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DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Ave SE • Bellevue, WA 98008-5452 • 425-649-7000
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May 2, 2019

Katie Moxley
Manager, Environmental Remediation
The Boeing Company
P.O. Box 3707
MC 9U4-26
Seattle, WA 98124-2207

Re: Washington State Department of Ecology Final Decision Under Formal Dispute Resolution: Agreed Order No. DE 96HS-N274, Upland Deep Groundwater Monitoring Wells, Groundwater Sampling Frequency and Indoor Air Sampling at the 40-56 Building

Dear Katie:

Thank you and the Boeing Company's (Boeing) team for attending the formal dispute resolution meeting on April 2, 2019, at the Washington State Department of Ecology (Ecology) Northwest Regional Office (NWRO). Boeing requested the meeting with Ecology, under the RCRA Corrective Action Agreed Order (AO), No. DE 96HS-N274, Section VII.10(B) to contest parts of Ecology's February 8, 2019 letter and Ecology's electronic mail dated March 11, 2019.

Below, in accordance with the AO, Section VII.10(B), is the NWRO Hazardous Waste and Toxics Reduction (HWTR) Section Manager's final decision on the remaining disputed issues.

This letter is Ecology's response to all Boeing letters and documents submitted during Dispute Resolution of the issues in Ecology's February 8, 2019 letter and March 11, 2019 electronic mail.

Background on the Dispute

Over the last 32 months, Boeing explained their objections to Ecology's prior decisions regarding:

1. The trigger for required future contaminated soil remediation at solid waste management units (SWMUs) where Ecology will initially allow capping and monitoring;

2. The need to install deep groundwater monitoring wells downgradient of several SWMUs where contaminated soils cannot be removed or treated in-situ immediately without interfering with commercial operations. These contaminated soils will remain in place for years (possibly decades) before active remediation will either remove or treat the contamination;
3. The sampling frequencies for those deep downgradient groundwater monitoring wells in (2) above; and
4. The need to sample indoor air in buildings where volatile contaminated soils are below the building floor, prior to future excavation or treatment. See (1) above.

A brief summary of the most pertinent events in the dispute is provided in Attachment A.

NWRO HWTR Section Manager's Decision

Boeing has agreed to many, but not all, of the decisions summarized in (1) through (4) above. These include: [1]

- Ecology's language[2] regarding the trigger requiring future contaminated soil remediation at SWMUs that will initially be capped and monitored (item 1 above);
- Installation of seven (7) deep groundwater monitoring wells downgradient of SWMUs where contamination is initially left in place[3].
- Routine indoor air sampling in 10 buildings where volatile contaminated soils are left in place below the building floor, before required excavation or treatment. Routine cross-slab pressure measurement events will be performed at building 40-56 (SWMUs 086/089/091) in lieu of routine indoor air sampling.

However, there remain points of disagreement that this final decision letter resolves. Ecology reviewed all pertinent information and data provided by Boeing as well as the relevant sections of MTCA. Following this review, I carefully considered Boeing's positions on the points of disagreement. It is my decision that Boeing has not presented information that warrants overturning our site manager's decisions. These decisions were communicated in prior written and/or meeting discussions.[4] Those decisions are summarized below.

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[1] Boeing letter dated March 1, 2019

[2] Ecology letter dated February 8, 2019

[3] Boeing has recently agreed to install seven (#1 thru #7) deep groundwater monitoring wells (Attachment #B). However, Boeing has not agreed to install the remaining three deep groundwater monitoring wells (#8, #9 and #11) Ecology requested in its February 8, 2019 letter. As discussed during the formal dispute resolution meeting on April 2, 2019 -- and previously conveyed by Raman Iyer, Section Manager NWRO, HWTR during a telephone call with Katie Moxley, Boeing, on March 15, 2019 -- deep groundwater monitoring well #10 need not be installed. The lower contaminant concentrations in soils at SWMU177 provide a justifiable basis for considering such a well unnecessary.

