The Boeing Company
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September 19, 2016
DAT-2016-100

Mr. Dean Yasuda
Environmental Engineer
Department of Ecology, NW Regional Office
3190 160th Avenue S.E.
Bellevue, Washington 98008-5452

Subject: Informal Dispute Resolution - Boeing Responses to Ecology's Comments on Draft Uplands and Powder Mill Gulch Feasibility Study Report, dated August 18, 2016

Dear Mr. Yasuda:

Thank you for your contingent approval letter, dated August 18, 2016 (reference a), of Boeing's Feasibility Study (FS) for the Upland Areas and Powder Mill Gulch (PMG) (reference b). We appreciate your agreement with many of the preferred alternatives presented in the FS and do not dispute many of Ecology's comments. We request to meet with Ecology to discuss those comments where Boeing either does not agree or needs clarification before agreeing or disagreeing with Ecology. Therefore, in accordance with Section VII.4 of the RCRA Corrective Action Agreed Order (AO) DE 96HS-N274 dated February 12, 1997 and subsequent amendments, and in regard to our responses above, this letter establishes a 20-day informal dispute resolution period.

As requested in your contingent approval letter (reference a) and your email dated August 22, 2016 (reference c), we have included brief descriptions of our concerns and questions in advance of the meeting. Our specific concerns and questions are presented as responses to your comments imbedded within the text of your letter Attachments A, B, and C, attached to this letter.

In order to facilitate our discussion, I have summarized below the most important issues that Boeing would like to discuss or clarify during our meeting:

Changes to remedies

Ecology has required different preferred remedies than Boeing for the following Solid Waste Management Units and Areas of Concern (SWMUs/AOCs):

SMWU/AOC	Boeing's preferred remedy	Ecology's preferred remedy
No. 171, Building 40-31, Former Bluestreak Vapor Degreaser	Maintain containment	Soil vapor extraction
Powder Mill Gulch, Esperance Sand	Continued GET System Operation and Institutional Controls	Enhanced In-Situ Bioremediation
No. 054, Building 40-51, Former Wastewater AST	Maintain containment	Future excavation
Nos. 067 and 071, Building 40-56, Former Recycling Unit & UST EV-153	Maintain containment	Future excavation
No. 165, Building 45-52, Former Fuel Farm USTs	Maintain containment	Future excavation
No. 093, Building 45-01, Former Solvent USTs	Maintain containment	Future excavation

Boeing believes that all alternatives proposed in the FS meet the threshold requirements required by Washington Administrative Code (WAC) 173-340, and also believes that Ecology's preferred remedies are disproportionately costly relative to Boeing's preferred remedy and should not be selected in accordance to WAC 173-340-360(3)(e). For additional details regarding each SWMU/AOC, please see our responses to Ecology's comments in Attachments A, B, and C.

Applicability of surface water criteria

Ecology has based many of the soil, groundwater, and surface water cleanup levels on the newly promulgated surface water standards from WAC 173-201A for human health criteria for consumption of water and organisms that were submitted to the US Environmental Protection Agency (EPA) for their review and approval on August 1, 2016. Boeing acknowledges that where the groundwater cleanup level is based on drinking water beneficial use, the standard Method B cleanup levels must be at least as stringent as protection of surface water beneficial uses, unless it can be demonstrated that the hazardous substances are not likely to reach surface water (per WAC 173-340-720(4)(b)(ii)). Therefore, the use of surface water criteria for the upland SWMUs/AOCs where chemicals of concern have not and are not expected to migrate to the Esperance Sand aquifer is not appropriate under MTCA. Additionally, Boeing does not believe that it is appropriate to base the groundwater cleanup levels for the entire plume at Powder Mill Gulch (PMG) on the surface water cleanup levels. Boeing would like to further discuss with Ecology the appropriate values that should be used for TCE in groundwater in PMG to be protective of surface water.

Point of compliance/Remediation levels/Monitored natural attenuation

Since surface water beneficial use criteria applies to groundwater discharges direct to surface water , it is not appropriate to base the groundwater cleanup levels for the entire plume at PMG on the surface water cleanup levels. Additionally, compliance with the surface water cleanup levels in groundwater would likely extend the cleanup restoration timeframes at PMG to over 50 years for all of the alternatives presented in the FS. Therefore, pursuant to WAC 173-340-720(8)(c and d), Boeing proposes the use of a conditional point of compliance for groundwater. Also, it is impractical and disproportionately costly to operate the GET system until groundwater cleanup levels are met site wide; therefore, Boeing proposes the use of remediation levels

(RELs) to determine when to discontinue operation of the GET system and rely on monitored natural attenuation to complete cleanup of PMG groundwater.

Reasonable restoration timeframe

Ecology refers to a "reasonable restoration timeframe" or "reasonable timeframe" in several comments related to the time required to achieve cleanup levels as well as to implement future excavation. Boeing requests that Ecology clarify its expectations of a reasonable restoration timeframe. Boeing notes that we are unable to predict when a window of opportunity may occur that would not significantly impact plant operations in areas where future excavation would be implemented.

Restrictive covenants for non-Boeing property

Boeing would like to discuss the feasibility of establishing restrictive covenants and institutional controls on non-Boeing property as requested by Ecology for PMG. Boeing does not believe that groundwater extraction for beneficial use would occur on the commercial properties overlying the TCE plume based on the reasons provided in our responses to Ecology's comments in Attachment A and, therefore, does not believe that restrictive covenants and institutional controls are necessary to prevent installation of groundwater supply wells.

Deep well monitoring

Ecology has required deep well installation and monitoring at the following 13 SWMUs/AOCs:

- No. 054, Building 40-51, Former Wastewater AST (Outside)
- Building 40-11, UST EV-48-1 (Outside)
- Nos. 086, 089, 094, Building 40-56, Former USTs (Outside)
- Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST EV-153 (Inside)
- Nos. 055 and 168, Building 40-24, Utility Trenches and Sumps (Inside and Outside)
- No. 170, Building 40-02, Large Vapor Degreaser (Inside)
- No. 169, Building 40-02, Small Vapor Degreaser (Inside)
- No. 098, Building 40-53, Mock-Up Degreaser (Inside)
- No. 171, Building 40-31, Former Bluestreak Vapor Degreaser (Inside)
- Building 40-32, Footing Excavation (Inside)
- No. 165, Building 45-52, Former Fuel Farm USTs (Outside)
- No. 083, Former UST EV-15 (Outside)
- No. 093, Building 45-01, Former Solvent USTs (Outside)

Boeing maintains that the vadose zone modelling results and empirical evidence provided by the analytical data generated during the RI/FS demonstrate that the existing contamination in SWMUs/AOCs where Boeing's preferred remedy is "maintain containment" or "future excavation" is completely and permanently contained such that additional deep wells for groundwater monitoring at each SWMU/AOC are not warranted. Also, for SWMUs/AOCs where extraction or dewatering of perched groundwater is part of the preferred remedy (e.g., SWMUs 086/089/094 and 055/168), additional deep well monitoring is not warranted. Please refer to Responses A14 and A21 for additional explanation.

Vapor intrusion monitoring

Ecology has required indoor air and sub-slab and/or soil gas monitoring at the following 12 SWMUs/AOCs:

- No. 090, Building 40-51, Former UST EV-11 (Outside)
- No. 054, Building 40-51, Former Wastewater AST (Outside)
- No. 112, Building 40-11, Oil/Water Separator (Outside)
- Nos. 086, 089, 094, Building 40-56, Former USTs (Outside)
- Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST EV-153 (Inside)
- No. 170, Building 40-02, Large Vapor Degreaser (Inside)
- No. 169, Building 40-02, Small Vapor Degreaser (Inside)
- Building 40-02, Former Paint Crib (Inside)
- No. 098, Building 40-53, Mock-Up Degreaser (Inside)
- No. 171, Building 40-31, Former Bluestreak Vapor Degreaser (Inside)
- Building 40-32, Footing Excavation (Inside)
- Powder Mill Gulch, Esperance Sand (Outside)

Boeing agrees to add annual indoor air monitoring at SWMUs/AOCs where sub-slab vapor concentrations underlying the buildings significantly exceed Ecology's Model Toxics Control Act (MTCA) Method C sub-slab vapor industrial screening levels. However, Boeing believes that routine sub-slab vapor and soil gas sampling is not warranted. The purpose of the FS soil gas and sub-slab vapor sampling was to assess whether there was a potential for impacts to indoor air consistent with Ecology's guidance. The sources of the contaminants of concern at each SWMU/AOC, except for PMG, have been removed so there is not a potential for contaminant concentrations in soil to increase. At PMG, the soil gas assessment identified no reasonable risk of vapor intrusion because soil gas concentrations were well below screening levels and TCE concentrations in groundwater continue to decline. Indoor air monitoring will provide sufficient data to assess whether the institutional controls are protective of the facility workers. Therefore sub-slab vapor and soil gas sampling would not provide a meaningful benefit commensurate with the cost for demonstrating compliance with indoor air cleanup levels.

Compliance monitoring and reporting

Boeing would like to discuss Ecology's anticipated requirements for the scope and frequency of routine compliance monitoring (groundwater, surface water, and indoor air sampling, cap inspections, and reporting) before drafting the cleanup action plan (CAP) since the implementation of compliance monitoring over the course of long-term remedies at several of the SWMUs and AOCs can have a significant impact on lifetime project costs. Boeing does not want to commit to open-ended or uncertain requirements and feels strongly that this should be resolved with Ecology during the FS process. It will allow the CAP and subsequent Agreed Order to be completed and finalized in a more efficient manner.

Contingency remedial action evaluation

Ecology makes several requirements for contingency remedial action evaluation and plans. Boeing understands that as part of the five-year periodic review process, Ecology may require a revised cleanup action plan if *changes in the cleanup action are necessary to protect human health and the environment* (WAC 173-340-420(6)). Boeing does not agree to include contingent remedial action evaluation in the CAP or Engineering Design Report (EDR) and does

not believe it will provide meaningful value to add a statement to the CAP or EDR that Boeing will provide Ecology with a contingency remedial action plan if the selected remedial action cannot attain cleanup levels (CULs) in a reasonable timeframe. Additionally, development of contingency plans prior to implementation of the CAP is not appropriate since conditions will likely change over time.

Revising the FS

Based on the extensive nature of Ecology's comments and Boeing's responses to those comments, Boeing believes that if Ecology intends to hold a public comment period for the FS report, it should be revised to reflect the agreements reached between Ecology and Boeing to allow the public the ability to review and understand the document without needing to interpret the various iterations provided in the comment and response letters. Alternatively, we would like to discuss with Ecology the possible benefits of waiting to request public comment until the draft CAP is prepared (as allowed under MTCA (WAC 173-340-600(13)(c) and the AO).

Please contact me if you have any questions.

Sincerely,

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Attachments: Boeing's Responses to Ecology's Comments from Attachments A, B, and C of Ecology's Contingent Approval Letter (reference a)

CC:

Raman Iyer, Neal Hines, Grant Yang, Jeanne Tran, Ecology
Ben Farrell, Tetra Tech
Tong Li, Ground Water Solutions
Mike Palacios, City of Everett
Willy Accame, Panattoni
Greg Bertch, Seaway West, LLC (property formerly owned by CRISTA Ministries)

References: (a) Letter 9171 9690 0935 0106 9638 93, Dean Yasuda (Ecology) to Debbie Taege (Boeing), Ecology Contingent Approval and Modifications to the Draft Boeing Everett Uplands and Powder Mill Gulch Feasibility Study Report, transmittal letter dated November 13, 2015. Letter dated August 18, 2016.

(b) Feasibility Study for Upland Areas and Powder Mill Gulch, BCA Everett Plant, dated November 16, 2015.

(c) Email, Dean Yasuda (Ecology) to Debbie Taege (Boeing), Ecology Response letter to Uplands FS Report& Changes to Contractors & bcage Sediment FS Copies. Email dated August 22, 2016.

(d) Letter from Neal Hines (Ecology) to James Bet (Boeing), Ecology Comments and Approval of Agency Review Draft Passive Sampling Comparability Study, Boeing Auburn Facility by Landau Associates Inc. for the Boeing Company, dated April 29, 2016; FS #2018; CS #5049; EPA #WAD041337130. Letter dated June 6, 2016.

BCA Everett Upland FS Report
Response to Ecology Comments, dated August 18, 2016

ATTACHMENT A: Summary of Ecology Preliminary Determination for Selected Remedies for the Boeing Everett Solid Waste Management Units

Caveat: the public has not been formally asked to comment on the RI Report, the FS, or a CAP yet. What follows, therefore, is a preliminary determination by Ecology prior to receiving comments during the FS formal comment period. Ecology may revise these determinations after the FS formal comment period.

Ecology made the preliminary determination that the remedial actions proposed to the public in a draft Cleanup Action Plan should include the following:

General Requirements:

1. Ecology is not approving use of passive diffusion bag (PDB) samplers at this time. Ecology responded to the use of PDBs (in lieu of low flow sampling with dedicated bladder pumps) several years ago. At that time Ecology requested a statistically based side-by-side PDB vs bladder pump sampling work plan for implementation. During those work plan discussions, Boeing decided not to pursue PDB use and agreed to continue with groundwater sampling with dedicated bladder pumps. If Boeing wishes to again consider the use of PDB sampler in lieu of dedicated bladder pumps, the same side by side sampling work plan must still be submitted and approved by Ecology. Ecology would be willing to entertain discussions for such a proposal only after the cleanup action plan is finalized in order to prevent delays approving the FS and cleanup action plan.

   Response A1: Boeing would like to discuss with Ecology the possibility of using passive diffusion bags for future groundwater sampling. This technology has been demonstrated and accepted for use by Ecology at another Boeing facility and by EPA at two locations located in Washington State. Boeing maintains that the study previously requested by Ecology was excessively onerous and therefore was not cost effective or technically warranted. Boeing believes that the studies that have been performed to date sufficiently justify the use of this technology and would like Ecology to consider approving this technology without a side by side study.

2. Minimum requirements for cleanup actions include the threshold requirement to "provide for compliance monitoring" and is usually addressed in a Compliance Monitoring Plan (see WAC 173-340-410 and -720(9)). The Compliance Monitoring Plan is typically prepared and submitted in the later stages of the Design process, and is often included in the final Engineering Design Report. Boeing made assumptions regarding groundwater sampling frequencies for various SWMUs in the FS report in order to better estimate alternative costs. But Ecology is not approving any of the proposed groundwater sampling frequencies at this time. During cleanup action plan development, groundwater sampling frequencies for the preferred alternative can be conceptually discussed so that the document can contain a general

description of likely monitoring requirements. Selection of specific monitoring goals, and determining how those goals should be measured, however, should await the remedial Design phase.

Response A2: Boeing would like to discuss Ecology's anticipated requirements for the frequency and locations of groundwater, surface water, and indoor air monitoring, cap inspection, and reporting scope and frequency before drafting the cleanup action plan (CAP). The number of monitoring locations and frequency of sampling over the course of long-term remedies at several of the SWMUs/AOCs can have a significant impact on lifetime project costs. Additionally, Boeing notes that Ecology has added requirements for compliance sampling and monitoring locations and frequencies in several other locations in the comment letter. Boeing does not want to commit to open-ended or uncertain requirements and feels strongly that this should be resolved with Ecology during the FS process. It will allow the CAP and subsequent Agreed Order to be completed and finalized in the most efficient manner.

Boeing hopes that Ecology will consider a reduced monitoring frequency compared to the current FS monitoring frequency, as the SWMUs/AOCs will no longer be in the FS investigation phase, but in the operation, maintenance, and monitoring (OMM) phase where the purpose of monitoring is different.

3. Where Ecology's preferred remedial alternative relies on containment of contamination rather than removal or in-situ treatment, Boeing is required to identify and implement contingency remedial actions if:

    a) contaminated groundwater from this SWMU is detected in the Esperance Sand Aquifer;
    b) new data or information suggests that the FS Vadose Zone Model (Appendix B) is less conservative than currently assumed, and the potential for contaminating the Esperance Sand Aquifer exists; or,
    c) contaminants are known to be migrating away from their current location (containment failure) at rates that make containment by itself ineffective.

Boeing is required to evaluate at least the following contingent remedial action options: removal of existing subsurface contamination above cleanup levels, in-situ treatment of subsurface contamination above cleanup levels, other actions to meet cleanup standards and prevent further migration of contamination vertically or laterally. Further contingent remedial action evaluation is required during the development of the draft cleanup action plan (dCAP) and engineering design report (EDR).

Containment remedial actions that are implemented at outdoor SWMUs require low permeability or sealed concrete cover and sealed joints to prevent water infiltration. They also require quarterly inspections for concrete and joint seal integrity, routine maintenance, and, if necessary, repair. Quarterly inspection reports shall be submitted to Ecology within 30 calendar days of the end of each quarter. They shall contain: conditions observed during the inspection, (any) recommended actions, and a description of any restoration, improvement and other corrective action work needed or taken to maintain a low permeability (7E-12 cm^2 per

Appendix B) cover.

Response A3: Boeing understands that as part of the five-year periodic review process, Ecology may require a revised cleanup action plan if *changes in the cleanup action are necessary to protect human health and the environment* (WAC 173-340-420(6)). Boeing does not agree to include contingent remedial action evaluation in the CAP or EDR and does not believe it will provide meaningful value to add a statement to the CAP or EDR that Boeing will provide Ecology with a contingency remedial action plan if the selected remedial action cannot attain cleanup levels (CULs) in a reasonable timeframe.

Boeing repairs or replaces damaged concrete, and repair/seal significant cracks and unsealed/damaged joints when identified in the areas covering outdoor SWMUs/AOCs as part of routine operations. Boeing notes that most of the outdoor SWMUs/AOCs without perched groundwater that are designated for containment are capped by concrete that is more than 25 years old and the empirical data obtained during the RI/FS (limited migration in soil since the known releases or removal of the sources (e.g. UST, AST, etc.), lack of perched groundwater to the depth explored (typically 30-40 feet below ground surface) indicate the current concrete is adequate to prevent rainfall/runoff infiltration sufficient to cause significant migration. Therefore maintaining the current concrete slab condition will prevent significant infiltration and protect against migration to the Esperance Sand.

All the SWMUs/AOCs with perched groundwater are spatially associated with storm water drains/downspouts/piping or subgrade sumps and oil/water separators that contain water. These structures and subgrade piping are surrounded by granular backfill which contains the utilities and are the likely source of perched water, as noted in Ecology's Footnote 18.

Boeing does not agree that quarterly inspections and reporting are warranted to "demonstrably reduce risks to ensure a protective remedy" (WAC 173-340-360(2)(e). The surface covers that are currently installed over all outdoor SWMUs/AOCs are designed for heavy, industrial traffic and Boeing's plant requirements include frequent inspection and maintenance to maintain the integrity of the surface and prevent foreign object debris (FOD). Annual inspections and routine maintenance of pavement conditions are appropriate and included in the FS for all maintain containment cleanup actions. When inspections identify issues, Boeing will (and currently does) complete repairs as necessary.

4. The dCAP and EDR will need to state that if Ecology determines that the selected remedial action cannot attain cleanup levels at the standard point of compliance in any contaminated media within a reasonable timeframe, Boeing shall provide Ecology with a contingency remedial action plan. The purpose of the contingency action proposed in that plan will be to meet cleanup standards within a reasonable timeframe. Boeing shall implement the contingency remedial action plan after approval by Ecology.

Response A4: Boeing understands that as part of the five-year periodic review process, Ecology may require a revised cleanup action plan if changes in the cleanup action are necessary to protect human health and the environment [WAC 173-340-420(6)]; therefore, Boeing believes that adding this statement to the CAP and EDR will not provide meaningful value. Boeing requests clarification from Ecology on how Ecology would apply a "reasonable timeframe" to the cleanup actions and how a "reasonable timeframe" is defined. Boeing also reserves the right to discuss with Ecology changes to the point of compliance based on

Ecology's requirements.

5. Financial assurance is required for all near and long terms costs for cleanup actions conducted under RCRA and MTCA, including: maintenance of institutional controls and environmental covenants; ongoing operation and maintenance (O&M) work; and, long term monitoring and repair costs until cleanup standards are met.

   Response A5: Boeing will provide Ecology with financial assurance for this project following finalization of the CAP.

6. Within 30 calendar days of receipt of Ecology's letter, Boeing shall submit revised Tables 5-1 through 5-11 that include individual chemical hazard quotients and individual excess carcinogenic risks. In addition, the tables shall include the sum of hazard quotients (hazard index) and summed excess carcinogenic risk for each chemical, pathway, and media.

   Response A6: Tables 5-1 through 5-11 will be revised as requested within 30 days once agreement of cleanup levels is reached for all SWMUs/AOCs.

7. The Ecology Water Quality Program has finalized its revisions to Chapter 173-201A WAC regulations on August 1, 2016, in response to EPA's revised 40 CFR Part 131 NTR water quality criteria. This regulatory revision was a several year process and updates surface water quality standards to include human health criteria. These regulatory revisions will reduce TCE surface water and groundwater cleanup levels as applicable ARARs. The revisions also increase other surface water and groundwater cleanup levels. Ecology included these revised ARARs into the determination of appropriate cleanup levels for the Site.

   Response A7: The comment implies that surface water Applicable or Relevant and Appropriate Requirements (ARARs) should be considered in development of groundwater ARARs for the Esperance Sand aquifer. Boeing does not agree and would like to discuss with Ecology the appropriateness of applying surface water criteria to the Esperance Sand aquifer..

8. For those soil cleanup actions under WAC 173-340-740(6)(f), Ecology recognizes that cleanup actions requiring containment of hazardous substances rather than removal will not meet soil cleanup levels at the standard soil point of compliance. However, Ecology expects the requirements of WAC 173-340-740(6)(f)(i) through (vi) are met.

   Response A8: The cleanup actions requiring containment proposed in the FS are compliant with these requirements.

SWMU Specific Requirements:

Exposure Pathway Model (EPM) A:
Based on the low concentrations of contaminants and low volumes of perched groundwater at these SWMUs, Ecology believes the likelihood of contaminated perched groundwater migrating to the Esperance Sand Aquifer is unlikely under WAC 173-340-720(2)(c). Therefore, based on current information, Ecology is not requiring Boeing meet soil cleanup levels protective of the more

stringent potable groundwater cleanup levels based on water quality ARARs.

Response A9: Comment noted.

SWMU 090, Building 40-51 Former UST EV-11 (outdoor unit):

Ecology's preferred remedy is the same as Boeing's preferred remedy: Alternative 1 – Maintain Containment. Ecology understands that the contaminated perched groundwater is limited to fill soils near the southwest corner of the building. As part of the preferred action, Boeing is required to conduct routine indoor air and sub-slab vapor sampling in the southwest side of this building. Institutional controls will be required to provide and implement an adequate health and safety plan for workers exposed to contaminated subsurface soils and perched groundwater. [1]

[1]Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A10: Given that the perched groundwater is outside the building, soil gas concentrations minimally exceed MTCA Method C sub-slab soil gas screening criteria, and Ecology did not include this SWMU/AOC in their previous requirements for indoor air sampling at the Everett facility, Boeing does not believe that indoor air and sub-slab vapor sampling is warranted. Therefore, Boeing does not agree to conduct routine indoor air or sub-slab vapor sampling for this SWMU/AOC. Boeing agrees to apply the short-term action level of 8 $\mu g/m^3$ and include administrative controls to prevent soil vapor exposure to female construction workers of child-bearing age.

SWMU 112, Building 40-11, Oil Water Separator (outdoor unit):

Ecology's preferred remedy is the same as Boeing's: Alternative 1 – Maintain Containment and Institutional Controls. Based on measurements of the most recent soil gas contaminant concentrations at this SWMU, routine soil gas and potentially indoor air sampling at the nearby building will be required. [1]

[1]Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A11: The site conditions at this SWMU/AOC consist of perched groundwater in a limited area that is continuously dewatered and outside of any buildings. Ecology did not include this SWMU/AOC in their previous requirements for indoor air sampling at the Everett facility, and Boeing does not believe that soil gas and indoor air sampling are warranted. Therefore, Boeing does not agree to conduct routine soil gas or indoor air sampling for this SWMU/AOC. Boeing agrees to apply the short-term action level of 8 $\mu g/m^3$ and include administrative controls to prevent soil vapor exposure to female construction workers of child-

bearing age.

SWMU 151 Building 40-51, Southern Air Scrubber Sump (outdoor unit):
Ecology's preferred remedy is the same as Boeing's: Alternative 1 – Maintain Containment and Institutional Controls. [1]

[1]Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A12: Comment noted.

EPM B:

SWMU 086, 089, 094, Building 40-56 Former Silkscreen USTs (outdoors):
Ecology's preferred remedy is the same as Boeing's: [2] Alternative 2 Soil Vapor Extraction, Groundwater Extraction, Institutional Controls and Monitoring. Ecology notes that an additional cleanup requirement for this SWMU (per WAC 173-340-747(2)(b)) is that the *soil concentration shall not result in the accumulation of nonaqueous phase liquid on or in ground water*. In addition, as part of the preferred alternative the groundwater extraction/containment system will be optimized for more effective containment and removal of the contaminated groundwater.

Response A13: Removal of NAPL at this SWMU/AOC is consistent with the recommended cleanup action in the FS. Boeing agrees to optimize the groundwater extraction system.

Based on the effectiveness of soil and groundwater treatment, routine indoor air and sub-slab vapor (SSV) sampling may also be required on the south side of this building (near SWMUs 086, 089, and 094). The need for further routine indoor air and soil gas (SG) sampling, once groundwater and soil cleanup levels are met, will be dependent on meeting Method C air cleanup levels in indoor air and Ecology's soil gas and sub-slab screening levels, protective of those indoor air levels (both levels are now available in the CLARC database).[3] Ecology's preferred alternative also requires deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer (as indicated by the vadose zone model, Appendix B of the FS report).

Response A14: Boeing agrees to conduct confirmational soil gas sampling once soil and groundwater cleanup levels are achieved to ensure that Method C soil gas screening criteria are met. In the event that soil gas concentrations exceed the applicable screening levels, Boeing agrees to conduct indoor air sampling. Boeing will conduct additional soil gas and/or sub-slab vapor sampling at its discretion to determine if the concentrations warrant continued indoor air monitoring.

Boeing does not believe installation of new deep well(s) is warranted because the preferred remedy includes additional groundwater extraction to remove and cleanup perched groundwater in addition to the SVE for soil cleanup within a time frame which will protect the Esperance Sand

from migration of the existing shallow contamination. Additionally, new deep wells near the downgradient edge of the contamination could provide a transport conduit for contaminants (which are currently bound at shallow depths by the till lithology) to reach the Esperance Sand Aquifer. Proper precautions taken during well installation can minimize the risk; however, even completion and maintaining a secured well head does not eliminate all risk of providing a preferential pathway for contaminants. The act of drilling into and monitoring the deep aquifer introduces unnecessary risk that Boeing does not want to incur.

Boeing would also like to note that it is not possible to install a deep well inside Building 40-56 as there is insufficient access inside the building for the type of drill rig needed.

The FS report indicates that this alternative can be implemented without significantly interfering with current building operations. [4] That is an important consideration. However, if alternative 2 is not successful in meeting soil and groundwater cleanup levels in a reasonable timeframe, Boeing will be required to prepare a contingent remedy work plan for Ecology's review and approval. This contingent remedy work plan will evaluate other technologies, including near-term excavation and dewatering (alternative 3), and propose a preferred action for implementation.

Response A15: Boeing requests that Ecology clarify its expectations of a reasonable timeframe. Boeing understands that as part of the five-year periodic review process, Ecology may require a revised cleanup action plan if *changes in the cleanup action are necessary to protect human health and the environment* (WAC 173-340-420(6)). Boeing does not agree to what a revised cleanup action plan will include at this time as the site conditions may change and warrant a different approach.

Furthermore, Boeing's proposed risk-based soil cleanup levels protective of potable groundwater, must be revised for three compounds. The levels for ethylbenzene, toluene and xylene in the Esperance Sand Aquifer do not properly consider State and Federal Water Quality (National Toxics Rule 40CFR131 and the 2015 updated National Recommend Water Quality Criteria - Human Health[5] criteria under Section 304(a) of the Clean Water Act) and Federal Groundwater MCL ARARs. These ARAR concentrations must be used in determining MTCAMethod B groundwater cleanup levels.

