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October 25, 2016

Ms. Dana Cannon
West of 4th Project Coordinator
Aspect Consulting
401 2nd Ave S, Suite 201
Seattle, WA 98104

Re: **West of 4th Site**
Agreed Order #DE 10402
Revised Feasibility Study Report for Site Units 1 and 2

Dear Ms. Cannon:

On August 12, 2016, the West of 4th PLP Group provided the Washington State Department of Ecology (Ecology) copies of the revised Site Unit (SU) 1 Feasibility Study (FS) Report. On that date we also received a link to an electronic copy of the revised SU 2 FS Report and Plant 2/4 investigation report (RI Data Resolution Report). The Reports are required deliverables of Agreed Order (AO) #DE 10402. Thank you for submitting the documents by their agreed-to due date and addressing Ecology's May 10 comments on their draft versions.

Ecology reviewed the revised FS Reports with two purposes in mind:

1. to determine if we concurred with proposals, hypotheses, interpretations, and other statements in the document (including the PLPs' preferred remedial alternatives and the basis for their selection); and, if sufficient information was contained in the Report,

2. to subsequently choose our – i.e., Ecology's – preferred West of 4th alternative(s).

Based on our review of the two FS Reports we believe that the West of 4th PLPs have collected and presented sufficient information to select a preferred remedial alternative for the site. We describe that alternative in the paragraphs below. In addition, we have provided four enclosures. Enclosures A and C identify those SU1 and SU2 proposals, hypotheses, interpretations, and other statements in the revised Reports that Ecology either significantly disagrees with or believes should be clarified, at least with respect to our own views. Since Ecology is not requesting a revision of the revised FS Reports, our comments in Enclosures A

and C are primarily intended to aid the PLPs during the drafting of the site Cleanup Action Plan (CAP).[1]

Enclosures B and D more fully describe Ecology's preferred alternatives for SU1 and SU2, and the basis for identifying them as such. Ecology's remarks and discussion in these two enclosures are being provided solely to communicate our cleanup action preferences and underlying rationale. No response is required and neither of the August 2016 revised Reports need be revised further. Hopefully the enclosed information will be useful to the PLPs during the next cleanup stage, when the four companies prepare the first draft of the site CAP.

Below we have summarized: (1) Ecology's preferred cleanup alternative for the SU1 portion of the West of 4th site; (2) our preferred cleanup alternative for the SU2 portion of the site; and, (3) the next (post-FS) steps for the site.

Preferred SU1 cleanup action

The preferred remedial alternative identified by the PLPs in the revised SU1 FS Report is Alternative 1. Alternative 1 combines a number of remedial elements, including the adjustment of groundwater pH in an area nearby the Art Brass Plating facility (to facilitate metals immobilization) and a number of controls. It relies heavily on the past results of the Art Brass Plating interim action (air sparging and soil vapor extraction), controls, and future natural attenuation to protect receptors and attain cleanup standards within a reasonable timeframe. The revised FS Report considers Alternative 1 the least expensive and most easily implementable of the nine alternatives evaluated.

In both FS Reports, and in the September 7, 2016, meeting following their submittal, the PLPs have expressed their willingness to implement actions other than those specified in the two (SU1 and SU2) Alternative 1s. These actions are referred to as *contingency actions* and, generally speaking, would be implemented at some later date if:

(1) either of the Alternative 1s were unable to adequately protect human health or the environment; or,

(2) either of the Alternative 1s were unable to attain other performance objectives (such as restoration timeframe goals), and implementation of a practicable additional action could better guarantee attainment.

The reason that *contingency actions* might be needed is because it is uncertain at this time whether these alternatives will, in fact, meet the site's groundwater-related remedial action objectives in a manner compliant with requirements in WAC 173-340. This is, at least in part, due to both Alternative 1s' dependence on future monitored natural attenuation (MNA) as the primary remedy for achieving a number of those objectives.

Ecology agrees that the expected performance of MNA (as proposed in SU1's and SU2's Alternative 1s) is uncertain. For this reason we also agree that if either alternative were selected, they would need to be coupled, in some fashion, with groundwater contingency actions.

[1] Ecology has not commented on the revised (Plant 2 and 4) RI Data Resolution Report.

Based on our evaluation of the potential cleanup actions capable of addressing SU1 contamination, Ecology disagrees that Alternative 1 should be the preferred SU1 alternative. Our preferred remedial alternative for SU1 is Alternative 5, though at this time we are not convinced that the benefits of its proposal to actively continue treatment of CVOC groundwater contamination in the source area justifies the added cost. The reasons we favor Alternative 5 over Alternative 1, and other FS alternatives, are described in detail in Enclosure B. As discussed in that enclosure (and to some extent in Enclosure A as well), Alternative 5 appears to be the most permanent action that can be practicably implemented. Among the nine SU1 alternatives, it would most aggressively reduce CVOC concentrations in groundwater as it migrates towards and discharges into the Duwamish Waterway.

Preferred SU2 cleanup action

The preferred remedial alternative identified by the PLPs in the revised SU2 FS Report is Alternative 1. The PLPs consider this alternative the least expensive and most easily implementable of the six alternatives evaluated. Alternative 1 includes treatment of contaminated soils and shallow groundwater beneath Capital Industries' Plant 4 and various SU2-area controls. It is based on the irreversible environmental benefits that have already resulted from soil excavations implemented as an interim action at the Blaser Die Casting facility and conducted earlier by Capital Industries subsequent to the Plant 2 fire. In SU2 areas where groundwater cleanup levels are exceeded, Alternative 1 relies heavily on future natural attenuation to protect receptors and attain cleanup standards within a reasonable timeframe.

Based on our evaluation of SU2 remedial alternatives, Ecology disagrees that the Report's Alternative 1 by itself should be the preferred alternative. Our preferred remedial alternative includes additions to Alternative 1. The primary addition is a "line" of active groundwater treatment along 1st Ave S., in the vicinity and south of where S. Fidalgo St. joins 1st Ave. from the east. We prefer this modification to Alternative 1 over the PLPs' Alternative 1, and other FS alternatives, for the reasoned described in detail in Enclosure D. As discussed in that enclosure (and to some extent in Enclosure C as well), Alternative 1, so modified, appears to be the most permanent action that can be practicably implemented.

Next steps

Now that the FS has been completed, the PLPs and Ecology must prepare a draft CAP that proposes the site's preferred remedial alternative(s). Requirements for CAP content are set out in Task II.1 of the Order's SOW (and WAC 173-340-380). In accordance with the AO's Schedule of Deliverables and the approved Deliverable Management Plan FS Tech Memo, the PLPs' first-draft version of the CAP is due 90 (ninety) days from receipt of today's letter. Once we have received the document, Ecology is likely to modify this draft version of the CAP prior to issuing it for public comment. Therefore, when it is electronically submitted it should be formatted in a manner that makes it easy to edit (such as in WORD).

At the time the PLPs prepare their first-draft version of the CAP, it will be necessary to perform two additional tasks. First, before the draft CAP is proposed to the public, Ecology must make a SEPA threshold decision. At the time that the PLPs submit their draft CAP, therefore, a filled-

out SEPA checklist should also be submitted. Ecology will then use the information provided in the checklist to prepare a SEPA determination.

Second, as discussed in the enclosures, new Washington State Water Quality Standards (WQS) were adopted on August 1. The new Standards' Criteria for a number of West of 4th contaminants of concern are ARARs. Certain surface water and groundwater cleanup levels for the site must therefore be adjusted in order to be ARAR-compliant. This includes the cleanup levels for trichlorothene (TCE) and vinyl chloride. Since this adjustment will reduce the cleanup levels for TCE and vinyl chloride, not only will the draft CAP need to modify its proposed cleanup levels for these compounds, but – presumably – revise groundwater restoration timeframes associated with the preferred alternative(s).[2]

A new West of 4th Agreed Order will be needed to implement the CAP.[3] The new Order should be similar in many respects to the current AO, but will have a completely different Scope of Work and Schedule of Deliverables. Ecology will develop a draft of the new Order during the CAP-preparation period; we will then forward it to the PLPs for their review. Since the new AO must be proposed to the public concurrently with the draft CAP, our goal should be to complete Order negotiations and have a draft AO ready for public review by the time the final version of the draft CAP has been completed.

AO #DE 10402 provides a process for resolving disputes between the parties. When, for example, the PLPs disagree with a decision made by Ecology's project coordinator, this process can be initiated to expeditiously settle the disagreement. Although we hope that the West of 4th PLPs will understand the reasons for, and accept, the preferred cleanup actions we have identified above and in Enclosures B and D, you should consider today's identification of these cleanup actions a *decision* subject to the Order's dispute resolution process. As such, if you disagree with our preferred alternatives for either SU1 or SU2, you should proceed to invoke section VIII.J of the AO. Your first step would then be to notify Ecology's project coordinator in writing of your objection to our decision. The written objection must be provided within fourteen (14) days and include sufficient detail to allow Ecology to evaluate the merits of the dispute.[4]

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[2] Although the new WQS have been adopted and are now MTCA ARARs, EPA is currently reviewing these standards for the purpose of compliance with section 303(c) of the Clean Water Act. This portion of the Act directs states to adopt WQS for their waters, and section 303(c)(2)(A) and EPA's implementing regulations at 40 CFR part 131 require, among other things, that a state's WQS specify appropriate designated uses of the waters, and water quality criteria that protect those uses. It is conceivable that the result of this review will be an EPA request for modification of particular Criteria values. While this is possible, Ecology believes it unlikely for TCE and vinyl chloride. EPA's response to the state is due in November; until then it is best to assume that further significant changes to the TCE and vinyl chloride WQS Criteria will not be forthcoming.

[3] The current AO is limited to the FS stage of cleanup. A new Order must therefore be drafted and proposed to the public during the comment period associated with the CAP and associated SEPA threshold determination. After the public comment period has ended, Ecology will consider all comments on both documents (the Order and CAP) and then finalize them, making modifications as needed. Please see WAC 173-340-600, -530, and -380.

[4] The PLPs should include the particular Ecology determination, or direction, in dispute, as well as the specific reasons for disagreeing with Ecology and invoking the dispute resolution procedures.

NOTE: The 14-day response period only applies to those situations where the PLPs choose to dispute our decision (as communicated in today's letter). You are not otherwise obligated to respond.

Considerable time and resources have been expended by the PLPs to complete a solid West of 4th RI/FS. Ecology appreciates this effort. We look forward to working with you during the next stages of the site cleanup. If you have any questions about today's letter, please contact me at either (425) 649-4449 or ejon461@ecy.wa.gov.