[4] That is, in previous meetings between Ecology and Boeing under informal and formal dispute resolution in 2016 and 2017; and, the Formal Dispute Resolution meeting at the Ecology NWRO on April 2, 2018. Relevant correspondence includes Ecology's August 18, 2016 letter; Ecology's July 20, 2017 letter; an Electronic Mail, dated November 27, 2018 from Ecology's assigned AAG; Ecology's February 8, 2019 letter; and Boeing's March 20, 2019 Electronic Mail.

Requirement to Install and Routinely Sample Three (3) Deep Groundwater Wells #8, #9, and #11 (Attachment B)

Boeing is required to install deep groundwater monitoring wells #8, #9, and #11, screened in the Esperance Sand Aquifer. Ecology based our decision on the regulatory and technical justifications provided in our electronic mail dated November 27, 2018, and letters dated February 8, 2019, July 20, 2017, and August 18, 2016. I believe these wells are needed for adequate compliance monitoring.[5]

Groundwater Well #8 (SWMU Groups 067/071, 086/089/094, Building 40-56)

One deep downgradient groundwater monitoring well must be installed on the western side of the north exterior wall of the 40-56 building, between building 40-56 and the road. The well's location should be moved approximately 100 feet further west of the location indicated in Attachment B to best monitor any groundwater contamination migrating from both SWMUs 086/089/094 and SWMUs 067/071.

Boeing asserts that monitoring well #6 could monitor these SWMUs instead of installing well #8. However, Ecology believes well #6 is located too far west to be an appropriate location for monitoring this SWMU group. Well #6 is correctly positioned immediately downgradient of SWMU EV 48-1 and should not be moved in an attempt to also monitor SWMU Groups 067/071 and 086/089/094 (as Boeing proposed on April 2nd). Ecology believes that moving well #6 would compromise its ability to monitor SWMU EV 48-1.

Groundwater Well #9 (Building 40-22, Utility Slants #2 and #3 AND Building 40-23, Static Test Pad

One deep downgradient groundwater monitoring well must be installed north of the outside north wall of the 40-32 building, between deep groundwater monitoring wells #1 (which monitors SWMUs 055/168) and #5 (which monitors the 40-32 building SWMU). This well must be located between the southeast corner of the building 40-56 and the southwest corner of building 40-58, approximately 100 feet further west than the position indicated in Attachment B. In our opinion, groundwater monitoring wells #2 and #5 are too far west and too cross-gradient to be optimal locations for monitoring SWMUs at Buildings 40-22 and 40-23. Based on the same observed groundwater elevations, groundwater flow directions could be more northerly than northwesterly, further supporting Ecology's requirement for this well.

[5] Boeing indicated in its March 1, 2019 response letter that they reserve the ability to perform a disproportionate cost analysis (DCA) to support their assertion that the incremental cost of additional downgradient groundwater monitoring wells is disproportionate to the incremental environmental benefit. This is an incorrect application of the DCA requirement in MTCA. Ecology has determined that the additional groundwater monitoring wells are required to meet threshold criteria under WAC 173-340-360(2)(a)(i), (ii), (iv) for the final cleanup remedies at these SWMUs where contaminated soil is left in place initially until future excavation or treatment may occur. Any final remedy without the installation of these monitoring wells would, in our opinion, fail to meet minimal, threshold requirements for a cleanup action. Therefore, remedial alternatives that do not include these wells, whether evaluated as part of the DCA process or not, cannot be selected as a final remedy for the site.

Groundwater Well #11 (SWMU No. 165, Former Fuel Farm USTs)

An additional deep downgradient groundwater monitoring well must either be located: a) due north of SWMU 165 on the south side of Highway 526 (preferred), or b) just north of Highway 526. Please refer to Attachment B. Groundwater samples from this near downgradient groundwater monitoring well must be used to validate the vadose zone modeling results[6]. Well #11 must be located in an optimal position to provide data – as soon as possible – whether contamination from this SWMU has migrated to the Esperance Sand Aquifer.

Ecology believes contamination from SWMU 165 could reach the Esperance Sand Aquifer. Reliance on vadose zone modeling results and outdoor concrete inspections alone is insufficient to address this concern. Samples collected from groundwater monitoring wells further downgradient (well #4 is 1000 feet downgradient) may eventually indicate that SWMU 165 has contaminated the aquifer. However, sampling results from well #4 will not detect groundwater contamination from this SWMU as quickly as possible.