Response A16: Comment noted. However, it is unclear why Ecology is requiring the use of surface water criteria to calculate the soil cleanup levels protective of the Esperance Sand aquifer. Boeing does not believe it is appropriate and requests clarification for the rationale to apply surface water criteria to the Esperance Sand Aquifer beneath the upland portion of the site.

Revised ethylbenzene, toluene and total xylene soil, perched groundwater and Esperance Sand Aquifer cleanup levels are calculated as such:

Compound	Soil Cleanup Level Protective of Esperance Sand Aquifer	Perched Groundwater Cleanup Level, Non-potable (inhalation + dermal)[6]	Esperance Sand Aquifer Cleanup Level used as basis for soil cleanup level
	(mg/kg)	(µg/L)	(µg/L)
Ethylbenzene	0.60	4300	68[7]
Toluene	0.41	15,100	57[8]
Total Xylenes	14.6	485	1600[9]
Benzene	0.002	122	0.44[10]
TCE	0.0025	9	0.38[11]
Vinyl chloride	0.00014	350	0.02[12]
1,1 DCE	0.046	799	7.0[13]
cis-1,2 DCE	0.078	3020	16[14]
Trans-1,2 DCE	0.520	30,200	100[15]
PCE	remove [16]	remove	4.9[17]

Response A17: Boeing agrees with the values in the above table for total xylenes, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2- dichloroethene, and tetrachloroethene. However, Boeing does not agree with using surface water criteria to calculate soil cleanup levels protective of groundwater for this SWMU/AOC.

Lastly, in order for Ecology to agree that the contaminated perched groundwater [18] does not need to meet Method B (potable) cleanup levels, the requirements of WAC l 73-340-720(2)(c) must be met. Under WAC 173-340-720(2)(c):

(c) The department determines it is unlikely that hazardous substances will be transported from the contaminated ground water to ground water that is a current or potential future source of drinking water, as defined in (a) and (b) of this subsection, at concentrations which exceed ground water quality criteria published in chapter 173-200 WAC

This requirement is intended to protect and prevent contamination of potable drinking water sources, such as the Esperance Sand Aquifer. It is not intended to act as a permit to discharge contamination from an upper non-potable aquifer to a deeper potable aquifer (similar to an underground injection well or NPDES permit) up to a groundwater cleanup level. This is especially important since the Esperance Sand Aquifer does not have detectable silkscreen (mainly xylene, ethylbenzene, and toluene) contaminant concentrations. The FS report, Appendix B Vadose zone modeling results show that silkscreen contaminants will reach the Esperance Sand Aquifer if water infiltration is allowed to occur at this SWMU. Therefore, in order for Ecology to allow non-potable cleanup levels for this contaminated perched aquifer, one of two options must occur at the site: (a) during and after operation of the SVE system, an low permeability (7E-12 cm^2 or lower) concrete cover must prohibit recharge of rainwater into the perched aquifer at this SWMU (and the result must be elimination of measurable perched groundwater below this SWMU), or (b) after the operation of the SVE system,

additional groundwater extraction wells are required to minimize to the maximum extent possible, the amount of contaminated perched groundwater at this SWMU.

> **Response A18:** The cleanup action recommended in the FS (soil vapor and groundwater extraction) includes groundwater extraction during and after SVE operation. Boeing proposed implementing groundwater extraction at five existing wells until cleanup levels are achieved as part of the cleanup action. It is Boeing's expectation that the combination of perched groundwater and soil remediation will meet the CULs and protect the Esperance Sand within an appropriate restoration timeframe. Boeing requests clarification from Ecology on whether Ecology is in concurrence with this component of the cleanup action or if Ecology is requesting a change.

[2] Alternative 1 (site monitoring and site cover) cannot be the most permanent remedy because it does not meet threshold requirement for achieving groundwater cleanup levels. Furthermore, it will not provide for a reasonable time-frame and overrelies on dilution (see WAC l 73-340-360(2)(a), (b) and (e)). Installation of new low permeability (or significant modification of the current) surface cover and its effectiveness is uncertain since it is not clear if rainwater is infiltrating through the current cover directly above the SWMU or if rainwater (or leaking water lines) is infiltrating at a distance from the SWMU and flowing under the SWMU.
[3] Due to the shallow perched groundwater in the area and shallow vadose zone soil contamination, use of Ecology's groundwater VI screening levels (also in CLARC) is not appropriate.
[4] Refer to Page 8-12, which states, Alternative 2 is the next most implementable because construction and operation of an SVE system is comparatively straightforward, without significant disruptions to on-site activities.
[5] Under WAC l 73-201A-600(1) and -602, Powder Mill Creek is protected for the following designated uses: Salmonid spawning, rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values.
[6] Same as FS report.
[7] Based on CWA304, Federal National Recommended Water Quality Criteria for Human Health updated in 2015.
[8] Based on CWA304, Federal National Recommended Water Quality Criteria for Human Health updated in 2015.
[9] Method B groundwater cleanup calculation
[10] Adopted Regulation Chapter 173-201A WAC
[11] Adopted Regulation Chapter l 73-201A WAC
[12] Adopted Regulation Chapter l 73-201A WAC
[13] EPA MCL
[14] Method B groundwater cleanup calculation
[15] EPA MCL
[16] Upon review of the most recent perched groundwater chemical data from groundwater monitoring wells, PCE was not a detected contaminant. In addition, Ecology bases its decision on its understanding that it is not aware of detected PCE in the soils. This decision assumes PCE is not found in perched groundwater or soils through finalization of the CAP.
[17] Adopted Regulation Chapter l 73-201A WAC
[18] In addition, based on the observation of year around perched groundwater at this SWMU, Ecology

assumes that rainwater infiltration into the contaminated soils is occurring now. Installation of new impervious (or significant modification of the current) surface cover will be expensive, more disruptive of any nearby operations, and its effectiveness uncertain since it is not clear if rainwater is infiltrating through the current cover directly above the SWMU or if rainwater (or leaking water lines) is infiltrating at a distance from the SWMU and flowing under the SWMU. The Vadose Zone Modeling report states that contamination will reach the Esperance Sand aquifer from the SWMU if water is allowed to infiltrate into the contaminated vadose zone soils. Ecology comments on the vadose zone modeling report indicated that contaminated perched groundwater was not accounted for in the modeling results and the most uncertainty in the modeling results lies in the accuracy in the amount of time before vadose zone contamination from either perched groundwater or subsurface soils reaches the Esperance Sand Aquifer.

> **Response A19:** Boeing reiterates that the preferred remedy includes additional groundwater extraction to remove and cleanup perched groundwater in addition to the SVE for soil cleanup within a time frame which will protect the Esperance Sand from migration of the existing shallow contamination.

EPM C:

SWMU 166, Building 45-53, Former UST EV1 10-1 (outdoors):

Ecology's preferred remedy is the same as Boeing's: Alternative 1 – Maintain Containment. This assumes that groundwater cleanup levels are met at the time the CAP is finalized.

> **Response A20:** Boeing requests clarification of Ecology's acceptance of the proposed cleanup action. It is unclear if Ecology accepts maintain containment for this SWMU/AOC only if concentrations meet perched groundwater CULs prior to implementation. Current concentrations are close to achieving the CULs, but it is unclear what Ecology would require if CULs are not met by the time the CAP is finalized. The media of concern at the site is perched groundwater with limited extent. If concentrations meet CULs by the time the CAP is finalized, it is reasonable that an NFA should be issued for the SWMU/AOC. The maintain containment cleanup action, as described on pages 6-11 and 6-12 of the FS report, proposes institutional controls and monitoring until concentrations meet the CULs, at which time the institutional controls and monitoring would be discontinued.

EPM D:

SWMU 055 and 168, Building 40-24, Utility Trenches and Sumps (indoors and outdoors):

Ecology's preferred remedy is the same as Boeing's: [19] Alternative 4- Near Term Excavation, Dewatering and Periodic Removal of Perched Groundwater present in backfill within the 40-24 building trenches. Ecology notes that an additional cleanup requirement at this SWMU is that the *soil concentration shall not result in the accumulation of nonaqueous phase liquid on or in ground water* (WAC 173-340-747(2)(b)). Ecology's preferred alternative requires deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer.

> **Response A21:** Removal of NAPL at this SWMU/AOC is consistent with the recommended cleanup action in the FS. Boeing agrees to excavate soil containing NAPL to prevent its

accumulation and the preferred remedy includes removal of perched groundwater with NAPL as well as dissolved constituents. However, Boeing does not agree to install additional deep well(s) for the reasons outlined for SWMU/AOC Nos. 086, 089, 094 in Response A14.

Similar to EPM B, in order for Ecology to agree that the contaminated perched groundwater does not need to meet Method B (potable) cleanup levels, the requirements of WAC 173-340- 720(2)(c) must be met. Under WAC 173-340-720(2)(c):

(c) The department determines it is unlikely that hazardous substances will be transported from the contaminated ground water to ground water that is a current or potential future source of drinking water, as defined in (a) and (b) of this subsection, at concentrations which exceed ground water quality criteria published in chapter 173-200 WAC

This requirement is intended to protect and prevent contamination of potable drinking water sources, such as the Esperance Sand Aquifer. It is not intended to act as a permit to discharge contamination from an upper non-potable aquifer to a deeper potable aquifer (similar to an underground injection well or NPDES permit) up to a groundwater cleanup level. This is especially important since the Esperance Sand Aquifer does not currently have detectable skydrol hydraulic fluid contaminant concentrations. The FS report, Appendix B Vadose zone modeling results show that skydrol hydraulic fluid contaminants will reach the Esperance Sand Aquifer if water infiltration is allowed to occur at this SWMU. Therefore, in order for Ecology to allow non-potable cleanup levels for this contaminated perched aquifer, the following is required: (a) after removal of the outdoor vault E contaminated soils and perched groundwater within vault E, the outdoor component of this SWMU must be repaired in a manner that prevents measurable rainwater (rainfall runoff) from entering the fill surrounding the area at the 40-24 building vault E and the utility tunnel. One option is the combination of backfilling the Vault E excavation with impermeable fill material and covering the area with low permeability concrete; and (b) "continuous" removal of measurable perched groundwater from within the remaining 40- 24 building utility trench;

Contaminated perched groundwater was discovered in boring ESB1290[20] and in the North Sump. Ecology's preferred alternative therefore requires "continuous" removal of perched groundwater from within the 40-24 building utility trench. Boeing should also use all reasonable methods to attempt to install additional groundwater extraction wells near ESB1290 and the North Sump, assuming these northerly areas of the utility trench in this area currently contains contaminated perched groundwater. Reducing the amount of perched groundwater[21] beneath the contaminated soils within the 40-24 building will reduce the migration force driving contamination through the unsaturated soils to the Esperance Sand Aquifer.

Response A22: Boeing agrees to requirement (a) but not requirement (b) above. Following near-term excavation of the sump, perched groundwater, and contaminated soil, site restoration and use of CDF as backfill will prevent infiltration of rainwater from entering fill in the excavation area and migrating to below the adjacent utility tunnel. As proposed in the FS, Alternative 4 includes periodic removal of perched groundwater from the backfill surrounding the trench following excavation. This periodic perched groundwater removal is anticipated to sufficiently dewater the area. Installation of a groundwater extraction system with continuous pumping in a

heavily used industrial space is not practical, nor is it likely that there will be sufficient recharge to maintain continual pumping. Boeing agrees to remove the perched groundwater in the backfill below the trench to the extent practical and thereby minimize the potential for migration.

Lastly, Ecology notes that EPA has not listed tributyl phosphate (TBP) in their Integrated Risk Information System (IRIS) database, which is the preferred source for toxicity data. This is due to inadequate toxicity data, needed to support a rigorous IRIS review. Our second preferred source for toxicity data is the Provisional Peer-Reviewed Toxicity Value (PPRTV) assessment. Boeing cited a 2010 TBP assessment document (EPA 2010) in the FS report, Appendix C. This PPRTV assessment found some evidence that bladder tumors were produced through regenerative cell proliferation in response to epithelial damage at high doses; this mechanism of cancer formation would not operate at lower doses that do not cause organ damage. EPA concluded that the mode of action for bladder cancer has not been sufficiently characterized.

TBP may also cause hepatocellular adenomas (liver cancer), but no mode of action has been elucidated for that type of cancer either. Based on these uncertainties, EPA chose to use the linear low-dose extrapolation, which assumes that there is no threshold for carcinogenesis, to derive an oral slope factor of 0.009 per mg/kg-day. This slope factor is reported in EPA's regional screening level database, which Boeing used to obtain some of the chemical parameters for the leaching model. As a result, Boeing should use the lower of the TBP calculated cleanup levels for cancer[22] and non-cancer effects.

Ecology's calculated soil and perched groundwater cleanup levels (protective of the Esperance Sand Aquifer cleanup levels) are shown in the table below:

Compound	Soil Cleanup Level protective of Esperance Sand Aquifer (based on carcinogenicity)	Perched Groundwater Cleanup Level (dermal pathway)	Esperance Sand Aquifer Cleanup Level (based on carcinogenicity)
	(mg/kg)	(µg/L)	(µg/L)
Tributyl Phosphate (TBP)[23]	0.51	4300 Unchanged from PS	9.7
BHT	7.4	12,000 Unchanged from PS	24

[19] Alternative l (site monitoring) cannot be the most permanent remedy because it does not meet the threshold requirement for achieving groundwater cleanup levels. Furthermore, it over-relies on dilution and will not provide for a reasonable restoration timeframe (per WAC 173-340-360(2)(a), (b) and (e)).

Response A23: Boeing believes that all alternatives considered for this SWMU/AOC in the FS meet the threshold requirements required by WAC 173-340-360.

[20] In 1998, 60 ppm of tributyl phosphate and 14 ppm of dibutyl phenyl phosphate were detected in

perched groundwater samples from ESB1290.

[21] In addition, based on the observation of year around perched groundwater at this SWMU, Ecology assumes that rainwater infiltration into the contaminated soils is occurring now.

> **Response A24**: Boeing does not agree that it can be assumed that rainwater infiltration into the contaminated soils is occurring now. Boeing notes that leaking underground utilities may be the only source of perched groundwater. In Footnote 18 of Ecology's comments, Ecology notes that leaking underground utilities are a potential source of perched groundwater and that it is unclear if rainwater infiltration is a source.

[22] Ecology notes that the FS report indicates the TBP non-potable groundwater cleanup level based on non-carcinogenicity is less than the cleanup level based on carcinogenicity. The FS report also uses the BHT non-potable groundwater cleanup level based on carcinogenicity (Ecology preference), even though the FS text indicates it would use the cleanup level based on noncarcinogenicity.

[23] Used as a surrogate for other Skydrol hydraulic fluid ingredients: Dibutyl Phenyl Phosphate (DBPP), Butyl Diphenyl Phosphate (BCPP), and Triphenyl Phosphate (TPP).

> **Response A25:** Boeing agrees to use the revised cleanup levels presented in the table above for TBP and BHT. Boeing would like to note that in order to achieve the revised cleanup levels, deeper excavation than currently assumed may be required and it may not be possible to excavate all soil above cleanup levels while maintaining the integrity of the building foundation. Maintaining containment and institutional controls can be applied to any residual contamination.
>
> Boeing notes that the lower cleanup levels have resulted in soil exceedances at SWMUs/AOCs not included in the RI and/or FS Work Plan/FS. These areas include: Building 40-22, Utility Upgrade area (Slant #2 and Slant #3); Building 40-23 Static Test Pad area; and SWMU/AOC No. 177, Building 40-25, Utility Vault. Boeing requests further discussion of these areas with Ecology.

EPM E:

Based on the absence of perched groundwater at these SWMUs, Ecology believes the likelihood of contaminated vadose zone soils migrating to the Esperance Sand Aquifer is unlikely under WAC 173-340-720(2)(c). Therefore, based on current information, Ecology is not requiring Boeing meet soil cleanup levels protective of the more stringent potable groundwater cleanup levels based on water quality ARARs.

> **Response A26:** Comment noted.

SWMU 097, Building 40-11, Former Vapor Degreaser (indoors):

Ecology's preferred remedy is the same as Boeing's:[1] Alternative 3[24] - Near Term Excavation of all contaminated soils to meet SWMU cleanup levels at a standard point of compliance.

[1] Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-

slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

[24] The FS Report, Table 8-8a describes only three alternatives. Alternative 3 is near term excavation remedial alternative. However the FS Report, page 9-8 discusses Alternative 4 as Boeing's preference. Ecology assumes Table 8-8a is correct and the text on page 9-8 is incorrect.

> **Response A27:** Boeing agrees to apply the short-term action level of 8 µg/m^3 and include administrative controls to prevent soil vapor exposure to female construction workers of child-bearing age. Thank you for identifying the typographical error on page 9-8 which incorrectly referred to Alternative 4 instead of Alternative 3 as the preferred alternative.

SWMU 171, Building 40-31, Former Bluestreak Vapor Degreaser (indoors):

Ecology's preferred remedy is Alternative 2 -Soil Vapor and Extraction. [1] Ecology prefers alternative 2 over alternative 1 – maintaining containment (Boeing's preferred remedy) – because of the following reasons:

a) very high TCE concentrations have been measured in vadose zone soil (up to 11,000 µg/kg) and in SSV (up to 48,000 µg/m3). Recent one-time (May 2016) indoor air measurements of TCE and VC were above MTCA Method B unrestricted air cleanup levels but below Method C industrial cleanup levels. Despite these findings, unacceptable TCE vapor intrusion into the building is a distinct possibility in the future given the high TCE soil and SSV concentrations;

b) the effectiveness (ranked *good* in Table 8-7a) of the SVE system in attaining soil cleanup levels at the standard point of compliance, and

c) alternative 2 (SVE) will minimally disrupt building operations (as stated in the FS report, Table 8-7a and page 8-26).

Boeing may implement Alternative 1 (maintenance of containment) in the short term while awaiting an acceptable window of opportunity (minimal interference with carpet storage and cutting operations) for the construction of the SVE system. During this time interval and following construction and operation of the SVE system, routine SSV and indoor air monitoring will be required. The duration of this monitoring program will be dependent on SVE's ability to quickly reduce soil gas concentrations to acceptable levels.

Ecology's preferred alternative also requires deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer (as indicated by the vadose zone model, Appendix B of the FS report).

[1] Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9

(2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A28: SVE can reduce some contaminant mass at this SWMU/AOC but may not achieve soil CULs throughout because of the challenging subsurface conditions associated with the glacial till, CDF backfill, and underground utilidors. Because of this, institutional controls and maintaining containment may be required in the long term at this SWMU/AOC even after implementation of Ecology's preferred cleanup action, Alternative 2 (SVE). Boeing believes that Alternative 1 (maintain containment) meets threshold criteria and is sufficiently protective of human health and the environment. Therefore, Boeing does not agree to implement Alternative 2 (SVE) because it provides only incremental benefits over Alternative 1 at a disproportionate cost.

Boeing agrees to include annual routine indoor air sampling in the cleanup action. However, Ecology is also requesting monitoring of sub-slab vapor, which is not a point of compliance. Boeing does not believe sub-slab vapor sampling would provide a meaningful benefit if the point of compliance (indoor air) is already monitored and sub-slab vapor concentrations are not increasing. Therefore, Boeing does not agree to include routine sub-slab vapor sampling in the cleanup action.

Boeing does not agree to install additional deep wells for the reasons outlined below:

1) Conservative vadose zone modeling results indicate that with building and concrete surface cover in place, residual Skydrol components present in soil where perched groundwater is not present at this SWMU/AOC will not leach to Esperance Sand groundwater for at least 999 years (maximum time frame in model). Therefore, the groundwater exposure pathway is considered incomplete, and performing deep groundwater monitoring would not be technically warranted given the timeframe that migration would occur relative to restoration timeframe for the proposed cleanup actions. The empirical evidence based on soil analytical data supports this conclusion.
2) The area within the building downgradient of the contamination is an area of both airplane (final assembly) and other vehicle traffic making it difficult to maintain well head integrity. Because of this difficulty and the potential risk of drilling near the downgradient edge of the contamination as discussed in Response A14, Boeing does not want to drill or maintain monitoring well(s) into the Esperance Sand aquifer in an active industrial area.

Boeing would like to note that it is not possible to install a deep well inside Building 40-31 downgradient of this SWMU as there is insufficient access inside the building for the type of drill rig needed.

SWMU 098, Building 40-53, Former Mock Up Degreaser (indoors):

Ecology's preferred remedy is the same as Boeing's: [1] Alternative 1 – Maintain Containment. Ecology's preferred remedy requires routine SSV and indoor air monitoring due to elevated TCE sub-slab vapor concentrations and shallow TCE vadose zone soil contamination. Ecology notes that recent one-time (May 2016) indoor air concentrations of TCE and VC were below MTCA Method C industrial cleanup levels. However, unacceptable TCE vapor intrusion into the building in the future is a distinct possibility given the high TCE SSV concentrations.

Ecology's preferred alternative also requires deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer.

[1] Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A29: Boeing agrees to include annual routine indoor air sampling in the cleanup action. However, Ecology is also requesting monitoring of sub-slab vapor, which is not a point of compliance. Boeing does not believe sub-slab vapor sampling would provide a meaningful benefit if the point of compliance (indoor air) is already monitored and sub-slab vapor concentrations are not increasing. Therefore, Boeing does not agree to include routine sub-slab vapor sampling in the cleanup action. Boeing agrees to apply the short-term action level of 8 µg/m^3 and include administrative controls to prevent soil vapor exposure to female construction workers of child-bearing age.

Boeing does not agree to install additional deep wells for the reasons provided in the response to Ecology comments on SWMU/AOC No. 171 related to deep well installation (Response A28).

Boeing would like to note that it is not possible to install a deep well inside Building 40-53 downgradient of this SWMU/AOC as there is insufficient access inside the building for the type of drill rig needed.

SWMU 170, Building 40-02, Former Large Vapor Degreaser (indoors):

Ecology's preferred remedy is the same as Boeing's: [1] Alternative 1 – Maintain Containment. Ecology's preferred remedy also requires the same types of gas and air monitoring, as well as deep groundwater monitoring, described in the SWMU098 discussion above.

[1] Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A30: Please refer to the response to SWMU/AOC No. 098, Building 40-53 (Response A29).

Boeing would like to note that it is not possible to install a deep well inside Building 40-02 because of the recent installation of a continuous slab for an assembly line as part of the Spar Shop construction.

SWMU 169, Building 40-02, Former Small Vapor Degreaser (indoors):

Ecology's preferred remedy is the same as Boeing's: [1] Alternative 1 - Maintain Containment. Ecology's preferred remedy also requires the same types of gas and air monitoring, as well as deep groundwater monitoring, described in the SWMU098 discussion above.

[1] Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

> **Response A31:** Please refer to the response to SWMU/AOC No. 098, Building 40-53 (Response A29).
>
> Boeing would like to note that it is not possible to install a deep well inside Building 40-02 because of the recent installation of a continuous slab for an assembly line as part of the Spar Shop construction.

Paint Crib, Building 40-02 (indoors):

Ecology's preferred remedy is the same as Boeing's: [1] Alternative 1 – Maintain Containment. Ecology's preferred remedy also requires the same types of gas and air monitoring described in the SWMU098 discussion above.

[1]Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

> **Response A32:** Boeing agrees to apply the short-term action level of 8 µg/m^3 and include administrative controls to prevent soil vapor exposure to female construction workers of child-bearing age. However, Boeing does not agree to conduct routine indoor air and sub-slab vapor sampling at this SWMU/AOC. All indoor air and SSV results were below Method C cleanup and screening criteria, with the exception of one SSV result that was minimally above the TCE Method C screening criteria. In addition, TCE has not been detected in the underlying soil.

SWMU 054, Building 40-51, Former Wastewater AST (outdoors):

Ecology's preferred remedy: Alternative 1 - Maintain Containment in the short term, together with Alternative 2- Future Excavation. [1] Boeing's preferred remedy is alternative 1. But Ecology prefers that this alternative be coupled with alternative 2' s future excavation, with excavation scheduled for a time when site maintenance or redevelopment minimizes disruption to building operations. Our preferred alternative also requires routine SSV and indoor air monitoring due to elevated TCE sub-slab vapor concentrations and shallow TCE vadose zone soil contamination. Though recent sampling of indoor air (May 2016) indicated that building 40-51 TCE and VC indoor air were below MTCA Method C industrial cleanup levels, unacceptable TCE vapor intrusion into the building in

the future is a distinct possibility given the high TCE shallow (1.25 foot depth) SG concentrations and shallow TCE soil contamination.

Other elements of Ecology's preferred alternative include:

a) maintaining a low permeability concrete surface as part of the remedial action and as assumed in the vadose zone modeling results (FS report, appendix B);
b) deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer; and,
c) submitting annual status update reports to indicate: (1) results of routine inspections to document the condition of the low permeable concrete surface cover (based on the vadose zone modeling results to have an intrinsic permeability of 7.0EE-12 cm2 above and adjacent to elevated TCE surface soil contamination; (2) any repairs and concrete joint sealing conducted to maintain a low permeability concrete surface cover, and at a minimum, seal surface cover cracks, expansion joints and other breaches in the concrete surface that can act as conduits for surface water to contact the contaminated subsurface soils; (3) all other maintenance work conducted on the low permeability concrete surface cover; (4) other necessary near-term repair or maintenance work required and the timeline for performing that work; and, (5) an updated schedule for planned future excavation of part or all of the subsurface contamination above SWMU-specific cleanup levels.

Boeing estimated this future excavation work could be conducted within 15 to 20 years (Table 8- 13a).

[1] Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A33: Boeing is concerned about the difficulty of removing contaminated soil in this area because of the presence of an underground utilidor in the middle of the area. There is potential for residual contamination to be left in place following excavation, which would then require institutional controls and maintaining containment in the long term. Boeing believes that Alternative 1 (maintain containment) meets threshold criteria and is sufficiently protective of human health and the environment. Therefore, Boeing does not agree to implement Alternative 2 (future excavation) because it provides only incremental benefit over Alternative 1 at disproportionate cost.

Boeing agrees to include annual routine indoor air monitoring in the cleanup action for this SWMU/AOC, but does not agree to include sub-slab vapor monitoring. Sub-slab vapor is not a point of compliance. Boeing agrees to apply the short-term action level of 8 µg/m^3 and include administrative controls to prevent soil vapor exposure to female construction workers of child-bearing age.

Boeing agrees to maintain a low permeability concrete surface above this SWMU/AOC. Boeing

agrees to submit annual status reports related to inspection, maintenance, and repairs to the concrete surface above this SWMU/AOC, as presented in the FS.

Boeing does not agree to install additional deep wells for the reasons provided in the response to Ecology comments on SWMU/AOC No. 171 related to deep well installation (Response A28).

Building 40-32, Footing Excavation (indoors):
Ecology's preferred remedy is the same as Boeing's: Alternative 1 -Maintain Containment [1] Ecology's preferred remedy requires the same types of gas and air monitoring, as well as deep groundwater monitoring, described in the SWMU 098 discussion above.

[1] Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 μg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

Response A34: Please refer to the response to SWMU/AOC No. 098, Building 40-53 (Response A29).

EPM F:

SWMU 068, South Complex, Former South Fire Pit (outdoors):
Ecology's preferred remedy is the same as Boeing's: Alternative 4 – Near Term Excavation to meet cleanup levels at a standard point of compliance.

Response A35: Comment noted.

EPM G:

SWMU 065, Building 40-51, Former Paint Stripping Tankline (metals only):
Ecology's preferred remedy is the same as Boeing's: Alternative 1 – Maintain Containment.

Response A36: Comment noted.

Building 40-11, UST EV48-l (outdoors):
Ecology's preferred remedy is Alternative 1 – Maintain Containment in the short term with Alternative 2 – Future Excavation. Boeing's preferred remedy is future excavation (only).

