequently and for a longer duration if the source impacts residential locations because people spend much of their time at home. People working in offices in the area are likely only exposed to Microsoft-related DEEP during the hours that they spend working near the facility.

Ecology typically makes simplified assumptions about receptors' exposure frequency and duration. Ecology assumes residential receptors are potentially continuously exposed, meaning they never leave their property. Ecology recognizes that these behaviors are not typical; however, these assumptions are intended to avoid underestimating exposure so that public health protection is ensured. Workplace and other non-residential exposures are also considered, but adjustments are made because the amount of time that people spend at these locations is more predictable than time that people could spend at their homes.

4.2.5. Background Exposure to DEEP in Quincy

Chapter 173-460-090 WAC states, "background concentrations of TAPs will be considered as part of a second tier review."[7] The word "background" is often used to describe exposures to chemicals that come from existing sources, or sources other than those being assessed.

Given the high interest in building data centers within the Quincy UGA, Ecology determined that the cumulative risk of all sources of diesel engine exhaust (including existing and proposed data centers' emissions) should be considered during the permitting process.

Ecology used an EPA-recommended dispersion model, AERMOD, to estimate concentrations of DEEP in Quincy emitted from locomotives traveling on the BNSF rail line, trucks on State Route 281 and State Route 28, and the permitted emissions from existing data centers: Microsoft, Yahoo!, and Intuit. Data center emissions and descriptions were obtained from input files provided by ICF International as part of their analysis accompanying the current Microsoft application. Data center emissions were derived from existing permits from Microsoft (2006), Yahoo! (2007), and Intuit (2007). The rail and highway emissions were taken from 2005 emissions inventories.

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[7] http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460-090

Ecology's analysis estimated prevailing DEEP concentrations to be about 100 times the DEEP ASIL (0.00333 $\mu g/m^3$) near two existing data centers. It is important to note that the ambient levels of DEEP estimated by Ecology are based on allowable (permitted) emissions instead of actual emissions. Actual emissions are likely to be much lower than what Ecology assumed, but Ecology calculated worst-case emissions to avoid underestimating "background" DEEP exposure concentrations.

Ecology calculated background DEEP concentrations near Microsoft based on allowable emissions from its existing permit and based on the allowable emissions after Microsoft agreed to reduce their allowable hours of operation and fuel use from their existing engines. The modeled DEEP concentrations in micrograms per cubic meter were converted to the cancer risk value assuming continuous lifetime exposure by using the relationship that 0.0033 $\mu g/m^3$ is an increased cancer risk of one in one million (CalEPA, 1998a). An increase in concentration by a factor of 10 produces an increased cancer risk 10 times higher.

Figure 4 shows the calculated background cancer risk near Microsoft based on allowable emissions from its existing permit (panel a) and estimated cumulative risks after installation of the proposed project and reduction in allowable fuel use from existing engines (panel b). Generally, maximum background risks near the Microsoft property decrease by a factor of around 25 to 35 percent. Estimated impacts near the northern boundary of Microsoft's property show the largest decline of up to 49 percent in some places.