For the 11 SWMUs on the Boeing Everett property, Ecology is allowing contaminated soil to remain under buildings until a soil treatment remedy can be implemented without disrupting Boeing operations. The contamination may remain in place for decades. We have also allowed Boeing to avoid installing the deep groundwater monitoring wells immediately downgradient of the 11 SWMUs so they are outdoors and not inside buildings. As a result, downgradient groundwater monitoring wells will be located a large distance from certain SWMUs (up to 1800 feet). The distance increases the uncertainty that a single groundwater well can accurately monitor groundwater downgradient of several SWMUs that are cross-gradient from each other. In addition, a downgradient well for each SWMU (or Ecology defined SWMU group[7]) detects and identifies contamination emanating from that particular SWMU.

Given the above, Ecology strongly believes the requirement for additional deep downgradient groundwater monitoring wells #8, #9 and #11, with 10-foot screens placed to intercept the top of the water table (Attachment B), are necessary to determine -- as soon as possible -- if contamination left in place at these SWMUs is reaching the Esperance Sand Aquifer. Ecology also requires all deep downgradient groundwater monitoring wells to be located to intercept the centerline of any SWMU groundwater plume. The large distance (up to 1000 feet) between the SWMUs or SWMU groups justifies Ecology's requirement for its 10 distinct deep downgradient groundwater monitoring wells that will monitor the centerline and highest concentrations of any plume. Boeing's argument is that groundwater plume dispersion in the downgradient direction

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[6] The vadose zone model predicts no vertical migration of petroleum contamination to the Esperance Sand Aquifer within 999 years assuming water infiltration. Ecology notes that the most significant uncertainty with this screening level vadose zone vertical migration model (or any other analytical/numerical vadose zone model), is the predicted time for contaminants to travel vertically downward to the aquifer.

[7] Ecology has defined the following SWMU groups that consist of SWMUs located close enough to each other to be monitored together as if a single SWMU. SWMUs 086/089/091 and 067/071; SWMUs Building 40-22 and 40-23; and SWMUs 055/168.

allows the expanding lateral edges of the plume to be detected by fewer groundwater wells. In our opinion, having fewer wells significantly increases the potential for missing (or underestimating) contaminate concentrations in groundwater.

Requirements for Groundwater Sampling Frequency

Boeing is required to routinely sample and analyze groundwater from each of the 10 new deep downgradient groundwater monitoring wells. Sampling and analysis shall occur at these 10 wells quarterly pursuant to the engineering design report (EDR)[8]. After two consecutive years of non-detections for analyzed contaminants, Boeing may reduce the sampling frequency to semi-annual. However, any verified detections in groundwater analytes immediately require return to quarterly groundwater sampling for that well[9].

Quarterly Sampling for two years establishes a baseline of chemical data that shows any seasonal fluctuations and verifies the low or high water season for future semi-annual groundwater sampling. Seasonality of vertical contaminant migration through the vadose zone could be different from the seasonality of horizontal contaminant migration within the Esperance Sand Aquifer. Therefore, a few years of semi-annual monitoring is necessary to understand contaminant migration fluctuations and seasonality before less frequent monitoring can be considered.

In addition, the groundwater equilibrium must be established around the newly installed wells. Sampling once every two years, as Boeing proposed, is too infrequent for this purpose, and will not quickly detect contaminant migration from SWMU soils to the Esperance Sand Aquifer. Effective compliance monitoring demands more frequent sampling.

Requirements for Confirmatory Indoor Air Sampling at 40-56 Building, SWMUs 086/089/091

Boeing is certain that the soil-vapor extraction (SVE) system, planned for the final remedy to remove volatile contaminants from the soils outside the 40-56 building (SWMU group 086/089/091), will create a negative-pressure field that fully extends under the south side of the 40-56 building. And that creating sustained negative pressure below the building will then act as a barrier to the advective flow of soil gas contamination into the structure. In this sense, SVE will perform a function similar to a sub-slab depressurization system, installed to mitigate vapor intrusion.

Ecology agrees that SVE can be designed and operated to create and sustain pressures below a building's slab that are lower than pressures inside that building. This has been demonstrated at

[8] Ecology reserves the right to require that these groundwater monitoring wells are installed earlier than at the implementation of the EDR, if continued negotiations for the final site cleanup take more time than expected.