Ecology's preferred alternative also includes:

a) components to remove all known free product (NAPL) to the maximum extent practicable. This is needed to comply with WAC 173-340-747(2)(b);
b) deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer; and,
c) annual status update reports documenting: (1) the results of routine inspections to assess the condition of the concrete surface cover (assumed in the vadose zone modeling results with

> intrinsic permeability of 7.0EE-12 cm^2) above and adjacent to elevated surface soil contamination; (2) any repairs and concrete joint sealing conducted to maintain a low permeability concrete surface cover, and, at a minimum, to seal surface cover cracks, expansion joints and other breaches in the concrete surface that can act as conduits for surface water to contact the contaminated subsurface soils; and, (3) all other maintenance work on the low permeability concrete surface cover. The reports shall also: (a) propose other necessary near-term repair or maintenance work required and include a timeline for that work, and (b) include an updated schedule for planned future excavation of part or all of the subsurface contamination above SWMU-specific cleanup levels. Ecology expects such excavation to occur at a time when the USTs have reached the end of their service life[25] and the timing minimizes disruption to operations.

Boeing estimated this future excavation work could be conducted within 15 to 20 years (Table 8-17a).

[25] page 9-11 of the FS report.

> **Response A37:** Boeing agrees to maintain containment at this SWMU/AOC until Future Excavation is implemented, which is consistent with the intentions of Alternative 2 as presented in the FS, with the following comments:
>
> a) Boeing agrees to remove known free product to the extent practicable at this SWMU/AOC. Please note that no NAPL has been identified at this site.
> b) Boeing does not agree to install additional deep wells for the reasons provided in the response to Ecology comments on SWMU/AOC No. 171 related to deep well installation (Response A28).
> c) Boeing agrees to submit annual status reports related to inspection, maintenance, and repairs to the concrete surface above this SWMU, as proposed in the FS. Please refer to the response to Ecology comments on SWMU/AOC No. 054, Building 40-51 (Response A33).

SWMU 165, Building 45-52, Former Fuel Farm USTs (outdoors):

Ecology's preferred remedy is Alternative 1 – Limited Excavation and Maintain Containment in the short term with Alternative 2 – Future Excavation. Boeing's preferred remedy was alternative 1 (only).

Ecology's preferred alternative also requires actions to remove all known free product and the installation of deep well(s), as described in b) of the Building 40-11, UST EV48-l, discussion above. It additionally requires annual status update reports, as described in c) of the Building 40-11, UST EV48-1, discussion. With respect to the schedule for planned future excavation, Ecology expects this work to be conducted at a time that minimizes disruption to operations and is consistent with the current substation upgrade schedule (as indicated in the FS report).

Boeing estimated this work could be conducted within 5-10 years (Table 8-18a).

> **Response A38:** Boeing does not agree to complete future excavation at the areas which do

not have NAPL. The minimal mass remaining after limited excavation will be sufficiently contained and significant effort to remove soil with concentrations above CULs was previously completed when the tanks were removed. The historical excavation areas adjacent to the sample locations were backfilled with CDF and the areas are covered to minimize surface water infiltration.

a) Boeing agrees to remove known free product to the extent practicable at the Former Fuel Farm USTs area.
b) Boeing does not agree to install additional deep wells for the reasons provided in the response to Ecology comments on SWMU/AOC No. 171 related to deep well installation (Response A28). In addition, RI results show very limited water infiltration in the Former Fuel Farm USTs area.
c) Boeing agrees to submit annual status reports related to inspection, maintenance, and repairs to the concrete surface above this area of concern, as presented in the FS. Please also refer to the response to Ecology comments on SWMU/AOC No. 054, Building 40-51 (Response A33).

SWMU 083, Flightline, Former UST EV-15 (outdoors):

Ecology's preferred remedy is the same as Boeing's: Alternative 1 – Maintain Containment. However, our preferred alternative also requires deep well(s) located as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer.

Response A39: Boeing does not agree to install additional deep wells for the reasons provided in the response to Ecology comments on SWMU/AOC No. 171 related to deep well installation (Response A28). There is very minimal, residual soil contamination remaining from previous excavation in a limited area. This SWMU/AOC is also located on the flightline, where it would be impractical to install a groundwater well.

EPM H:

SWMU 093, Building 45-01, Former Solvent USTs (MEK) (outdoors):

Ecology's preferred remedy is Alternative 1 – Maintain Containment in the short term with Alternative 2 – Future Excavation. Boeing's preferred remedy is alternative 1 (only).

Ecology's preferred alternative requires:

a) maintenance of a low permeability concrete surface as part of the remedial action and as assumed in the vadose zone modeling results (FS report, appendix B);
b) deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer; and,
c) annual status update reports, as described in c) of the Building 40-11, UST EV48-1, discussion. With respect to the schedule for planned future excavation, Ecology expects this work to be conducted at a time when upgrade or removal of fuel lines or other site maintenance and redevelopment occurs so as to minimize disruption to building operations (as stated in the FS report).

Boeing estimated this future excavation work could be conducted within 15 to 20 years (Table 8-20a).

Response A40: Boeing is concerned that an excavation at this SWMU/AOC could impact the building foundation because soil contamination may extend to 18 to 20 feet below ground surface and beneath the building edge. Because of this, there is potential for residual contamination to be left in place following excavation, which would then require institutional controls and maintaining containment in the long term. Boeing believes that Alternative 1 (maintain containment) meets threshold criteria and is sufficiently protective of human health and the environment. Therefore, Boeing does not agree to implement future excavation because it provides only incremental benefit over Alternative 1 at disproportionate cost. Boeing agrees to maintain a low permeability concrete surface at this SWMU/AOC as part of the cleanup action. Boeing also agrees to submit annual status reports related to inspection, maintenance, and repairs to concrete surface above this SWMU/AOC, as presented in the FS. Please also refer to the response for SWMU/AOC No. 054, Building 40-51.

Boeing does not agree to install additional deep wells for the reasons provided in the response to Ecology comments on SWMU/AOC No. 171 related to deep well installation (Response A28).

SWMU 067 and 071, Building 40-56, Former Recycling Unit and USTs (indoors):

Ecology's preferred remedy is Alternative 1 – Maintain Containment in the short term with Alternative 2 – Future Excavation. Boeing's preferred remedy is alternative 1 (only). Our preferred alternative requires:

a) routine SSV and indoor air monitoring. Elevated sub-slab vapor concentrations have been detected as well as shallow vadose zone VOC soil contamination. Although May 2016 indoor air VOC concentrations were below MTCA Method C industrial air cleanup levels, unacceptable vapor intrusion into the building is a distinct future possibility given the shallow soil contamination below the building floor and immediately outside;

b) deep well(s) as close as possible to the downgradient edge of the SWMU in order to verify that contamination from this SWMU is not leaching into the Esperance Sand Aquifer; and,

c) annual status update reports as described in (c) of the EV-48-1 SWMU.

The reports shall also: (1) propose other necessary near-term repair or maintenance work required and include a timeline for that work, and (2) include an updated schedule for planned future excavation of part or all of the subsurface contaminationabove SWMU-specific cleanup levels at a time when future maintenance or redevelopment minimizes disruption to building operations.

Boeing estimated this work could be conducted within 5 to 20 years (Table 8-21a).

In addition, the dCAP's soil and indoor air cleanup levels for benzene, toluene, ethylbenzene, and xylene shall be identical to the cleanup levels for SWMUs 086, 089, and 094 since they share the same contaminants of concern, identical depths, media, vertical migration pathway, and the same

general location with respect to the building. [26]

[26] There is currently no perched groundwater under SWMUs 067 and 071. However, the potential exists for outdoor area (SWMU 86, 89, 94) contaminated perched groundwater to migrate a short distance under the 40-56 building to SWMUs 067 and 071.

Response A41: Boeing does not agree to complete future excavation at this SWMU/AOC. Alternative 1 (maintain containment) meets threshold criteria and is sufficiently protective of human health and the environment. Therefore, Boeing does not agree to implement future excavation because it provides only incremental benefit over Alternative 1 at disproportionate cost. In addition:

a) Boeing does not agree to conduct routine indoor air and sub-slab vapor sampling at this site. Neither sub-slab vapor nor indoor air results exceeded screening criteria or cleanup levels. As noted in the FS, CDF backfill is present immediately beneath the concrete slab in the area of contamination at this SWMU/AOC, thereby limiting the potential for sub-slab vapor intrusion.
b) Boeing does not agree to install additional deep wells or monitor existing deep wells for the reasons provided in response to Ecology comments on SWMU/AOC No. 171 related to deep well installation (Response A28). In addition, infiltration is not a concern at this SWMU/AOC as the area is located within a building and there is no evidence of perched groundwater at this SWMU/AOC.
c) Boeing agrees to maintain the current concrete surface of this SWMU/AOC and submit annual status reports related to inspection, maintenance, and repairs to concrete surface, as proposed in the FS.
d) Boeing does not agree to use the soil cleanup levels established for SWMU/AOC Nos. 086, 089, 094 (protection of groundwater). The preferred cleanup action for SWMU/AOC Nos. 086, 089, 094 includes continuous pumping of perched groundwater; therefore, it is unlikely that perched groundwater will migrate to SWMU/AOC Nos. 067 and 071.

EPM I:

Esperance Sand Aquifer; EGW061:

Ecology's preferred remedy is no further action subsequent to two additional rounds of sampling (August 2016 and October 2016) and analysis of total and dissolved arsenic and lead from EGW217, EGW061, EGW067, and EGW079. This is contingent on monitoring results continuing to indicate that metals concentrations near EGW061 are stable, through finalization of the CAP, thus providing another line of scientific evidence of natural arsenic groundwater regional background. Boeing's preferred remedy is alternative 1 - institutional controls and monitoring.

Response A42: Boeing agrees to conduct two additional rounds of sampling for total and dissolved arsenic and lead from EGW217, EGW061, EGW076, and EGW089 as discussed in a phone call between Deborah Taege (Boeing) and Dean Yasuda (Ecology) on September 7, 2016, with the understanding that no additional sampling would be required if results are consistent with historical data.

EPM J:

SWMU 100, South Complex Former Gun Club (outdoors):
Ecology's preferred remedy is the same as Boeing's: Alternative 2 – Comprehensive Excavation to meet cleanup levels at a standard point of compliance.

> **Response A43:** Boeing appreciates Ecology's agreement with the preferred alternative.

EPM K:

Powder Mill Gulch (PMG) Trichloroethylene (TCE) Groundwater Contamination in Esperance Sand Aquifer:
Ecology's preferred remedy is Alternative 4 - Enhanced In-Situ Bioremediation in the Source Area and Downgradient locations to meet groundwater and surface water cleanup levels at their respective standard points of compliance (SPOCs). [1] Alternative 1 is Boeing's preferred remedy. However, alternative #1 does not meet the threshold and other requirements for attaining groundwater cleanup standards in source and downgradient areas within a reasonable timeframe [please see WAC 173-340-360(2)(a)(ii) and (2)(b)(ii)].

> **Response A44:** Boeing does not agree with this statement. Each alternative includes an estimated restoration timeframe in the decades range (further extended by about 20 years for each alternative with the new CULs proposed by Ecology). Also, the risk for impact to human health and the environment is minimal under current and likely future site uses, and a steady decline in groundwater TCE concentrations in the last 4 years during groundwater extraction and treatment (GET) system operations (upon which Alternative 1 is centered) has already been demonstrated. Based on these factors, Ecology determining that the restoration timeframe of Alternative 1 is not reasonable, while the restoration timeframes for the other alternatives are reasonable, is not appropriate.

Cost estimates in the FS report for alternatives 1 through 4 are based on meeting groundwater remediation levels (RELs), not groundwater cleanup levels, at the SPOC. Achieving groundwater and surface water **cleanup levels** at their respective standard points of compliances in a reasonable timeframe is an important and required remedial action objective for the site. In order to accomplish this cleanup objective within a reasonable timeframe, injections cannot be limited to just those target areas where TCE levels are 500 µg/L or greater (a threshold established for the groundwater interim action only), as proposed by Boeing. Our preferred alternative therefore anticipates additional injections.[27]

> **Response A45:** Boeing indicates in the FS report that, for Alternatives 3 and 4, injections would be performed in TCE focus areas, which are defined as areas with TCE concentrations greater than 250 micrograms per liter (µg/L; 500 µg/L was only used for Alternative 2 for the source area) and that this value was not arbitrary, but based on a data analysis of all current groundwater TCE levels that indicated a data break between wells with concentrations lower than 200 µg/L and those with concentrations greater than 250 µg/L (see FS page 6-38). Additionally, injections would be technically impracticable or risky in many locations and practicably infeasible as well as disproportionately costly in areas of the plume with TCE concentrations less than 200 µg/L

Ecology's preferred alternative (Alternative 4) requires the following in the cleanup action plan:

a. injections and monitoring designed and operated such that groundwater recovery wells are kept running at all times to minimize the flux of TCE contaminated groundwater entering the creek (objective of the ongoing MTCA interim action);

Response A46: While Boeing understands the intent behind Ecology's comment (i.e., continuing to achieve the interim action [IA] objectives of the GET system), Boeing requests clarification as to whether Ecology means that all the extraction wells must be kept in operation during and after injection events. During and for some period after injection events, it would be Boeing's intent to continue to only operate extraction wells outside of the zone of influence of the bio-injections. Injections and subsequent dispersion of donor material and subsequent microbial activity in the vicinity of operating extraction wells runs a very serious risk of fouling the extraction wells to the point where they would quickly become inoperable and/or having donor pass through the treatment system and discharge to Powder Mill Creek. Therefore, it would be necessary to shut off extraction wells in these areas until there is sufficient evidence that no residual donor material remains in these areas and that bioremediation has run its course so that the wells could be safely restarted without risking surface water quality violations and the long-term integrity of the system.

b. locations of EISB injections to be determined in the EDR. These locations may differ (more or fewer locations) than what was proposed in the FS preliminary design. The objective of the preferred alternative is to attain cleanup levels for groundwater and surface water at respective SPOCs; not to meet less stringent Powder Mill Gulch (PMG) interim action TCE contaminated groundwater treatment objectives. The cleanup action must therefore be designed to provide adequate groundwater treatment and minimize the groundwater restoration timeframe;

c. at least two to three EISB injection phases. More injection may be required at new or repeat locations in order to facilitate attainment of groundwater cleanup levels at the SPOC;

Response A47: Boeing disagrees with specifying a minimum number of injection events. The need for additional injection events after each round of injections should be determined by evaluation of post-injection monitoring results to determine the result and effectiveness of the prior injection event(s) in progressing or reaching CULs in and downgradient of the treatment areas.

d. establishment of a "decision-point" regarding the need for additional EISB injections. If Boeing believes that additional EISB injections are not needed and that monitored natural attenuation (MNA) will achieve groundwater and surface water cleanup levels in a reasonable timeframe, AND that the MNA action meets all necessary cleanup requirements under MTCA, Boeing may propose to terminate EISB injection in favor of an MNA approach. If Ecology agrees, we may still require operation of the groundwater extraction wells in order to minimize TCE contaminated groundwater flux to the creek;

e. controls to ensure that the extraction of groundwater contaminated with chlorinated volatile organic compounds (CVOCs) is not only prohibited for drinking water purposes but prohibited for any use, unless specifically approved by Ecology;

f. continued efforts to inform the public about site contamination and prevent access to creek surface water and nearby creek bank TCE contaminated groundwater seeps throughout the cleanup process. This includes additional signage near Powder Mill Creek access points, warning the public to stay away from the creek (creek bank groundwater seeps and within water);

g. restrictive covenants and institutional controls on all downgradient (including non-Boeing) properties in accordance with WAC 173-340-440. Newly constructed buildings near and above the TCE groundwater plume must be designed to mitigate potentially unacceptable vapor intrusion impacts;

Response A48: In response to items (e) and (g) above, Boeing does not agree that restrictive covenants and institutional controls are necessary for preventing groundwater extraction on the commercial properties overlying the TCE plume (i.e., Panattoni and Bertch Capital/Seaway West properties) based on the following reasons:

1) Per the City of Everett municipal code (ECY14.16.020) "The utilities division shall provide for the construction, operation and maintenance of all necessary and desirable collection, diversion, impoundment, transmission, treatment, storage and distribution facilities to produce and convey a potable water supply to all inhabitants of the city and such surrounding areas as the city council may determine, for domestic, commercial, industrial and manufacturing purposes."
2) Based on review of Ecology's online water resources map, no groundwater rights currently exist on either of these properties.
3) Current and likely future land use (commercial business) do not lend themselves to needing private groundwater supply wells.
4) Portions of the properties above the plume mostly consist of steep slopes where drilling would be unlikely to be performed.
5) Groundwater is too deep to necessitate dewatering for construction activities or for construction worker/direct contact exposure to be a concern.

Boeing also requests clarification on how Ecology intends to enforce requirements that non-responsible offsite property owners place restrictive covenants and institutional controls on their properties, and incur design and construction costs for buildings when current soil gas data are below Ecology screening levels and indicate no reasonable risk of vapor intrusion into indoor air spaces. Furthermore, Boeing notes that a number of buildings have recently been built on the Panattoni property and are currently planned for the Bertch Capital/Seaway West property that may be completed prior to the CAP being approved and implemented; therefore, further build-outs on these properties may not occur.

h. routine soil gas sampling from (soil gas) wells ESG00l, ESG002, ESG003, and

ESG004 (Bertch Capital Partners and Panattoni properties located over the TCE contaminated groundwater). The purpose of this sampling is to determine whether soil gas TCE levels pose a potential and future vapor intrusion threat during the period that TCE concentrations in the Esperance Sand groundwater exceed cleanup levels;

Response A49: Boeing does not agree that routine soil gas monitoring is necessary from these locations. The soil gas assessment at PMG identified no reasonable risk of vapor intrusion because soil gas concentrations were well below screening levels and TCE concentrations in groundwater continue to decline.

i. optimization of the interim action groundwater pump and treat system to reduce TCE contaminated groundwater flux to the creek to the maximum extent practicable; and,

j. financial assurance for all near and long terms costs for cleanup actions required under RCRA and MTCA, including maintenance of institutional control and environmental covenants; ongoing O&M work, long term repair costs until cleanup levels are met and shown be maintained at those levels.

Furthermore, groundwater and surface water cleanup levels proposed by Boeing for the Esperance Sand Aquifer must be revised since all of the groundwater eventually discharges to Powder Mill Creek. Given, the. use of standard points of compliance, groundwater and surface water cleanup standards must be established that consider: State and Federal Water Quality ARARs (Chapter l 73-201A WAC, National Toxics Rule 40CFR13 l and the 2015 updated National Recommend Water Quality Criteria - Human Health[28] criteria under Section 304(a) of the Clean Water Act); Federal Groundwater MCLs; and, as appropriate, MTCA Method B groundwater cleanup levels.

Response A50: As noted above, Boeing does not agree that surface water criteria apply to all upland SWMUs. Firstly, Boeing will implement all upland remedies so that contamination will not reach the Esperance Sand aquifer and secondly, the Esperance Sand aquifer underlying the upland SWMUs will not reach surface water in Powder Mill Creek in a reasonable time period.

Groundwater and surface water CVOC cleanup levels should be revised as follows:

	Media	Cleanup Level (µg/L)	ARAR Source
Trichloroethylene (TCE)	Groundwater Surface Water	0.38 0.38	Chapter l73-201A Chapter l73-201A
cis-1,2-Dichloroethylene(cis-1,2 DCE)	Groundwater Surface Water	16 [MTCA B] 590	Na EPA Eco
trans-1,2-Dichloroethylene (trans-1,2 DCE)	Groundwater Surface Water	100 100	MCL CWA304[29]
1,1-dichloroethylene(1,1 DCE)	Groundwater Surface Water	7 7	MCL MCL
Vinyl chloride	Groundwater Surface Water	0.02 0.02	Chapter 173-201A Chapter 173-201A

Response A51: Ecology indicates that the groundwater and surface water CULs for 1,1-dichloroethylene (1,1-DCE) should both have a cleanup level of 7 µg/L based on the maximum contaminant level (MCL). Boeing disagrees with these values. Per WAC 173-340-720, groundwater CULs must be protective of surface water beneficial uses. As indicated in Table 5-11 of the FS report (page 5-24), the surface water CUL (and consequently groundwater CUL) for 1,1-DCE would be 3.2 µg/L (consumption of organisms) based on the National Toxics Rule (40 Code of Federal Regulations [CFR] 131).

[1]Shallow (1.25 foot depth) TCE soil gas concentrations have been measured above Ecology's sub-slab vapor screening levels. Ecology will therefore require that Boeing apply the EPA Region 9 (2014) short-term TCE action level of 8 µg/m3 as a maximum allowable TCE exposure concentration for a female construction ("trenching") worker that may be the first trimester of pregnancy.

[27] Described on page 6-42 of the FS report.

[28] WAC 173-340-730(1) states that the classification and the highest beneficial use of a surface water body, determined in accordance with chapter 173-20 IA WAC, shall be used to establish the reasonable maximum exposure for that water body. Surface water cleanup levels shall use this presumed exposure scenario. Under WAC 173-201A-600(1) and -602, Powder Mill Creek is protected for the following designated uses: Salmonid spawning, rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values.

[29] Federal National Recommended Water Quality Criteria for Human Health updated in 2015.

Response A52: Ecology has based many of the groundwater and surface water cleanup levels for PMG on the newly promulgated surface water standards from WAC 173-201A for human health criteria for consumption of water and organisms that were submitted to the US Environmental Protection Agency (EPA) for their review and approval on August 1, 2016. Compliance with these new lower

cleanup levels will extend all of the restoration timeframes by about 20 years (to over 50-year cleanups for all the alternatives). Boeing wishes to discuss the possible use of a conditional point of compliance for groundwater at PMG at the groundwater/surface water interface as allowable under WAC 173-340-720(8)(d).

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Response to Ecology Comments, dated August 18, 2016

ATTACHMENT B: Description of, and rational for, Ecology's preferred remedial alternatives - where the primary remedial technology differs from Boeing's preferred alternative

For many Boeing Everett facility SWMUs, Ecology's preferred remedial alternative is the sameas Boeing's. In some instances, Ecology added requirements so that the alternative would be fully compliant with the MTCA regulations, but the basic remedial technology is the same. This Attachment (B) does not discuss these SWMUs. Ecology's rationale for additional requirementsis summarized in Attachment A.

For a few SWMUs, Ecology's preferred alternative is significantly different than what Boeing proposed, and this is due to Ecology's determination that a different remedial technology (for example, enhanced bioremediation versus groundwater pump and treat) is appropriate. This Attachment B only focuses on the two facility SWMUs where Ecology's preferred remedial alternative is significantly different from, and includes more aggressive treatment than, Boeing's preferred alternative.

B.1. EPM E: SWMU 171, Building 40-31, Former Bluestreak Vapor Degreaser

B.1.1 Threshold Requirements: requirements that all alternatives must comply with if selected; described in WAC 173-340-360(2)(a).

B.1.1.1 Protect Human Health and the Environment (WAC 173-340-360(2)(a)(i)):

Conclusions: All four of Boeing's alternatives should adequately protect human health and the environment as long as: (a) institutional controls are effective over time; (b) shallow TCE soil contamination does not result in unacceptable indoor air vapor intrusion (above cleanup levels), and (c) TCE soil contamination does not eventually migrate to the Esperance Sand Aquifer.

Response B1: All cleanup action alternatives presented in the FS protect human health and the environment and meet the requirements above based on the following:

(a) All alternatives include institutional controls that prevent exposure to contamination when media exceeding CULs will be left in place and/or be treated or excavated at a future point in time. All alternatives that include institutional controls include annual inspection (monitoring) and reporting to ensure the institutional controls are effective over time.
(b) Indoor air monitoring completed in May 2016 at SWMU/AOC No. 171 indicates VOC concentrations were below MTCA Method C Indoor Air Cleanup Levels; therefore, there is no evidence that unacceptable indoor air vapor intrusion (above cleanup levels) has occurred. However, Boeing agrees to add annual indoor air monitoring to Alternative 1 (maintain containment) to address Ecology concerns over elevated concentrations in sub-slab vapor, per the response to Ecology's comments in Attachment A (Please refer to Response A28). If indoor air results exceed cleanup levels Boeing will consider contingent remedies such as SVE.

(c) Conservative transport model simulations indicate that TCE (used as a surrogate for all VOC COCs at this SWMU/AOC) is predicted not to migrate to the Esperance Sand Aquifer within the 999-year modeling period. Furthermore, SWMU/AOC No. 171 is currently contained by a concrete surface (floor) and located within Building 40-31. There is no perched groundwater at this SWMU/AOC, and therefore no surface water infiltration can occur to contribute to migration.

B.1.1.2 Comply with cleanup standards (WAC 173-340-700 through 173-340-760):

Conclusions: Boeing estimated a restoration timeframe of 30 years for Alternative 1. The alternative would not require the removal of TCE-contaminated soil above cleanup levels (0.025 µg/kg, per Table 5-5 of the FS report) at the Standard Point of Compliance. Instead, TCE-contaminated soils (estimated to be as high as 11,000 µg/kg in shallow soils) would be left in place under the concrete floor.

Response B2: Boeing has not assumed a restoration timeframe of 30 years for Alternative 1. Boeing estimated costs for all cleanup action alternatives at the upland SWMUs/AOCs using a maximum timeframe of 30 years for consistency and comparison of alternative costs. The components of the Maintain Containment alternative will be implemented indefinitely as long as COC concentrations exceed the applicable CULs. The sitewide institutional controls plan to be developed for upland sites will include monitoring, reporting, and repairs of containment at SWMU/AOC No. 171 and will provide for additional action in the future if containment is not maintained (i.e., change in land or building use).

Under WAC 173-340-740(6)(f), Ecology recognizes that cleanup actions requiring containment of hazardous substances rather than removal will not meet soil cleanup levels at the standard soil point of compliance. In these cases, the cleanup action may still be determined to comply with cleanup standards, provided the cleanup action is:

(i) permanent to the maximum extent practicable per WAC 173-340-360;
(ii) protective of human health;
(iii) protective of terrestrial ecological receptors under WAC 173-340-7490 through 173-340-7494;
(iv) inclusive of WAC 173-340-440 institutional control requirements that prohibit or limit activities that could interfere with the long-term integrity of the containment system;
(v) inclusive of monitoring requirements under WAC 173-340-410 and periodic reviews under WAC 173-340-430 to ensure the long-term integrity of the containment system; and,
(vi) inclusive of identifying the types, levels and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the draft cleanup action plan.

Remedial alternative #1 is compliant with (iii) and (vi) and can be made compliant with (iv) with a few additional requirements. However, alternative #1 is not compliant with (i) (refer to Section B.1.2.3 below). Nor does it meet (ii) and (v), since routine indoor air and sub-slab vapor sampling, at a minimum, is required due to the shallow TCE soil contamination.

Alternatives #2 through #4 are expected to either remove TCE contamination from the subsurface soils OR remove TCE-contaminated soil itself in order to meet proposed soil cleanup levels at the

standard point of compliance within a reasonable timeframe.

Response B3: Alternative 1 (Maintain Containment) is compliant with WAC 173-340-740 (6)(f)(i) – (vi) based on the following:

a) Alternative # 1 is "permanent to the maximum extent practicable per WAC 173-340-360." Containment is permanent to the maximum extent practicable based on the results of the disproportionate cost analysis (DCA) completed in the FS. "To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, the disproportionate cost analysis specified in (e) of this subsection shall be used" per WAC 173-340-360(3)(b). The DCA in the FS complies with WAC 173-340-360(3)(e). Furthermore, a "permanent cleanup action" is defined in 173-340-200 as "a cleanup action in which cleanup standards of WAC 173-340-700 through 173-340-760 can be met without further action being required." Therefore, by meeting the requirements of WAC 173-340-700 through 173-340-760, Alternative 1 is considered permanent.

b) Alternative #1 is "protective of human health" by preventing exposure pathways to receptors. The SWMU/AOC No. 171 area is currently contained under an existing concrete floor, which would continue to be maintained under the proposed cleanup action and prevents direct contact with soil and soil vapor. Additionally, indoor air monitoring indicates VOC concentrations are below the applicable Method C cleanup levels. Boeing agrees to add annual indoor air monitoring to Alternative 1 to verify that containment continues to prevent unacceptable sub-slab vapor intrusion, per the response to Ecology comments in Attachment A (Please refer to Response A28).

c) Alternative #1 is "inclusive of monitoring requirements under WAC 173-340-410 and periodic reviews under WAC 173-340-430 to ensure the long-term integrity of the containment system." Alternative 1 includes compliance monitoring (per 173-340-410) and periodic reviews (per 173-340-420) which will be designed to confirm the long-term integrity of the containment at SWMU 171 and assure that human health and the environment are being protected.