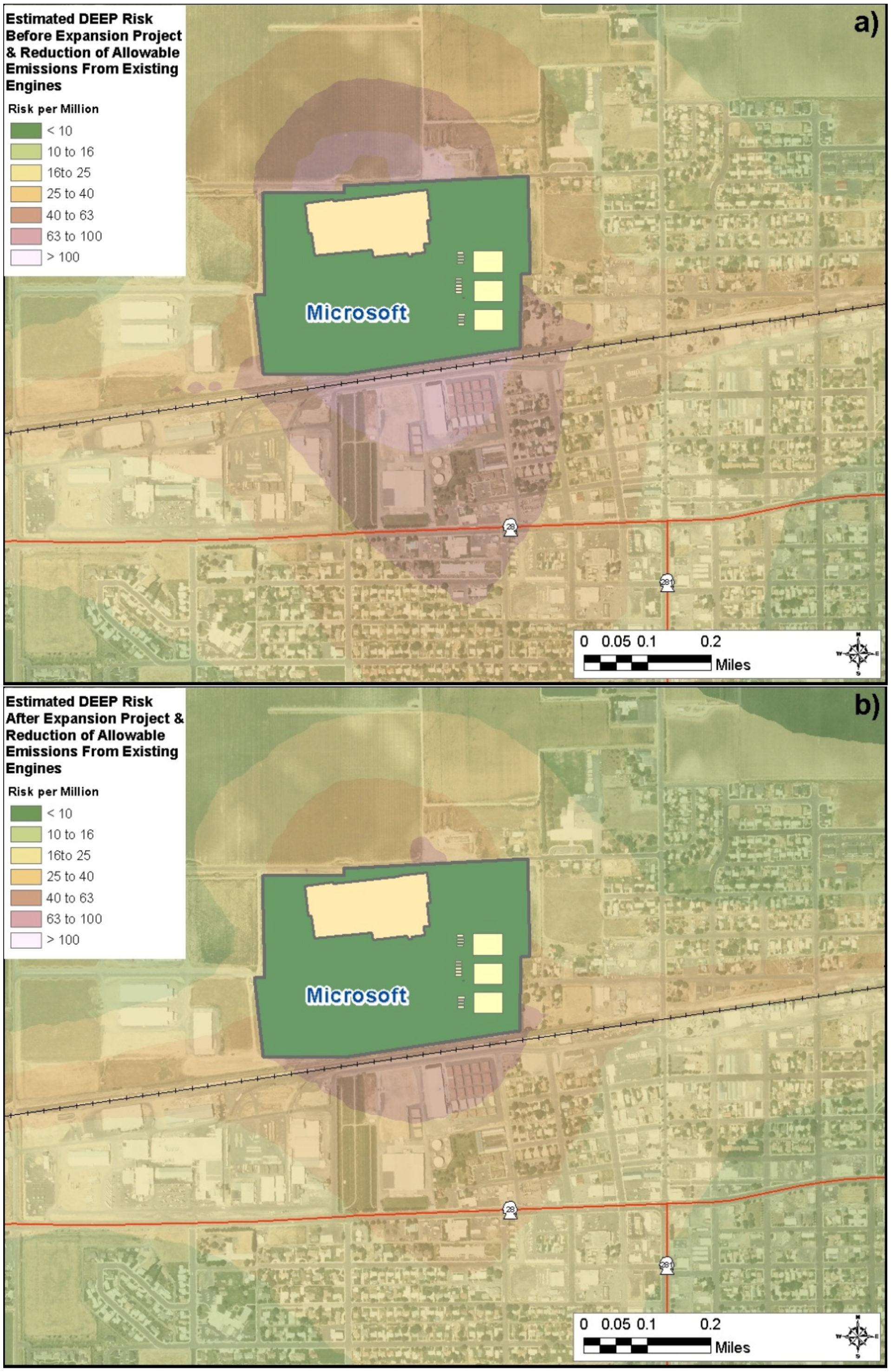

Figure 4. a) Background risk near Microsoft prior to the reduction in allowable fuel use for the existing engines. b) Estimated cumulative risk after approval of Columbia Data Center expansion project and reduction in allowable fuel use for existing engines.

4.3. Dose Response Assessment

Dose-response assessment describes the quantitative relationship between the amounts of exposure to a substance (the dose) and the incidence or occurrence of injury (the response). The process often involves establishing a toxicity value or criterion to use in assessing potential health risk.

The U.S. Environmental Protection Agency (EPA) and California Office of Environmental Health Hazard Assessment (OEHHA) developed toxicological values for DEEP evaluated in this project (EPA, 2002; CalEPA, 1998b). These toxicological values are derived from studies of animals that were exposed to a known amount (concentration) of DEEP, or from epidemiological studies of exposed humans, and are intended to represent a level at or below which adverse non-cancer health effects are not expected and a metric by which to quantify increased risk from exposure to a carcinogen. Table 7 shows DEEP non-cancer and cancer toxicity values.