[9] Routine groundwater sampling and analyses will end when contaminated soil from an associated SWMU is excavated or otherwise treated and soil cleanup levels met through confirmation sampling. In the event that contaminated soil excavation or in-situ treatment occurs at any of the above SWMUs and soil confirmation sampling verifies soil cleanup levels are met, prior to deep well installation, the deep well installation will not be necessary.

other sites. When this "negative pressure field" extends across the footprint of the building it can act similarly to a sub-slab depressurization system and minimize the transport of soil gas VOCs from the subsurface to the building's interior. However, if sub-slab soil gas VOC concentrations are sufficiently elevated to pose a potential threat to indoor air quality, post-mitigation sampling of indoor air is typically conducted to confirm the effectiveness of any depressurization system.[10] This confirmational sampling must be performed at the 40-56 Building once the SVE system is operational. It is the primary line of evidence for ensuring the adequate protection of workers inside the building.

After indoor air sampling data verify that vapor intrusion is not contaminating indoor air above protective levels, future "mitigation-effectiveness" monitoring during operation of the SVE system can be limited to pressure field extension measurements. These cross-slab pressure-differential measurements should be compared to: a) initial measurements taken at the same time indoor air was sampled, and b) "acceptable" values established in the final SVE design document (work plan). Pressure monitoring can then provide an indirect indication that vapor intrusion does not unacceptably impact the building's indoor air.[11]

If Boeing disagrees with Ecology's approach, they may always collect routine indoor air samples (similar to the other 10 SWMUs), which is Ecology's preference[12].

Next Steps

This letter provides Ecology's final formal dispute resolution decisions on the points of disagreement discussed above, and concludes the formal Dispute Resolution process (as set out in AO Section VII.10(B) for the issues discussed in this letter).

Next, Ecology looks forward to working with Boeing to complete the dispute resolution process for the Powder Mill Gulch (PMG) TCE groundwater remedy. Ecology will soon provide a written response letter on your supplemental feasibility study (SFS) report. Once Ecology identifies[13] its preferred PMG TCE groundwater remedial action (treatment technology, cleanup levels and groundwater point of compliance) for public comment, Boeing is required to submit a draft uplands cleanup action plan (dCAP). The requirements outlined in the Ecology February 8, 2019 letter, as modified by this letter, shall be fully incorporated into the draft uplands cleanup action plan (dCAP) and subsequent engineering design report (EDR) for the upland Site cleanup.

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[10] The DTSC Cal EPA VI Mitigation Advisory and NJ VIM Technical Guidance discuss indoor air sampling to confirm VIM-SSD system performance. Ecology believes it is prudent to follow the recommendations of these guidances and not just rely on routine negative pressure field extension measurements in order to protect workers in the building.

[11] Assuming no newly identified building floor openings to the subsurface soils are found or created.

[12] Given the high concentrations of volatile soil, perched groundwater and LNAPL contamination under or adjacent to the south side of the 40-56 building, Ecology reserves the right to require the routine indoor air sampling at these SWMUs earlier than at the implementation of the EDR, if continued negotiations for the final site cleanup take more time than expected. Indoor air and sub slab vapor concentrations vary temporally and one sub-slab vapor sampling event (2015) with low volatile concentrations at this SWMU is not adequate to eliminate future unacceptable vapor intrusion into the building.

[13] Subject to the dispute resolution provisions of the Agreed Order, as necessary.

If you have any questions or require clarifications regarding my decision, you may contact me at (425) 649-7053, or Dean Yasuda at (425) 649-7264 or dyas461@ecy.wa.gov.