Sincerely,

Ed Jones
Environmental Engineer
Hazardous Waste and Toxics Reduction Program

By certified mail: 9171 9690 0935 0136 8280 56
Enclosures

cc: William Joyce, SJZ
Doug Hillman, Aspect
William Carroll, PCE
Jeff Kaspar/Peter Jewett, Farallon
Janet Knox, PGG
Donald Verfurth, G&R
Ronald Taylor, CI
Marlys Palumbo, VNF
William Beck, Stericycle
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Central Files
PLPs' W4 repository

ecc: Peter Hapke, ALG
Nels Johnson, AAG
Tong Li, GWS
Patty Foley, GTCC
Neal Hines, Ecology
Raman Iyer, Ecology
Ron Timm, Ecology

ENCLOSURE A

Ecology's Comments on the August 2016 revised Site Unit 1 FS Report[5]

COMMENTS

1. Page ES-5, last two paragraphs on the page. As discussed in Enclosure B, if Alternative 1 meets "MTCA threshold requirements," in our (Ecology's) opinion it does so only marginally.

   In addition, Ecology does not believe that groundwater restoration timeframes over 280 years for inorganic COCs are reasonable for the West of 4th site. Nor do we believe that restoration timeframes over 40-50 years for organic COCs are reasonable unless coupled with active, near-Waterway treatment. Please see Enclosure B for a fuller discussion of this topic.

2. Pages ES-6 and -7. Ecology has performed its own disproportionate cost analysis (DCA; see Enclosure B) and does not concur with several of the PLPs' statements and conclusions on these pages. Please also see Comments #33 through 42 below.

3. Pages ES-7 and -8. Ecology has selected a preferred SU1 alternative that is not Alternative 1, so we do not concur with a number of the statements and conclusions presented in the "Conclusions and Recommendations" section. Please see Enclosure B and Comment #42 below.

   In addition, statements in the last paragraph on page ES-8 (which are re-iterated on page 66) require clarification. The Report discusses a "phased, adaptive design and implementation process" for Alternative 1. According to section 3, however, there is little to actually implement in Alternative 1 other than the pH neutralization action. Are the PLPs referring to this action when they speak of a "phased, adaptive design and implementation process"?

4. Table ES-4, DCA summary. As noted above, Ecology has performed its own DCA and does not concur with several of the PLPs' rankings and other conclusions. We also do not agree that restoration timeframes longer than 280 years are reasonable for inorganic groundwater contamination at the West of 4th site. Please see Enclosure B and Comment #32 below.

5. Pages 13 and 14, sections 5.4.1 and 5.4.2.1. Ecology agrees that the PCULs were developed in the West of 4th FS to establish concentrations corresponding to acceptable

[5] In this enclosure Ecology has used the term "active" to simply refer to treatment, or remediation, that requires human intervention. So "natural attenuation" is not, in this sense, active. We do not mean to imply that a cleanup action that includes natural attenuation and conforms to expectations set out in WAC 173-340-370(7) should not be considered an *active remedial measure* under the MTCA regulations.

site risk levels and non-carcinogenic threshold values. But the PLPs' additional reference to "interim mitigation measure" plans should have drawn the distinction between *acceptable* site risk levels utilized during interim actions and those required in establishing MTCA-compliant cleanup standards.

In addition, SU1 RAO-2, described on page 14, should be listed under both the "Surface Water Pathway" and the "Air Pathway" (unless the intent of RAO-3A is interpreted as meaning the reduction of soil VOC levels to directly protect soil gas and underlying groundwater quality).

6. Page 15, section 5.4.2.2. Minor comments, but:
   - the groundwater Point of Compliance for the vapor intrusion (VI) migration pathway should (only) be considered the depth corresponding to the Water Table zone, and
   - the reference to RAO-5B's "VI-based MTCA Method B PCULs" should have noted that these are groundwater PCULs.

7. Page 18, second bullet of the last paragraph. Neither in situ chemical reduction (ISCR) nor enhanced anaerobic bioremediation (EAnB) are utilized in Alternatives 2 through 8 to treat "widespread groundwater" contamination in the downgradient areas of SU1. For each of these alternatives the two technologies are applied as "interceptor treatment walls." So while Ecology did not expect the SU1 FS to evaluate in situ chemical oxidation (ISCO) as an alternative downgradient treatment technology, the rationale provided in the bullet is not a compelling justification for its exclusion.

8. Page 19, second bullet. A minor comment, but the air sparging (AS) summary here fails to mention that the sparge curtain concept was incorporated into one of the nine alternatives, but only one. For other alternatives it is considered a "contingency" action.

9. Page 20, section 7.2.2 (and section 7.3.8.1, pp. 43-44). With respect to hazardous/ dangerous waste designations for soils and groundwater contaminated with plating wastes and brought to the surface, please note that:

   a) CVOC-contaminated groundwater is also subject to designation under Section WAC 173-303-090. Under this regulation total trichloroethene (TCE) and vinyl chloride groundwater concentrations must be compared to the TCLP extract threshold values;

   b) contained-out determinations for F002 listed dangerous waste contaminated soils are based on adequate data that support knowledge of the amount of contamination in the soils proposed for the contained-out determination. To successfully show that the soils do not "contain" the waste, CVOC concentrations must be below standard Method B direct contact cleanup levels, below applicable LDR soil standards, and not designate as a Federal or State-Only hazardous/dangerous waste;

   c) contained-out determinations for F002 listed dangerous waste contaminated groundwater are based on very low CVOC concentration values (standard Method B

groundwater cleanup levels, applicable wastewater LDR values, and TCLP threshold values). Usually the best management option is to dispose of F002 listed dangerous waste groundwater under the domestic exclusion rule (this requires King County authorization to dispose of the water in an on-site sewer); and,

d) metals-contaminated soils (with Zn, Cu, and/or Ni) need to be designated using either the "book designation" or fish toxicity testing to determine if the soils are State Only Toxic dangerous waste (see WAC 173-303-100). Likewise if the CVOCs in soils are in the ppm range, the PLP's should apply the State Only Toxicity "book designation" process to see if the soils designate as WT01 or WT02. There is also the option to run fish bioassay tests for designation purposes.

10. Page 21, section 7.2.3. Ecology notes the following on the "mitigation" discussion here:

- The PLPs are correct that some controls in each of the alternatives are "temporary," even if needed for "extended" periods of time. To improve the clarity of this discussion, however, the Report should have identified the controls, per alternative, that cannot be considered *temporary*. For example, some alternatives leave levels of vadose zone soil contamination in place that exceed cleanup standards. As discussed in Comment #12 below, in most of these cases it is unreasonable to state that the standards will later be attained within any reasonably foreseeable future. This should have been made apparent to the reader.

- The 4th bullet is correct: environmental covenants are used for the protection of current and future receptors located at the subject property. Another important function of covenants, however, which is not stated, is their establishment of (above and below ground) land use restrictions designed to protect the integrity and continued effectiveness of the cleanup remedy.

- While Ecology agrees that the West of 4th cleanup action will require notifications to utility companies (as discussed in the Report's third bullet), we anticipate that institutional controls related to informing and updating the affected public about the nature of site contamination and cleanup progress will be broader and more comprehensive than simply the notifications described here.

11. Page 28, section 7.2.4. There appears to be typographical errors at the end of this section. According to later statements made in the Report, the inorganic restoration timeframe for Alternatives 1 through 7 is 280, not 400, years.

12. Page 31, section 7.3.1, and page 32, top of the page. The second bullet on page 31 states that there will be future natural attenuation of CVOCs and metals in SU1 soils. Ecology agrees that where soil contamination is at a depth such that it is at least seasonally below the water table, transfer of some of the contamination into groundwater should be expected. With sufficient saturation there may also be a degree of biodegradation. If this

is the form of MNA the PLPs are referring to, the statement is reasonable. But Ecology does not anticipate loss mechanisms in soils above the water table to be so significant that CVOC or inorganic concentrations currently well above cleanup standards will be attained via "natural attenuation." In our opinion neither the RI nor FS has demonstrated this (NOTE: this comment applies to all nine alternatives).

13. Page 31, section 7.3.1. Ecology notes the following on the bulleted discussions concerning capping and utility-company notifications:

    - Where soil contamination exceeds direct contact-based soil cleanup levels, the Report is correct: cover/capping should be maintained to prevent exposures to that contamination. However, cover/capping on the ABP property will need to serve a second function as well. Until soil contaminant concentrations attain groundwater-protective cleanup levels, or until the PLPs have demonstrated that residual soil contamination poses no threat to groundwater quality, cover/capping must be maintained to minimize transport of contamination from the vadose zone to groundwater.

    - Ecology anticipates the need for site institutional controls that go beyond utility-company notifications. Please see Comment #10 above.

    These comments apply to all nine Alternatives (assuming Alternative 9 is incapable of achieving cleanup levels in all soils on the property), not just Alternative 1.

14. Page 33, section 7.3.1.2. The FS Report states that multiple injections may be needed to increase groundwater pH in the area targeted for neutralization. But an important consideration appears to have been left unmentioned. The Report should have noted the desired and expected timeframes, following injection, for groundwater pH to reach target levels. The PLPs could then have linked their "remedial design concept" proposals and related cost assumptions to the objective of raising the pH to an *X* level, across a *Y* area, and within a *Z* timeframe. This comment applies to Alternatives 2 through 7, as well as Alternative 1.

15. Page 33, section 7.3.1.3. The first bullet in this section refers to vapor intrusion (VI) mitigation needs in SU1. Ecology notes the following:

    - We agree that VI mitigation systems will need to be operated as long as soil gas CVOC concentrations beneath buildings located in the affected SU1 area exceed levels protective of indoor air quality. To provide an indication of whether CVOC soil gas concentrations above contaminated groundwater are as low as these protective levels, VI-based Water Table zone groundwater cleanup levels have been calculated for the site. However, groundwater is not the only source of soil gas contamination in some locations. The ABP building and buildings nearby are also likely to be located above soil gas that has become contaminated due to vadose zone soil contamination, as well as groundwater contamination. For these

buildings, it is not necessarily the case that mitigation can be terminated once VI-based groundwater cleanup levels have been attained.