B.1.1.3 Comply with applicable state and federal laws (see WAC 173-340-710):
Conclusions: All four Boeing remedial alternatives could be designed to comply with ARARs.

Response B4: All cleanup action alternatives presented in the FS comply with ARARs.

B.1.1.4 Provide for compliance monitoring (see WAC 173-340-410 and 173-340-720 through 173-340-760):
Conclusions: All four Boeing alternatives could be designed to meet Ecology requirements for compliance monitoring.

Response B5: All cleanup action alternatives presented in the FS comply with Ecology requirements for compliance monitoring. In response to Ecology's comments in Attachment A, Boeing agrees to include annual indoor air monitoring at this SWMU/AOC (please refer to Response A28).

B.1.2 Other Requirements: When selecting from cleanup action alternatives that fulfill the threshold requirements, the selected action shall also meet the following requirements:

B.1.2.1 Provide for a Reasonable Restoration Timeframe, WAC 173-340-360(2)(b)(ii) and (4)

To determine whether a cleanup action provides for a reasonable restoration time frame, the following factors must be considered:

(i) potential risks posed by the site to human health and the environment;
(ii) practicability of achieving a shorter restoration time frame;
(iii) current uses of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site;
(iv) potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site;
(v) availability of alternative water supplies;
(vi) likely effectiveness and reliability of institutional controls;
(vii) ability to control and monitor migration of hazardous substances from the site;
(viii) toxicity of the hazardous substances at the site; and
(ix) natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions.

Conclusions: Boeing's estimated restoration timeframe for alternative #1 is 30 years. The FS report did not provide a discussion of how this restoration timeframe was calculated. However, Ecology believes it is very likely that subsurface TCE soil contamination will remain below the concrete floor for longer than 30 years given that the compound is not expected to degrade under current subsurface conditions.

In-situ treatment (SVE) is capable of reducing volatile soil contamination concentrations, however, and is thus capable of practicably achieving a much shorter restoration timeframe (restoration via SVE under alternative #2 was estimated to take approximately 5 years). The high **toxicity** of trichloroethylene (TCE) as the primary contaminant in subsurface soils and subslab vapor further emphasizes the importance of a shorter restoration timeframe for this SWMU. **In our view Alternative #1** therefore fails to meet criterion (ii); i.e., it is practicable to achieve a shorter restoration timeframe.

Alternatives #2 through #4 have estimated restoration timeframes of 5 years (SVE-alternative #2), 15-20 years (future excavation - alternative #3) and 2 years (near term excavation - alternative #4). We believe that they each meet the reasonable restoration timeframe criteria of WAC 173-340-360(2)(b)(ii) and (4).

Response B6: Alternative #1 provides for a reasonable restoration timeframe. WAC 173-340-360(4) lists nine factors, all of which should be considered but none of which are determinative. Alternative #1 considers all nine factors, and even if we were to agree with Ecology's position as stated above, favorably addresses at least eight of the nine. Ecology agrees and has stated "that WAC 173-340-360(4) provides criteria for determining if the cleanup provides for a reasonable restoration timeframe, but does not require that an alternative with a 'far shorter reasonable restoration timeframe be selected.' Instead, the rule provides a series of factors that need to be considered." Ecology, Response to Comment on "Draft Model Remedies for Sites with Petroleum Impacts to Groundwater" (Publication No. 16-09-057) (Aug. 3, 2016).

B.1.2.2 Consider public concerns, WAC 173-340-360(2)(b)(iii):

Conclusions: Compliance with this requirement is generally best measured after the draft Cleanup Action Plan (CAP) has been provided to the public for comment. Given that this contaminated area is within the boundary of the Boeing Everett Plant, it is difficult to predict the (non-Boeing) public sentiment regarding the type of cleanup action that would be preferred. However, Ecology considers it likely that the employees working in the building above this TCE contaminated soil and the downgradient public would prefer a faster and more permanent remedial alternative.

Response B7: Boeing agrees that it is difficult to predict public sentiment regarding the preferred type of cleanup action and does not think it is appropriate to assume that Boeing employees and the downgradient public would prefer a faster and more permanent remedial alternative without seeking their input first. The FS ranked all cleanup action alternatives at this SWMU/AOC as being "excellent" with respect to consideration of public concerns as all of the alternatives are protective of human health and the environment.

B.1.2.3 Use permanent solutions to the maximum extent practicable, WAC 173-340-360(2)(b)(i) and (4) Evaluative Criteria:

As noted above, the MTCA disproportionate cost analysis (DCA) applies to those alternatives that meet **minimum requirements for cleanup actions** (WAC 173-340-360(2). If these minimum requirements are not met, the corresponding "alternative" is not evaluated under the DCA and cannot be selected as the site's cleanup action. We believe this is the case for alternative 1; it does not meet WAC 173-340-360(2) minimum requirements. Nevertheless, in our responses below to Boeing's analysis of the DCA criteria we also included comments on alternative 1.

WAC 173-340-360(3) provides the regulations for 'determining whether a cleanup action uses permanent solutions to the maximum extent practicable.' Besides using permanent solutions to the maximum extent practicable, the preferred cleanup action must:

- Protect human health and the environment
- Comply with cleanup standards.
- Comply with ARARs
- Provide for compliance monitoring
- Provide for a reasonable restoration timeframe
- Consider public concerns
- Not primarily rely on ICs where it is technically possible to implement a more permanent cleanup action

To decide whether a cleanup action uses permanent solutions to the maximum extent practicable, a DCA is performed. This analysis requires ranking the alternatives from most to least permanent. If the incremental costs of an alternative over that of a less permanent, lower cost alternative exceed the incremental benefits, the added costs are "disproportionate." The preferred alternative, then, is the most permanent action whose costs are not disproportionate to cheaper, less permanent actions.

Boeing used the WAC 173-340-360(3)(f) criteria to evaluate permanence to the maximum extent practicable for the four remedial alternatives for EPM E Bluestreak Degreaser. A score of from 1 to 10 was assigned to each alternative, per criterion. Each criterion was assigned a weighting factor where the sum of the weighting factors for each criterion equaled 1.0. The sum of the criterion score multiplied by its associated weighting factor were then totaled up as the weighted score for each of the four remedial alternatives. MTCA does not say this is how the DCA should be performed; however, it is a reasonable methodology as long as it is applied consistent with the objectives of WAC 173-340-360. These objectives are essentially to determine which alternatives are the most permanent, how much each alternative is likely to cost, and – through use of the DCA criteria - what benefits are associated with each alternative.

In accordance with WAC 173-340-360(3)(e)(ii)(C), the comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment. Ecology has the discretion to favor or disfavor qualitative benefits and use that information in selecting a cleanup action. Where two or more alternatives are equal in benefits, we select the less costly alternative provided the requirements of WAC 173-340-360(2) are met.

Below is Ecology's response to Boeing's evaluation of the four remedial alternatives with respect to the "permanent to the maximum extent practicable" criterion. We evaluated and weighted the DCA criteria somewhat differently than Boeing. This resulted in a conclusion that alternative #2 is the cleanup option permanent to the maximum extent practicable.

Response B8: For the reasons discussed above, Alternative 1 meets threshold requirements and therefore should be considered in the DCA. In addition, while Alternatives 1 – 4 all rely on institutional controls, none of the cleanup actions rely primarily on institutional controls as the mechanism for protecting against unacceptable risk to human health and the environment. The mechanism for protecting against risk under Alternative 1 (maintain containment) is containment of the contamination under a concrete surface (cap). Alternative 1, as well as the other alternatives considered for this SWMU/AOC, includes institutional controls to ensure the effectiveness and maintenance of the cap.

Boeing recognizes that benefit scores are subjective and may differ based on professional judgement; however altering the scoring and rankings of the four alternatives will continue to result in Alternatives 2 – 4 being disproportionately costly to Alternative 1 because of the drastic difference in the magnitude of cost between Alternative 1 and Alternatives 2 – 4 ($91,000 and $1,089,000 – $2,661,000, respectively). As Ecology states in its comment above "The preferred alternative, then, is the most permanent action whose costs are not disproportionate to cheaper, less permanent actions." Although Ecology prefers Alternative 2, its costs continue to be disproportionately costly compared to Alternative 1.

Protectiveness -360(3)(f)(i)):
This criterion is intended to compare each remedial alternative's *time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality*.

Boeing believes that alternatives #1 through #4 are equally protective (a score of 8 was assigned to each). However, Ecology believes alternative #1 is less protective than alternatives #2 through #4.

Sub-slab vapor (SSV) TCE concentrations as high as 35,000 µg/m3 have been detected (2013), and these concentrations are 500 times higher than the Method C SSV screening level (and 2800 times higher than the Method B SSV screening level). To ensure that vapor intrusion is not unacceptably impacting indoor air quality, routine indoor air and sub-slab vapor monitoring would be required. However, routine (yet infrequent) indoor monitoring could miss transient indoor air TCE concentration spikes, and once monitoring indicates that indoor levels are too high, exposures have already occurred and will continue to occur until the levels drop.

If unacceptable levels of indoor air TCE were detected, and were due to vapor intrusion, Boeing would be required to propose contingent remedial/mitigative actions. However, exposures would continue until the actions had been successfully completed.

Response B9: Boeing agrees to include annual indoor air monitoring in the cleanup action at SWMU/AOC No. 171, per the response to Ecology comments in Attachment A (Response A28). However, sub-slab vapor is not a point of compliance. Boeing does believe that sub-slab vapor monitoring would provide a meaningful benefit if the point of compliance (indoor air) is already monitored and sub-slab vapor concentrations are not increasing. Boeing does not agree to include routine sub-slab vapor sampling in the cleanup action. Boeing also notes that Building 40-31, where SWMU/AOC No. 171 is located, is a storage facility and not used as a continuous workspace. Boeing understands that as part of the five-year periodic review process, Ecology may require a revised cleanup action plan if *changes in the cleanup action are necessary to protect human health and the environment* [WAC 173-340-420(6)], consistent with the response to Ecology comments in Attachment A (Response A3).

Permanence (360(3)(f)(ii)):
This criterion is used to compare the degree each remedial alternative *permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated*.

The FS report states that remedial alternatives #2 through #4 are the most permanent actions (score of 7 to each). Remedial alternative #1 received a slightly lower score (6). Ecology agrees that remedial alternatives #2 through #4 (which all proposed to remove contamination from the subsurface) are more permanent than remedial alternative # 1 (containment of contamination below the building floor), with its heavy reliance on institutional controls. However, we also believe that alternative #1 is significantly less permanent. A larger differential in scoring between alternatives #2 through #4 and alternative #1 was, in our opinion, therefore warranted.

Response B10: Comment noted. Please also refer to Response B8.

Cost (360(3)(f)(iii)):
Boeing developed cost estimates for the four remedial alternatives in Appendix D, Table D-24.
Remedial alternative #1 cost estimate is $0.091 million;
Remedial alternative #2 cost estimate is $1.1 million;
Remedial alternative #3 cost estimate is $2.4 million; and

Remedial alternative #4 cost estimate is $2.7 million.

Alternative #1 is the least costly, followed- in increasing cost - by alternatives 2, 3, and 4. Ecology notes, however, that the cost estimate for alternative #1 is largely underestimated if routine indoor air and sub-slab vapor sampling is required throughout the duration of the 30+ year restoration timeframe.[30]

[30] Ecology anticipates that two indoor air and two sub-slab vapor sampling events would be needed per year (heating and nonheating season). Given the size of this SWMU, at least two indoor air, one ambient air, and two sub-slab vapor samples would be required for each sampling event. A contingency remedial action plan and implementation would be required if unacceptable vapor intrusion were confirmed.

Response B11: Boeing agrees to include annual indoor air monitoring in the cleanup action for this SWMU/AOC, but does not agree to include routine sub-slab vapor monitoring for the reasons provided in Response B9. .Additional monitoring required by Ecology for IA, SSV, and deep wells is not considered in the DCA evaluation.

Long-term effectiveness (360(3)(f)(iv))
This criterion is used to compare the long-term effectiveness of each remedial alternative *Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: Reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or off-site disposal in an engineered, lined and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.*

Boeing believes remedial alternatives #3 and #4 have the highest long-term effectiveness (score of 7 assigned to both). This is followed by alternative #2 (score of 6), and lastly alternative #1 (score of 5). The FS report defines a score of 5-6 as "good."

Ecology generally agrees with this ranking. Excavation alternatives (#3 and #4) are considered more effective than in-situ treatment technologies (alternative #2) and much more effective than containment approaches (alternative #1).

Response B12: Comment noted.

Consideration of public concerns (360(3)(f)(vii))
Boeing believes remedial alternatives #1 and #3 should be ranked higher (a score of 8 each) than alternatives #2 and #4 (a score of 7 each). The public has not yet been provided any opportunity to give formal or informal input on Boeing's preferred remedial alternative (#1). And, as noted above in B.1.2.2, prior to the FS and CAP formal public comment periods Ecology can only anticipate public sentiment regarding the type of cleanup action they would prefer. However, we

believe that employees working in the building above this TCE contaminated soil, as well as the downgradient (non-Boeing) public, would likely prefer a faster and more permanent remedial alternative (such as proposed by alternatives #2, 3, and 4).

Response B13: As noted in Response B7, Boeing agrees that it is difficult to predict public sentiment regarding the preferred type of cleanup action and prefers not to speculate if they have a different preference than assumed in the FS before getting the public's input. The FS ranked all cleanup action alternatives at this SWMU/AOC as being "excellent" with respect to consideration of public concerns as all of the alternatives are protective of human health and the environment. Intrusive cleanup action alternatives (i.e., Alternative 2 [SVE] and Alternative 4 [near-term excavation]) were ranked numerically one point lower on the 10-point scale than Alternatives 1 (maintain containment) and Alternative 3 (future excavation) because of the potential to delay plant operations, which could negatively impact plant workers.

Implementability (360(3)(f)(vi))
This criterion is used to compare the degree each remedial alternative is able to be *implemented including consideration of whether the alternative is technically possible, availability of necessary off-site facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions*.

Boeing rated remedial alternative #1 highest (a score of 9), followed by alternative #2 (score of 7), alternative #3 (score of 4), and alternative #4 (score of 3).

The FS Report states that Alternatives #3 and #4 would require significant disruptions to manufacturing operations and complicated planning and logistics to complete the work. Based on this information, Ecology agrees that excavation-based actions will disrupt manufacturing operations in that portion of the 40-31 building and, as a consequence, be more difficult to implement.

According to the FS report (Section 8, page 8-26): Alternative 2 is the next most implementable because construction and operation of an SVE system is comparatively straightforward without significant disruptions to on-site activities. The question, then, is whether this alternative is substantially more difficult to implement than alternative 1. The latter, of course, proposes to do less (in terms of remediation). But "Implementability" is not included in WAC 173-340-360(3)(e) to offset the benefits associated with more protective, permanent, and effective remedies that require relatively more to be implemented than those alternatives proposing to implement much less. Ecology therefore places less emphasis on this criteria when comparing a remedial alternative that proposes no aggressive treatment to one which will result in contaminant mass reduction - unless there are significant technical or administrative hurdles expected to be associated with implementing the latter.

Response B14: Comment noted. Boeing would like to point out that implementability is an important factor to consider when comparing cleanup action alternatives, as it demonstrates the in-field feasibility of any given alternative and is included as a criterion in WAC 173-340-360(3)(e). The implementability of construction activities at an active industrial plant are realistically limited by the

plant operations. Boeing believes that the DCA rankings used in the FS for implementability reflect the realistic feasibility of executing the cleanup action alternatives at the plant given the conditions at the time of the FS.

Management of short-term risks (360(3)(f)(v)):
This criterion is used to compare the degree each remedial alternative presents risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

Boeing rates remedial alternative #1 highest (score of 9), followed by alternative #2 (score of 7), alternative#4 (score of 6), and alternative #3 (score of 5).

As noted above for Implementability, the purpose of the "management of short-term risks" consideration is not to simply favor alternatives that propose to do less over those cleanup options proposing to do more. It is important, therefore, to fairly credit more aggressive alternatives when they can be designed to effectively manage those potential risks associated with their construction and implementation. Ecology believes the remedial alternatives evaluated by Boeing can all be designed so that the risk of danger to the public and site workers is minimal. Text in the FS report (page 8-25) appears to concur: *These risks can typically be managed effectively through careful design and implementation, however the risks are present.*

In our view, then, while alternative 1 seems to certainly pose the lowest potential short-term risk among the four alternatives, the construction and implementation of other three can be designed to effectively manage these risks.

Response B15: Boeing believes that the short-term risks were ranked appropriately in the FS based on the proposed cleanup technology and construction involved.

B.1.3 Ecology Selection of Preferred Remedial Alternative: EPM E: SWMU l71, Building 40-31, Former Bluestreak Vapor Degreaser

Ecology has determined that alternative 1 does not meet threshold criteria and other minimum requirements for a cleanup action (WAC 173-340-360(2)(a) and (b)).[31] It is therefore excluded from the DCA and cannot be selected as the cleanup action. Our reasons are summarized below:

1. **Threshold Requirements-Comply with Cleanup Standards:** Alternative #1 proposes to leave contaminated soils in place under the concrete floor. This includes soils contaminated above applicable cleanup standards. Containment remedies are allowed under MTCA provided all conditions of WAC 173-340-740(6)(f)(i) through (vi) are met. Alternative #1**,** however, does not meet condition (i) because it is not permanent to the maximum extent practicable.

2. **Provide for a Reasonable Restoration Timeframe, WAC 173-340-360(2)(b)(ii) and (4):** Soil containment remedies are often associated with long, and sometimes indefinite, restoration timeframes. When they are selected, then, it is usually because: a) there is no

feasible way to effectively treat the soil contamination, and b) the restoration timeframes associated with protecting nearby groundwater and indoor air quality *are* reasonable.

Ecology believes it is very likely that the TCE subsurface soil contamination will remain below the concrete floor for longer than 30 years, given that TCE is not expected to degrade under current subsurface conditions.[32] Because in-situ treatment (such as alternative 2's SVE) is capable of reducing volatile TCE soil contamination concentrations, and thus can practicably achieve a much shorter restoration timeframe (approximately 5 years), Alternative #1 does not meet the WAC 173-340-360(4)(b)(ii) and (viii) criteria. Furthermore, the high **toxicity** of TCE, the primary contaminant in subsurface soils and sub-slab vapor, emphasizes the importance of minimizing the restoration timeframe for this SWMU.

Response B16: For the reasons discussed above, Alternative 1 for SWMU/AOC No. 171 meets threshold criteria and the minimum requirements. In addition:

a) In accordance with WAC 173-340-360(3)(b), the DCA is the appropriate method to determine permanence. Alternative 1 is permanent to the maximum extent practicable as discussed in Response B1.
b) Alternative 1 provides for a reasonable restoration timeframe based on a review of the nine factors presented in WAC 173-340-360(4)(b) as discussed above.

Alternatives #2 through #4 meet threshold and other minimum requirements for a cleanup action. They are expected to comply with cleanup standards because they either intend to remove TCE contamination from the subsurface soils OR remove TCE-contaminated soil. They will accomplish this within a reasonable timeframe. **Alternatives #2 and #4** use more aggressive treatment (excavation or SVE) than Alternative #1 and have much shorter estimated restoration timeframes. Ecology therefore considers alternatives #2 (SVE) and #4 (near term excavation) to be associated with reasonable restoration timeframes, as defined by the criteria in WAC 173- 340-360(2)(b)(ii) and (4). **Alternative #3** (future excavation) has an estimated restoration timeframe of 15-20 years. While this period may be as much as three times longer than the timeframes for alternatives 2 and 4, Ecology believes that, within the context of what can be done at this SWMU, it is also reasonable.

The MTCA regulations require the feasibility study to include at least one permanent cleanup action alternative, as defined in WAC 173-340-200, to serve as a baseline against which other alternatives shall be evaluated for the purpose of determining whether the selected cleanup action is permanent to the maximum extent practicable. Ecology chose remedial alternative #2 as the baseline alternative.

The MTCA regulations also require that remedial alternatives which **meet threshold and other minimum requirements** be ranked from most to least permanent. If the incremental costs of a more permanent alternative over a lower cost/less permanent alternative exceed the incremental benefits, the added costs are deemed "disproportionate." Per WAC l 73-340-360(3)(ii)(C), the comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment. Ecology has the discretion to favor or disfavor qualitative benefits and use that information in selecting a cleanup action.

With this mind, we believe that alternatives #2 through #4 score higher in the DCA than alternative #1 (were it to be included in the DCA). This is because, in our view, the three alternatives appear to be more protective, more permanent, more effective over the long-term, and more likely to be welcomed by the public. Even if alternative #1 is less expensive, could be more easily implemented, and would have fewer potential short-term risks, we believe these advantages are out-weighed by the benefits of the other three alternatives. Remedial alternative #2 (SVE) is the least expensive option among alternatives #2 through #4, at an estimated cost of $1.1 million. It is therefore Ecology's preferred remedial alternative. [33]

While Ecology concludes that alternative #2 is our preferred remedial alternative for the EPM E SWMU 171 Former Blue streak Degreaser, we also believe that when it is proposed to the public in the dCAP it must contain additional elements. This is further discussed in Attachment A. So, besides the use of SVE to remove TCE contamination from subsurface soils, the Ecology preferred cleanup action shall also contain the following:

a. Post-SVE operation subsurface confirmation sampling.
b. Post-SVE operation indoor air and SSV sampling to confirm remaining CVOC soil contamination does not present an unacceptable vapor intrusion threat.
c. Contingency remedial action options if the SVE system fails to meet cleanup standards in a reasonable timeframe.
d. Restrictive covenants and institutional controls on areas where cleanup levels above unrestricted cleanup levels are not met (per WAC 173-340-440).

These additions are needed to ensure that threshold and other minimum requirements for cleanup actions are met.

[31] In the FS report, Boeing argues that alternative 1 is its preferred alternative because other alternatives 2 through 4 are disproportionately costly and therefore alternative # 1 is permanent to the maximum extent practicable. Ecology has dismissed alternative# 1 because it does not meet all threshold and other minimum requirements for a cleanup action.

[32] Alternative# 1 is not expected to utilize natural processes (such as biodegradation) to reduce concentrations of hazardous substances (TCE). Please see WAC 173-340-360(4)(b)(ix).

[33] Remedial alternatives #3 (future excavation) and #4 (near term excavation) would be slightly more permanent than alternative #2 mainly because excavation activities are likely to be more effective than in-situ SVE technologies. The cost estimates for remedial alternatives #3 and #4 are $2.4 million and $2.7 million, respectively.

Response B17: For the reasons discussed above, Alternative 1 meets threshold requirements; however, Boeing agrees to enhance Alternative 1 to address Ecology concerns. Specifically, Boeing will revise Alternative 1 to include annual indoor air monitoring as part of compliance monitoring to protect against the risk for unacceptable vapor intrusion.

B.2. EPM K: Powder Mill Gulch

B.2.1 Threshold Requirements: requirements that all alternatives must comply with if selected; described in WAC 173-340-360(2)(a).

B.2.1.1 Protect Human Health and the Environment (WAC 173-340-360(2)(a)(i):
Conclusions: All four of Boeing's alternatives should adequately protect human health and the environment as long as: a) institutional controls are effective; b) contaminated groundwater is not withdrawn for drinking water or other purposes, currently or in the future; and, (c) walkers on the trail within Powder Mill Gulch obey the signage and stay away from the creek and TCE contaminated groundwater seeps.

B.2.1.2 Comply with cleanup standards (see WAC 173-340-700 through 173-340-760):

Conclusions: **Alternative 1** [condition 1 - cleanup standards met and condition 2 - groundwater cleanup standards not met but groundwater remediation levels met prior to discharge into the creek] does not meet this threshold requirement. The alternative overrelies on the existing interim action groundwater extraction wells[34], by themselves, to achieve cleanup levels in the TCE groundwater source area. [35] Reliance on the current interim action pump and treat system, attempts at monitored natural attenuation, and institutional controls will not, in Ecology's view, achieve cleanup standards (within the source or throughout the TCE groundwater plume). The use of MNA without groundwater source remediation is not allowed under WAC 173-340-370(7)(a). Furthermore, selection of MNA as a cleanup action under the regulations requires that the attenuation be due at least in part to chemical degradation, and that this degradation consistently occur throughout the remediation interval at an appreciable rate. Nor do we believe that the aerobic aquifer conditions are favorable for chemically degrading the contamination. Instead, dilution is likely to be the main mechanism for attenuating contaminant concentrations, and attainment of cleanup levels is unlikely, let alone within a reasonable timeframe.

Under **Alternative 1** [condition 3-groundwater cleanup standards and remediation levels not met], Boeing states that the company may either: (a) optimize the interim action groundwater extraction system, (b) shut down the interim action groundwater extraction system and rely on MNA, or (c) implement contingent in situ groundwater treatment at strategic locations within the plume (in-situ enhanced bioremediation or in-situ chemical oxidation). Ecology does not believe that maintaining or optimizing operation of the interim action groundwater extraction wells will meet this threshold requirement by remediating the TCE groundwater source and downgradient areas to cleanup levels. Currently, the groundwater pumping wells are downgradient and 750 feet or more from the TCE groundwater source area. Moreover, cleanup levels are low, and groundwater pump and treat systems are not known for achieving such levels successfully. Secondly, MNA without groundwater source remediation is unlikely to be successful.[36] As noted above, WAC 173-340-370(7) assumes any cleanup action employing MNA is preceded

by or coupled with effective source reduction. In addition, shutting off the interim action groundwater extraction wells before cleanup standards, intended to protect the creek, is also not an acceptable option to Ecology because this allows elevated concentrations of TCE contaminated groundwater to enter the creek. The groundwater pump and treat system (interim action) was required to prevent this.

Response B18: Ecology states that "The use of MNA without groundwater source remediation is not allowed under WAC 173-340-360(7)(a) [source control]". Boeing reminds Ecology that both an ERH and supplemental EISB interim remedial action were performed in the source area which reduced TCE concentrations from upwards of 30,000 µg/L to below 100 µg/L at most source area monitoring wells. Boeing recognizes that 2 or 3 wells continue to exhibit elevated concentrations of TCE; however, concentrations are sufficiently low in these wells indicating that there is no remaining "source" contamination (i.e., no DNAPL or other source of contamination that is contributing significant ongoing contaminant mass to downgradient groundwater). Ecology also states that "selection of MNA as a cleanup action under the regulations requires that the attenuation be due at least in part to chemical degradation . . ." WAC 173-340-370(7)(c) states "(7) The department **expects** [emphasis added] that natural attenuation of hazardous substances may be appropriate at sites where: (c) there is evidence of natural biodegradation or chemical degradation . . ." Boeing notes that an expectation is not the same as a requirement, and that per Ecology guidance on MNA (Ecology 2005), this expectation relates to a remedy that intends to "rely **solely** [emphasis added] on natural attenuation to achieve ground water cleanup standards". The proposed possible use of MNA is not intended to be the sole form of remediation, but rather it is to be used as a polishing step after the various forms of active remediation identified in Alternative 1 (or any of the other Alternatives).

[34] Ecology reminds Boeing that the groundwater extraction wells are at least l 000 feet from the TCE groundwater source area and not expected to treat source area TCE contaminated groundwater AND not expected to have significant influence in midplume regions where many groundwater extraction wells are located at the edge of the plume near the creek. Again, the objective of the PMG interim action groundwater extraction wells was to provide hydraulic containment at Seaway Blvd (Boeing north property line) and intercept TCE contaminated groundwater before reaching the creek. The Phase 1 and Phase 2 PMG interim action was not intended to treat the source area and downgradient groundwater plume to meet cleanup levels in a reasonable timeframe. Instead, the main purpose of the IA was to quickly minimize the flow of TCE contaminated groundwater into Powder Mill Creek. This interim action was never intended to meet groundwater cleanup standards and this was the basis for Boeing agreeing to implement this required action.