Sincerely,

Raman Iyer
Section Manager, Northwest Regional Office
Hazardous Waste and Toxics Reduction Program

Enclosures: Attachments A and B

Sent by Certified Mail: 9171 9690 0935 0214 2538 79

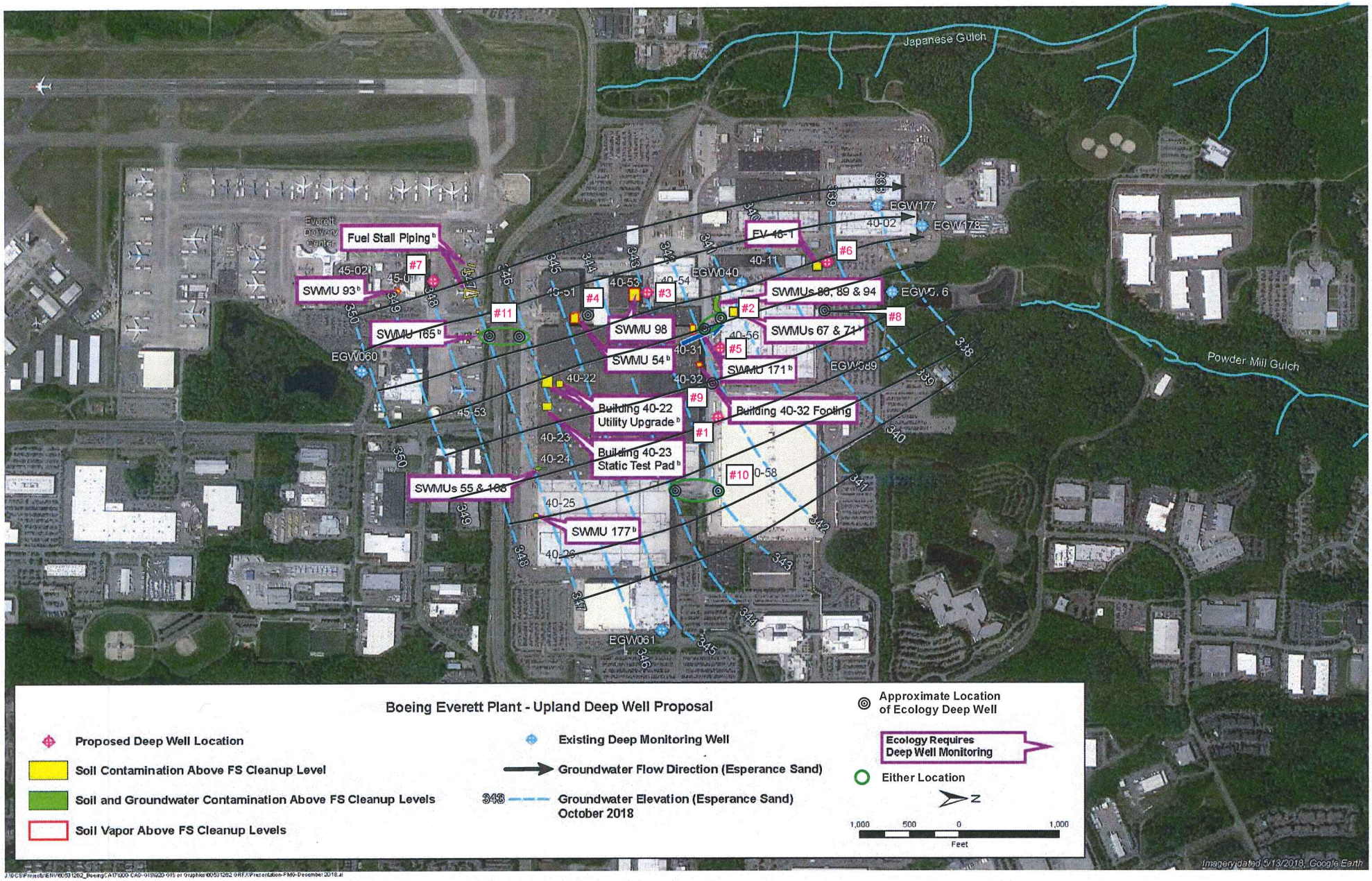
cc: Stanley N. Alpert, Senior Environmental Counsel, The Boeing Company
Michael Dunning, Perkins Coie LLP, Attorney for The Boeing Company
Scott Lathrop, Exotic Tool Welding Inc.
Roger Hoot, BBNC
Dianne Riter, BBNC
Greg Bertch, Bertch Capital Partners
Robert List, MMA Environmental
Ben Hochan, PGIM Real Estate
Catherine Minor, PGIM Real Estate
Krissy Bierlein, JSH Properties
Chuck Wiegman, JSH Properties
Wendy McClure, City of Everett
Mike Palacios, City of Everett
Mark Sadler, City of Everett
Dr. Tong Li, Groundwater Solutions
Ivy Anderson, Assistant Attorney General, Attorney for Department of Ecology
Christa Colouzis, Ecology
Thea Levkovitz, Ecology
Dean Yasuda, Ecology