- The FS Report does not mention the new building located immediately north of the ABP facility (305 S. Lucile St.). The PLPs intend to sample indoor air within the building this coming winter. If VI is not causing unacceptable levels of indoor air contamination within the building (as expected), this may be due to the subsurface vapor barrier that was installed during construction. If so, it is also serving – like the systems installed at 218 and 220 Findlay – as a mitigation measure. Similarly to those two buildings, and the ABP building, then, the SU1 cleanup action should assume that 305 S. Lucile's passive mitigation system will need to perform effectively until soil gas VOC concentrations north of the ABP facility attain levels protective of indoor air quality.

These comments apply to all nine Alternatives.

16. Page 35, section 7.3.2.1. ISCR treatment is proposed along Fidalgo St., west of East Marginal Way S. In the discussion at the top of the page the Report states that direct push injections will target the shallow groundwater zone (20' to 40' bgs). Ecology agrees that these depths should be targeted. We assume that the PLPs have not proposed to also target intermediate zone depths at Fidalgo because CVOC levels at wells 140-70 and 24-50, as well as at 22-50 and 23-50, have been relatively low. But it is also true that:

    - TCE levels measured at MW 26-55, located on the east side of East Marginal Way S., were as high as 1200 µg/l in March of this year. This is more than 1000 times the newly adopted Washington State WQS level; and,

    - TCE and vinyl chloride levels measured at MW 21-50, just north of well MW 26-55, were as high as 20 and 28 µg/l, respectively, in March of this year. The vinyl chloride detection is almost 100 times the new WQS level, and the TCE measurement, while more moderately elevated (with respect to the cleanup standard), continues an apparent trend of increasing concentrations at the well since 2011.

    Even though an upward vertical hydraulic gradient likely exists near the Duwamish Waterway due to the saltwater wedge, we do not know how far the wedge extends inland. So an ISCR treatment line depth of 40 feet along Fidalgo may not capture contamination migrating from the area and depths of wells 26-55 and 21-50. For this reason the target zone at Fidalgo should seemingly extend to about 50 feet bgs.

17. Page 37, sections 7.3.3.1 and 7.3.3.2. EAnB is proposed in Alternative 3 for application in the ABP source area and the downgradient Fidalgo St. treatment "line." The Report states that the injected EAnB amendment would be a combination of colloidal matrix, donor, and microbes capable of degrading the particular COCs of concern. Regenesis' PlumeStop product is referenced as an example.

Ecology agrees with the "combination approach" and we also agree that PlumeStop or a similar liquid activated carbon (LAC) product would likely be very effective if applied within certain areas of SU1. It can be coupled with active in situ bioremediation, for example, with the injected PlumeStop serving as a "sorptive barrier" while upgradient enhancement of biodegradation is carried out. Based on information received from Regenesis, however, PlumeStop is likely to be more cost-effective in areas of groundwater contamination where TCE is the primary COC, not vinyl chloride. The latter is more difficult for carbon to sorb. So, for example, the more upgradient SU1 areas near the ABP facility and areas of water table zone contamination are probably its best fit.

18. Page 40, section 7.3.5.1. The PLPs propose to space the sparging wells 15' apart and screen them from 35-40'. Ecology realizes these are FS-stage proposals and do not represent a fully designed system. But, it is not obvious to us at this point that 15' spacing will necessarily be adequate; nor is it apparent why the screened injection interval should be so narrow. The air introduced will certainly disperse upwards, but why should the injection interval not extend deeper than 40' and/or shallower than 35'?

19. Page 41, section 7.3.6.2 (and Appendix E). The Report states that the estimated cost of Alternative 6 is $8M, about $2.6M more than Alternative 4. The primary difference between the two alternatives is the added line of ISCR treatment (at East Marginal Way S.) proposed by Alternative 6. Table E-6 in Appendix E indicates that this added treatment line will cost approximately $2M, which – when added to the increased contingency cost for Alternative 6 (primarily due to assuming that 30% of the East Marginal Way treatment cost needs to be included within the contingency line item) – accounts for the difference in the two alternatives' estimates.

    Implementing ISCR at East Marginal Way S. is about $1.3M more than implementing it along Fidalgo St. This is because the PLPs have assumed that the East Marginal Way S. line should be 1.5 times as long, with 1.5 times as many injection points, and that enough reagent is needed to treat both the shallow and upper intermediate zones. While it is reasonable to make these assumptions in designing one particular approach to treating contaminated groundwater at and approaching East Marginal Way, Ecology notes the following:

    - extending the East Marginal Way treatment line more than 50' south of well cluster MW-26 is unlikely to be needed for reducing elevated levels of TCE at and upgradient of that location;
    - treating groundwater depths shallower than 40' along East Marginal Way to reduce TCE levels may not be *needed* in SU1 – especially if, as Alternative 6 proposes, the Fidalgo line of treatment is also implemented; and,
    - if, therefore, the East Marginal Way treatment line was shortened to 300' and limited to treating only the 40'-60' depth interval, its cost would likely be about $1.3M less.

An East Marginal Way treatment line shortened to 300' and limited to treating only 40'-60' depths was not evaluated during the FS. The Report should have stated why. It should also have explained (in section 7.3.6.1) that the primary benefit of extending East Marginal Way treatment farther south than cluster MW-26 is to intercept elevated concentrations of vinyl chloride, migrating from areas in the vicinity of well cluster 141. At this cluster vinyl chloride has been detected at levels greater than 100 µg/l at 40-foot (in 2015) and 50-foot (2015 and 2016) depths. Although there is brief mention of the proposed East Marginal Way treatment line in connection with cluster 141 on page 23 (under the modeling and remediation level section of the Report), the vinyl chloride detections at well 141-50 are not included in that discussion and later portions of the document devoted to the FS DCA do not appear to specifically consider the singular benefits of Alternatives 6 and 7 with respect to vinyl chloride reduction.

20. Page 41, section 7.3.7. A minor comment, but the last sentence on the page incorrectly states that ISCR would be applied at Fidalgo St and East Marginal Way "...as in Alternatives 2, 4, and 6,..." Alternatives 2 and 4 do not propose ISCR treatment at East Marginal Way S.

21. Page 41, sections 7.3.7.1 and 7.3.7.2. The total estimated cost of Alternative 7 is very close to that of Alternative 6, even though the former includes an additional line of active treatment in the downgradient area. Costs are similar because the PLPs have assumed that the cost of ISCR at 1st Ave. S. is essentially offset by reductions in East Marginal Way treatment costs, arising from the assumption that amendment injection at the latter location need only be applied twice. This may be a good assumption in terms of the reduced CVOC levels migrating towards East Marginal Way from the 1st Ave. S. treatment line, but it is less clear that two dosing events would be sufficient at East Marginal Way to adequately reduce vinyl chloride levels emanating from the upgradient area between Mead and Fidalgo Streets.

    Please also see our discussion about the East Marginal Way treatment line dimensions and purpose in Comment #19 above.

22. Page 43, section 7.3.8. A minor point of clarification, but although the Report contends that Alternative 8's ISCO proposal "addresses" direct-contact, surface water, and air pathways" by its reduction of COCs in groundwater and saturated soils, Ecology understands that ISCO will not be applied in the vadose zone and will therefore not attain VI- or groundwater-protective soil cleanup levels at depths above the seasonal high water table level.

23. Pages 43 and 44, section 7.3.8. As part of Alternative 8, the Report proposes injection/extraction well pairs. As we noted in Comment #18, Ecology realizes these are FS-stage proposals and do not represent a fully designed system. But based on the proposed distances between injection pairs and extraction pairs, and their screened depths (10' to 25'), it is questionable whether much "recirculation" would actually be realized. In addition, if Alternative 8's pump-and-treat action is for a purpose other than

"recirculation" of injected oxidant (e.g., for plume capture or COC mass removal), it is not apparent that the proposed well locations are optimum.

24. Page 46, section 7.3.9.4. The restoration timeframe prediction for metals (1000 years), should Alternative 9 be implemented, does not appear to account for the beneficial effects of soil excavations and in-situ solidification. Based on the description of Alternative 9 in the Report, we believe that the restoration timeframes for CVOCs and metals could be significantly less than the model's predictions, even if the ISS action and downgradient ISCR target only a sub-set of the "hot-spot" areas.

25. Pages 49 through 65, section 8. In this section devoted to "Evaluation of Remedial Alternatives" the FS Report properly refers to cleanup regulations contained in WAC 173-340-360. However, the section would have been improved by including a sub-section that discussed Ecology's expectations for the development of cleanup action alternatives and the selection of cleanup actions. These expectations are described in WAC 173-340-370.

26. Page 49, section 8.1.2. The FS Report correctly states that a threshold requirement for cleanup actions is that they must "consider public concerns." However, once the FS has been completed, a draft Cleanup Action Plan (CAP) will be issued for public comment – not "the Draft FS report." During the public comment period associated with the draft CAP, the public may also review and comment on the final (i.e., approved) FS Report.

27. Page 49, section 8.1.3. WAC 173-340-360(3)(e)(vii) requires the DCA to factor-in "consideration of public concerns," as the seventh bullet states. As noted in the comment above, once the FS has been completed, a draft CAP will be issued for public comment, and during this comment period the public may also review and provide feedback on the approved FS Report.

    Ecology has attached comments on the SU1 FS Report provided by the Georgetown Community Council (see Attachment 1 to this enclosure). In preparing today's letter we considered these comments, many of which we share.[6]

    If other public comments are received prior to the draft CAP's formal comment period, the concerns expressed in those comments should be considered during the FS as part of the DCA's remedy evaluation process. We should not wait until later, when the public has an opportunity to review the draft CAP, to consider these concerns. By waiting we

[6] The Council's comments regarding the FS Report's inadequate consideration of 1,4-dioxane contamination, and their suggestion to apply Monte Carlo statistical techniques, are based on concerns Ecology shares. But we did not expect the PLPs to discuss 1,4-dioxane remediation more fully in the FS Report, since this contamination is a responsibility of only one of the PLPs, and will be addressed under Stericycle's east-of-4th Order. We do, however, expect the West of 4th site's future EDR to assess the effects of the cleanup action on 1,4-dioxane attenuation/mobility. We also expect future groundwater monitoring in the West of 4th area to continue to include 1,4-dioxane as an analyte. With respect to Monte Carlo techniques: again, although we share the Council's underlying rationale for making this suggestion, Ecology did not expect the PLPs to use these techniques in the FS Report. We did expect sensitivity analyses, and we believe the PLPs' SU1 analysis roughly indicates the effects of assumed "treatment effectiveness" on predicted cleanup timeframes.

ensure that the FS Report's conclusions must be revisited after the CAP's comment period, and that public concerns not recognized during the evaluation of alternatives be incorporated into further revision of the Report.[7]

28. Page 52, section 8.2.2. In the first bullet the Report states that Alternatives 1 and 2 rely on natural attenuation to attain soil CVOC cleanup levels. Footnote 34 says this is likely to take decades. As we note in Comment #12, Ecology does not anticipate natural loss mechanisms in soils above the seasonal high water table to be significant. We assume that those CVOC or inorganic concentrations currently well above cleanup standards will not be attained via "natural attenuation." Only Alternative 9's excavation of vadose zone soils, in our view, has the potential to attain all COC soil cleanup standards.