Response B19: Ecology indicates that, based on the distance from the extraction wells to the source area and to the edge of the plume in the mid-plume area, the Downgradient Plume IA is not anticipated to have significant influence in cleaning up these areas and that the IA "was not intended to treat . . . downgradient groundwater plume to meet cleanup levels in a reasonable timeframe". Boeing agrees that the Downgradient Plume IA had specific objectives for plume containment, but as stated in the Ecology-approved Phase 1 IA Work Plan (LAI 2011) "the extraction wells will provide a hydraulic barrier to offsite migration of TCE-impacted groundwater, thereby allowing flushing of the offsite aquifer with clean groundwater to accelerate restoration of groundwater beneath offsite properties. Groundwater restoration beneath the Boeing Everett property will be accelerated through direct removal of TCE mass from the groundwater and increased flushing." Therefore, Boeing disagrees with Ecology's assessment of the GET system's lack of influence on the mid-plume area. Operation of the extraction wells steepens gradients and

shortens groundwater flow paths in most downgradient areas of the plume thereby increasing pore-volume flushing rates. Related to the source area, Boeing also notes that based on the restoration timeframe analysis with BIOCHLOR, the source area is not driving the restoration timeframes (i.e., the source area is anticipated to naturally clean up faster than some other areas of the plume where gradients and hydraulic conductivities are lower). The success of both the source area and downgradient plume interim actions in removing source area contamination and significantly reducing TCE concentrations plume-wide provides an opportunity for GET system operations alone to successfully meet cleanup levels in a reasonable timeframe (with the option of performing supplemental actions if it becomes evident that successful progress toward cleanup levels is no longer occurring).

[35] Benzene is also found in the groundwater source area.

Response B20: Boeing requests clarification of the pertinence of this statement, especially considering that benzene was not identified as an indicator hazardous substance or a contaminant of concern in the RI or FS, and that benzene has only been detected recently in one monitoring well and at concentrations below the MCL (benzene has not been detected in most source area wells since around 2009).

As a final contingency (alternative 1, condition 3(c)), Boeing states in-situ (injections) bioremediation or chemical oxidation could be performed. However, this contingency action is discussed vaguely in the FS Report and Boeing does not discuss how this contingent in situ treatment would be conducted, how strategic injection locations would be identified under a final groundwater remedy. More importantly, the risk of employing in-situ treatment of the source area and downgradient groundwater contamination, only after waiting years for the groundwater pump and treat system to fail to meet cleanup standards, is that the mass of TCE in the source area and downgradient zones becomes more diffuse, resulting in a more difficult attempt to adequately treat groundwater to meet cleanup standards. This contingency will require more injection phases and more injection locations in an attempt to remove the same amount of TCE, had injections begun immediately, under alternatives #3 through #4. Ecology believes, this version of alternative #1 (pump and treat followed years later by in-situ treatment) will remove less contaminant mass than alternative #3 and #4. By alternative #1 treating less TCE contaminant mass, this results in high uncertainty that cleanup standards are attained. This is a consequence that Ecology does not want to accept.

Response B21: Ecology states that "the risk of employing in-situ treatment . . . after waiting years . . . is that the mass of TCE in the source area and downgradient zones becomes more diffuse, resulting in a more difficult attempt to adequately treat groundwater to meet cleanup standards." Boeing disagrees with the fundamental principle behind this statement. Ecology's logic suggests that reducing groundwater concentrations by one remedial method is not acceptable because it prevents reducing groundwater concentrations through another remedial method. While Boeing agrees that waiting to perform a supplemental action may result in a more diffuse/lower concentration plume, the design and operation of the GET system is intended to capture and treat that diffuse plume while maintaining protection of potential receptors. Furthermore, as already shown through the past 4 years of GET system operations, the location and magnitude of the downgradient areas exhibiting elevated TCE concentrations have shrunk considerably and become more defined. Boeing expects that these areas will either a) continue diminish and potentially disappear entirely, or b) continue to become more distinct allowing for targeted supplemental remedial actions (e.g., EISB) in the future.

The reasonable maximum exposure (RME) scenario for the Esperance Sand Aquifer contaminated aquifer is use as a current or future drinking water source.
It is not in the State's or local public's best interests to take a low probability wait-and see approach under alternative #1 when more aggressive and successful treatment alternatives are available [37].

[36] As stated in Table 6-11, *Unlikely that MNA on its own would be effective in cleaning up the groundwater in reasonable restoration time frame as demonstrated by already long-term presence of plume concentrations. Can be used as polishing step after completion of more aggressive cleanup action,* and on page 6-31 through 6-32, *However, based on the historical performance of a large number of pump and treat systems, it is generally demonstrated that pump and treat requires long restoration time frames to achieve parts per billion cleanup levels and, in many cases (especially near source zones), restoration may never be practically achieved using pump and treat technologies alone (USEPA 1996).*

[37] Ecology notes the in-situ enhanced bioremediation interim groundwater cleanup action in the TCE groundwater source area in reducing TCE groundwater concentrations.

Response B22: Ecology states that "It is not in the State's or local public's best interest to take a low probability wait-and-see approach . . . when more aggressive and successful treatment alternatives are available[37]" and references the success of EISB in the source area of reducing TCE groundwater concentrations. Boeing agrees that EISB did successfully reduce TCE concentrations in the source area, but also notes that since beginning GET system operations in 2012 with only three extraction wells, TCE concentrations in the downgradient plume have declined from over 800 µg/L to around 300 µg/L or less in the areas with the highest TCE concentrations, and that the current 12 extraction well system has been only in operation for the last 6 months. Based on the successful results of the Phase 1 IA, it is Boeing's opinion that it is entirely reasonable to "wait-and-see" what sort of results are obtained across the plume from operation of the full system prior to making any decisions on whether (and where) supplemental remedial actions are necessary.

In addition, we must also consider that:

- the regulations require that active source-reduction measures be taken to prevent/minimize releases to surface water via surface runoff and groundwater discharges in excess of cleanup levels. Dilution cannot be the sole method of demonstrating compliance with cleanup standards in this context. Please see WAC 173-340-370(7) and -370(6).; and,
- it is apparent from the most recent groundwater monitoring data that elevated TCE groundwater concentrations in certain source areas (EGW144, EGW127 and EGW158-1) are not decreasing and are highly unlikely to be affected by interim action groundwater extraction wells installed farther downgradient (mid-plume and toe of the plume).

Response B23: Ecology states that ". . . TCE groundwater concentrations in [EGW158-1] are not decreasing . . ." Boeing acknowledges that TCE concentrations at EGW158-1 did spike to over 600 µg/L in 2014; however, since that time, TCE concentrations have been steadily declining (TCE was 190 µg/L in April 2016). Therefore, Boeing disagrees with this portion of Ecology's statement.

Alternative 2 (source area-only enhanced bioremediation) meets the "compliance with cleanup standards" threshold criterion because additional and immediate source treatment is,

in our view, the only dependable means of meeting groundwater cleanup standards at the source area. However, Ecology expects alternative 2 to have a significantly longer restoration time than alternative 4, since the former primarily relies on aquifer flushing to remediate all downgradient portions of the TCE groundwater plume (approximately 2500 feet in length).

Both **Alternatives 3 and 4**[38] (immediate source area and downgradient groundwater plume treatment with enhanced bioremediation or in-situ chemical oxidation) meet the "compliance with cleanup standards" threshold criteria. Both are also expected to result in relatively short restoration timeframes.

[38] Page 6-41 states, Remediation of TCE focus areas would be implemented using EISB to achieve the following: Accelerate remediation of TCE focus areas and accelerate restoration of groundwater.

B.2.1.3 Comply with applicable state and federal laws (see WAC 173-340-710):

Conclusions: All four Boeing alternatives could be modified and then designed to comply with ARARs.

B.2.1.4 Provide for compliance monitoring (see WAC 173-340-410 and 173-340-720 through 173-340-760):

Conclusions: All four Boeing alternatives could be modified to meet Ecology requirements for compliance monitoring.

B.2.2 Other Requirements: When selecting from cleanup action alternatives that fulfill the threshold requirements, the selected action shall also meet the following requirements:

B.2.2.1 Provide for a Reasonable Restoration Timeframe, WAC 173-340-360(2)(b)(ii) and (4)

Conclusions: The FS report uses a standard point of compliance where groundwater and surface water cleanup levels must be met within a reasonable timeframe throughout the contamination. Therefore, Ecology expects the preferred alternative to achieve these levels. Since the source of TCE surface water contamination (in Powder Mill Creek) is solely due to TCE contaminated groundwater flowing into the creek, we also expect the preferred alternative to protect surface water quality. This means that groundwater cleanup levels must be as low as surface water cleanup levels.

Response B24: Ecology states that "Since the source of TCE surface water contamination . . . is solely due to TCE contaminated groundwater flowing into the creek, we also expect the preferred alternative to protect surface water quality. This means that groundwater cleanup levels must be as low as surface water cleanup levels." Boeing acknowledges that where the groundwater cleanup levels is based on a drinking water beneficial use, the Method B cleanup level must be at least as stringent as the protection of surface water beneficial uses (per WAC 173-340-720(4)(b)(ii)). Per WAC 173-340-720(8)(d), where a property "directly abuts the surface water, the department may

approve a conditional point of compliance that is located within the surface water as close as technically possible to the point or points where ground water flows into the surface water . . ." Therefore, Boeing wishes to discuss with Ecology the potential use of remediation levels (RELs) and/or conditional points of compliance for groundwater entering the creek.

The FS report estimates that it will take 55 years, 46 years, 32 years, and 32 years to attain groundwater cleanup levels employing remedial alternatives 1, 2, 3, and 4, respectively. These are long timeframes.

Ecology believes that **Alternative 1** does not meet the "reasonable restoration timeframe" threshold requirement for many of the same reasons it does not meet the threshold criterion for "complying with cleanup standards." We believe, in fact, that the only way to modify alternative 1 to meet this reasonable restoration timeframe requirement is to incorporate (immediate) source area and immediate downgradient groundwater treatment by enhanced bioremediation or in-situ oxidation. This essentially transforms alternative #1 into alternative #3 or #4.

Alternatives 2, 3, and 4 propose the addition of more aggressive groundwater treatment (enhanced bioremediation or in-situ chemical oxidation) to the interim action groundwater pump and treat system. The resulting restoration timeframes for these three remedial alternatives are 9 (alternative 2) and 23 years (alternatives 3 and **4)** swifter than alternative 1 's. There is value in hastening groundwater cleanup (reducing restoration timeframe). The Esperance Sand Aquifer is a potential drinking water source, and faster attainment of groundwater and surface water cleanup levels means that unrestricted access to the creek and creek banks can be realized sooner than later. [39] Furthermore, given the high toxicity and carcinogenicity of TCE, if it is technically practicable to achieve groundwater and surface water (creek) restoration timeframes shorter than what alternative 1 can achieve, this is what we should do [WAC 173-340-360(4)(b)(ii) and (viii)]. Enhanced biodegradation (alternative 4) and in-situ chemical oxidation (alternative 3) are well established technologies for in-situ treatment of TCE contaminated groundwater.

[39] Groundwater seeps with elevated TCE contamination are present on some of the creek banks. The TCE concentrations in these seeps are consistent with elevated groundwater TCE concentrations and higher than surface water TCE concentrations.

B.2.2.2 Consider public concerns (see WAC 173-340-360(2)(b)(iii):

Conclusions: Compliance with this requirement is generally best measured after the draft Cleanup Action Plan (CAP) has been provided to the public for comment. Ecology can only anticipate public sentiment during the formal FS public comment period, regarding the type of cleanup action that would be preferred, based on previous comments and discussions during the BBNC meeting on February 25, 2016. However, attendees at the Boulevard Bluffs Neighborhood Coalition (BBNC) meeting were positively receptive to alternative #4, which has a significantly shorter groundwater restoration timeframe compared to the groundwater restoration timeframe for Boeing's preferred alternative #1.

Response B25: Ecology states that "attendees at the [BBNC] meeting were positively receptive to alternative #4". This statement is misleading. The attendees were not more or less receptive (and no preference was given) to any of the four alternatives described to them at the meeting.

Much of the site's groundwater and surface water TCE contamination is located off Boeing property, on City of Everett property (Lot #9) and on private property further north (toward Puget Sound). We are concerned that the public will view option #1 as essentially no action (beyond continued implementation of the interim action). And, we assume that the City of Everett, as owner of the Lot #9 property, prefers minimal groundwater and surface water restoration timeframes. This means performing more aggressive groundwater treatment (e.g., enhanced bioremediation and/or in-situ chemical oxidation) than what Boeing proposed in alternative #1. For these reasons Ecology considers it likely that alternatives #3 and #4, and perhaps alternative #2 as well, will be more acceptable to the public than alternative #1.

Response B26: Ecology states that "Much of the site's . . . TCE contamination is located off Boeing property, on City of Everett property (Lot 9) and on private property further north (toward Puget Sound)". This statement is misleading as it makes it sound like contamination extends further north than the Lot 9 property, whereas the other private property where TCE contamination in groundwater is located is adjacent to the west of the Lot 9 property and TCE contamination in surface water declines to below screening levels shortly after leaving the Lot 9 property (also on City property).

Response B27: Ecology states that Ecology assumes "that the City of Everett, as owner of Lot #9, prefers minimal groundwater and surface water restoration timeframes". This statement is misleading. During the many meetings Boeing has had with the City and at the BBNC meeting, the City has express no preference related to the type of remedy performed or the timeframe during which it will occur.

B.2.2.3 Use permanent solutions to the maximum extent practicable WAC 173-340-360(2)(b)(i) and (4) Evaluative Criteria:

As discussed above, the DCA is only applied to those cleanup alternatives capable of meeting the **minimum requirements for a cleanup action.** If these minimum requirements are not met, the "alternative" cannot be selected as the site's cleanup action. Even though alternative# 1 does not meet the minimum requirements for a cleanup action, Ecology's responses below to Boeing's DCA also includes alternative # 1.

As noted in B.1.2.3 above, to decide whether a cleanup action uses permanent solutions to the maximum extent practicable, a DCA is performed. Boeing used a DCA scoring and weighting methodology that is not established in regulation, but is reasonable as long as it is applied in a manner consistent with the objectives of WAC 173-340-360. The objectives of WAC 173-340-360 are to essentially determine which alternatives are the most permanent, how much each alternative is likely to cost, and - through use of the DCA criteria - what benefits are associated with each alternative.

Ecology evaluated and weighed the DCA criteria differently than Boeing, resulting in an

overall conclusion that, among the four alternatives, alternative #4 is "permanent ... to the maximum extent practicable." [40] Below we discuss the FS Report's DCA and explain how we arrived at our own conclusions per criterion.

[40] WAC 173-340-360(3)(e)(ii)(C) states that: *The comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment. In particular, the department has the discretion to favor or disfavor qualitative benefits and use that information in selecting a cleanup action. Where two or more alternatives are equal in benefits, the department shall select the less costly alternative provided the requirements of subsection (2) of this section are met.*

Protectiveness (360(3)(f)(i)):
Boeing believes that remedial alternatives #3 and #4 (score of 8 assigned to both) are slightly more protective of human health and the environment than alternatives **#1** and #2 (score of 7 assigned to both).

Based on Boeing's estimates for achieving groundwater cleanup levels at the standard point of compliance for each of the four remedial alternatives (times ranging from 32 years to 55 years), Ecology believes remedial alternatives #3 and #4 rank equally and are clearly more protective than remedial alternatives #1 (especially) and #2. Ecology would not score remedial alternatives #1 and #2 equally, as Boeing does in the FS report; we believe alternative #1 (Boeing's preferred alternative) is less protective. Risks to human health and the environment are finite and probable in the future, but the more aggressive treatment alternatives get to lower contaminant masses in the groundwater and surface water.

Response B28: Ecology states that "Based on Boeing's estimates for achieving groundwater cleanup levels for each of the four remedial alternatives (times ranging from 32 years to 55 years), Ecology believes remedial alternatives #3 and #4 rank equal [for protectiveness] and are clearly more protective . . ." Boeing disagrees with this statement. The criteria of protectiveness centers around the reduction of risk to human health and the environment (WAC 173-340-360(3)(f)(i)). Because there is nobody currently using or likely in the future to use groundwater or surface water for drinking water and there are no fish currently in the creek, the only complete exposure pathways are currently for ecological and human direct contact to surface water. The risk associated with these exposures is small because seep and creek TCE concentrations are currently near or below the most conservative ecological benchmarks, and human contact during recreational activities would be restricted through institutional controls and would occur for only short duration and at low frequency if institutional controls were not completely effective. Because the risks are minor to begin with, the reduction of risk of all the alternatives would be similarly low with only minor distinctions between the alternatives based on restoration timeframes.

Permanence (360(3)(f)(ii)):
The FS report states that remedial alternatives #3 and #4 are the most permanent actions (score of 8 assigned to both). Boeing believes that alternative #2 is the next most permanent (score of 7 assigned), followed by alternative #1 (a score of 6).

We agree with Boeing's relative rankings. However, Ecology believes that remedial alternative # 1 is significantly less permanent that alternative #2, given that it relies on ONLY the existing interim action groundwater pump and treat system - at least initially -- to achieve groundwater

and surface water cleanup levels. Ecology also believes less total TCE contaminant mass will be removed from the groundwater plume if in-situ treatment is implemented after many years of groundwater pump and treatment (alternative #1) instead of immediately (alternatives #2 through #4).

Response B29: Ecology states that ". . . less total TCE contaminant mass will be removed from the groundwater plume if in-situ treatment is implemented after many years of groundwater pump and treatment . . . instead of immediately . . ." Boeing disagrees with this statement. The GET system is designed to contain and capture and treat TCE contaminated groundwater to the maximum extent practicable prior to discharge to surface water; therefore, most of the TCE contaminant mass currently present in the plume will have been captured or will still be in the plume if and when future in situ treatment occurs (and remaining mass will be captured and removed after potential future treatment).

Cost (360(3)(f)(iii)):
Boeing developed cost estimates for all four remedial alternatives in Appendix D, Table D-24. Costs for alternatives 1, 2, and 4 are roughly similar then, but alternative 3 is expected to be more expensive.

Remedial alternative #1 cost was $10.7 million;
Remedial alternative #2 cost was $12.5 million;
Remedial alternative #3 cost was $16.9 million; and
Remedial alternative #4 cost was $12.0 million.

FS cost estimates for alternatives 1 through 4 were not and should have been generated by assuming the goals for each alternative were attainment of **both** groundwater cleanup levels and surface water cleanup levels at their respective standard points of compliance. Instead, the FS Report provided estimated costs based on attaining groundwater remediation levels (RELs), not cleanup standards. The proposed groundwater RELs are higher than groundwater cleanup levels, and therefore attaining the former takes less time than attaining the latter. Boeing's estimated restoration timeframes for attaining BOTH groundwater and surface water cleanup levels are 55 years, 46 years, 32 years and 32 years for Alternatives 1, 2, 3, and 4, respectively. Boeing's estimated timeframes for attaining groundwater remediation levels is 38 years, 37 years, 22 years, and 22 years for Alternatives 1, 2, 3 and 4, respectively.

Response B30: Ecology states that "FS cost estimates...should have been generated assuming...attainment of both groundwater cleanup levels and surface water cleanup levels [rather than remediation levels]." This comment, along with others in Ecology's letter, imply that RELs will not be allowed by Ecology for site cleanup or decision making for discontinuing use of the GET system under any of the Alternatives presented. Boeing acknowledges that where the groundwater cleanup level is based on a drinking water beneficial use, the Method B cleanup levels must be at least as stringent as the protection of surface water beneficial uses (WAC 173-340-720(4)(b)(ii)); however, this does not preclude the use of remediation levels for endpoints of parts of the remedial action. Per WAC 173-340-355(1), -705(7), -708(3)(d) & (10)(b), "Remediation levels are used to identify the concentrations . . . of hazardous substances at which different cleanup action components will be used"; and also, when using Method B cleanup levels an alternate reasonable maximum exposure scenarios may be used "to help assess the protectiveness to human health of a cleanup action alternative that incorporates remediation levels". Boeing prepared FS cost estimates based on a practical (and allowable) assumption that once surface water cleanup levels and RELs were attained at the groundwater/surface water interface that the GET system would be shut down because the GET system would no longer be

serving a practical function (i.e., pumping and treating large quantities of groundwater with low TCE concentrations that pose no risk to surface water). Because the surface water cleanup levels have changed since submittal of the FS, the REL values and way in which RELs would be used at the site may need to be revisited; however, the logic and procedures for use of RELs and the three Conditions outlined in Section 6.3.9 (Alternative 1) should still be applicable for use as part of any of the Alternatives. Therefore, the associated costs for duration of operation of the GET system would still be based on attainment of RELs (i.e., O&M costs would not be incurred once the GET system is shut down). Due to the cleanup levels dropping an order of magnitude and extending the cleanup timeframe for all of the alternatives to 50 years more, Boeing proposes to use the ecological freshwater benchmark of 21 µg/L TCE as the REL based on the current reasonable maximum exposure at the site being exposure to ecological receptors. This value also corresponds to the approximate point where Biochlor and batch flushing modeling indicates that asymptotic declines in TCE levels will likely be reached, indicating that GET system operation will no longer be effectively reducing groundwater concentrations at the site (making it disproportionately costly to continue to run the system).

Based on the FS Report, Appendix D, annual O&M costs for both Alternatives 1 and 4 are estimated at approximately $300k per year. Since alternative #1 will take more time to reach cleanup standards than alternative #4, Ecology can expect that those extra annual O&M costs for alternative #1, results in a higher overall cleanup cost (to meet cleanup standards) than alternative #4. Another words, the O&M cost estimate (to attain cleanup standards) for alternative #1 was significantly underestimated compared to Alternatives #2, #3, and #4.

Response B31: Ecology states that ". . . the O&M cost estimate (to attain cleanup standards) for alternative #1 was significantly underestimated compared to Alternatives #2, #3, and #4" based on the additional years of GET system operation to get from the RELs to the cleanup levels. Boeing disagrees with this statement based on two factors:
At some point, the operation of the GET system will likely reach a point of diminishing return (i.e., pumping and treating groundwater will either provide no additional protection of receptors because RELs would be reached and/or will have no significant effect on remediation because of diffusion limited processes/reaching asymptotic conditions). Therefore, it would be reasonable to shut off the GET system at this point and O&M costs would no longer be incurred.
The timeframe between reaching RELs and the cleanup levels, which Ecology is asserting is not being accounted for under the cost estimates for Alternative 1, would be the same under any of the alternatives, none of which account for O&M of the GET system after attaining the RELs. Therefore, the cost estimates for all the alternatives would be underestimated by the same value. Boeing also notes that the lowering of cleanup levels will significantly increase the restoration timeframes for the site and the FS cost estimates and the DCA will need to be revisited to determine the impact of cost and practicability of each of the Alternatives.

Furthermore, Boeing indicates its cost estimates are only accurate to within -30% to +50% uncertainty. This uncertainty alone results in the total costs for remedial alternatives # 1 thru 4 being essentially equivalent.

Response B32: Ecology states that ". . . cost estimates are only accurate to within -30% to +50% uncertainty. This uncertainty alone results in the total cost for remedial alternatives #1 thru #4 being essentially equivalent." Boing disagrees with this statement. The -30% to +50% cost range is the standard FS range of uncertainty based on EPA guidance (EPA 2000) and does not lead to a conclusion that any estimates that overlap within this range are "essentially equivalent". While this range of uncertainty indicates that the costs could be closer than identified, it is equally possible that the actual the costs difference could be much more significant. For example, the difference between Alternative 1 and Alternative 3 could range as much as $17.9M [i.e., between $7.5M ($10.7M minus

30%) for Alternative 1 and $25.4M ($16.9M plus 50%) for Alternative 3].

Long-term effectiveness (360(3)(f)(iv))
Boeing believes remedial alternatives #3 and #4 have the highest long-term effectiveness (score of 8 assigned to both). This is followed by alternative #2 (score of 7), and alternative #1 (score of 6).

Ecology agrees that alternatives #3 and #4 will be more effective over the long-term than alternative #2. Alternatives #3 and #4 will both apply aggressive source and downgradient treatment technologies. From our perspective, alternative #1 over-relies on the existing interim action groundwater pump and treat system and natural attenuation, and is unlikely to meet cleanup standards even if in-situ treatment follows years of groundwater pump and treatment. The difference in effectiveness between alternatives #3 and #4, versus alternative #1, is therefore likely to be very significant.

Response B33: Ecology states that Alternative 1". . . is unlikely to meet cleanup standards even if in-situ treatment follows years of groundwater pump and treatment." Boeing notes that because of the already existing nature of the large and mature plume, regardless of the type or timing of in-situ treatment, there is a risk that none of the four alternatives will be able to meet cleanup standards in a reasonable restoration timeframe due to diffusion rate limited desorption in low permeability/low hydraulic conductivity areas of the plume. Therefore, this line of reasoning is not sufficient to disallow Alternative 1 while retaining the other alternatives.

Consideration of public concerns (360(3)(f)(vii))
As noted above, Ecology and Boeing can only anticipate public sentiment during the FS formal public comment period regarding the type of cleanup action that would be preferred based on previous comments and discussions. Boeing believes remedial alternatives # 1 and #2 should be ranked highest (a score of 10 each). Remedial alternative #4 is rated next highest (scores of 9), followed by remedial alternative #3 (score of 8). The FS report states that public concerns with remedial alternatives #3 and #4 would be due to: (1) clearing and grading required on City of Everett (Lot #9) property for the installation of injection wells, and (2) limited/restricted access because of construction and injection activities.

It is difficult to know what the public will value most, aggressive and faster treatment or an action that does not temporarily restrict access to parts of Lot #9.[41] It may depend on who, among the local public, benefit most from unrestricted Lot #9 access. Ecology believes the public could accept temporary access restrictions during injections in order to attain a faster cleanup by 20 or more years.

[41] Injections are relatively fast activities and related access restrictions are expected to be of short duration only. Ecology agrees with Boeing, though, that some clearing of trees and shrubs on Lot #9 may be required.

Response B34: Ecology states that "It is difficult to know what the public will value most, aggressive and faster treatment or an action that does not temporarily restrict access to parts of Lot #9." While Boeing agrees that it is uncertain what everyone in the public will be concerned with, members of BBNC have previously expressly identified concerns with loss of access to the Lot 9 trails. Ecology also indicated that "Injections are relatively fast activities and related access restrictions are expected to be of short duration only." Boeing notes that while the injection events themselves may be short, depending on the location of where injections are necessary, access restrictions could be lengthy due to

site clearing and grading activities, installation of injection wells and possible associated aboveground injection piping networks.

At this point in the process, however, Ecology believes that alternatives #2 through #4 are likely to be the most acceptable to the public and City of Everett, since they are associated with relatively shorter restoration times (especially alternatives #3 and #4). Faster attainment of groundwater and surface water cleanup levels means that unrestricted access to the creek and creek banks can occur sooner than later,[42] and as discussed in B.2.2.2 above, members of the public may view alternative #1 as essentially no action (beyond implementation of the interim action).

[42] Groundwater seeps with elevated TCE contamination are present on some of the creek banks. The TCE concentrations in these seeps is consistent with the elevated groundwater TCE concentration and higher than the surface water TCE concentrations.

Implementability (360(3)(f)(vi))
Boeing rated remedial alternative #1 highest (a score of 9), followed by alternative #2 (score of 7), alternative #4 (score of 6), and alternative #3 (score of 5).

According to Section 8 of the FS report, all four remedial alternatives are both technically and administratively implementable. Enhanced bioremediation and in-situ chemical oxidation are well-established groundwater treatment technologies. Of course, it is easier to implement nothing than something, and generally tougher to implement more than less, so alternative #1 is more easily implementable than the other three remedial alternatives. As stated above, though, there should not be significant technical or administrative hurdles to implementing any of the alternatives.

Response B35: Ecology states that ". . . there should not be significant technical . . . hurdles to implementing any of the alternatives." This statement underestimates and downplays the significant challenges and risks of implementing injection technologies at the site including: preventing injection fluids surfacing and/or discharging to surface waters of the creek, wetlands, and seeps; preventing biofouling and/or direct fouling of GET system extraction wells and the treatment system and/or passing injection fluids through the treatment system and discharging to the creek at the NPDES permitted outfall, and safely and effectively drilling and performing injections on steep slopes and proximate to or beneath wetlands.

Management of short-term risks (360(3)(f)(v))
Boeing rates remedial alternative #1 highest (score of 10), followed by alternative #2 (score of 9), alternative #4 (score of7) and alternative #3 (score of 6). Alternative #1 proposes to implement fewer active measures and for this reason there is less potential risk to manage. For this reason Boeing ranked it highest. But Ecology believes that all four alternatives can be designed so that the risk of danger to the public and site workers is minimal.