Attachment A: Summary of the Most Important Events in the Dispute Resolution Process

- August 18, 2016, Ecology Letter, Ecology Contingent Approval and Modifications to the Draft Boeing Everett Uplands and Powder Mill Gulch Feasibility Study (FS) Report, dated November 13, 2015.
- September 19, 2016, Boeing Letter, Boeing Informal Dispute Resolution Letter and Responses to Ecology's Letter dated August 18, 2016. [14]
- July 20, 2017, Ecology Letter, Ecology Final Decision Under Informal Dispute Resolution Regarding the Upland Feasibility Study (FS) Report and Ecology Selected Remedies for the Boeing Everett Site.
- September 8, 2017, Boeing Letter, Boeing Invoking Formal Dispute Resolution – Ecology's Final Decision under Informal Dispute Resolution Regarding the Upland Feasibility Study Report, dated July 20, 2017, and Written Statement of Boeing's Position on Disputed Items for the Boeing Everett Facility.
- September 7, 2018, Boeing Letter, Boeing Everett Uplands/Powder Mill Gulch (PMG) Feasibility Study (FS) Formal Dispute.
- November 27, 2018, Ecology AAG Electronic Mail, Boeing Everett Site – Remaining Three Issues.
- December 21, 2018 Boeing Attorney Electronic Mail, Proposal on Three Issues.
- February 8, 2019, Ecology Letter, Final Decision on the Remaining Three Issues under Dispute Resolution, Ending Informal Dispute Resolution.
- March 1, 2019, Boeing Letter, The Boeing Company Response to Ecology's February 8, 2019 Final Decision Letter on the Remaining Three Issues under Dispute Resolution and Invoking Formal Dispute Resolution.
- March 11, 2019, Ecology Electronic Mail, Requirement of Indoor Air Sampling at SWMU 086/089/094.
- March 20, 2019, Boeing Electronic Mail, Agenda of April 2nd Meeting and Response to New Requirement of Indoor Air Sampling at SWMU 086/089/094.
- April 2, 2019 Meeting at the Ecology NWRO Under Formal Dispute Resolution.

[14] Ecology met with Boeing on five separate occasions (October 5, 2016, October 27, 2016, November 3, 2016, January 10, 2017 and March 22, 2017) and attended three telephone conference calls with Boeing staff (April 19, 2017, May 4, 2017 and June 8, 2017) under informal dispute resolution.

Attachment B: Figure


Japanese Gulch
Powder Mill Gulch
Everett Delivery Center
Fuel Stall Piping [b]
SWMU 93 [b]
SWMU 165 [b]
SWMU 98
SWMU 54 [b]
SWMUs 55 & 168
SWMU 177 [b]
SWMUs 86, 89 & 94
SWMUs 67 & 71
SWMU 171 [b]
Building 40-22 Utility Upgrade [b]
Building 40-23 Static Test Pad [b]
Building 40-32 Footing
EV-48-1
EGW177
EGW178
EGW040
EGW060
EGW061
EGW069
40-02
40-11
40-22
40-23
40-24
40-25
40-26
40-31
40-32
40-53
40-54
40-56
40-58
45-02
45-53
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
Boeing Everett Plant - Upland Deep Well Proposal
Proposed Deep Well Location
Soil Contamination Above FS Cleanup Level
Soil and Groundwater Contamination Above FS Cleanup Levels
Soil Vapor Above FS Cleanup Levels
Existing Deep Monitoring Well
Groundwater Flow Direction (Esperance Sand)
343 Groundwater Elevation (Esperance Sand) October 2018
Approximate Location of Ecology Deep Well
Ecology Requires Deep Well Monitoring
Either Location
N
1,000 500 0 1,000
Feet
Imagery dated 5/13/2018, Google Earth