29. Page 49, section 8.2.2. The summary of monitoring included here should have also mentioned the expectation that the CAP will require other media to be sampled. Air and soil gas sampling is likely to be needed in the future as part of the site's VI program. Sediment and/or sediment porewater sampling should also be assumed.

30. Page 53 and the top of page 54, section 8.3. As we state above, Ecology believes that Alternatives 1 through 8 "meet" cleanup standards by containing (covering/capping) contaminated soils, not by achieving all COC soil cleanup levels.

    In addition, we agree with the PLPs' characterization of FS modeling predictions (in the first paragraph of page 53 and the associated footnote). These predictions are associated with "significant uncertainty" and are only "rough approximations." Given the uncertainty, we would also say that using these predictions to "evaluate alternatives relative to one another" has the potential to credit some alternatives with more or fewer benefits than – in comparison to other alternatives – they would actually deliver.

31. Page 54, section 8.3. In the first paragraph on the page the PLPs state that:
    - there are currently no unacceptable exposures to SU1 contamination,
    - potential future exposures will be reliably treated or controlled by all nine alternatives, and
    - groundwater contamination discharging to the Duwamish Waterway does not represent an unacceptable risk.

    With respect to SU1 groundwater contamination discharging to the Waterway, Ecology does not fully concur with these contentions. First, neither the PLPs nor Ecology knows that currently there are no unacceptable exposures to this contamination as it enters the Waterway. We hope there are not, but the surest indicator we have of the potential for unacceptable exposures is exceedance of the cleanup standards and those surface water ARARs they incorporate. These standards are currently being exceeded, and the FS

[7] If concerns expressed by the public during the CAP's comment period are significantly different than those considered in the approved FS Report, the Report's conclusions must be revisited in any case. The benefit to considering *likely* concerns at the time the FS Report is prepared is that if additional concerns are not raised during the CAP's comment period, there may be no need to revisit the FS Report's evaluation of the WAC 173-340-360(3)(e)(vii) criterion.

Report predicts they will continue to be exceeded for decades – regardless of which of the nine alternatives is selected and implemented.

Second, Ecology would not characterize Alternative 1 as reliably treating or controlling discharging groundwater contamination. The lack of control is evident. And while natural attenuation is expected to treat groundwater contamination, we do not believe it can be a considered a reliable means of ensuring that all CVOC concentrations in discharging groundwater will meet cleanup standards in a timely manner.

32. Page 54, section 8.3. Ecology does not believe that a metals groundwater restoration timeframe of 1000 years is reasonable. Seven of the nine alternatives, according to the FS Report, are capable of practicably achieving restoration more than 700 years faster.

33. Pages 55 through 64, section 8.4. This section presents the PLPs' DCA. Though we agree with many of the conclusions the PLPs have reached about the relative merits, and disadvantages, of the alternatives with respect to each other, Ecology has performed its own, separate DCA. We have therefore limited our comments on section 8.4, and refer the PLPs to the rationale provided for our own DCA, provided in Enclosure B.

34. Page 57, section 8.4.1. Ecology disagrees that Alternative 9 obtains cleanup standards faster than other alternatives. Inorganic groundwater contaminant concentrations would not reach cleanup standards for several hundred years longer than the timeframe predicted for Alternatives 1 through 7.

35. Page 58, section 8.4.2. FS Alternatives 1 through 6 and Alternative 8 rely heavily on future natural attenuation to meet groundwater CVOC cleanup levels site-wide. Alternative 1, the PLPs' preferred alternative, relies the most heavily on this form of treatment – not only to achieve groundwater cleanup levels site-wide but to reduce levels of contamination discharging into the Waterway. Since there is significant uncertainty as to future natural attenuation's ability, by itself, to permanently reduce the toxicity, mobility, and volume of not only TCE but its degradation products, Ecology cannot concur with the PLPs' contention that "all alternatives are considered to have a relatively high permanence…" In our opinion this is viewing the capabilities of several alternatives very optimistically. We believe that those alternatives which incorporate more active downgradient CVOC treatment should be viewed as more likely to irreversibly reduce the toxicity, mobility, and volume of all chlorinated COCs, and should therefore be viewed as significantly more permanent.

    In addition, Ecology rates Alternative 8 lower in terms of permanence than the PLPs have. Although we agree that an alternative proposing to pump some of the source area's groundwater contamination to the surface, and treat these COCs ex situ, may potentially result in greater "permanence," Alternative 8 only incorporates active downgradient CVOC treatment at one location and is associated with a very long (over 1000-year) inorganic COC restoration timeframe. We therefore believe Alternative 8's permanence is unlikely to be significantly greater than Alternative 4's.

36. Pages 58 and 59, section 8.4.3. Ecology agrees with the Report that institutional controls *can* be effective. However, we also agree with WAC 173-340-360(3)(f)(iv)'s description of these controls as commonly having the least degree of long-term effectiveness. This is especially the case when the types of institutional controls the remedy relies upon are either dependent on voluntary compliance by a third party, or cannot be easily enforced. A number of the controls proposed in the Report are of this type.

37. Page 59, section 8.4.3. Ecology agrees with the second bullet that Alternative 1 (especially) relies predominantly on future natural attenuation and controls to achieve groundwater-related RAOs. In our view this reliance is not only associated with a longer restoration timeframe. It is also associated with a higher degree of uncertainty that the remedy will actually be successful.

38. Page 61, section 8.4.3. Although the Report is correct that Alternative 9 is by far the most aggressive alternative evaluated, the fifth bullet on this page should have also noted that it is not an effective remedy in terms of restoring inorganic groundwater contamination to cleanup standards within a reasonable timeframe. Ecology believes this drawback diminishes the degree of certainty that Alternative 9 will be successful. It also decreases its relative reliability. Under this alternative hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels for 1000 years; this implies that institutional controls, inherently less reliable than other forms of cleanup action, will also be needed this long.

39. Pages 61 and 63, sections 8.4.4 and 8.4.5. A minor comment, but Ecology assumes that the references to Alternative 6 in the last paragraph of page 61 and the first bullet of page 63 are typographical errors. The Report presumably meant to refer to Alternative 9.

    We also assume that the reference to Alternative 5 at the top of page 63 should have been to Alternative 8.

40. Page 63, section 8.4.6. On September 28, 2016, Ecology received comments on the SU1 FS Report from the Georgetown Community Council. We have included these comments in Attachment 1. Ecology believes that the concerns expressed by the Council regarding the uncertainty associated with natural attenuation support the ranking of Alternative 1 as the FS alternative least likely to satisfactorily address public concerns.

41. Page 63, section 8.4.7. A minor comment, but Ecology assumes that the reference to <u>four</u> remedial alternatives is a typographical error, and should have been *nine*.

42. Page 66, section 9. This section presents the PLPs' FS conclusions. As we noted in Comment #33, Ecology has performed its own DCA. Based on this analysis we do not concur that Alternative 1 should be the preferred SU1 alternative. A description of Ecology's preferred alternative and our rationale for its selection is provided in Enclosure B.

43. Table 5-1 (and ES-1). At the time the revised FS Report was prepared, the document properly identified the current surface water quality ARARs, which must be considered when selecting Method B surface water cleanup levels and groundwater cleanup levels based on surface water protection. However, the Washington State Water Quality Standards (WAC 173-201A) have been in the process of being revised this year. The significance of this revision to cleanup sites is that the Standards are an ARAR for the establishment of MTCA-site surface water cleanup levels. The West of 4th surface water cleanup levels, and groundwater cleanup levels based on those surface water concentrations, must therefore be at least as stringent as the WAC 173-201A Standards. Some FS PCUL values are currently this low, but others are not.

    In February 2016 Ecology issued a proposed Water Quality Standards rule which included revised Criteria for several West of 4th COCs. The proposed Criteria were adopted on August 1, 2016. For SU1 COCs the Criteria values are:

COC	Criteria	Proposed concentration (µg/l)	Adopted[8] concentration (µg/l)
1,1-DCE	Human Health Fish Consumption	4100 (much higher than the PCUL)	4100
Trans-1,2-DCE	Human Health Fish Consumption	5800 (higher than the PCUL)	5800
PCE	Human Health Fish Consumption	7.1 (lower than the PCUL)	7.1
TCE	Human Health Fish Consumption	0.86 (lower than the PCUL)	0.86
Vinyl chloride	Human Health Fish Consumption	0.26 (lower than the PCUL)	0.26
As			10
Cd	Marine aquatic		9.3
Cu	Marine aquatic		3.1
Ni	Human Health Fish Consumption Marine aquatic		190 8.2
Zn	Human Health Fish Consumption Marine aquatic		2900 81

    EPA has 60 days to approve, or 90 days to disapprove, Washington State's adopted rule language. During preparation of the draft West of 4th CAP the PLPs should therefore monitor the progress of EPA's approval (or disapproval) of the new State Water Quality Standards (WQS) rule. Cleanup levels eventually proposed in the draft CAP will need to be adjusted to be complaint with the new WQC. This means that the cleanup levels for COCs such as TCE and vinyl chloride will need to be adjusted (from PCUL values), and

[8] Effective 9/1/2016

groundwater restoration timeframes associated with the preferred alternative(s) accordingly revised.