EPA's reference concentration (RfC) and OEHHA's reference exposure level (REL) for diesel engine exhaust (measured as DEEP) was derived on the basis of dose-response data on inflammation and changes in the lung from rat inhalation studies. Each agency established 5 $\mu g/m^3$ as the concentration of DEEP in air at which long-term exposure is not expected to cause adverse non-cancer health effects.

OEHHA derived a unit risk factor (URF) for estimating cancer risk from exposure to DEEP. The URF is based on a meta-analysis of several epidemiological studies of humans occupationally exposed to DEEP. URFs are expressed as the upper-bound probability of developing cancer assuming continuous lifetime exposure to a substance at a concentration of one microgram per cubic meter (1 $\mu g/m^3$), and are expressed in units of inverse concentration [i.e., $(\mu g/m^3)^{-1}$]. OEHHA's URF for DEEP is 0.0003 $(\mu g/m^3)^{-1}$ meaning that a lifetime of exposure to 1 $\mu g/m^3$ of DEEP results in an increased individual cancer risk of 0.03 percent or a population cancer risk of 300 excess cancer cases per million people exposed.

Table 7. DEEP Toxicity Values Used to Assess and Quantify Non-Cancer Hazard and Cancer Risk

Agency	Non-Cancer	Cancer
U.S. Environmental Protection Agency	RfC = 5 $\mu g/m^3$	NA[a]
California EPA—Office of Environmental Health Hazard Assessment	REL = 5 $\mu g/m^3$	URF = 0.0003 per $\mu g/m^3$

[a] EPA considers DEEP to be a probable human carcinogen, but has not established a cancer slope factor or unit risk factor.

4.4. Risk Characterization

Risk characterization involves the integration of data analyses from each step of the HIA to determine the likelihood that the human population in question will experience any of the various forms of toxicity associated with a chemical under its known or anticipated conditions of exposure.

4.4.1. Quantifying Non-Cancer Effects

4.4.1.1. Risk-Based Concentrations (non-cancer effects)

To evaluate possible non-cancer effects from exposure to DEEP, modeled concentrations at receptor locations were compared to its respective non-cancer toxicological values [EPA inhalation reference concentration (RfC), OEHHA reference exposure level (REL)].

National Ambient Air Quality Standards (NAAQS) and other regulatory toxicological values for short-term and intermediate-term exposure to particulate matter have been promulgated, but values specifically for DEEP exposure at these intervals do not currently exist, therefore, only risks from chronic exposure to DEEP are quantified.

Table 8. Chronic Non-Cancer Risk-Based Concentrations for Maximally Exposed Receptors

Receptor	Averaging Time	DEEP Non-Cancer Chronic Risk-Based Concentration (µg/m^3)	Source
Residential	annual	5	EPA RfC, OEHHA REL
Occupational			
Elementary School Student			
Elementary School Staff			

As discussed in the previous section, EPA and OEHHA developed non-cancer toxicity values for chronic exposure to DEEP. Because chronic toxicity values (RfCs and RELs) are based on a continuous exposure, an adjustment is sometimes necessary or appropriate to account for people working at commercial properties who are exposed for only eight hours per day, five days per week. While EPA risk assessment guidance recommends adjusting to account for periodic instead of continuous exposure, OEHHA does not employ this practice. For the purpose of this evaluation, Ecology determined the RfC or REL (5 µg/m^3) will be used as the chronic risk-based concentration for all scenarios where receptors could be exposed frequently (e.g., residences, work places, or schools). This determination is summarized in Table 8.

4.4.1.2. Hazard Quotient/Hazard Index

Hazard quotients were calculated for the maximally exposed residential, workplace, and school receptors. A hazard quotient (HQ) is the ratio of the potential exposure to a substance compared to the exposure level at which health effects are not expected (e.g., risk-based concentration).

$$HQ = \frac{\text{annual average concentration } (\mu g/m^3)}{\text{Corresponding chronic RBC } (\mu g/m^3)}$$

A hazard quotient of one or less indicates that the exposure to a substance is not likely to result in adverse health effects. As the HQ increases above one, the probability of human health effects increases by an undefined amount. However, it should be noted that a HQ above one is not necessarily indicative of health impacts due to the application of uncertainty factors in deriving toxicological reference values (e.g., RfC and REL).