Response B36: Ecology states that ". . . all four alternatives can be designed so that the risk of danger to the public and site workers is minimal." Boeing agrees with this statement; however, notes that the management of short-term risk criteria also includes risk to the environment. The proximity of potential injection areas near surface water also presents the risk to the environment of discharging ISCO or EISB injection fluids into the creek or wetlands through surfacing or flow from groundwater, which cannot always be anticipated or prevented even with good planning and design.

B.2.3 Ecology Selection of Preferred Remedial Alternative: EPM K Powder Mill Gulch (PMG)

Ecology has determined that **alternative #1,** Boeing's preferred alternative, does not fully meet threshold criteria and fails "other" minimum requirements for a cleanup action (WAC 173-340-360(2)(a) and (b)). It should be excluded from the DCA and cannot be selected as the cleanup action. Even if alternative # 1 is included Ecology's DCA analysis, it is clear to Ecology that alternative #4 (lowest cost of alternatives #2-#4) is the most permanent to the maximum extent practicable. Alternative# 1 falls short in most of the DCA categories when compared to alternatives #2 - #4. The cost estimates for all four alternatives are approximately equal (within uncertainties in these types of high level estimates). Our reasons for this determination are summarized below:

Threshold Criteria-Comply With Cleanup Standards (WAC 173-340-360(2)):
Alternative #l will not, in our view, effectively remediate contaminated groundwater in the source area and all points downgradient, and will not attain cleanup levels plumewide using the current interim action groundwater extraction and treatment. The groundwater extraction wells are primarily located near Powder Mill Creek (Creek) and the southern Boeing-Everett property boundary. They were placed at these locations in order to achieve interim action objectives. These IA objectives include hydraulically containing groundwater contamination within the limits of Boeing property AND minimizing, to the maximum extent possible, the flux of TCE-contaminated groundwater into the Creek. They do not include attaining groundwater and surface water cleanup standards site-wide. The objectives of the final site cleanup action are broader and more demanding. Even if the groundwater pump and treat system were further optimized, historically speaking, these types of groundwater treatment systems alone not very successful in achieving low groundwater and surface water cleanup standards (TCE). At many sites and especially near source zones, successful restoration has not been achieved using pump and treat technologies alone.

Response B37: Ecology states that it is Ecology's view that Alternative 1 ". . . will not attain cleanup levels plume-wide using the current interim action groundwater extraction and treatment." Boeing agrees that it is possible that the GET system will not be able to attain cleanup levels, which is why contingent remedial actions were identified to supplement the alternative if it became evident that this was the case. Also, there is a risk that none of the alternatives will attain cleanup levels (see Response 33).

Response B38: Ecology provides support of the assertion that the GET system will not attain cleanup levels based on the location of the GET system extraction wells near the creek, the limits of the interim action objectives associated with the GET system, and the history of pump and treat systems not achieving successful restoration "especially near source zones". Boeing notes that while the GET system was designed to meet the IOAs, it was also intended to increase aquifer flushing (see Response 19); monitoring results to date have already shown significant decreases in TCE concentrations plume-wide with only a portion of the system running for any substantial length of time, and source zone remediation has already been performed to the point where source material has been substantially removed (see Response 18).

Monitored natural attenuation (MNA) is an optional contingency of alternative #1, if the groundwater pump and treat system does not attain cleanup levels. However, active source

remediation is a requirement of MNA. Without active source remediation, MNA will fail to attain cleanup standards in groundwater and surface water.

As a final optional contingency under alterative #1, Boeing states in-situ (injections) bioremediation or chemical oxidation could be performed. It is true that alternative #1 could potentially include future implementation of in-situ groundwater treatment at strategic locations when groundwater cleanup standards are not met with the groundwater pump and treat system. However, this contingency action is discussed vaguely in the FS Report and Boeing does not describe specifically how this future action would be included as part of the site's final groundwater remedy. Ecology envisions such contingent in-situ treatment would only successful attain cleanup standards if implemented immediately in the locations and frequencies immediately as described in alternatives #3 and #4. The risk of employing in-situ treatment of the source area and downgradient groundwater contamination, only after waiting years for the groundwater pump and treat system to fail to meet cleanup standards, is that the mass of TCE in the source area and downgradient zones becomes more diffuse resulting in a more difficult attempt to adequately treat groundwater to meet cleanup standards. This contingency will require more injection phases and more injection locations to remove the same amount of TCE, had injections begun at the beginning, under alternatives #3 through #4. In fact, Ecology believes alternative #3 and #4 will remove more contaminant mass than alternative #1 (pump and treat followed by in-situ treatment). By alternative #1 treating less TCE contaminant mass, this results in high uncertainty that cleanup standards are attained. This is a consequence that Ecology does not want to accept.

Response B39: Ecology states that ". . . contingent in-situ treatment would only successful attain cleanup standards if implemented immediately [because] the mass of TCE in the source area and downgradient zones becomes more diffuse resulting in a more difficult attempt to adequately treat groundwater to meet cleanup standards". Boeing disagrees with the technical basis of this statement (see Response 21).

Alternatives #2 through #4 fully comply with this threshold criteria because aggressive groundwater treatment in the source areas and source areas plus downgradient areas are performed immediately and this will destroy contaminant mass more quickly and thoroughly than alternative #1. These alternatives can immediately target the higher contamination zones within the TCE groundwater plume, that are currently accessible, thus maximizing the total mass of contamination removed from the aquifer. This results in faster reductions in contaminant concentrations and lower endpoint contaminant concentrations.

Reasonable Restoration Timeframe [WAC 173-340-360(2)(b)] : **Alternative #l** does not meet this requirement. Boeing can practicably achieve a shorter and **reasonable restoration timeframe** by employing either enhanced in-situ bioremediation in the source and downgradient contaminated groundwater areas (alternative #4) OR in-situ chemical oxidation (alternative #3) in the contaminated source and downgradient groundwater areas. As mentioned previously, both of these groundwater cleanup technologies are well established and can be successful if implemented correctly. The FS report does not specify limitations to implementing either that cannot be reasonably overcome with good engineering design. ·

The Esperance Sand Aquifer is considered a potential drinking water source. Even though residents in the area are currently supplied drinking water from other sources, the MTCA regulations emphasize the preservation of future drinking water sources. In addition, TCE is highly **toxic** and the primary contaminant in the Esperance Sand Aquifer. Quickly reducing levels of this compound (while minimizing the production of vinyl chloride) should be a cleanup action priority.

Alternatives #2 through #4 fully comply with this other requirement because they Boeing can practicably achieve a shorter and more reasonable restoration timeframe than alternative # 1, by employing either enhanced in-situ bioremediation or in-situ chemical oxidation, both well-established technologies.

Institutional Controls [WAC 173-340-360(2)(e)(iii)]: Alternative #1 has an overreliance on institutional controls, when a more aggressive treatment alternative is available. Ecology is confident that institutional controls can be effective when applied at property owned and/or under the control of Boeing. We are less confident about their effectiveness/enforceability when employed elsewhere. Even though the City of Everett has placed several signs[43] in the area to stay on the walking trails and away from the creek and creek banks (TCE groundwater seeps) during the current creek and groundwater remediation, those institutional controls alone are not sufficient cleanup actions under MTCA, given the long restoration time required under alternative # 1.

[43] At Ecology's request, the City of Everett placed signs on Lot #9 property in 2009 to stay out of the creek during the interim TCE groundwater cleanup action.

Alternatives #2 through #4 do not over-rely on institutional controls. In fact these alternatives have a reasonable balance of immediate and aggressive groundwater treatment and institutional controls during that treatment.

The MTCA regulations require the feasibility study to include at least one permanent cleanup action alternative to serve as a baseline against which other alternatives shall be evaluated for the purpose of determining whether the cleanup action selected is permanent to the maximum extent practicable. Remedial alternative #4 is the baseline remedial alternative.

The MTCA regulations also require that remedial alternatives which **meet threshold and other minimum requirements** be ranked from most to least permanent and evaluated by the DCA process. Per WAC 173-340-360(3)(ii)(C), the DCA's comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment. Ecology has the discretion to favor or disfavor qualitative benefits and use that information in selecting a cleanup action.

As stated in B.2.1 above, Ecology considers alternatives 2 through 4 to fully meet threshold and other minimum requirements. In our opinion alternatives 3 and 4 also score much higher than alternative #2 (and #1, if it were included) in the categories of protectiveness, permanence, long-term effectiveness, and public acceptability. Both of these alternatives (as well as alternative 2) can be readily implemented and designed to effectively manage potential short-term risks.

We believe that remedial alternative #4 (the baseline remedial alternative) and alternative #3 are essentially equally permanent. Both are more permanent than alternative #2. Since remedial alterative #4 is more permanent and less expensive than alternative #2, (and # 1, were it included), alternative #2 can be eliminated under the DCA evaluation.[44] What remains for the DCA to determine, then, is which remedial alternative, #3 or #4, is permanent to the maximum extent practicable.

The estimated costs for alternatives #3 and #4 are $16.9 million and $12 million, respectively. When two alternatives are approximately equal in benefits, Ecology chooses the less costly of the two as our preferred alternative - provided, of course, that this alternative meets the WAC 173-340-360(2) minimum requirements for cleanup actions. Since alternative #4 is less expensive than alternative #3, alternative #4 is permanent to the maximum extent practicable and is Ecology's preferred cleanup action.

While Ecology concludes that alternative #4 is our preferred remedial alternative for the Powder Mill Gulch SWMU, we also believe that when it is proposed to the public in the dCAP it must contain additional elements. Those additional elements are discussed in Attachment A.

[44] Ecology previously noted in Section B2. l that the estimated cost of alternatives 1 -4 are underestimated due to additional O&M costs not accounted for the time between potentially attaining groundwater RELs to attaining groundwater cleanup levels at the SPOC. However, since alternatives 2-4 have similar (within reasonable uncertainties) restoration timeframes, this error is expected to have little effect in comparing the relative estimated costs of alternatives 2-4 only. However, correcting this error for alternative # 1 estimated costs is expected to increase alternative # 1 costs relative to alternatives #2 through #4 such that alternative # 1 costs will be equal to or more expensive than alternatives #2 through #4.

Response B40: Ecology states that ". . . the estimated cost of alternatives 1-4 are underestimated due to additional O&M costs not accounted for the time between potentially attaining groundwater RELs to attaining groundwater cleanup levels . . ." Boeing disagrees with this statement (see Response 31).

BCA Everett Upland FS Report
Response to Ecology Comments, dated August 18, 2016

Attachment C: Specific Comments and Revisions to the Draft Uplands FS Report under the Contingent Approval:

Section 2.0:

1. Page 2-4, Section 2.1.3 SWMU 171 Current Conditions, Sub-Slab Vapor Conditions, Paragraph 2: The FS Report text states: *Upon review of the sub-slab vapor data that exceeded the industrial MTCA screening levels for TCE and because similar chemicals are used in the manufacturing processes, Boeing industrial hygienists were requested to assess indoor air to evaluate potential worker exposures. PCE, TCE, and their degradation products were not detected. Based on this assessment, the concentrations in sub-slab vapor are not a risk to workers via indoor air at this SWMU/AOC. No further investigation is necessary for this SWMU/AOC in compliance with the Washington State Airborne Contaminants Standard, Chapter 296-841 WAC.* This statement is incorrect and not approved by Ecology. The Washington State Worker Safety regulations cited do not supersede the MTCA regulatory authority (Chapter 173-340 WAC) to establish health risk based cleanup standards for indoor air as a result of vapor intrusion into buildings following a spill of volatile chemicals to the environment. The OSHA air standards are much higher than MTCA CULs, and at a cleanup site where indoor air is contaminated by vapor intrusion, the MTCA cleanup levels are the pertinent risk-based levels.

   Response C1: Boeing maintains that concentrations in the sub-slab vapor are not currently a risk to workers at this SWMU/AOC based on the indoor air sampling at 3 locations within the former excavation footprint. COC concentrations were below MTCA Method C cleanup levels as well as OSHA levels. Boeing agrees to include annual indoor air monitoring in the cleanup action for this SWMU/AOC, as noted in the response to Ecology's comments on SWMU/AOC No. 171 in Attachment A (Response A28). Boeing does not necessarily agree that the MTCA Method C cleanup levels should be applied at active work areas at the Boeing Everett plant.

2. Page 2-35, Section 2.14.1 SWMU 055 and 168 Summary Description, First Paragraph: Ecology adds that SWMU 055 (two dangerous waste storage tanks) are RCRA regulated dangerous waste storage tanks covered under Boeing Everett's interim status Part A permit.

   Response C2: Comment noted. As stated on page 2-35 of the FS report, accumulation tanks EV-75 and EV-76 were removed from service in 1992 and are no longer operational.

3. Page 2-49, Section 2.16.3 SWMU 067 and 071 Current Conditions, Sub-Slab Vapor Conditions: The FS Report text states, *VOCs in subslab vapor are well below Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs), which are applicable to these SWMUs/AOCs because the same chemicals present in sub-slab vapor are in use within the shop (WAC 173-340-750[1J[a]).* This statement is incorrect and not approved by Ecology. Boeing has since informed Ecology[45] that these VOCs are not used in the manufacturing process within the southern portion of the 40-56 building. In addition, The Washington State Worker Safety regulations cited do not supersede the MTCA regulatory

authority (Chapter 173-340 WAC) to establish health risk based cleanup standards for indoor air as a result of vapor intrusion into buildings following a spill of volatile chemicals to the environment. The OSHA air standards are much higher than MTCA CULs, and at a cleanup site where indoor air is contaminated by vapor intrusion, the MTCA cleanup levels are the pertinent risk-based levels.

[45] March 1, 2016 telephone conference call.

Response C3: Comment noted. Boeing notes that COC concentrations in indoor air and sub-slab vapor samples were below MTCA Method C cleanup levels as well as OSHA levels.

4. Page 2-63, Section 2.19.3, PMG Esperance Sand Aquifer, Groundwater Conditions, Paragraph 2: The FS report text states, *Hydrologic and water quality data collected as a part of the Phase 1 IA indicate that the plume has been effectively hydraulically contained at Seaway Boulevard and plume migration minimized by the groundwater capture zone created through operation of the GET system (Landau 2014a and 2015b).* Ecology does not agree that the chemical groundwater data yet support this statement. The hydraulic data do indicate a majority of the contaminated groundwater is captured before migrating beyond Boeing Everett property

Response C4: Comment noted. Boeing also notes that, as indicated in recent PMG downgradient plume interim action quarterly status reports, groundwater quality data has identified declining TCE concentration trends in most of the downgradient PMG monitoring wells, many of which appear directly attributable to operation of the GET system. These declines are anticipated to continue with operation of the GET system.

5. Page 2-72, Section 2.21.4 SWMU 098 Sub-slab Vapor Conditions, Second Paragraph: The FS report text states: *Upon review of the sub-slab vapor data that exceeded the industrial MTCA screening levels for TCE, and because similar chemicals are used in the manufacturing processes, Boeing industrial hygienists were requested to assess indoor air to evaluate potential worker exposures. PCE, TCE, and their degradation products were not detected. Based on this assessment, the concentrations in sub-slab vapor are not a risk to workers via indoor air at this SWMU/AOC. No further investigation is necessary for this AOC in compliance with the Washington State Airborne Contaminants Standard, Chapter 296-841 WAC.* This statement is incorrect and not approved by Ecology. TCE is not currently used in the manufacturing process within this building because the degreaser was removed. In addition, The Washington State Worker Safety regulations cited do not supersede the MTCA regulatory authority (Chapter 173-340 WAC) to establish health risk based cleanup standards for indoor air as a result of vapor intrusion into buildings following a spill of volatile chemicals to the environment. The OSHA air standards are much higher than MTCA CULs, and at a cleanup site where indoor air is contaminated by vapor intrusion, the MTCA cleanup levels are the pertinent risk-based levels.

Response C5: Boeing maintains that concentrations in the sub-slab vapor are not currently a risk to workers at this SWMU/AOC based on the indoor air sampling at 2 locations within the former excavation footprint. COC concentrations were below MTCA Method C cleanup levels as well as OSHA levels. Boeing agrees to include annual indoor air monitoring in the cleanup action for this SWMU/AOC, as noted in the response to Ecology's comments on SWMU/AOC No. 098 in Attachment A (Response A29).

6. Page 2-79. Section 2.24.2 Building 40-32 Sub-slab Vapor Conditions, Second Paragraph: The FS report text states: *Upon review of the sub-slab vapor data that exceeded the industrial MTCA screening levels for TCE, and because similar chemicals are used in the manufacturing processes, Boeing industrial hygienists were requested to assess indoor air to evaluate potential worker exposures. TCE and its degradation products were not detected. Based on this assessment, the concentrations in subslab vapor are not a risk to workers via indoor air at this SWMU/AOC. No further investigation is necessary for this AOC in compliance with the Washington State Airborne Contaminants Standard, Chapter 296-841 WAC.* This statement is incorrect and not approved by Ecology. TCE may be infrequently and in small amounts routinely used in this building (but not documented during actual sampling). The Washington State Worker Safety regulations cited do not supersede the MTCA regulatory authority (Chapter 173-340 WAC) to establish health risk based cleanup standards for indoor air as a result of vapor intrusion into buildings following a spill of volatile chemicals to the environment. The OSHA air standards are much higher than MTCA CULs, and at a cleanup site where indoor air is contaminated by vapor intrusion, the MTCA cleanup levels are the pertinent risk-based levels.

   Response C6: Boeing maintains that concentrations in the sub-slab vapor are not currently a risk to workers at this SWMU/AOC based on the indoor air sampling at 1 location adjacent to the former excavation. COC concentrations were below MTCA Method C cleanup levels as well as OSHA levels. Boeing agrees to include annual indoor air monitoring in the cleanup action for this SWMU/AOC, as noted in the response to Ecology's comments on the Building 40-32 Footing Excavation in Attachment A (Response A34).

Section 3.0

7. Page 3-1, Section 3.1 Sitewide Conceptual Site Model and Figure 3-1: Figure 3-1 does not show the presence of fill material over the entire site. Not only are fill soils present in excavations below grade that hold various underground waste or product holding tanks, but fill soils are also present in areas outside of many of these SWMUs. Page 3-3, Section 3 .1.3 - Soil section states, The fill at the Everett Plant is generally less than 15 feet thick, except in the areas of the filled upper reaches of PMG where fill thickness ranges to greater than 120 feet.

   Response C7: Comment noted.

8. Page 3-1, Section 3.1.1 History and Potential Sources, First Paragraph: The FS report should also state that contamination originating from Boeing Everett property has migrated to other non-Boeing properties (such as within Powder Mill Gulch). Boeing is responsible for cleanup of contamination originating on its property and migrating off-property.

   Response C8: Comment noted.

9. Page 3-2, Section 3.1.2 Types of Hazardous Substances: The FS report should also state that PCBs and hydraulic fluid (Skydrol) are also hazardous Substances present inthe environmental media and that Boeing is responsible for the cleanup of these contaminants.

Response C9: PCBs have been detected in soils at some locations beneath the flightline and were removed when encountered as part of construction projects involving flightline panel replacement and joint compound removal. PCBs in surface water and sediment are addressed in the Sediment and Surface Water FS that was submitted to Ecology on August 19, 2016. Phosphate-based hydraulic fluid (Skydrol) compounds are considered SVOCs and are therefore already included in this category.

10. Page 3-3, Section 3.1.3-Soils, Paragraph 2, Second Bullet: The FS report states: *The density and permeability of the glacial till impedes the downward migration of water and water-born contaminants, compared to a looser and more permeable material.* Ecology clarifies this statement by adding that the water (perched groundwater) will migrate slowly downward to the Esperance Sand Aquifer as a result of gravity flow and capillary pressure under unsaturated conditions. This is the recharge mechanism for the Aquifer.

Response C10: Boeing agrees that perched groundwater will migrate slowly downward but notes that the empirical data shows that for all SWMUs/AOCs, including those with perched groundwater, contaminant migration has not occurred over multiple decades nor is the contaminant rate as fast as the conservative rate shown in the model.

11. Page 3-6, Section 3.2.1 Exposure Pathway Model A, Second Paragraph: Ecology adds the following statements: *The vapor intrusion pathway is a potential complete exposure pathway that will require routine sub-slab gas and indoor air sampling.*

Response C11: Boeing agrees that the vapor intrusion pathway is potentially complete but does not agree that routine sub-slab vapor and indoor air sampling is warranted for EPM A for the reasons provided in Response A10 and Response A11 and notes that Section 3 in the FS (Conceptual Site Model) is not the appropriate section to discuss compliance monitoring.

12. Page 3-6, Section 3.2.1 Exposure Pathway Model A, Third Paragraph: Ecology revises this paragraph to include the need for institutional controls per WAC 173-340-440 in order to apply the exemption from terrestrial ecological risk evaluation under WAC 173-340-7491(1)(b).

Response C12: As stated in WAC 173-340-7490(3): *The goal of the terrestrial ecological evaluation process is the protection of terrestrial ecological receptors from exposure to contaminated soil with the potential to cause significant adverse effects.* As noted in Table 5-1 in the FS, Model A contaminants in soil are volatile and not persistent, and no screening criteria are listed in Table 749-2 or 749-3. Thus, the Model A exposure model does not meet the requirement of 73-340-7494, which states that *the data indicate a significant tendency of the hazardous substance to persist, bioaccumulate, or be highly toxic to terrestrial ecological receptors*. In addition, WAC 173-340-7490(3) states: *For industrial or commercial properties, current or future potential for exposure to soil contamination need only be evaluated for terrestrial wildlife protection. Plants and soil biota need not be considered unless: (i) The species is protected under the federal Endangered Species Act; or (ii) The soil contamination is located on an area of an industrial or commercial property where vegetation must be maintained to comply with local government land use regulations.* Neither of these exceptions apply. Thus given the above reasons, a formal exemption is not required to achieve the Department's goal as stated in WAC 173- 340-7490(3). Therefore, Boeing proposes that the following text will be modified in Section 3.2.1 as follows: "These SWMUs/AOCs ~~are excluded from~~ do not pose a risk to terrestrial ecological **receptors** ~~risk~~

~~evaluation~~ in accordance with the criteria of WAC 173-340-7491 because the soil data do not indicate a significant tendency of the hazardous substance to persist, bioaccumulate, or be highly toxic to terrestrial ecological receptors." (Underlined text indicates proposed text additions.)

In addition, Boeing proposes that the text in Section 5.1.5 be modified to read:
"The terrestrial ecological evaluation process is potentially applicable to portions of the Boeing Everett Plant that are not excluded under WAC 173-340-7491 or does not need to be addressed because the soil data do not indicate a significant tendency of the hazardous substance to persist, bioaccumulate, or be highly toxic to terrestrial ecological receptors, which includes PMG and the Former Gun Club Area B." (Underlined text indicates proposed text additions.)

13. Page 3-7, Section 3.2.2 Exposure Pathway Model B, Third Paragraph: Ecology adds the following statements, *The vapor intrusion pathway and contaminant migration pathway to the Esperance Sand Aquifer are both potential complete exposure pathways that will require routine sub-slab gas, indoor air and Esperance Sand Aquifer sampling. There is a potential for contaminated soil gas from the outdoor shallow contaminated soils to migrate under and into the south portion of the 40-56 building. The year around presence of perched groundwater in shallow soils just south and outside of the 40-56 building footprint, represents evidence that water infiltration is present even though the area is covered with either asphalt or concrete and there is a current potential for this contaminated perched groundwater to reach the Esperance Sand Aquifer. Or there are leaks from water lines that result in the recharging of the perched aquifer. These are mechanisms for recharging the perched groundwater.*

Response C13: Boeing agrees that the vapor intrusion pathway is potentially complete, but that it is insignificant, and maintains that the migration pathway to the Esperance Sand aquifer is incomplete. Boeing does not agree that routine sub-slab gas, indoor air, and Esperance Sand aquifer sampling are required for EPM B and notes that Section 3 in the FS (Conceptual Site Model) is not the appropriate section to discuss compliance monitoring.

14. Page 3-9, Section 3.2.4 Exposure Pathway Model D, Fourth Paragraph: Ecology adds the following statements in order correct the text: *The contaminant migration pathway to the Esperance Sand Aquifer is potential complete exposure pathways that will require routine Esperance Sand Aquifer sampling. The year around presence of perched groundwater in shallow soils outside and within the 40-24 building footprint, represents evidence that water infiltration is present even though the area is covered with either asphalt or concrete. Or there are leaks from water lines that result in the recharging of the perched aquifer.*

Response C14: Boeing maintains that the migration pathway to the Esperance Sand aquifer is incomplete and does not agree that routine Esperance Sand aquifer sampling is required for EPM D. Boeing notes that Section 3 in the FS (Conceptual Site Model) is not the appropriate section to discuss compliance monitoring. Boeing also notes that the proposed FS cleanup action includes removal of perched groundwater to the extent practicable, which will mitigate the potential for perched groundwater migration, as Ecology also noted in paragraph 2 on Page 11 of their comments.

15. Page 3-9, Section 3.2.4 Exposure Pathway Model D, Fourth Paragraph: Ecology revises this paragraph to include the need for institutional controls per WAC 173-340-440 in order for the exemption from terrestrial ecological risk evaluation under WAC 173-340-7491(1)(b).

Response C15: As stated in WAC 173- 340-7490(3): *The goal of the terrestrial ecological evaluation process is the protection of terrestrial ecological receptors from exposure to contaminated soil with the potential to cause significant adverse effects.* There are no screening criteria listed in Table 749-2 or 749-3 for the soil contaminants in Exposure Pathway Model D identified in Table 5-4 in the Upland FS. Vegetation does not need to be maintained nor are there endangered species (Please refer to response to Response C12). Thus, a formal exemption is not required and institutional controls should not be necessary to achieve the Department's goal as stated in WAC 173- 340-7490(3). Boeing proposes that the following text be modified in Section 3.2.4 as follows: *These SWMUs/AOCs ~~are excluded from~~ do not pose a risk to terrestrial ecological receptors risk evaluation in accordance with the criteria of WAC 173-340-7491 because the soil data do not indicate a significant tendency of the hazardous substance to persist, bioaccumulate, or be highly toxic to terrestrial ecological receptors.* (Underlined text indicates proposed text additions.)

16. Page 3-10, Section 3.2.5, Exposure Pathway Model E, Third Paragraph: Ecology adds the following statements in order to correct the text: *The vapor intrusion pathway and contaminant migration pathway to the Esperance Sand Aquifer are both potential complete exposure pathways that will require routine sub-slab gas, indoor air and Esperance Sand Aquifer sampling. There is a potential for contaminated soil gas from beneath the indoor building floors to migrate into those buildings. The potential for contamination to migrate downward to the Esperance Sand Aquifer is directly affected by the long term effectiveness for preventing contamination infiltration through the vadose soils.*

Response C16: Boeing agrees that the vapor intrusion pathway is potentially complete, but that the pathway is insignificant, and maintains that the migration pathway to the Esperance Sand aquifer is incomplete. Boeing does not agree that sub-slab vapor, indoor air, and Esperance Sand aquifer sampling is required at all SWMUs/AOCs in EPM E. Boeing notes that Section 3 in the FS (Conceptual Site Model) is not the appropriate section to discuss compliance monitoring.

17. Page 3-10, Section 3.2.5 Exposure Pathway Model E, Third Paragraph: Ecology revises this paragraph to include the need for institutional controls per WAC 173-340-440 in order for the exemption from terrestrial ecological risk evaluation under WAC 173-340-7491(1)(b).