44. Table 7-3. Ecology notes the following on this summary of alternatives and RAOs:

- Alternative 9, source area soils: it is unclear why the excavation of soils proposed by Alternative 9 would not also remove inorganic contamination.
- Alternatives 1-8 (and possibly 9 as well), source area soils: it is unclear why the row associated with RAO-1B is blank. Ecology has understood from the Report that, though limited, soil contamination exceeding direct contact cleanup levels is present on the ABP property. If so, maintenance of cover will be required to protect aboveground receptors.[9]
- Alternatives 1-8 (and possibly 9 as well), source area soils: it is unclear why the row associated with RAO-2A is blank and does not mention engineered controls. Soil contamination exceeding cleanup levels protective of groundwater quality is present on the ABP property. If so, maintenance of cover/capping will be required to protect the quality of underlying groundwater.
- Alternatives 1-7, source area soils: it is unclear why the row associated with RAO-2B refers to pH adjustment. It does not appear that any of these alternatives propose to actively alter the pH of vadose zone soil. If "pH neutralization" in this row is only meant to refer to saturated soils, this should have been noted.
- Alternative 8, source area soils: it is unclear why the row associated with RAO-2B refers to pH adjustment. Ecology did not understand from the Alternative 8 description in section 6 that soil pH would be neutralized by this alternative.
- Alternatives 1-8, source area soils: it is unclear why the row associated with RAO-3A refers to groundwater treatment. RAO-3A is a soil objective related to the protection of air quality. If the inclusion of ISCR, EAnB, and ISCO in this row is only meant to refer to the treatment of saturated soils, this should have been noted.
- Alternatives 1-7, source area groundwater: it is unclear why the rows associated with RAO-4A and 4B do not refer to pH adjustment.
- Alternative 9, source area groundwater: it is unclear why the excavation of soils should be included in rows related to meeting groundwater RAOs
- Alternatives 1-9, downgradient CVOC groundwater contamination: it is unclear why a "soils" RAO is included here. If this was meant to refer to (only) saturated soils, there should have been a corresponding note.
- Alternatives 1-9, downgradient CVOC groundwater contamination: it is unclear why the row associated with RAO-5A refers to remediation levels (RLs). Ecology has understood that the RLs are concentrations calculated to be

[9] The row corresponding to soil RAO 3B states that capping is included for alternatives in order to protect direct contact. But RAO-3B is an **air** quality-related objective.

protective of groundwater discharging to the Waterway. RAO-5A is a water table-only objective, intended to protect air quality.

- Alternatives 1-9, downgradient CVOC groundwater contamination: it is unclear why the rows associated with RAO-7A and -7B refer only to RLs, and not cleanup levels as well. The RLs are upgradient groundwater concentrations calculated to be protective of groundwater discharging to the Waterway. It appears that the proposals within the nine alternatives to attain cleanup levels, not RLs, in discharging groundwater are intended to protect sediment quality.
- Alternatives 1-9, downgradient vinyl chloride groundwater contamination: it is unclear why the rows associated with RAO-5A, -5B, and -6 have not been qualified (or left blank). According to Figure 5-3 (and Figure 29 in the Site Conceptual Model tech memo), the only downgradient SU1 area where vinyl chloride exceeds VI-based PCULs in the water table zone is along Fidalgo St., west of East Marginal Way S.

45. Figure 7-4. This figure depicts the area, shaded in yellow, where the PLPs propose to implement ISCR within the SU1 source area (Alternatives 4 through 7). Ecology's Figure 7-4 does not appear to indicate that ISCR will be applied below the ABP property, even in areas where the figure suggests that currently there are no buildings. So PMW-1, for example, where some of the highest concentrations of TCE at the water table have been recently detected (380 µg/l in March 2016), is not within the proposed "Treatment Area." If the PLPs' do not intend to apply ISCR treatment to areas on the ABP property where groundwater CVOC levels are especially elevated, this should have been discussed in section 7.3.4.1. The rationale should have been provided, and the statement on page 38 (in the bullet) proposing application of "ISCR amendment throughout the Source Area" should have been qualified. In addition, should the selected cleanup action include active source area treatment for CVOCs, application of treatment on the ABP property itself will need to be considered during the Design phase.

46. Figures 7-6 and -7. The figures associated with Alternatives 6 and 7 depicts the TCE plumes, but should also have indicated those areas where groundwater vinyl chloride concentrations currently exceed RLs. Please see Comment #19 above.

47. Figure 8-1 is a good figure; thank you for including it. The PLPs are correct: due to the long periods of time associated with attaining groundwater cleanup levels approaching the Waterway, restrictions on harvesting fish and shellfish may be needed for (at least a number of) the alternatives.

    As noted above, Ecology anticipates that institutional controls related to informing and updating the affected public about the nature of site contamination and cleanup progress will be broader (more comprehensive) than simply the utility company notifications described in the figure's right-hand margin.

48. Figure 8-2. Ecology agrees that Alternatives 1 through 8 should incorporate requirements for capping/covering of the ABP property. This will certainly reduce

migration of contaminated soil gas into overlying buildings compared to a scenario where a building on the property is constructed without a slab. The most significant engineered control for the purposes of protecting indoor air quality, however, will likely be a mitigation system designed to depressurize the subsurface relative to interior pressures. It is Ecology's expectation that such a system will be installed following cessation of source area SVE, and continue to operate as long as needed to ensure acceptably low indoor air CVOC concentrations in ABP buildings.

49. Appendix B, July 12, 2015 Anchor memorandum, Figures 6, 8, and 13. A minor comment, but the well symbols are incoherent in the three Eh-pH diagrams. There are no blue squares and pink diamonds, only a few red circles, "Y", and partial blue diamonds. These maps should be corrected or re-generated for the CAP.

50. Appendix B, Attachment B, Figure 1, Subsurface Utilities. This is a good map that shows the main utility lines near the ABP facility and areas immediately downgradient. The figure could be improved, however, to: (1) include areas from west of 1st Ave. S. to the Waterway, and (2) indicate estimated or surveyed depths of the utility lines. Manhole invert depths are helpful information, but the flow directions of the combined sewer main line cannot be determined without ground surface elevations. These additions should be made during preparation of the EDR.

51. Appendix C, Figure C-9. This figure seems to be identical to Figure C-11, which includes active treatment at 2nd Ave S. Since C-9 appears to depict active treatment at 2nd Ave., Ecology assumes it is in error. A C-9 figure showing no treatment at 2nd Ave., but treatment at the three downgradient locations, should be provided.

52. Appendix D, page 2. In the last paragraph the Report states that the source area removal modeling scenario was based on an assumption that "the portion of the source area accessible for removal..." would be "...80 feet long...". The Report should then have also discussed the excavation and ISS proposals associated with Alternative 9. It appears from Figure 7-9 that excavation and ISS under Alternative 9 would extend over a "length" much greater than 80'. This makes it unclear as to what connection, if any, Alternative 9's source area "removal" has with the source area removal modeling scenario discussed in Appendix D.

53. Appendix D, page 3. Ecology believes that assuming the "timescale for pH neutralization is...negligible compared to the simulation time (1000 years)" is a good assumption, but the Report should still have estimated how long it will likely take to reach groundwater-pH targets once the neutralization actions proposed by Alternatives 1 through 7 are initiated.

54. Appendix D, Figure 4. The graphical representation of the nickel plume at time = 0 years is different than the natural attenuation plume representation at the same starting period. This suggests that t = 0 for the pH-neutralization plume depiction follows some prior activity that includes both: a) adjustment of source area groundwater pH to neutral

conditions, and b) reduced groundwater nickel concentrations as a result of that adjustment. The timeframe associated with these pre time = 0 activities should have been estimated and included in notes to the figure.

Figure 4 also appears to indicate that pH neutralization will very quickly (within a year) reduce nickel concentrations to cleanup levels in contaminated groundwater areas downgradient of the ABP property. This is certainly desirable, but does not seem fully consistent with observations at MW-8. Samples collected from this well have had both high nickel concentrations and relatively neutral pH levels for several years.

55. Appendix E monitoring and treatment cost estimates. As Ecology noted in our comments on the draft West of 4th FS Reports, post-CAP groundwater monitoring will be guided by a West of 4th Compliance Monitoring Plan. This Plan will set out monitoring objectives, the wells to be sampled, sampling frequencies, analyte lists per monitoring event, etc. (per WAC 173-340-720(9)). In the FS Reports, then, the PLPs can only make assumptions about future monitoring needs. Ecology understands this and has viewed the cost estimates within this context. Generally speaking, the number of wells that will be sampled in the future and the frequency of that sampling will be guided by Ecology's confidence in the likelihood that COC concentrations currently:
    a) below cleanup levels will continue to stay this low, and
    b) above cleanup levels are decreasing to those levels at acceptable rates (i.e., rates consistent with the cleanup action's expectations).

    This is a general guide. There are likely to be other groundwater monitoring needs that are more related to assessing the performance of particular cleanup action elements.

    With respect to the PLP's estimated active treatment costs, Ecology notes the following:

    - there appears to be a typographical error in the Alternative 3 downgradient EAnB line item associated with "percentage of capital costs below." Total cost for this item should be about $49,600, not $900; and,

    - EAnB-related treatment costs appear to be more than 1.5 times the costs associated with ISCR. There may be good reasons for this difference in costs between the two technologies, but the SU2 FS Report assumes essentially the opposite (ISCR-related treatment costs will be more than 1.5 times the costs associated with EAnB). Ecology noted this difference in assumptions in our comments on the draft FS Reports, and asked for the explanation. It remains inexplicable in the revised documents.[10]

[10] If the difference is explained in either of the SU Reports, we apologize for missing it. In any case, it should be provided in the PLP's first draft of the CAP.

ENCLOSURE A

ATTACHMENT 1

Georgetown Community Council's Comments on the August 2016 revised Site Unit 1 FS Report

Received by Ecology via Email on September 28, 2016

September 2016

Comments from Environment International Ltd. on W4 Group Site Unit 1 Feasibility Study, August 2016:

In general, this document was prepared in accordance with CERCLA and MTCA FS requirements, was prepared to professional standards, and is a quality document. We reviewed the Remedial Action Objectives (RAOs) and Preliminary Cleanup Levels (CULs) and believe they are reasonable, logical, and comply with both CERCLA and MTCA guidance. However, we have several technical questions and concerns we would like to express in the interest of clarity and completeness.

After reviewing the characteristics of the preferred alternative (Alt #1), we are concerned about the likely need for future contingency actions. This proposed remedy would rely heavily on monitored natural attenuation (MNA) for numerous toxic or carcinogenic VOCs (especially TCE and daughter products DCE/vinyl chloride, as well as 1,4-dioxane, PCE, and nickel), and if this natural "recovery" occurs more slowly or different than predicted, several "contingency" measures would need to be implemented, including active treatment along the Duwamish Waterway shoreline and active treatment of VOCs in specific source areas to reduce time required to achieve cleanup levels. We believe it would be prudent to address these potentially hazardous contaminant plumes proactively before they are discharged to the highly stressed, already Superfund-listed receiving waters of the Duwamish Waterway, thus further contributing to contaminant burdens already stressing the Waterway.