Table 9 shows HQs at the maximally exposed residential, occupational, and student receptors attributable to project-related and cumulative DEEP emissions. HQs are much lower than one, indicating adverse non-cancer effects are not likely to result from chronic exposure to DEEP emitted from Microsoft's backup generators and other sources of DEEP in Quincy.

Table 9. Non-Cancer Hazards for Residential and Occupational Scenarios

Maximally Exposed Receptors	Average Annual DEEP Concentration ($\mu g/m^3$)			Hazard Quotient		
	Attributable to Expansion Project	Estimated "background" Pre-reduction	Estimated Project + "background" Post-reduction	Attributable to Expansion Project	Estimated "background" Pre-reduction	Estimated Project+ "background" Post-reduction
Project Maximum Impact at Property Boundary	0.016	0.258	0.174	0.003	0.052	0.035
Residential	0.008	0.135	0.100	0.002	0.027	0.020
Occupational	0.010	0.172	0.123	0.002	0.034	0.024
School—Staff and Student	0.007	0.092	0.061	0.001	0.018	0.012

Note: **Pre-reduction** refers to Microsoft's allowable annual fuel consumption limit from existing (Phase 1 and 2) engines at 890,021 gallons per year. **Post-reduction** refers to Microsoft's voluntary reduction in allowable annual fuel consumption from existing (Phase 1 and 2) engines from 890,021 to 300,000 gallons per year.

4.4.2. Quantifying an Individual's Increased Cancer Risk

Cancer risk is estimated by determining the concentration of DEEP at each receptor point and multiplying it by its respective unit risk factor (URF). Because URFs are based on a continuous exposure over a 70-year lifetime, exposure duration and exposure frequency are important considerations.

The formula used to determine cancer risk is as follows:

$$\text{Risk} = \frac{\text{CAir x URF x EF x ED}}{\text{AT}}$$

Where:

CAir = Concentration in air at the receptor ($\mu g/m^3$)
URF = Unit Risk Factor $(\mu g/m^3)^{-1}$
EF1 = Exposure Frequency (days per year)
EF2 = Exposure Frequency (hours per day)
ED = Exposure Duration (years)
AT = Averaging Time (days)

Current regulatory practice assumes that a very small dose of a carcinogen will give a very small cancer risk. Cancer risk estimates are, therefore, not yes or no answers but measures of chance (probability). Such measures, however uncertain, are useful in determining the magnitude of a cancer threat because any level of a carcinogenic contaminant carries an associated risk. The validity of this approach for all cancer-causing chemicals is not clear. Some evidence suggests that certain chemicals considered carcinogenic must exceed a threshold of tolerance before initiating cancer. For such chemicals, risk estimates are not appropriate. Guidelines on cancer risk from EPA reflect the potential that thresholds for some carcinogenesis exist. However, EPA still assumes no threshold unless sufficient data indicate otherwise.

In this document, cancer risks are reported using scientific notation to quantify the increased cancer risk of an exposed person, or the number of excess cancers that might result in an exposed population. For example, a cancer risk of 1×10^{-6} means that if 1,000,000 people are exposed to a carcinogen, one excess cancer might occur, or a person's chance of getting cancer in their lifetime increases by one in one-million or 0.0001 percent. The reader should note that these estimates are for excess cancers that might result in addition to those normally expected in an unexposed population. Cancer risks quantified in this document are an upper-bound theoretical estimate.