Response C17: As stated in WAC 173- 340-7490(3): *The goal of the terrestrial ecological evaluation process is the protection of terrestrial ecological receptors from exposure to contaminated soil with the potential to cause significant adverse effects.* With the exception of TPH, there are no screening criteria listed in Table 749-2 for the soil contaminants in identified in Table 5-5 for Exposure Pathway Model E in the FS. TPH was identified as a soil contaminant in the Building 40-32 Footing Excavation based on TPH concentrations greater than MTCA levels at one location, depth range of 14 feet below ground surface to 16 feet below ground surface, at the base of the 2010 excavation below both the concrete pavement and subsurface CDF backfill. The area of impact is 7 ft^2. Given that the soil is not accessible to terrestrial receptors and the depth range falls within the realm of the WAC exception of 15 feet: *An institutional control is not required if the contamination is at least fifteen feet below the ground surface (WAC 173-340-7490(4)(b)),* institutional controls do not appear necessary to achieve Ecology's goal to protect "*ecological receptors from exposure to contaminated soil with the potential to cause significant adverse effects."*

18. Page 3-11, Section 3.2.6, Exposure Pathway Model F, Third Paragraph: Ecology adds the following statements to order to correct the text: *The vapor intrusion pathway and contaminant*

migration pathway to the Esperance Sand Aquifer are both potential complete exposure pathways that would require routine sub-slab gas, indoor air and Esperance Sand Aquifer groundwater sampling. However, the Ecology preferred remedial action is excavation of contaminated soils to meet soil cleanup levels at the standard point of compliance. Therefore, successful completion of this remedial action should result in residual soil and soil gas contamination that is protective of indoor air and the Esperance Sand Aquifer.

Response C18: Boeing maintains that the vapor intrusion pathway and migration pathway to the Esperance Sand aquifer are incomplete, and does not agree that routine sub-slab gas, indoor air, and Esperance Sand aquifer sampling are required for the EPM F SWMU/AOC. Boeing notes that Section 3 in the FS (Conceptual Site Model) is not the appropriate section to discuss compliance monitoring.

19. Page 3-12, Exposure Pathway Model G, Third Paragraph: Ecology adds the following statements to order to correct the text: *The contaminant migration pathway to the Esperance Sand Aquifer is potential complete exposure pathways for some of these SWMUs and therefore will require routine Esperance Sand Aquifer sampling. The potential for contaminant migration to the Esperance Sand Aquifer will depend on the effectiveness of any outdoor surface cover (asphalt or concrete) in preventing water infiltration. The potential exists for unacceptable vapor intrusion into future buildings constructed over the shallow contaminated soils.* Ecology notes that Table 5-7 EPM G FS Cleanup Levels includes indoor air cleanup levels.

Response C19: Boeing agrees that the potential exists for unacceptable vapor intrusion into future buildings but notes that none of the soil gas samples in these SWMUs/AOCs exceeded sub-slab vapor screening criteria. Boeing also maintains that the migration pathway to the Esperance Sand aquifer is incomplete, does not agree that routine Esperance Sand aquifer sampling is required for EPM G, and notes that Section 3 in the FS (Conceptual Site Model) is not the appropriate section to discuss compliance monitoring.

20. Page 3-14, Section 3.2.8 Exposure Pathway Model H, First Paragraph: Ecology adds the following statements: *The vapor intrusion pathway and contaminant migration pathway to the Esperance Sand Aquifer are both potential complete exposure pathways that will require routine sub-slab gas, indoor air and Esperance Sand Aquifer sampling. There is a potential for contaminated soil gas from below the building floor AND from the outdoor shallow contaminated soils to migrate under and into the south portion of the 40-56 building. Migration of nearby perched groundwater in shallow outdoor area soils toward the interior of the 40-56 building is possible.*

Response C20: Boeing agrees that the vapor intrusion pathway is potentially complete but notes that none of the soil gas or sub-slab vapor samples in the EPM H SWMUs/AOCs exceeded sub-slab vapor screening criteria. Boeing also maintains that the migration pathway to the Esperance Sand aquifer is incomplete. Therefore, Boeing does not agree that routine sub-slab gas, indoor air, and Esperance Sand aquifer sampling are required for EPM H, and does not agree with Ecology's statement that there is a potential for contaminated soil gas and perched groundwater to migrate under and into the south portion of Building 40-56 (please refer to Response C25). Boeing also notes that Section 3 in the FS (Conceptual Site Model) is not an appropriate place to discuss compliance monitoring.

21. Page 3-16, Section 3.2.11, Exposure Pathway Model K, Second Paragraph: Ecology adds the following statements: *The potential exists for future unacceptable vapor intrusion into future buildings constructed over the shallow contaminated soils. Institutional Controls are required to prohibit the construction of buildings over and near the TCE groundwater without engineering measures to prevent unacceptable vapor intrusion into the building. In addition, routine soil gas and/or indoor air sampling is required for buildings near or above any portion of the TCE groundwater* plume in order to verify the continued assumption that unacceptable vapor intrusion is not occurring in these buildings.

Response C21: Boeing disagrees or seeks clarification regarding portions of these statements. Regarding institutional controls for future buildings, see Response A48. Further, Boeing disagrees with the requirement for routine soil gas and/or indoor air sampling as this is not required under regulation or Ecology guidance (Ecology 2009) since a Tier 1 assessment was performed and identified that no reasonable risk of vapor intrusion exists because soil gas concentrations were well below screening levels.

22. Tables 3-1 through 3-3: Exposure pathway characteristics are modified to include Ecology added exposure pathways described in previous responses under Section 3.0.

Response C22: Boeing agrees to modify the exposure pathways consistent with Boeing's Responses C11 through C21 above.

Section 4.0:

23. Page 4-5, Exposure Duration and Frequency: The FS report text states: *However, because of the intermittent presence of perched groundwater across the sites, construction worker exposures to perched groundwater are not expected to occur throughout an entire year. Therefore, an exposure frequency of 3 months (60 days/year) was selected as a more appropriate, yet still conservative, facility-specific exposure frequency for construction worker exposures to perched groundwater.* Ecology does not agree with this statement, perched groundwater is found year around at the SWMUs where non-potable cleanup levels are developed.

Response C23: The intention of this text was to state that the perched groundwater is spatially intermittent, not temporal, across the facility on a SWMU/AOC by SWMU/AOC basis. Boeing maintains that perched groundwater is spatially intermittent across the facility, and proposes to modify the text to be: *However, because of the spatially intermittent presence of perched groundwater across the sites, construction worker exposures to perched groundwater are not expected to occur throughout an entire year. Therefore, an exposure frequency of 3 months (60 days/year) was selected as a more appropriate, yet still conservative, facility-specific exposure frequency for construction worker exposures to perched groundwater*. (Underlined text indicates proposed addition.) Boeing also notes that if there was a significant amount/depth of perched water exposed during a construction project that required a worked in an excavation, it would be dewatered. Therefore, an exposure frequency of 3 months (60 days/year) is considered a reasonable and appropriate assumption for construction worker exposures to perched groundwater.

Section 5.0:

24. Page 5-3 Section 5.1, Last Paragraph and three bulleted statements through Page 5-4 Paragraph 1 and six bulleted statements: These nine (9) bullets statements are not exact quoted statements from WAC 173-340-745(l)(a)(i). Boeing has edited these statements (and inserted a regulatory citation) in a manner that does not always reflect the full intent of the regulation. In addition, Boeing should have included equally important regulations WAC 173-340-745(1)(a)(iii)(A) – (E) regarding the qualification for an industrial site. Consequently, Ecology does not approve of this FS report text and instead Boeing should refer to the exact regulatory citation in the MTCA regulation.

    Response C24: Boeing acknowledges that the regulation was not cited verbatim. However, Boeing believes that the Boeing Everett property still meets the requirements of WAC 173-340-745(1)(a)(i) – (iii), as described in the FS report.

25. Page 5-5, Section 5.1.1, Paragraph 1: SWMUs 067 and 071 in the 40-56 building have the same contaminants and contaminated media as SWMUs 086, 89, and 094. Furthermore, these five (5) SWMUs are located very close to each other and share commingled soil contamination. Therefore, Ecology will apply MTCA Method B soil cleanup levels for SWMUs 067 and 071 (similar to SWMUs 086, 089 and 094). All five SWMUs share the same potential soil to groundwater contaminant pathway.

    Response C25: There is no evidence to indicate that SWMU/AOC Nos. 067 and 071 (indoors) and SWMU/AOC Nos. 086/089/094 (outdoors) share commingled soil contamination. The conditions for each SWMU/AOC grouping are uniquely different and unrelated. For example, there is no perched groundwater under SWMU/AOC Nos. 067 and 071 and the COC concentrations in soil drop off to below CULs or are not detected at the edges of each contaminated area, which are about 50 feet apart. Therefore, Boeing does not agree that these SWMU/AOC groupings share the same potential soil to groundwater contaminant pathways and does not agree to use the MTCA Method B soil cleanup levels for SWMU/AOC Nos. 067 and 071.

26. Page 5-6, Section 5.1.3, Last Paragraph: The FS text reads, *However, Boeing's evaluation of indoor air against the worker exposure requirements of Chapter 296-841 WAC, Airborne Contaminants, indicates no current risk to workers at the facility. Therefore, no cleanup action specific to sub-slab vapor is proposed in this FS.* Ecology disapproves of this text because these Washington State health and safety regulations Labor and Industries) do not supersede the MTCA indoor air cleanup regulations and cleanup action required as a result of exceedances of those MTCA indoor air cleanup regulations, as related to a release of volatile contaminants to the environment.

    Response C26: While Boeing maintains that there is no current risk to workers at the facility, as confirmed by the recent indoor air sampling in May 2016, Boeing agrees to include annual indoor air monitoring in the cleanup actions for the EPM E SWMUs/AOCs, with the exception of SWMU/AOC No. 097 (not required by Ecology) and Building 40-02, Former Paint Crib (indoor air and sub-slab vapor are below the applicable cleanup levels and screening criteria). This is consistent with responses to Ecology comments in Attachment A.

27. Page 5-8, Section 5.1.4, First Paragraph, Criterion 3: The leaching model shows that the soil contamination and perched groundwater contamination in many SWMUs has the potential to reach the Esperance Sand Aquifer if the water is allowed to infiltrate into the contaminated vadose zone soils. At this time, due to the existence of the perched groundwater in many contaminated areas, Ecology assumes that water infiltration is occurring to some finite extent.

Response C27: Comment noted. Boeing would like to point out that two SWMUs/AOCs have contaminated soil and perched water above CULs (SWMU/AOC Nos. 086, 089, 094 and Nos. 055 and 168) and that active cleanup actions have been proposed for these two areas. Boeing maintains that the groundwater extraction at SWMU/AOC Nos. 086, 089, 094 and dewatering at SWMU/AOC Nos. 055 and 168 will protect the Esperance Sand from migration of the existing shallow contamination, as Ecology also noted in the second paragraph on Page 2 of their comments to the FS.

28. Page 5-9, Section 5.1.6, Paragraph 2: Consistent with the derivation of terrestrial ecological soil cleanup levels for antimony and lead using Table 749-3, arsenic terrestrial ecological soil cleanup levels shall be based on the numeric criteria in Table 749-3 also. Given the Ecology preferred remedial action for the former gun club is excavation of contaminated soils, and given the main contaminants of concern are lead and PAHs will drive this cleanup, it is unlikely that arsenic soil contamination will remain at levels exceeding Table 749-3 numeric values (10 mg/kg).

Response C28: Boeing does not agree with lowering the arsenic level to below 20 mg/kg, a concentration which Ecology considers representative of "urban background" concentrations for soils in the State of Washington (https://fortress.wa.gov/ecy/publications/publications/1109095.pdf) and which is listed in Table 749-2. As noted in footnote (a) of Table 749-3: *Exceedances of the values in this table do not necessarily trigger requirements for cleanup action under this chapter. Natural background concentrations may be substituted for ecological indicator concentrations provided in this table.* The lowering of the arsenic cleanup level below background will affect the cleanup footprint. At boring location ESB1328, the arsenic concentration is 16 mg/kg at 1 foot below ground surface, but there are no lead or PAH exceedances. Thus, Ecology would be requiring Boeing to clean up soils with concentrations lower than background, which is impracticable.

29. Page 5-13, Point of Compliance, Fourth Paragraph: Ecology clarifies the surface water standard point of compliance as the point or points at which hazardous substances are released to surface waters of the state which includes (a) the stormwater outfall (PMG-26 sample location), (b) groundwater seeps that flow into the surface water, and (c) groundwater nearest to the surface water (without being diluted by surface water mixing). These points of compliance are consistent with WAC 173-340-730(6).

Response C29: Boeing disagrees that the stormwater outfall at PMG26 is a point of compliance because this outfall enters a reach of the creek that does not sustain perennial flow. Boeing requests that Ecology consider the point where perennial flow begins as the point of compliance for Powder Mill Creek (i.e., PMG20). Please refer to Response C30 below for additional discussion on point of compliance.

30. Page 5-14, Point of Compliance, Second Paragraph: The FS Report text states, *In accordance with the FSWP, this FS proposes conditional points depending on the cleanup action alternatives developed and evaluated in Section 6. The FS compares such alternatives to other alternatives that include a standard point of compliance.* Based on telephone conversations with Boeing's project manager, there are no SWMUs where a conditional point of compliance are proposed.

Response C30: Ecology is correct that no conditional points of compliance were proposed in the FS report for any of the SWMU/AOCs; however, Boeing now proposes the use of a conditional point of compliance for PMG, as discussed in Response A52 above.

31. Page 5-14, Point of Compliance: The indoor air point of compliance was not included in this section. Therefore, Ecology will require Boeing to use the standard point of compliance for indoor air as defined in WAC 173-340-750(6). At this time there are no buildings near or directly above the PMG TCE groundwater plume. However, Ecology expects that institutional controls, notification of the owner/builder to prevent such construction until after engineering controls are in place to prevent unacceptable vapor intrusion into buildings.

Response C31: Boeing disagrees or seeks clarification from Ecology regarding institutional controls at offsite properties (see Response A48).

Section 6.0:

In the explanation of alternatives 2, 3 and 4, Boeing states that the GET system is the primary cleanup technology. Alternative 2/3/4 is similar to Alternative 1 and includes GET as the primary cleanup technology supplemented with institutional controls. Ecology disagrees with this statement as the GET system was installed to provide hydraulic containment and little expectation existed at that time or currently that it would effectively treat the source and downgradient TCE groundwater plume mass to reach cleanup levels.

Response C6.0: As indicated in Response B19 Boeing disagrees with Ecology regarding the GET system's ability to address VOC contamination in the mid- and downgradient portions of the plume through increased flushing of the aquifer and direct capture and treatment.

32. Page 6-1, Section 6.3 Description of Cleanup Action Alternatives, Paragraph 2: In order for Ecology to accept a future excavation remedial alternative as the Ecology preferred alternative, there must be a timeline associated with the future excavation work. An Ecology final cleanup action must include an enforceable timeline schedule. In many instances where Boeing evaluated a 'future excavation' remedial option, a timeline estimate was provided for this work. Without an enforceable time schedule in a MTCA Order, future excavation remedial actions cannot be considered as final cleanup actions.

Response C32: Boeing requests discussion with Ecology on this comment. It is not possible for Boeing to commit to an enforceable timeline for future excavation as the timeline for site

improvement projects changes on a frequent basis. Committing to an excavation date that is 10 to 20 years in the future could result in significant disruptions to plant operations if the planned work was inconsistent with site improvement plans.

33. Page 6-2, Section 6.3 Description of Cleanup Action Alternatives, Paragraph 1: This paragraph attempts to interpret the institutional control requirements for the site. Ecology will look to the exact wording in WAC 173-340-440 for institutional control requirements for this site cleanup (on and off Boeing Everett property). Ecology will also require notification and Ecology approval prior to conducting any activities not in compliance with Ecology approved institutional controls and associated environmental covenants.

Response C33: Comment noted.

34. Page 6-2, Section 6.3.1 Exposure Pathway Model A SWMUs: The existence of perched groundwater indicates current rainwater infiltration. In addition, there is a potential for unacceptable indoor air vapor intrusion due to elevated soil gas contamination (refer to FS report page 6-4) and the close proximity of the contaminated soil gas to the all three buildings in this EPM A area.

Response C34: The source of perched groundwater is not known and could be caused by leaking underground utility lines, as noted by Ecology on page 7 of their comments (Attachment A, Footnote 2). It should be noted that sub-slab vapor and soil gas concentrations are below screening levels at SWMU/AOC No. 151 and minimally exceed the screening levels at outdoor SWMU/AOC No. 90 and No. 112. Boeing does not believe that vapor intrusion is a significant concern for this EPM and notes that Ecology did not include these SWMUs/AOCs in the May 2016 indoor air sampling event.

35. Page 6-4, Section 6.3.1, EPM A Monitoring Components, Second Bullet: If groundwater cleanup levels are met, then Boeing will propose long term conformational monitoring for this SWMU 151. Routine soil gas and indoor air sampling is required as long as screening levels (soil gas, sub-slab vapor and/or groundwater) for indoor air are exceeded.

Response C35: Boeing requests clarification of Ecology's requirements in this comment. It is unclear why long-term confirmational groundwater monitoring will be required if cleanup levels are met, and why soil gas and indoor air sampling is required for SWMU/AOC No. 151 when sub-slab vapor and soil gas concentrations are below screening criteria.

36. Page 6-7, Section 6.3.2 EPM B SWMUs, Paragraph 1**:** Ecology also includes the potential for contaminated perched groundwater and contamination in soils to migrate downward to the Esperance Sand aquifer. The existence of perched groundwater indicates current rainwater infiltration. In addition, there is a potential for unacceptable vapor intrusion due to elevated contamination in soil gas and the close proximity of the contaminated soil gas to the 40-56 building.

Response C36: The source of perched groundwater is not known and could be caused by leaking underground utility lines, as noted by Ecology on page 7 of their comments (Attachment A, Footnote 2). Please also refer to Response C34.

37. Page 6-8, Section 6.3.2, EPM B Alternative #1, Paragraph 1, Subparagraph #1 AND Paragraph #5: Alternative #1 – containment fails threshold requirements (WAC 173-340-360(2)(a)(ii)) as groundwater cleanup levels will not be met. Alternative #1 also fails to meet WAC 173-340-360(2)(e)(iii) for overreliance on institutional controls when it is technically possible to implement a more permanent remedy.

Response C37: The Boeing and Ecology preferred alternative is Alternative 2 (Soil Vapor and Groundwater Extraction). Although Alternative 1 (Maintain Containment) is not the preferred alternative, Boeing believes it meets threshold requirements by complying with cleanup standards in WAC 173-340-700 through 173-340-760 and is permanent to the maximum extent possible. Alternative 1 meets WAC 173-340-360(2)(e)(iii) because it relies on containment as the primary method of protection; institutional controls are an additional component of the alternative to ensure containment is continued.

38. Page 6-9, Section 6.3.2, EPM B Alternative 2 – In Situ Treatment, Bullet #1: Ecology would expect optimization of the groundwater recovery system.

Response C38: Boeing agrees with this comment and intends to extract perched groundwater in the most efficient method possible to optimize recovery.

39. Page 6-13, Section 6.3.4, EPM D SWMUs, Paragraph 2, Subparagraph #1 AND Page 6- 14, EPM D Alternative 1 – Maintain Containment: Alternative #1 – containment fails threshold requirements (WAC 173-340-360(2)(a)(ii)) as groundwater cleanup levels will not be met. Alternative #1 also fails to meet WAC 173-340-360(2)(e)(iii) for overreliance on institutional controls when it is technically possible to implement a more permanent remedy.

Response C39: The Boeing and Ecology preferred alternative is Alternative 4 (Near-Term Excavation with Dewatering); however, Ecology prefers continuous dewatering instead of periodic dewatering. Although Alternative 1 (Maintain Containment) is not the preferred alternative, Boeing believes it meets threshold requirements by complying with cleanup standards in WAC 173-340-700 through 173-340-760 and is permanent to the maximum extent possible. Alternative 1 meets WAC 173-340-360(2)(e)(iii) because it relies on containment as the primary method of protection; institutional controls are an additional component of the alternative to ensure containment is continued.

40. Page 6-18, Section 6.3.4 EPM D Alternative 4, Monitoring Components: Ecology will require downgradient monitoring of the Esperance Sand Aquifer for Skydrol contaminants since active remediation within the footprint of the 40-24 building is not going to occur.

Response C40: Boeing does not agree that downgradient monitoring of the Esperance Sand aquifer is necessary for Skydrol contaminants remaining below Building 40-24. The conservative modeling presented in Appendix B in the FS indicates that with a low permeability cover, which the building provides, no migration will occur within the limit of the model (999 years). Please also refer to Response C14.

41. Page 6-19, EPM E-F SWMUs, Paragraph 2: Ecology also includes the potential for

contamination in soils to migrate downward to the Esperance Sand aquifer. In addition, there is a potential for unacceptable indoor air vapor intrusion due to elevated contamination in soil gas beneath the building floor.

Response C41: Comment noted. Please also refer to Responses C16 and C18 above, which pertain to the conceptual site models for EPMs E and F, respectively.

42. Page 6-20, EPM E-F Alternative 1 – Maintain Containment: Ecology will require monitoring of the Esperance Sand Aquifer downgradient of SWMUs. Routine sub-slab vapor and indoor air sampling is required where soil gas and/or sub-slab vapor screening levels exceed those thresholds protective of indoor air cleanup levels.

Response C42: Boeing does not agree to monitor the Esperance Sand aquifer or to sub-slab vapor sampling for the reasons provided in the responses to the comments in Attachment A. Boeing agrees to include annual indoor air sampling as part of the cleanup action at EMP E SWMUs/AOCs for which maintain containment is proposed, with the exception of Building 40-02, Former Paint Crib, for the reasons provided in the responses to the comments in Attachment A. Please also refer to Response C26.

43. Page 6-23, Section 6.3.6 EPM G-H Paragraph 2 AND Page 6-24, EPM G-H Alternative 1– Maintain Containment: Ecology will require monitoring of the Esperance Sand Aquifer downgradient of SWMUs. Routine sub-slab vapor and indoor air sampling is required where soil gas and/or sub-slab vapor screening levels exceed those thresholds protective of indoor air cleanup levels.

Response C43: Boeing does not agree to monitoring of the Esperance Sand aquifer or to indoor air and sub-slab vapor sampling for these SWMUs/AOCs for reasons provided in the responses to the comments in Attachment A.

44. Page 6-29, Section 6.3.9, Model K SWMU, Paragraph 1: Ecology includes dermal contact as a complete exposure pathway.

Response C44: Boeing agrees that dermal contact with contaminated surface water is a potential exposure for humans; however, Boeing is not aware of any ARARs or MTCA cleanup levels for water associated with dermal contact and requests clarification of the pertinence of this statement.

45. Page 6-29, Section 6.3.9, Model K SWMU, Paragraph 2, Bullet #1: Alternative #1 fails threshold and other requirements under WAC 173-340-360(2)(a) and (b). Refer to Ecology Appendix B discussion.

Response C45: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

46. Page 6-30, Section 6.3.9, Model K SWMU, Alternative #1: Alternative #1 fails threshold and other requirements under WAC 173-340-360(2)(a) and (b). Refer to Ecology Appendix B discussion.

Response C46: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

47. Page 6-31, Section 6.3.9, Model K SWMU, Alternative #1, Groundwater Extraction and Treatment, last paragraph: *Continued operation of the GET system will be protective of human and ecological receptors and will (and has already been observed to) accelerate remediation of the plume through direct removal of TCE mass from the groundwater and increased aquifer flushing.* Ecology disagrees and disapproves this statement that alternative #1 will restore groundwater with only the operation of the interim action groundwater recovery wells, to cleanup levels.

Response C47: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

48. Page 6-37, Section 6.3.9 EPM K Alternative #2, Focused EISB Source Area Remediation: Any EISB injections would be targeted at contaminated groundwater source zones in order to meet the cleanup level at the standard point of compliance, not limited to areas where TCE concentrations exceed the arbitrary 500 µg/L as stated in the PS report text.

Response C48: If a value of 500 µg/L is not acceptable to Ecology, Boeing requests clarification on what Ecology considers a "contaminated groundwater source zone" where injections should be performed, especially with consideration that there is a clear distinction in groundwater concentrations in the source area between the few wells where concentrations have recently been between around 300 and 600 µg/L and the majority of wells that are below approximately 100 µg/L.

49. Page 6-38, Section 6.3.9 EPM K Alternative #2, Institutional Controls: Ecology expects institutional controls under WAC 173-340-440 to apply to all downgradient properties above the Esperance Sand Aquifer where contaminants are above cleanup levels.

Response C49: Boeing requests clarification from Ecology regarding institutional controls at offsite properties (see Response A48).

50. Page 6-39, Section 6.3.9 EPM K Alternative #3, Focused ISCO Remediation: Any ISCO injections would be targeted at contaminated groundwater source zones in order to meet the cleanup level at the standard point of compliance, not limited to areas where TCE concentrations exceed the arbitrary 500 µg/L as stated in the PS report text.

Response C50: Boeing requests clarification from Ecology regarding target areas (see Response A45).

51. Page 6-40, Section 6.3.9 EPM K Alternative #3, Paragraph 2: Injections and monitoring designed and operated such that the primary focus should be to keep the groundwater recovery wells running at all times to minimize the flux of TCE groundwater entering the creek (objective of the interim action);

Response C51: Boeing requests clarification from Ecology regarding extraction well operations

during injection events (see Response A46).

52. Page 6-41, Section 6.3.9, EPM K Alternative #4, Paragraph#1, Bullet #2: Refer to paragraph #49.

Response C52: Boeing requests clarification from Ecology regarding institutional controls at offsite properties (see Response A48).

53. Page 6-41, Section 6.3.9 EPM K Alternative #4, Focused EISB Remediation: Any EISB injections would be targeted at contaminated groundwater source zones in order to meetthe cleanup level at the standard point of compliance, not limited to areas where TCE concentrations exceed the arbitrary 500 µg/L as stated in the FS report text.

Response C53: Boeing requests clarification from Ecology regarding target areas (see Response A45).

54. Page 6-42, Section 6.3.9 EPM K Alternative #4, Paragraph 3: Injections and monitoring shall be designed and operated such that the primary focus should be to keepthe groundwater recovery wells running at all times to minimize the flux of TCE groundwater entering the creek (objective of the interim action);

Response C54: Boeing requests clarification from Ecology regarding extraction well operations during injection events (see Response A46).

55. Page 6-42, Section 6.3.9, EPM K Alternative #4, Institutional Controls: Restrictive covenants and institutional controls shall apply to all downgradient including non-Boeing properties in accordance with WAC 173-340-440.

Response C55: Boeing requests clarification from Ecology regarding institutional controls at offsite properties (see Response A48).

Section 7.0:

56. Page 7-1, Section 7.0 Analysis of Cleanup Action Alternatives, Paragraph 2: The FS text states: *This section documents that cleanup action alternatives selected for evaluation meet these threshold criteria. The analysis in this section satisfies AO SectionVI(7)(B)(iii).* Ecology disagrees with this statement and it is not approved. Several of Boeing's cleanup action alternatives do not meet threshold or other requirements for a cleanup action under WAC 173-340-360(2) (a) and (b). Ecology has identified those cleanup action alternatives that fail threshold or other requirements in Appendix B and Appendix C of this letter.

Response C56: Boeing believes that all of the alternatives presented meet threshold and other requirements. Detailed responses to specific issues identified by Ecology are provided in the responses to Ecology comments in Attachments A and B.

57. Page 7-1, Section 7.0 Analysis of Cleanup Action Alternatives, Paragraph 6: In this

paragraph Boeing expresses its opinion regarding only the negative aspects of selecting the most permanent cleanup action (such as traffic, possible coordination with production activities in the area, etc.). Ecology does not approve these statements. Boeing should have mentioned that the public may also see and prefer the benefits for a more permanent remedy with a much shorter restoration timeframe from a human health and environmental protection standpoint.

Response C57: Comment noted.

58. Page 7-3, Section 7.1.1 Exposure Path Models A-J, Comply with Cleanup Standards: This FS text is an attempt to summarize the cleanup action requirements for contaminated soils left in place and not remediated/removed to meet soil cleanup levels at the standardpoint of compliance. As stated previously, Boeing should either cite the MTCA reference (Ecology preference) or restate verbatim the MTCA regulation and not attempt to summarize or restate/interpret the regulation in the FS report. Ecology does not approve any of the bulleted statements that are not exact statements found in the MTCA.

Response C58: Comment noted.

59. Page 7-4, Section 7.1.1 Exposure Path Models A-J, Provide for a Reasonable Restoration Time Frame, Paragraph 1: Many of the SWMUs also have contaminated (perched) groundwater above cleanup standards. The FS text is revised to read: The maintain containment alternatives for soil contamination must meet all applicable MTCA requirements including WAC 173-340-740(6)(f), provide for a reasonable restoration timeframe. ~~*by establishing containment and institutional controls immediately following Ecology approval of the Institutional Controls Management Plan*~~.