It is also noted that Alternative 1 relies on treatment of the source area and MNA, while other alternatives, such as #2 includes in situ treatment of the downgradient TCE plume, #3 through #8 includes features of in situ treatment, and #9 actually includes removal of contaminants from the most contaminated source areas.

We would suggest that the responsible party (RP) team integrate frequent, systematic deep and shallow groundwater monitoring over time to reduce uncertainty and assure, to the extent possible, that MNA is actually occurring as predicted in order to protect vulnerable aquatic and human receptors. In addition, this monitoring will assure that the remedy, especially a relatively

uncertain remedy such as MNA, is performing as expected, and also will confirm whether groundwater quality will be restored within the anticipated time frame. Modeling input parameters are inherently uncertain, especially when they are generic, not measured or field-verified, and tend to oversimplify complex hydrogeologic systems and environmental transport dynamics.

The FS executive summary (ES-2) states that interim remedial action for SU1 includes source control through soil vapor extraction (SVE) and air sparging (AS), which are effective for VOCs, but doesn't appear to include treatment methods that would address the residual nickel contamination from former electroplating operations, which is a major constituent of concern (COC) for this site.

We note that "secondary" COCs 1,4-dioxane and non-plating metals (arsenic, barium, iron), which are redox-sensitive and therefore prone to being mobilized with changes in site geochemical conditions (Section 7.4), are not directly considered in developing the remedial alternatives for SU1, yet their environmental fate and effects profiles are quite different from the main COCs, especially TCE and daughter products, and therefore addressing the main COCs and not these secondary COCs could lead to inadequately addressing potential hazards associated with these other contaminant plumes. For example, the document states that the preferred alternative 1 is unlikely to reduce concentrations of 1,4-dioxane in groundwater, thus implying that addressing primary COCs would implicitly address secondary COCs, which is not obviously the case.

The uncertainty analysis (Section 8.5) is qualitative and while it does specify that fate and transport of contaminants is important, it should be more specific and perhaps a quantitative uncertainty analysis (e.g. Monte Carlo based) should have been done as an important part of the uncertainty analysis. This is a widely accepted statistical tool for identifying important sources of uncertainty. For example, the uncertainty analysis does not address the inherent uncertainty of monitored natural attenuation, which forms the basis for Alternative #1 and which is highly site-specific and varies for each individual constituent. Because of the complex system present at the site, increased monitoring will be critical to assessing the rate of recovery and the need for contingent actions such as subsequent treatments, as noted above. We disagree with the simplifying assumption that "inaccuracies in assumptions often apply to a greater or lesser extent to all alternatives", as the basis for analyzing each separate alternative has fundamental differences, some of which are more easily quantified and verified than others.

After reviewing the Disproportionate Cost Analysis (Section 8.4 and Tables 7-3 and 8-1), used to support conclusions and alternative selection, we made the following observations concerning Alternative #1, the preferred alternative. First, this alternative has the lowest cost of all the alternatives ($2.8M); the highest contingency cost ($1.8M), the lowest overall MTCA benefit score; and was the weakest on the highest weighting criteria (overall protectiveness, permanence, and long term efficiency). It is also noted above that this alternative relies the most on MNA as opposed to active treatment of contaminated areas. This leads to the question of whether this alternative was selected as the preferred alternative based on lowest overall cost as opposed to overall protectiveness or other key characteristics.

ENCLOSURE B

Ecology's Site Unit 1 DCA and Preferred Alternative[11]

A. Cleanup action threshold requirements, WAC 173-340-360(2).

The revised Report states that all nine Site Unit (SU) 1 alternatives meet the WAC 173-340-360(2)(a) threshold requirements, including protection of human health and the environment (-360(2)(a)(i)) and compliance with cleanup standards (-360(2)(a)(ii)). Ecology agrees this is possible, if:

(1) controls are included in each alternative to protect:
   a) indoor receptors from vapor intrusion, and
   b) outdoor construction workers ("trenchers") working below grade in areas of soil, soil gas, and/or shallow groundwater contamination;

(2) contaminated groundwater is not drawn from the aquifer for drinking water or other uses leading to contaminant exposures; and,

(3) the alternatives are either capable of quickly, effectively, and sustainably reducing CVOC levels in groundwater discharging to the Waterway, or include controls to protect harvesters of Duwamish Waterway fish or shellfish contaminated by this groundwater.

Ecology's approach to evaluating the nine alternatives has been to assume – at least initially – that each of them can meet protectiveness- and cleanup standard-related threshold requirements. We have then factored-in the different degrees of protectiveness the alternatives are likely to afford during the Disproportionate Cost Analysis.

B. Selected cleanup actions must use permanent solutions to the maximum extent practicable, WAC 173-340-360(2)(b)(i).

To determine whether a cleanup action uses permanent solutions to the maximum extent practicable under the MTCA regulations, a disproportionate cost analysis (DCA) is used. The analysis compares the costs and benefits of the cleanup action alternatives evaluated in the FS by applying the seven evaluation criteria identified in WAC 173-340-360(3)(f). Costs are deemed disproportionate to benefits if the incremental costs of the alternative over that of a lower cost alternative exceed the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative.

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[11] In this enclosure Ecology has used the term "active" to simply refer to treatment, or remediation, that requires human intervention. So "natural attenuation" is not, in this sense, active. We do not mean to imply that a cleanup action that includes natural attenuation and conforms to expectations set out in WAC 173-340-370(7) should not be considered an *active remedial measure* under the MTCA regulations.

The FS Report utilizes a DCA scoring system that has been used at other Washington State cleanup sites. This is only one way to perform a DCA, however, and WAC 173-340-360 does not refer to this particular technique. Ecology's approach, described in the discussion below, is based on a more qualitative evaluation. As the regulations note, the DCA "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."

1. *Protectiveness*, WAC 173-340-360(3)(f)(i)

Table 8-1 identifies the PLPs' ranking of the nine alternatives with respect to the criterion of protectiveness. Alternative 1 is considered the least protective remedy, and Alternative 9 the most protective. The other seven alternatives vary in protectiveness from those which are only marginally more protective than Alternative 1, such as Alternatives 2, 3 4, and 8, to those only marginally less protective than Alternative 9, such as Alternatives 5, 6, and 7.

As noted above, the nine alternatives *could* be protective, but the degree of their expected protectiveness varies depending on how quickly the protection is afforded and the certainty that protectiveness will be adequately maintained over time. To better evaluate protectiveness within the context of the DCA, it is helpful to look at the primary potential exposure pathways and how each alternative will address them.

Potential exposures to COCs via Direct Contact (with soils and/or groundwater):

Alternatives 1 through 8 appear to address this pathway primarily via controls ("capping" soils, placing a covenant on the Art Brass property, notifying utility companies about the risks associated with contaminated groundwater, etc.). The proposed soil excavation element in Alternative 9 could potentially negate the need for a "cap" to assure direct-contact protection, or at least shrink the needed footprint of any such covering. But few areas/depths contain soil COC concentrations that pose an unacceptable direct contact risk, even should the soils be uncovered. From Ecology's perspective, then, there is little advantage to any of the alternatives in terms of direct-contact protection. Alternative 9's proposed actions directed towards Source Area soil remediation may merit a somewhat higher *benefit* as part of the DCA.

Potential exposures to COCs via inhaling contaminated soil particles (dust):

Ecology sees little advantage between the alternatives with respect to this exposure pathway. There are few areas where soils contain COC concentrations likely to pose an unacceptable dust-inhalation risk, even should the soils be uncovered. Alternative 9's Source Area soil actions, though, may merit a somewhat higher *benefit* as part of the DCA.

Potential exposures to volatile COCs via inhaling contaminated indoor air due to vapor intrusion from soils:

The areal extent of soils posing a potential VI threat is limited to the Art Brass Plating (ABP) property. The FS alternatives appear to address this pathway primarily (with the

exception of Alternative 9) via controls. Controls include a continuation of the West of 4th VI Program;[12] VI mitigation; and, placing an environmental covenant on the ABP property. Controls would remain in place until soil gas CVOC concentrations dropped to levels protective of indoor air quality.

Alternative 9 proposes to excavate contaminated vadose zone soils on the ABP property. Even if some residual contamination remains following this work, CVOC mass in the vadose zone would be significantly reduced and the timeframe for attaining VI-protective soil gas CVOC concentrations could well be shortened. For the soil-to-indoor air VI pathway, therefore, Ecology concludes that Alternative 9 is the most protective (for the purposes of the DCA) remedial option.

Alternatives 3 through 8 propose to treat shallow groundwater contamination in the ABP "source area." This would likely enhance the reduction of CVOCs in those contaminated soils that are only saturated during high-water table portions of the year. For this reason it is probable that these alternatives may achieve soil gas levels protective of indoor air faster that Alternatives 1 and 2. The latter alternatives (1 and 2) should therefore be considered the least protective of the nine – in terms of the soil-to-indoor air exposure pathway.

Potential exposures to contaminated groundwater (and/or, eventually, surface water) due to future migration of vadose zone soil contamination to the water table:

The areal extent of soils posing a potential threat to groundwater quality appears to be limited to the ABP property. As discussed above, Alternative 9 proposes to excavate contaminated vadose zone soils on the ABP property. COC mass in the vadose zone would be significantly reduced, minimizing the potential degree of transport into the saturated zone. For the soil-to-groundwater migration pathway, therefore, Ecology concludes that Alternative 9 is the most protective remedial option.

Alternatives 3 through 8 propose to treat shallow groundwater contamination in the ABP "source area." This would likely enhance the reduction of at least the organic COCs in contaminated soils only saturated during high-water table portions of the year. For this reason it is probable that these alternatives may minimize the potential degree of transport into the saturated zone more than Alternatives 1 and 2, which rely solely on cover/capping. Although all six of these alternatives include cover/capping to minimize COC leaching, it is reasonable to expect the added "source area" remedial elements of Alternatives 3 through 8 to further protect groundwater quality from future vadose zone impacts.