The following table shows ranges of estimated worst-case residential, off-site worker, school staff and students increased cancer risks attributable to DEEP exposure near the proposed Microsoft facility. As shown in Table 10, cancer risks attributable to the Columbia Data Center expansion project are less than one in one hundred thousand (1 x 10^{-5}). Under Chapter 173-460 WAC, Ecology may recommend approval of a project if the applicant demonstrates that the increase in emissions of TAPs is not likely to result in an increased cancer risk of more than one in one hundred thousand (1 x 10^{-5}). Cumulative risk for the maximally exposed residence near Microsoft's property, however, exceeds one in one hundred thousand (Table 10).

For the purpose of this third tier petition, Ecology established a cumulative risk management goal of 100 excess cancer cases in one million people exposed. Ecology has defined this goal to represent the cumulative level of concern for Quincy residents (also called an "ample margin of safety")[8] above which a new source of DEEP would not be approved to locate in Quincy, without requiring offsets or other mitigation. It therefore represents an upper-bound risk for community-wide impacts on nearby receptors.

As shown in Table 10, the maximum cumulative cancer risk for the maximally impacted residential receptor potentially exposed to Microsoft's DEEP emissions is 30 in one million. Occupational, student, and church attending receptors' cumulative risks from DEEP exposure are much lower than 10 in one million. Because these cumulative risks are less than 100 in one million, the cumulative risks as a result of Microsoft's expansion project are acceptable. It is important to note that approval of the project and reduction in allowable emissions from the existing data center would result in a decline in the residential receptor's maximum estimated "background" risk (from 41 per million to 30 per million).

Table 10. Estimated Increased Cancer Risk for Residential, Occupational, Student, and Church Scenarios

Location/ Scenario	Scope	Annual DEEP Concentration (μg/m^3)	URF	EF1 (days/yr)	EF2 (hr/24-hr)	ED (yr)	AT (days)	Individual Increased Cancer Risk	Risk/ Million
Maximum Impacted Residence	Attributed to project	0.008	0.0003	365	24/24	70	25550	2.4 x 10^{-6}	2
	"Background" pre-reduction	0.135						4.1 x 10^{-5}	41
	Cumulative Project + "Background" post-reduction	0.099						3.0 x 10^{-5}	30
Maximum Impacted Workplace	Attributed to project	0.010		250	8/24	40	25550	3.9 x 10^{-7}	<1
	"Background" pre-reduction	0.172						6.7 x 10^{-6}	7
	Cumulative Project + "Background" post-reduction	0.122						4.8 x 10^{-6}	5

[8] "Ample margin of safety" is the phrase used in the federal clean air act to describe the goal of National Emission Standards for Hazardous Air Pollutants.

Location/ Scenario	Scope	Annual DEEP Concentration ($\mu g/m^3$)	URF	EF1 (days/yr)	EF2 (hr/24-hr)	ED (yr)	AT (days)	Individual Increased Cancer Risk	Risk/ Million
School-Staff	Attributed to project	0.007		200	8/24	40	25550	2.2 x 10^{-7}	<1
	"Background" pre-reduction	0.092						2.9 x 10^{-6}	3
	Cumulative Project + "Background" post-reduction	0.061						1.9 x 10^{-6}	2
School-Student	Attributed to project	0.007		180	8/24	6	25550	3.0 x 10^{-8}	<1
	"Background" pre-reduction	0.092						3.9 x 10^{-7}	<1
	Cumulative Project + "Background" post-reduction	0.061						2.6 x 10^{-7}	<1
Church Attendance	Attributed to project	0.0035		52	2/24	70	25550	1.2 x 10^{-8}	<1
	"Background" pre-reduction	0.062						2.2 x 10^{-7}	<1
	Cumulative Project + "Background" post-reduction	0.043						1.5 x 10^{-7}	<1

Note: **Pre-reduction** Microsoft's allowable annual fuel consumption limit from existing (Phase 1 and 2) engines at 890,021 gallons per year. **Post-reduction** refers Microsoft's voluntary reduction in allowable annual fuel consumption from existing (Phase 1 and 2) engines from 890,021 to 300,000 gallons per year.