Response C59: Comment noted.

60. Page 7-14, Section 7.1.8 Exposure Path Models A-J, Future Excavations: In order for Ecology to accept a future excavation remedial alternative as the Ecology preferred alternative, there must be a timeline associated with the future excavation work. An Ecology final cleanup action must include an enforceable timeline schedule. In many instances where Boeing evaluated a 'future excavation' remedial option, a timeline estimate was provided for this work. Without an enforceable time schedule in a MTCA Order, future excavation remedial actions cannot be considered as final cleanup actions.

Response C60: Boeing proposes that the enforceable timeline schedule apply to the institutional controls portion of each future excavation alternative. The institutional controls would be implemented in a short timeframe and hold Boeing accountable to complete excavation at the applicable sites in the future.

61. Page 7-19, Section 7.2.2 Exposure Path Model K, Comply with Cleanup Standards: Ecology does not believe alternative 1 meets this threshold requirement and therefore this section is not approved. Refer to Appendix B and C for more detailed statements on this

Ecology conclusion.

Response C61: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

62. Page 7-20, Section 7.2.2 Exposure Path Model K, Provide for a Reasonable Timeframe: Ecology does not believe alternative 1 meets this requirement for a final cleanup action [WAC 173-340-360(2)(b)] and therefore this section is not approved. Refer to AppendixB and C for more detailed statements on this Ecology conclusion.

Response C62: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

Section 8.0:

63. Page 8-1, Section 8.0, Paragraph 1: The text states: The MTCA DCA is used to evaluate which of the alternatives that meets the threshold requirements is permanent to the maximum extent practicable. This is an incorrect statement. Remedial alternatives that meet threshold requirements (WAC 173-340-360(2)(a)) and other requirements (WAC l73-340-360(2)(b)(ii) and (iii)) are then evaluated under the MTCA DCA to determine which remedial alternative(s) are permanent to the maximum extent practicable.

Response C63: Boeing maintains that the two statements are essentially equivalent.

64. Page 8-2, Section 8.0, Last Paragraph: The text states, *Ecology has provided informal guidance (Myers 2010) during review of FS reports for other sites regarding the selection of these weighting factors, and the weighting factors used in this FS report are those recommended informally by Ecology.* Ecology did not approve or informally recommend any weighting factors. Instead, Ecology recommended that Boeing justify the weighting factors they select to use.

Response C64: Comment noted. AECOM researched weighting factors used for other FS projects in Washington State and found that the factors used for the DCA in the FS are in alignment (within 5% for each criterion) with factors used in other FS reports accepted by Ecology.

65. Page 8-3, Section 8.1 Exposure Pathway Model A: Ecology adds that a potential pathway exists for some SWMUs for TCE vapor intrusion due to elevated TCE soil gas concentrations [46].

[46] Exceeded the soil gas screening values for Method C based on sub-slab vapor attenuation. Soil gas samples depths were very shallow, less than 2 feet below the surface.

Response C65: Comment noted. Please also refer to Response C11.

66. Page 8-7, Section 8.1 Exposure Pathway Model A, Management of Short Term Risks: Ecology clarifies the text by adding, *"Management of short-term risks" was not added to*

WAC-173-340-360(3)(e) as a criterion so that it could be used to offset the benefits associated with more protective, permanent, and effective remedies. Ecology believes the remedial alternatives evaluated by Boeing can be ranked about equally in terms of how effective they could be designed to manage short term risks. All could be designed so that the risk of danger to the public and site workers was minimal.

Response C66: Boeing disagrees with the addition of the new text. Boeing's understanding is "Management of short-term risks" is specifically being evaluated to balance the other criteria. Boeing has weighted "Management of short-term risks" at only 10% to show it has less importance than other criterion. It would not be accurate to rank all alternatives the same for this criterion when there are clearly more risks associated with more aggressive alternatives.

67. Page 8-7, Section 8.1 Exposure Pathway Model A, Technical and Administrative Ecology clarifies the text by adding, Implementability: *'Implementability' is not included in WAC 173-340-360(3)(e) to offset the benefits associated with more protective, permanent, and effective remedies that require relatively more to be implemented than their less protective/permanent/effective alternatives. All four remedial alternatives are both technically and administratively implementable, however Alternative 4 (excavation) will be close to underground utilities and subsurface structures. Alternative 2 (injections for reductive dechlorination or biodegradation) were found implementable based on the successful results of previous FS pilot studies.*

In-situ bioremediation and chemical reductive dechlorination are well established groundwater treatment technologies. It is obviously easier to implement nothing than something, and generally more difficult to implement more than less, so according to

Response C67: The comment appears to be incomplete. Please provide the missing text at the end of the comment. However, based on the portion of the comment provided, Boeing disagrees with the addition of the new text. Similar to the Response C66 above, "Implementability" is specifically being evaluated to balance the other criteria. Boeing has weighted "Implementability" at only 10% to show it has less importance than other criterion. Furthermore, it would be deceiving to indicate injections were successful given the variable results achieved during pilot testing and the difficulties that were encountered during implementation.

68. Page 8-8, Section 8.1 Exposure Pathway Model A, Consideration of Public Concerns: The FS text states it believes ALL of the EPM A alternatives are rated as excellent in regard to public concerns. Alternative 4 (excavation) was rated excellent in regard to public concerns, but slightly lower numerically than the other alternatives because it involves the highest degree of construction activity that could potentially impact site operations. The public has not provided any comment on the Boeing preferred remedial actions at these contaminated areas. Ecology considers it likely the employees working in the area and the downgradient public would prefer a faster and more permanent remedial alternative.

Response C68: Comment noted.

69. Page 8-9, Section 8.2 Exposure Pathway Model B: Ecology adds that a potential pathway exists for the contaminated perched groundwater to migrate to the lower Esperance Sand Aquifer[47] AND for volatile organic solvent vapor intrusion into the

building due to elevated volatile soil gas concentrations[48]. The existence of perched groundwater indicates current rainwater infiltration and the potential for vertical migration of contamination to the Esperance Sand Aquifer.

[47] This potential was evaluated in the FS report, Appendix B
[48] Exceeds the soil gas screening values for Method C based on sub-slab vapor attenuations

Response C69: Comment noted. The source of perched groundwater is not known and could be caused by leaking underground utility lines, as noted by Ecology on page 7 of their comments (Attachment A, Footnote 2). Please also refer to Response C34.

70. Page 8-9, Section 8.2 Exposure Pathway Model B, Paragraph 2, Sub-paragraph #1: Ecology has determined that alternative #1 (containment of contamination only) fails threshold requirements because this alternative will not achieve groundwater or soil cleanup standards. This alternative also has an overreliance on institutional controls when it is technically possible to implement a more permanent remedy. WAC 173-340-360(2)(e)(iii). Therefore, alternative #1 should not be included in the DCA evaluation of this subsection 8.2 (discussion of protectiveness, permanence, long term effectiveness, management of short term risks, technical and administrative implementability, and public concerns). Regardless, Boeing did not select alternative #1 as its preferred remedy and instead proposed alternative #2 (in-situ vapor extraction and groundwater extraction).

Response C70: Boeing disagrees that Alternative 1 does not meet threshold criteria and disagrees with Ecology's statement that it should not be included in the DCA. Institutional controls are an important component of the alternative, but not the primary method of protection. Alternative 1 relies primarily on containment to protect against risk to human health and the environment. Please also refer to Response C40.

71. Page 8-12, Section 8.2 Exposure Pathway Model B, Technical and Administrative Implementability: Ecology clarifies the text by adding, *'Implementability' is not included in WAC 173-340-360(3)(e) to offset the benefits associated with more protective, permanent, and effective remedies that require relatively more to be implemented than their less protective/permanent/effective alternatives. All remedial alternatives are both technically and administratively implementable, however excavation alternatives will be close to underground utilities and subsurface structures. It is obviously easier to implement nothing than something, and generally more difficult to implement more than less.*

Response C71: Boeing disagrees with the addition of the new text. Boeing believes "Implementability" is specifically being evaluated to balance the other criteria. Boeing has weighted "Implementability" at only 10% to show it has less importance than other criterion. Please also refer to Response C67.

72. Page 8-12, Section 8.2 Exposure Pathway Model B, Consideration of Public Concerns: The public has not provided any comment on the Boeing preferred remedial actions at these contaminated areas. Ecology considers it likely the surrounding neighbors and the downgradient public would prefer the faster and most permanent remedial alternative.

Response C72: Comment noted. Boeing also notes that it is difficult to predict public, non-Boeing sentiment regarding the preferred type of cleanup action, as stated by Ecology in Section B.1.2.2, Attachment B of Ecology's comments.

73. Page 8-13, Section 8.2 Exposure Pathway Model B, Results of Disproportionate Cost Analysis (DCA): Ecology disagrees with this section and it is not approved. Ecology eliminates alternative # 1 because it fails threshold criteria-compliance with cleanup standards. Therefore the DCA would need to evaluate alternatives #2 and #3, both of which pass MTCA threshold and other requirements for a cleanup action.

Response C73: Please refer to Response C70.

74. Page 8-17, Section 8.4 Exposure Pathway Model D: Ecology adds that a potential pathway exists for the contaminated perched groundwater to migrate to the lower Esperance Sand Aquifer. The existence of perched groundwater indicates current rainwater infiltration and the potential for vertical migration of contamination to the Esperance Sand Aquifer.

Response C74: Please refer to Response C27. Boeing also notes that the proposed FS cleanup action includes removal of perched groundwater to the extent practicable, which will mitigate the potential for perched groundwater migration, as Ecology also noted in paragraph 2 on Page 11 of their comments.

75. Page 8-17, Section 8.4 Exposure Pathway Model D, Paragraph 2, Sub-paragraph #1: Ecology has determined that alternative # 1 (containment of contaminated groundwater only) fails threshold requirements because this alternative will not achieve groundwater cleanup standards. This alternative also has an overreliance on institutional controls when it is technically possible to implement a more permanent remedy. WAC 173-340-360(2)(e)(iii). Therefore, alternative #1 should not be included in the DCA evaluation of this subsection 8.4 (discussion of protectiveness, permanence, long term effectiveness, management of short term risks, technical and administrative implementability, and public concerns). Regardless, Boeing did not select alternative # 1 as its preferred remedy and instead proposed alternative #4 (near term excavation and groundwater dewatering).

Response C75: Boeing disagrees that Alternative 1 does not meet threshold criteria. Institutional controls are an important component of the alternative, but not the primary method of protection. Alternative 1 relies on primarily containment to protect against risk to human health and the environment and should be considered in the DCA evaluation.

76. Page 8-20, Section 8.4 Exposure Pathway Model D, Management of Short Term Risks: Refer to Ecology comment #66.

Response C76: Please refer to Response C66.

77. Page 8-21, Section 8.4 Exposure Pathway Model D, Technical and Administrative Implementability: Ecology clarifies the text by adding, *'Implementability' is not included in WAC 173-340-360(3)(e) to offset the benefits associated with more protective, permanent, and effective remedies that require relatively more to be implemented than*

their less protective/permanent/effective alternatives. All remedial alternatives are both technically and administratively implementable.

Response C77: Please refer to Response C71.

78. Page 8-21, Section 8.4 Exposure Pathway Model D, Consideration of Public Concerns: Refer to Ecology Comment #72.

Response C78: Please refer to Response C72.

79. Page 8-21, Section 8.4 Exposure Pathway Model D, Results of Disproportionate Cost Analysis (DCA): Ecology eliminates alternative #1 because it fails threshold criteria-compliance with cleanup standards. Therefore the DCA would need to evaluate alternatives #2 and #3, both of which pass MTCA threshold and other requirements for a cleanup action.

Response C79: Boeing disagrees that Alternative 1 does not meet threshold criteria. Institutional controls are a component of the alternative not the primary method of protection. Alternative 1 relies on containment to protect human health and the environment and should be considered in the DCA evaluation.

80. Page 8-22, Section 8.5 Exposure Pathway Models E-F: Ecology adds that a potential pathway exists for the vadose zone soil contamination to migrate to the lower Esperance Sand Aquifer AND for volatile organic solvent vapor intrusion into the building(s) due to elevated volatile soil gas concentrations[49].

[49] Exceeds soil gas screening values for Method C based on sub-slab vapor attenuations.

Response C80: Please refer to Responses C16 and C18 above, which pertain to the conceptual site models for EPMs E and F, respectively.

81. Page 8-22, Section 8.5 Exposure Pathway Models E-F, Paragraph 2, Fourth Sentence: The FS text states, *Where volatile constituent concentrations in sub-slab vapor exceed the industrial MTCA screening levels, the concentrations are not a current risk to industrial indoor air, either based on Boeing's industrial hygiene evaluation of the interior work spaces, or because the sub-slab vapor detections are outside of existing structures.* This statement is incorrect since industrial hygiene evaluations are not applicable to attaining indoor air cleanup levels under the MTCA regulations for spills of volatile chemicals that contaminate shallow soils and groundwater.

Response C81: Please refer to Response C26.

82. Page 8-25, Section 8.5 Exposure Pathway Models E-F, Management of Short Term Risks: Refer to Ecology comment #66.

Response C82: Please refer to Response C66.

83. Page 8-25, Section 8.5 Exposure Pathway Models E-F, Technical and Administrative Implementability: Refer to Ecology Comment #77.

Response C83: Please refer to the Response C71.

84. Page 8-26, Section 8.5 Exposure Pathway Models E-F, Consideration of Public Concerns: Refer to Ecology Comment #72

Response C84: Please refer to Response C72.

85. Page 8-27, Section 8.6 Exposure Pathway Models G-H: Ecology adds that a potential pathway exists for some SWMUs (067, 071, 093) in this group for the vadose zone soilcontamination to migrate to the lower Esperance Sand Aquifer AND for volatile organic solvent vapor intrusion into the building(s) due to elevated volatile soil gas concentrations[50].

[50] Above the soil gas screening values for Method C based on sub-slab vapor attenuations

Response C85: Please refer to Responses C19 and C20, which pertain to the conceptual site models for EPMs G and H, respectively.

86. Page 8-30, Section 8.6 Exposure Pathway Models G-H, Management of Short Term Risks: Refer to Ecology comment #66.

Response C86: Please refer to Response C66.

87. Page 8-31, Section 8.6 Exposure Pathway Models G-H, Technical and Administrative Implementability: Refer to Ecology Comment #77.

Response C87: Please refer to Response C71.

88. Page 8-31, Section 8.6 Exposure Pathway Models G-H, Consideration of Public Concerns: Refer to Ecology Comment #72.

Response C88: Please refer to Response C72.

89. Page 8-36, Section 8.9 Exposure Pathway Model K, Third Paragraph: Ecology has determined that alternative # 1 fails threshold requirements because this alternative will not achieve groundwater cleanup levels at the standard point of compliance. The means for alternative # 1 to attain cleanup standards is to immediately apply aggressive groundwater treatment (such as in-situ chemical oxidation or in-situ enhanced bioremediation) in the source and downgradient areas (alternatives #3 and #4).

Response C89: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

90. Page 8-36, Section 8.9 Exposure Pathway Model K, Paragraph 3, Third Sentence: The FS

text reads, *As reflected by the scores for Alternatives 2, 3, and 4, there is uncertaintyin the optimal configuration and application of bioremediation or JSCO in these alternatives, and hence uncertainty regarding the relative benefit of ISCO or bioremediation as a supplement to GET system operation.* Ecology disagrees with this text and this text is not approved in the FS report. Ecology acknowledges that there is uncertainty all of the four remedial alternatives evaluated but there is larger uncertainty with alternative #1 (relying mainly on the current interim action groundwater pump and treat system to remediate the Esperance Sand Aquifer to cleanup levels at the standard point of compliance (source area and throughout the TCE groundwater plume).

Response C90: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

91. Page 8-36, Section 8.9 Exposure Pathway Model K, Paragraph 3, Fourth Sentence: The FS text reads: *There is also uncertainty regarding the potential for ISCO or bioremediation to create conditions that decrease the effectiveness of the GET system, such as biofouling of well screens or the treatment system or increased downgradient migration of degradation products.* Ecology believes this is a valid concern, however, this concern is present with all ISCO and bioremediation injection technologies ever implemented and there are engineering design features that can be implemented to reduce or mitigate this outcome. For example, designing the groundwater injection locations distant (upgradient and downgradient) from the groundwater extraction and monitoring wells. This recommendation is also stated in the FS report on page 8-38 (Alternative #4).

Response C91: Boeing disagrees with Ecology because ISCO and EISB remediation projects are not always combined with GET system operations, and when they are combined they present unique risks and challenges for preventing and remedying fouling and system bypass situations (see Responses A46 and B35). Boeing has had direct experience with these types of scenarios and they have proven to be very difficult and costly to deal with. As previously indicated (see Response A46), shutting down extraction wells until the injection fluid has been spent and bioremediation has run its course would be the safest and most likely way to prevent fouling of extraction wells and the treatment system.

92. Page 8-45 Section 8.9 Exposure Pathway Model K, Disproportionate Cost Analysis: Ecology disagrees with Boeing's DCA analysis and it is not approved. Ecology has determined that alternative #1 fails threshold requirements and cannot not be included in the DCA evaluation. Refer to Appendix B, Section B.2.

Response C92: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

Section 9.0:

93. Page 9-1, Section 9.0, First Paragraph, Third and Fourth Sentences: The text states: *This is because, with the exposures controlled, the substantial cost to perform active treatment is clearly disproportionate to the small additional benefit gained. For some SWMUs/AOCs, the DCA results indicate that containment should be selected, but an intrusive cleanup action is instead recommended in this FS.* As discussed in more detailin

Appendices A and B, Ecology does not agree that active treatment for many of the upland SWMUs is disproportionately costly compared to Boeing preferred containment cleanup remedies. In many cases, the Boeing preferred containment remedy did not satisfy MTCA threshold and other requirements for a final cleanup action, thus the Boeing preferred containment remedy was not allowed to be evaluated in the DCA evaluation.

Response C93: As discussed in the responses to Ecology comments in Attachments A and B, Boeing believes that all cleanup action alternatives included in the FS meet threshold criteria, and that they should be included in the DCA evaluation.

94. Page 9-2, Section 9.0, Second Paragraph (including 6 bulleted statements): Boeing describes interim cleanup actions conducted at many of the SWMUs. These are worthy cleanup actions, however, Ecology notes that many of these interim cleanup actions were not intended to and did not meet cleanup levels at the standard point of compliance.

Response C94: Comment noted.

95. Page 9-3, Section 9.0, Third Paragraph: Boeing discusses two excavation alternatives: near-term excavation and future excavation. A final cleanup under a MTCA administrative order must have a firm time schedule and therefore a 'future excavation' option without indicating the timeframe for when that excavation occurs is not an acceptable remedial action alternative. How can Ecology evaluate the 'reasonable restoration timeframe' requirement under WAC 173-340-360(4) for such an alternative?

Response C95: Boeing is committed to completing excavation at the SWMUs/AOCs where future excavation is the selected alternative, but cannot commit to a specific year because of operational activities. Boeing maintains that implementation of the maintain containment and institutional controls components of the future excavation alternatives comply with the cleanup standards and a firm timeframe is not warranted.

96. Page 9-4, Section 9.0, Fourth Paragraph, Bullet #2: The text reads *....procedures to require that construction activities involving excavation or that could impact a remedy be reviewed by Boeing EHS personnel against the requirements and limitations of the institutional control plan.* Ecology must be notified prior to and approve of any activities that are forbidden by Ecology approved institutional controls or environmental covenants.

Response C96: Comment noted.

97. Page 9-6, Section 9.2: Ecology does not agree with Boeing's statement that remedial alternative #2 is disproportionately costly compared to alternative #1 (containment only). The MTCA regulations (WAC 173-340-360(2)(c)(II)(A)) require reasonable efforts to remove source contamination and NAPL at this SWMU. Alternative# l will fail threshold criteria-compliance with cleanup levels for groundwater. Therefore, alternative # 1 does not meet this requirement for a permanent groundwater remedy and cannot be selected as a cleanup action and cannot be evaluated in a disproportionate cost analysis (DCA). Remedial alternative #2 (SVE and groundwater extraction) offers reasonable efforts to remove source contamination and NAPL. Boeing agrees to implement remedial alternative #2 and Ecology agrees because alternative #1 is not allowed under MTCA as stated above.

Response C97: This comment pertains to EPM B, SWMU/AOC Nos. 086, 089, and 094. Boeing believes Alternative 1 meets threshold requirements. Please also refer to Response C37.

98. Page 9-7, Section 9.4: Ecology does not agree with Boeing's statement that remedial alternative #4 (Near Term Excavation with Dewatering) is disproportionately costly compared to alternative #1 (containment only). The MTCA regulations (WAC 173-340-360(2)(c)(II)(A)) require reasonable efforts to remove source contamination and NAPL at this SWMU. Alternative #1 fails threshold criteria - compliance with cleanup standards for groundwater. Therefore alternative# 1 cannot be selected as a cleanup action and cannot be evaluated in a disproportionate cost analysis (DCA). Remedial alternative #4 offers reasonable efforts to remove source contamination and NAPL. Boeing agrees to implement remedial alternative #4 and Ecology agrees because alternative #1 is not allowed under MTCA as stated above.

Response C98: This comment pertains to EPM D, SWMU/AOC Nos. 055 and 168. Boeing believes Alternative 1 meets threshold requirements. Please also refer to Response C39.

99. Page 9-8, Section 9.5: Ecology's preferred remedial alternative for SWMU #97 alternative #3 (near term excavation). Ecology believes this alternative is permanent to the maximum extent practicable. Ecology does not agree with Boeing's statement that remedial alternative #3 (SWMU#97) is disproportionately costly compared to alternative #1 (containment only). The MTCA regulations (WAC 173-340-360((2) and (4) require a reasonable restoration timeframe. Near term excavation is a dependable and well-established technology for further active TCE contaminated soil treatment. Ecology believes the additional cost to implement remedial alternative #3 over alternative # 1 is not disproportionate. Therefore, remedial alternative #3 is the permanent to the maximum extent practicable remedy. In the end, Boeing agrees to implement near term excavation as the final cleanup action for SWMUs #97.

Ecology's preferred remedial alternative for SWMU#171 is alternative #2, soil vapor extraction (SVE). Ecology disagrees with Boeing's section summary that results in the selection of alternative #1 (containment only) for SWMU#171. Ecology's regulatory justification for preferring alternative #2 is discussed in Appendix B.l.

Response C99: Boeing believes Alternative 1 meets threshold requirements for both SWMU/AOC No. 097 and No. 171. There is no meaningful change to SWMU/AOC No. 097 provided by this comment. Please refer to the detailed discussion of SWMU/AOC No. 171 in the responses to Ecology's comments in Attachment B.

100. Page 9-9, Section 9.6: Ecology's preferred remedial alternative for SWMU #68 alternative 4 (near term excavation). Ecology believes this alternative is permanent to the maximum extent practicable. Ecology does not agree with Boeing's statement that remedial alternative #4 (SWMU#68) is disproportionately costly compared to alternative #1 (containment only). The MTCA regulations (WAC 173-340-360((2) and (4) require a reasonable restoration timeframe. Near term excavation is a dependable and well-established technology for remediating contaminated soil. Ecology believes the additional

cost to implement remedial alternative #4 over alternative #1 is not disproportionate. Therefore, remedial alternative #4 is the permanent to the maximum extent practicable remedy. In the end, Boeing agrees to implement near term excavation as the final cleanup action for SWMU#68. Therefore, Ecology doesn't believe it should spend additional time disagreeing with Boeing's justification statements.

Response C100: Comment noted.

101. Page 9-10, Section 9.7: Boeing discusses two excavation alternatives for the SWMU UST EV-48-1: near-term excavation and future excavation. A final cleanup under a MTCA administrative order must have a firm time schedule and therefore a 'future excavation' option without indicating the timeframe for when that excavation occurs is not an acceptable remedial action alternative.

Response C101: Boeing is committed to completing excavation at the SWMUs/AOCs where future excavation is the selected alternative, but cannot commit to a specific year because of operational activities. Boeing maintains that implementation of the maintain containment and institutional controls components of the future excavation cleanup actions comply with the cleanup standards and a firm timeframe is not warranted. Please also refer to Response C95.

102. Page 9-12, Section 9.9: Ecology believes remedial alternative#2 (comprehensive excavation) meets all threshold and other requirements for a final cleanup action and is permanent to the maximum extent practicable. Boeing agrees to implement comprehensive excavation to attain cleanup levels at the standard point of compliance.

Response C102: Comment noted.

103. Page 9-13, Section 9.10: Ecology believes remedial alternative #4 meets all threshold and other requirements for a final cleanup action and is permanent to the maximum extent practicable. Ecology disagrees with Boeing's section summary that results in the selection of alternative #1 for this the PMG TCE Groundwater Contamination SWMU. Ecology's regulatory justification for preferring alternative #4 is discussed in Appendix B.2.

Response C103: Boeing disagrees with Ecology's comment regarding Alternative 1 meeting threshold criteria and attaining cleanup levels (see Responses A44 and B19).

FS Report, Appendix B: Vadose Zone Modeling Results

Generally, Ecology believes that the SESOIL modeling methodology and the assumptions applied to the SESOIL model are conservative. The model input parameters, including soil physical and chemical properties and contaminant concentrations, are generally representative of RI data, and reasonably conservative. We believe that the model results, particularly the predicted peak groundwater concentrations in the Esperance Sand Aquifer, can be used as one line of evidence to evaluate remedial alternatives for the soil contamination within various SWMUs/AOCs in the feasibility study.

Ecology also believes that SESOIL model, similar to other screening level analytical models, has its

limitations and uncertainties. These limitations and uncertainties should be clearly stated and well understood by readers, and the modeling results should be interpreted and evaluated within these limitations and uncertainties. Specifically, the following limitations must be considered when SESOIL model is applied:

- SESOIL Model is applicable and useful to estimate the future maximum (peak) groundwater concentrations (for example, see Figures B-5, B-6, and B-7). However, the model cannot reliably to predict the times for soil contamination to reach the underlying Esperance Sand Aquifer and for groundwater contamination to reach the maximum (peak) concentration and/or to attenuate to below the MCLs or cleanup levels. The considerable uncertainty with time prediction mainly results from: (1) vadose zone flow is assumed as gravity driven flow in most analytical vadose zone models. This inherited assumption will under-predict velocities of vertical groundwater flow and contaminant transport. In fact, vertical groundwater flow is generally driven by capillary pressure under unsaturated conditions within the vadose zone where capillary pressure driven flow transports much faster than the gravity driven flow; and (2) uncertainties associated with model input parameters for simulation of the vadose zone flow and transport, including infiltration rate, intrinsic permeability, total organic content, and adsorption coefficient or retardation factor. For some SWMUs/AOCs (such as Building 40-51), SESOIL model predicts contaminate will reach the peak concentrations in 40 to 50 years (see Figures B-5, B-6, and B-7). But for other SWMUs/AOCs (such as Building 40-56), the model predicts the peak concentrations will not be reached in several hundred years to over 1,000 years (see Figures B-14 and B-17). Uncertainty associated with these time predictions is significant and the timeframe is most likely over-estimated by the model.

- SESOIL Model cannot be used directly to simulate perched groundwater within the vadose zone, which is an important feature for several SWMUs/AOCs. Contaminated perched groundwater will not only behave as additional vadose zone source to the underlying Esperance Sand Aquifer, it could also migrate latterly to spread contamination within the vadose zone to a larger area than the original source area above. SESOIL model is not designed to simulate a perched groundwater within the vadose zone therefore the modeling results may have significant uncertainty if perched groundwater exists.

- SESOIL model results should be compared to the observed groundwater data within the Esperance Sand Aquifer for a "reality check". Building 40-32 modeling results predict TCE will not reach or migrate to the Esperance Sand Aquifer in approximately 300 years (see Figure B-37a), which seems to be a long time that cannot be supported by minimal site data. This type of modeling results should be evaluated against observed data at the site or contamination data from different SWMUs/AOCs with similar geologic and hydrogeologic settings. Uncertainty should be considered when remedial alternatives are evaluated and selected.

Response C104: Comments noted.