Potential exposures to COCs in soil, soil gas, and/or shallow groundwater by subsurface construction workers ("trenchers"):

Alternatives 1 through 9 address this concern primarily via controls (notifications and other institutional controls). While controls may afford adequate protection, a greater degree of protection results from relying less on them and either reducing the length of time that COC concentrations in soil, soil gas, and shallow groundwater exceed health-

[12] Which must include VI assessment at the new building located just north of the ABP property at 305 S. Lucile St.

based levels or reducing the physical extent of the areas of contamination. For this reason Ecology believes that Alternative 9 should be considered the most protective of subsurface construction workers. After Alternative 9, we would rate the Alternatives in the following descending order (from relatively more to less protective): Alternative 7; Alternatives 5 and 6; Alternatives 3, 4, and 8; Alternative 2; and, Alternative 1.

Potential exposures to volatile COCs via inhaling contaminated indoor air due to vapor intrusion from shallow (Water Table zone) groundwater:

All alternatives appear to address this pathway primarily via a combination of groundwater treatment and controls (continued monitoring and a continuation of the West of 4th VI Program; VI mitigation where needed; and, placing a covenant on the ABP property). Controls would remain in place until groundwater treatment – implemented in the source area – reduced water table CVOC concentrations to levels protective of indoor air quality.

According to the FS Report (Table 8-1), groundwater cleanup levels protective of indoor air will be attained in 20 to 25 years, regardless of which alternative is implemented. The 25-year timeframe is associated with Alternatives 1 and 2, and Ecology agrees that these options should be considered the least protective of vapor intrusion. The FS Report also differentiates between the time to reach VI-based groundwater cleanup levels at the ABP property versus the time to reach these levels between ABP and 2nd Ave. S. Alternatives 1 and 2 are predicted to result in attainment of the cleanup levels at ABP within 15 years; Alternative 9 in less than 5 years; and, apparently, Alternatives 3 through 8 in 10 years.

Indoor receptors can generally be effectively protected from vapor intrusion impacts by the installation and continued operation of mitigation measures. All nine alternatives include such measures, as needed. Based on these timeframe predictions and the types of active treatment being proposed in the ABP source area, however, it is reasonable to rate Alternatives 3 through 9 higher, in terms of protectiveness, that Alternatives 1 and 2.

Potential exposures to Waterway receptors (including humans who consume contaminated fish or shellfish) due to site-caused contamination of surface water and/or sediments:

All of the Report's alternatives address this pathway via a combination of groundwater treatment and controls. Among the "treatment" proposals, there is a greater or lesser degree of reliance on future natural attenuation to reduce groundwater COC levels and achieve surface water-based cleanup levels in groundwater discharging to the Waterway.

For inorganic COCs, Alternatives 1 through 7 propose actions to increase groundwater pH at and near the ABP property. This is predicted to speed attenuation of plating metals and shrink the current nickel, copper, and zinc plumes. According to the FS Report, cleanup levels for these metals will then be met within about 280 years. Alternatives 8 and 9, which do not include actions to neutralize existing acidic groundwater near the ABP property, will not attain plating metal cleanup levels for much longer periods (1000 years for Alternative 9 and longer than 1000 years for Alternative 8). Clearly, the pH

neutralization proposed in Alternatives 1 through 7, then, results in a significantly greater degree of protection with respect to these particular contaminants.

Currently, CVOC concentrations in groundwater discharging to the Waterway exceed surface water-based cleanup levels. For this reason, eight of the nine alternatives propose active treatment of groundwater along Fidalgo Ave. S., about 150 feet east of the river. Only Alternative 1 proposes no active treatment of contaminated groundwater; it relies on future natural attenuation of CVOCs to reduce contaminant levels discharging now and in the future. According to Table C-6 in the Report, the PLPs believe that if Alternative 1 is selected, contaminant concentrations in groundwater discharging to the Waterway will continue to exceed surface water-based cleanup levels for 50 to 55 years. This cannot be considered adequate protection unless there is simply no additional action that can be taken that is both cost-effective and capable of reducing the mass of discharging contamination more quickly.

The PLPs believe that Alternatives 5, 6, 7, and 9 should be capable of significantly reducing the time needed to reach surface water-based groundwater cleanup levels at the river's eastern shoreline. Each of these alternatives employs active treatment in multiple downgradient areas.[13] Nevertheless, the shortest timeframe for meeting PCULs in groundwater approaching the riverbank is predicted by the PLPs to be about 30 years (for Alternative 9). Timeframes for all alternatives are expected to be longer once PCULs for TCE and vinyl chloride are adjusted downwards to be complaint with new Washington State WQS (please see Enclosure A, Comment #43).

In rating the alternatives with respect to Waterway (surface water and sediment) protectiveness, Ecology believes the speed at which CVOC concentrations in discharging groundwater can be sustainably and confidently reduced should be the primary factor. The ultimate goal, of course, is to attain surface water-based cleanup levels in this groundwater. But significant reductions should correspond to lower potential risks, and also lessen the need for controls such as fish/shellfish-harvesting advisories. We therefore conclude that, from most to least protective, the alternatives' degree of protectiveness should be perceived as follows:

- Alternatives 5 and 9
- Alternative 7
- Alternative 6
- Alternatives 3, 4, and 8
- Alternative 2
- Alternative 1

Overall protectiveness of human health and the environment

Consistent with the reasoning and conclusions described above, Ecology rates the FS alternatives in the following descending order (from relatively more to less protective):

- Alternative 9

[13] As well as source area groundwater treatment.

- Alternative 5
- Alternative 7
- Alternative 6
- Alternatives 3, 4, and 8
- Alternative 2
- Alternative 1

Ecology also believes the rationale for concluding that Alternative 1 is sufficiently "protective" (i.e., meets cleanup action threshold requirements for protectiveness) is debatable. As we noted in comments on the draft Report: a) groundwater CVOC concentrations currently exceed their PCULs immediately upgradient of the Waterway; b) RLs are exceeded at several SU1 wells; c) vinyl chloride appears to be increasing over time at two downgradient wells; and, d) no active remediation is proposed near the river to either reduce concentrations or otherwise protect the Waterway.

2. *Permanence*, -360(3)(f)(ii)

The PLPs consider Alternatives 1, 2, and 3 to be the least permanent options among the nine alternatives evaluated. Alternative 9 is deemed the most permanent. The other five alternatives vary in permanence from those only marginally more permanent than Alternatives 1, 2, and 3 – such as Alternatives 4 through 7 – to the alternative only marginally less permanent than Alternative 9, Alternative 8.

Alternative 9 was developed to be the most permanent alternative the PLPs evaluated. Ecology agrees that it may indeed be the most permanent cleanup action, if the in situ solidification action proposed for the source area is effective in significantly and irreversibly reducing groundwater COC levels in the more upgradient area of SU1. Alternatives 3 and 4 both propose ISCR in the Source Area, and primarily differ in the downgradient treatment technology they will employ (ISCR vs enhanced ISB). It is reasonable during the DCA to consider them similarly permanent. Likewise, Alternative 8 only proposes to treat the source area (with ISCO) and downgradient groundwater at Fidalgo. In our opinion, its degree of permanence does not appear to be significantly greater than Alternative 4's.

Alternatives 5 and 6 incorporate source area treatment plus treatment in two areas of downgradient groundwater contamination. It is reasonable to consider them similarly permanent, though one could argue that more CVOC mass would be targeted by the action at East Marginal Way than the sparge curtain at the shoreline. In this sense Alternative 6 may be somewhat more permanent. Alternative 7 targets three areas of downgradient groundwater contamination, in addition to the ABP source area. For this reason we believe it would likely result in the permanent destruction of more CVOC mass and rate a somewhat higher degree of permanence than Alternatives 5 and 6.

We agree with the PLPs that Alternatives 1 and 2 are likely to be the least permanent options evaluated in the FS. Alternative 2's line of ISCR treatment along Fidalgo merits, in our view, a slightly higher permanence rating than Alternative 1.

3. *Cost*, -360(3)f)(iii)

The revised FS Report estimates the costs of the nine alternatives to be (from least to most expensive):

(1) Alternative 1, $2.8M
(2) Alternative 2, $4.6M
(3) Alternative 4, $5.2M
(4) Alternative 3, $6M
(5) Alternative 8, $6.8M
(6) Alternative 5, $7.8M
(7) Alternative 6, $8M
(8) Alternative 7, $8.2M
(9) Alternative 9, $18.1M

4. *Effectiveness over the long term*, -360(3)(f)(iv)

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. Alternatives relying most heavily on institutional controls and monitoring should generally be viewed as relatively less effective over the long term. Alternatives capable of more confidently achieving the most important RAOs should typically be seen as relatively more effective.

According to Table 8-1, the PLPs believe that Alternative 9 would be the most effective remedy over the long term. Alternative 1 is judged to be the least effective. Alternatives 2, 3, and 8 are rated more effective than Alternative 1, but less than Alternatives 4 through 7. Ecology generally agrees with these conclusions.

Groundwater restoration timeframes for all alternatives are expected to be longer than predicted in the revised Report once PCULs for TCE and vinyl chloride are adjusted downwards to be complaint with new Washington State WQS (see Comment #43 in Enclosure A). While the relative speed of restoration is not used directly in WAC 173-340-360(3)(f)(iv) to rate alternatives under "long-term effectiveness," longer timeframes have implications for the reliability of those alternatives that are relatively more dependent on controls.

In addition, even if SU1's more aggressive cleanup actions will only result in smaller areas or fewer zones where groundwater COCs exceed cleanup levels, and may not dramatically shorten the overall restoration timeframe for every area within the site unit, these actions may still be more effective. Quickly reducing COC levels in groundwater approaching and discharging to the Waterway, for example, should be considered one of the primary SU1 cleanup objectives. When we are relatively more confident that this objective will met by an alternative, even if it may not quickly attain cleanup levels for all

COCs, the alternative deserves to be credited as not only more protective but more *effective* (for at least this groundwater-to-surface water pathway).

Based on our perception of what constitutes a "successful" SU1 remedy and the likelihood that the FS alternatives will meet this goal, we therefore rate the alternatives in the following descending order (from relatively more to less effective):

- Alternative 9
- Alternative 5
- Alternative 7
- Alternative 6
- Alternative 4
- Alternatives 3 and 8
- Alternative 2
- Alternative 1

5. *Management of short-term risks*, -360(3)(f)(v)

The PLPs consider Alternative 1 to have the lowest associated risks during construction and implementation. Alternatives 2 through 7 should also be associated with low risks. Alternative 9 is judged to have the highest construction/implementation-related risks, with Alternative 8 a close second.

Ecology generally agrees with these conclusions, though we note that this evaluation factor is not titled "short-term risks." It is titled "*management of* short-term risks" because the emphasis is intended to be on the effectiveness of measures included in each alternative that will be taken to manage such risks. In our opinion the potential risks associated with all nine SU1 alternatives could be effectively managed.