5. UNCERTAINTY CHARACTERIZATION

Many factors of the HIA are prone to uncertainty. Uncertainty relates to the lack of exact knowledge regarding many of the assumptions used to estimate the human health impacts of DEEP emissions from Microsoft's backup generators and "background" sources of DEEP in Quincy. The assumptions used in the face of uncertainty may tend to over- or underestimate the health risks estimated in the HIA.

5.1. Exposure Uncertainty

It is difficult to characterize the amount of time that people can be exposed to Microsoft's DEEP emissions. For simplicity, Microsoft and Ecology assumed a residential receptor is at one location for 24 hours per day, 365 days per year for 70 years. These assumptions tend to overestimate exposure.

The duration and frequency of power outages is also uncertain. Microsoft estimates that they will use the generators during emergency outages for no more than 48 hours per year. Since 2003, the average outage for all power customers in Quincy has been about 2.5 hours per year.

While this small amount of power outage provides some comfort that power service is relatively stable, Microsoft cannot predict future outages with any degree of certainty. Microsoft accepted a limit of emergency operation for 48 hours per year and estimated that this limit should be sufficient to meet their emergency demands.

The “background” level of DEEP in Quincy is also uncertain, but the estimates derived for this project represent a thorough attempt to describe existing DEEP levels.

5.2. Emissions Uncertainty

The exact amount of DEEP emitted from Microsoft’s diesel-powered generators is uncertain. Microsoft applied EPA’s Tier 2 emission factors to describe the emission rates from the diesel engines. The real amount of DEEP that Microsoft’s engines emit on average is likely to be less than the limits set by EPA, but certified engine-specific emission rates are not available. As a result, Microsoft’s use of EPA’s Tier 2 engine particulate matter (PM) emission limit as the DEEP emission factor estimate is intended to represent worst-case emission rates.

5.3. Air Dispersion Modeling Uncertainty

The transport of pollutants through the air is a complex process. Regulatory air dispersion models are developed to estimate the transport and dispersion of pollutants as they travel through the air. The models are frequently updated as techniques that are more accurate become known but are written to avoid underestimating the modeled impacts. Even if all of the numerous input parameters to an air dispersion model are known, random effects found in the real atmosphere will introduce uncertainty. Typical of the class of modern steady-state Gaussian dispersion models, the AERMOD model used for the Microsoft analysis will likely slightly overestimate the short-term (24-hour average) impacts and somewhat underestimate the annual concentrations. The expected magnitude of the uncertainty is probably similar to the emissions uncertainty and much lower than the toxicity uncertainty.

5.4. Toxicity Uncertainty

One of the largest sources of uncertainty in any risk evaluation is associated with the scientific community’s limited understanding of the toxicity of most chemicals in humans following exposure to the low concentrations generally encountered in the environment. To account for uncertainty when developing toxicity values (e.g., RfCs), EPA and other agencies apply “uncertainty” factors to doses or concentrations that were observed to cause adverse non-cancer effects in animals or humans. EPA applies these uncertainty factors so that they derive a toxicity value that is considered protective of humans including susceptible populations. In the case of EPA’s DEEP RfC, EPA acknowledges (EPA 2002):

> *"…the actual spectrum of the population that may have a greater susceptibility to diesel exhaust (DE) is unknown and cannot be better characterized until more information is available regarding the adverse effects of diesel particulate matter (DPM) in humans."*

Quantifying DEEP cancer risk is also uncertain. Although EPA classifies DEEP as probably carcinogenic to humans, they have not established a URF for quantifying cancer risk. In their health assessment document, EPA determined that "human exposure-response data are too uncertain to derive a confident quantitative estimate of cancer unit risk based on existing studies." However, EPA suggested that a URF based on existing DEEP toxicity studies would range from 1×10^{-5} to 1×10^{-3} per µg/m^3. OEHHA's DEEP URF (3×10^{-4} per µg/m^3) falls within this range. Regarding the range of URFs, EPA states in their health assessment document for diesel exhaust (EPA 2002):

> *"Lower risks are possible and one cannot rule out zero risk. The risks could be zero because (a) some individuals within the population may have a high tolerance to exposure from [diesel exhaust] and therefore not be susceptible to the cancer risk from environmental exposure, and (b) although evidence of this has not been seen, there could be a threshold of exposure below which there is no cancer risk."*

Other sources of uncertainty cited in EPA's health assessment document for diesel exhaust are:

- Lack of knowledge about the underlying mechanisms of DEEP toxicity.
- The question of whether toxicity studies of DEEP based on older engines is relevant to current diesel engines.

Table 11 presents a summary of how the uncertainty affects the quantitative estimate of risks or hazards.

Table 11. Qualitative Summary of How the Uncertainty Affects the Quantitative Estimate of Risks or Hazards

Source of Uncertainty	How Does it Affect Estimated Risk From This Project?
Exposure assumptions	Likely overestimate of exposure
Emissions estimates	Possible overestimate of emissions concentrations
Air modeling methods	Possible underestimate of average long-term ambient concentrations and overestimate of short-term ambient concentration
Toxicity of DEEP at low concentrations	Possible overestimate of cancer risk, possible underestimate of non-cancer hazard for sensitive individuals

6. OTHER CONSIDERATIONS

6.1. Short-Term Exposures to DEEP

As discussed previously, exposure to DEEP can cause both acute and chronic health effects. However, as discussed in Section 4.4.1.1, reference toxicological values specifically for DEEP exposure at short-term or intermediate intervals do not currently exist. Therefore, Ecology did not quantify short-term risks from DEEP exposure. By not quantifying short-term health risks in this document, Ecology does not imply that they have not been considered. Instead, we have assumed that compliance with the 24-hour $PM_{2.5}$ NAAQS is an indicator of acceptable short-term health effects from DEEP exposure. In our analysis, we assumed all DEEP emissions to be $PM_{2.5}$.

Relevant to Microsoft's DEEP emissions, the 24-hr $PM_{2.5}$ NAAQS was set by EPA to protect people from short-term exposure to small particles (which include DEEP). Ecology determined that Microsoft adequately demonstrated compliance with the $PM_{2.5}$ NAAQS. Therefore, short-term impacts from DEEP exposure were considered and found to be acceptable.

6.2. Other Possible Acute Non-Cancer Health Effects

In the event of a system-wide power outage in Quincy, dozens of backup diesel engines could run simultaneously resulting in higher short-term emission rates of nitrogen dioxide (NO_2) and other toxic air pollutants. The impacts of higher short-term emission rates from the existing unmodified engines have not been evaluated in this document because only DEEP emissions from the project exceeded the ASIL. Because emissions of NO_2 and other toxic air pollutants from the project were below the ASIL, no further review was required for those pollutants. Emissions below the ASIL suggest that increased health risks from these pollutants are acceptable.

Although a total system-wide power outage in Quincy is unlikely due to system reliability and redundancy, we cannot completely rule out the possibility of having such an outage. If such an event were to occur, people with asthma who might be cumulatively exposed to NO_2 and DEEP from Microsoft and other sources may experience respiratory symptoms such as wheezing, shortness of breath, and reduced pulmonary function with airway constriction.

7. SUMMARY OF THIRD TIER REVIEW APPROVAL CRITERIA

Section 3.5.2 lists the minimum approval criteria for a third tier review. The criteria are restated below followed by a brief summary of how Microsoft satisfied each approval criterion for a third tier review:

(a) Proposed emission controls represent at least BACT.

As described in section 3.2, Ecology's ERO determined that tBACT for DEEP is restricted operation of the EPA Tier-2 certified engines and compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII. Ecology HQ agreed that in this case, the technology described represents at least tBACT.

(b) A health impact assessment (HIA) has been completed as described in WAC 173-460-090(3).

Microsoft submitted to Ecology a complete HIA. Section 4 above summarizes Ecology's review and interpretation of Microsoft's HIA.

(c) Approval of the project will result in a greater environmental benefit to the state of Washington.

Section 2.3 describes Microsoft's proposal to reduce the total facility-wide (existing and proposed data center) allowable fuel consumption from 890,021 gallons per year to 439,493 gallons per year. This enforceable reduction in capacity to burn diesel fuel in its diesel engines translates into a reduction in Microsoft's maximum allowable DEEP emissions. Without this proposed project, such reductions would not be realized. Ecology views this enforceable limit as a commitment by Microsoft to minimize its facility-wide potential air quality impact and as an environmental benefit to the state of Washington.

8. THIRD TIER RISK MANAGEMENT DECISION

Microsoft's proposed Columbia Data Center expansion project DEEP emissions could result in an increased cancer risk of up to 2×10^{-6} (two per million). This risk falls below Ecology's threshold of maximum acceptable risk (i.e., one per one hundred thousand or 10 per million) as defined in Chapter 173-460 WAC. However, the increased risks from the new source added to the existing "background" level of DEEP exceeds a risk of 10 per million.

Based upon Ecology's review of Microsoft's third tier petition, Ecology concludes that Microsoft satisfied the requirements for approval of the third tier review petition. These requirements are listed in Section 3.5.2 and Section 6 of this document. Microsoft satisfies these requirements because:

- The emission controls contained in their proposal, as proposed for approval by Ecology's ERO, represent at least tBACT.
- Microsoft completed a HIA, in compliance with WAC 173-460-090(3).
- Microsoft's willingness to reduce their facility-wide maximum fuel consumption by more than 50 percent demonstrates that approval of the project will result in a greater environmental benefit to the state of Washington.

In terms of overall health risk impact from the proposed project and other sources of DEEP, the cumulative risks are within a range considered by Ecology to reflect an "ample margin of safety."

The project review team recommends that the director approve Microsoft's third tier petition. However, as required by state rules, Microsoft must hold a public hearing in which Microsoft and Ecology will present the results of the health impact assessment, the proposed emission controls, pollution prevention methods, additional proposed measures, and any remaining risks posed by the project. Microsoft must participate in discussions and answer the public's questions at the public hearing.

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10. LIST OF ACRONYMS AND ABBREVIATIONS

AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ASIL	Acceptable Source Impact Level
AT	Averaging Time (days)
bhp	Brake Horsepower
BNSF	Burlington Northern Santa Fe
CAir	Concentration in air
CalEPA	California Environmental Protection Agency
CAS #	Chemical Abstracts Service Number
DEEP	Diesel engine exhaust, particulate
Ecology	Washington State Department of Ecology, Headquarters Office
ED	Exposure Duration (years)
EF	Exposure Frequency
EF1	Exposure Frequency (days per year)
EF2	Exposure Frequency (hours per day)
EPA	United States Environmental Protection Agency
ERO	Washington State Department of Ecology, Eastern Regional Office
ESSB 6789	Engrossed Substitute Senate Bill 6789 – Computer Data Centers – Sales and Use Tax Exemption
HIA	Health Impact Assessment
HQ	Hazard Quotient
hr	Hour
ICF	ICF International
kW	Kilowatt
kWe	Kilowatt, electrical
kWm	Kilowatt, mechanical
$\mu g/m^3$	Micrograms per Cubic Meter
µm	Micron or micrometer
Microsoft	Microsoft Corporation
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NAS	National Academies of Science
NATA	National Air Toxics Assessment
NO_2	Nitrogen dioxide
NOC	Notice of Construction Order of Approval
OAC	Order of Approval to Construct
OEHHA	California Environmental Protection Agency's Office of Environmental Health Hazard Assessment
$PM_{2.5}$	Particulate Matter less than 2.5 micrometers in diameter
PRIME	Plume Rise Model Enhancements
RBC	Risk Based Concentration

REL	OEHHA Reference Exposure Level
RfC	Reference Concentration
SQER	Small Quaintly Emission Rate
TAP	Toxic Air Pollutant
tBACT	Best Available Control Technology for Toxics
TEQ	Toxic Equivalent
UF	Uncertainty Factor
UGA	Urban Growth Area
URF	Unit Risk Factor
WAC	Washington Administrative Code

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