6. *Technical and administrative implementability*, (3)f)(vi)

The PLPs believe that Alternative 1 is the most implementable remedial option, followed by Alternative 2. Alternative 9 is seen as most difficult to implement. Among the other six alternatives, the PLPs expect Alternatives 5, 6, and 7 to be harder to implement than 3, 4, and 8.

Ecology basically agrees. Alternative 9 would be much more difficult to implement than the other alternatives. The excavation and ISS remedial elements could not be implemented, in fact, unless portions of the ABP facility were temporarily or permanently closed. Plus, Alternative 9 proposes to access a large number of private properties throughout downgradient areas of groundwater contamination. Cost-effectively obtaining access to all these properties is likely to be very difficult if not impossible.

Alternatives that propose to *do less* (in terms of active treatment or engineered-control implementation) can be viewed as more easily implementable. Likewise, alternatives that propose to site treatment systems or engineered controls on properties owned by the PLPs are likely to be more easily implementable than alternatives depending on access to

(non-PLP) privately-owned properties. From these perspectives Ecology agrees that Alternative 1 can be seen as the most implementable remedy, followed by: Alternative 2; 3 and 4; and, 8.[14]

Among Alternatives 5, 6, and 7, Ecology is unsure which may be – relatively – the easiest or hardest to implement. Alternative 7 requires access to a third area (1st Ave. S.) for treating groundwater contamination; solely from this perspective it may be more difficult to implement than Alternative 6. Alternative 5 does not require downgradient access from any areas at or east of East Marginal Way S., but must install a sparge curtain in a busy, congested area just east of the riverbank.

7. *Consideration of public concerns*, -360(2)(b)(iii) and (3)(f)(vii)

The FS Report ranks Alternative 5 the highest under this criterion. Alternatives 1 and 9 are ranked lowest.

Based on comments we have received in the past on the West of 4th site, on the Stericycle Georgetown site east of 4th Ave., and on other sites in the same general locale, Ecology believes the public:

- strongly supports restoration of the Waterway's ecological habitat and its availability for fish and shellfish harvesting. For this reason, the PLPs should assume that remedial alternatives more likely to ensure minimal COC discharge to the river will be generally favored by the public;
- will support the use of exposure controls, such as VI mitigation and restrictions on land and/or resource use, but only to the extent that these controls are coupled with active measures to reduce contaminant levels and thereby hasten the ultimate achievement of conditions that no longer require such controls;
- expects shrinkage of the extent of groundwater contamination, as expeditiously as possible, so that properties above the current plume not owned by the PLPs can be freed from the "stigma" of contamination; and,
- will often be reluctant to grant free access to privately-owned property for the purposes of site remediation, monitoring, etc.

On September 28, 2016, Ecology also received comments on the SU1 FS Report from the Georgetown Community Council. These comments have been attached to Enclosure A. They express concerns about the PLPs' preferred alternative's heavy reliance on monitored natural attenuation and the likely need for future contingency actions. Among their recommendations, they state that "it would be prudent to address these potentially hazardous contaminant plumes proactively before they are discharged to the…Duwamish Waterway…".

[14] Due to the dangerous waste status of contaminated groundwater brought to the ground surface, Alternative 8's pump-and-treat recirculation system may pose implementability issues that go beyond those likely to be confronted in Alternatives 1 through 7. Please see Comment #9 in Enclosure A.

Alternative 5 is the only alternative that incorporates an action designed to intercept groundwater contamination just before it discharges into the Waterway. We assume the general public will view this action as likely to ensure minimal COC discharge to the river and thereby best protect the Waterway's eco-systems and on-going restoration. Alternatives 1 and 9, on the other hand, could well be viewed less enthusiastically. The former proposes few new cleanup actions and relies almost completely on future natural attenuation to – eventually – protect the Waterway. The latter, while very ambitious, demands a great deal of disruption to a 25-acre area of the neighborhood. The ranking of the other alternatives (Alternatives 2, 3, 4, and 6 through 8) in the FS Report appears reasonable.

C. Comparison of alternatives to select the cleanup action that uses permanent solutions to the maximum extent practicable

FS alternatives are ranked from most to least permanent, based on the evaluation of the factors discussed in "B" above. The most permanent alternative is the baseline cleanup action alternative against which the other alternatives are compared. As noted above, Ecology agrees that Alternative 9 may be the most permanent cleanup action evaluated in the FS. It is therefore considered the "baseline cleanup action alternative." Ecology believes that the other eight alternatives should be ranked as follows, from greatest to least permanence:

- Alternative 7
- Alternative 6
- Alternative 5
- Alternative 8
- Alternative 4
- Alternative 3
- Alternative 2
- Alternative 1

This is similar to the PLPs' rankings, but Ecology has rated the permanence associated with Alternatives 5 and 6 to be greater than that likely to result from implementation of Alternative 8.

1. Alternative 9 vs Alternative 7

Under the MTCA cleanup regulations, preference is given to permanent solutions to the maximum extent practicable. Alternative 9 would therefore be Ecology's preferred alternative unless we concluded the incremental costs of Alternative 9 over that of a lower cost alternative exceeded the former's incremental degree of benefits.

As discussed above, Alternative 9 may be the most effective of the FS alternatives over the long term. It is also one of the most protective alternatives. The PLPs believe it will result in the fastest attainment of VI-based and surface water-based CVOC cleanup

levels.[15] It would also most directly address soil contamination beneath the ABP property. Because it proposes to implement ISCR at more than a thousand points in downgradient areas of groundwater contamination, it is additionally the alternative least dependent on natural attenuation and modeling predictions of future cleanup progress that embody considerable uncertainty.

Against these "benefits," the drawbacks associated with Alternative 9 include its high cost and considerable implementability challenges. Alternative 9 is estimated to cost over $18 million. This is almost $10 million more than the estimated cost of Alternative 7, the next most permanent alternative. Ecology has ranked Alternative 7 as the third-to-most protective and effective of the nine alternatives. It would also be associated with implementation difficulties, but does not require shutdown of the ABP facility or access to a huge number of dispersed downgradient locations. Alternative 7 is more dependent on controls (e.g., continued cover/capping of soil contamination) and relies more heavily on natural attenuation to achieve VI- and surface water-based CVOC cleanup levels. But its predicted CVOC groundwater restoration timeframes are not significantly different than Alternative 9's. Both are expected to attain VI-based groundwater cleanup levels site-wide within 20 years, and both should achieve surface-based groundwater cleanup levels site-wide in 40 years. Alternative 9 is predicted to meet cleanup levels in groundwater discharging to the Waterway more quickly than Alternative 7, but the PLPs believe the difference is only five years.

Perhaps more importantly, the Report states that Alternative 7 should achieve inorganic groundwater cleanup levels some 700 years faster than Alternative 9. It is possible that Alternative 9's timeframe could be decreased somewhat by adding a pH-neutralization component to its group of actions (implemented prior to the proposed Alternative 9 source area work), but this would increase the alternative's total cost by about $500K and was not evaluated during the FS.

Ecology believes the very large cost difference between Alternative 9 and Alternative 7 does not correspond to a commensurate difference in environmental benefit. We therefore conclude that, while it may be the most permanent alternative, Alternative 9 is disproportionately costly and an impracticable remedy for the site.

2. Alternative 7 vs Alternative 6

After Alternative 7, Alternative 6 is the next most permanent alternative. The estimated costs of Alternatives 7 and 6 are very similar; the former is only $200K more than the latter ($8.2M vs $8M). The primary differences between the two alternatives are that: (1) Alternative 7 includes a 300' ISCR treatment "line" at 1st Ave. S., which is not

[15] Table 8-1 indicates that Alternative 9 and 6 of the other 8 alternatives should attain VI-based groundwater cleanup levels site-wide in 20 years. These levels would be achieved by Alternative 9 at the ABP property, however, more quickly than via any of the other 8 alternatives.

Table 8-1 also states that Alternative 9's estimated timeframes for meeting surface water-based CVOC groundwater cleanup levels at the Waterway, and site-wide, are 30 and 40 years, respectively. No other alternative is expected to meet cleanup levels at the Waterway this quickly. Two other alternatives – Alternatives 6 and 7 – are predicted to also attain site-wide CVOC groundwater cleanup levels within 40 years.

included in Alternative 6, and (2) the 450' ISCR treatment "line" at East Marginal Way S., which both alternatives include, would only be dosed twice under Alternative 7, while Alternative 6 would include a third injection event. The expected results of these differences on groundwater cleanup can be summarized as follows:

a) The time to achieve VI-based groundwater cleanup levels (20 years) and surface water-based cleanup levels (40 years), site-wide, are the same for both alternatives, but Alternative 7 is predicted to meet surface water-based cleanup levels at the Waterway's shoreline five years faster (35 vs 40 years); and,

b) Alternative 7 is apparently (assuming this is what Table C-7 purports to indicate) predicted to meet surface water-based *remediation levels* at East Marginal Way five years faster (35 vs 40 years).

Ecology has ranked Alternative 6 as the fourth-to-most protective and effective of the nine alternatives. It would also be associated with fewer implementation difficulties than Alternative 7, but relies somewhat more heavily on natural attenuation to achieve surface water-based CVOC cleanup levels. Alternative 7's line of treatment at 1st Ave. S. has the advantage of more directly targeting elevated TCE concentrations observed at well cluster 17 (17-40 and 17-60) and elevated vinyl chloride levels at well 19-40. By incorporating an ISCR treatment line at East Marginal Way S. that extends as far south as Fidalgo St., both alternatives potentially serve to actively treat elevated levels of vinyl chloride migrating from areas east of East Marginal Way near the SU1/SU2 "boundary" (e.g., in the vicinity of well CG-141-40/50; please see Comment #19 in Enclosure A). Alternatives 1 through 5, and Alternative 8, do not.

There is very little cost difference between Alternatives 7 and 6. In our view there are also few differences in environmental benefit. Although Alternative 7 may be the more permanent of the two options, implementing ISCR at a third downgradient location poses access/implementation hurdles that would not be associated with Alternative 6. Compared to Alternative 6, Ecology is unsure whether Alternative 7 is disproportionately costly. For the purposes of continuing the DCA, we have assumed that neither alternative has yet been determined to be impracticable.

3. Alternative 5 vs Alternatives 6 and 7

After Alternative 6, Alternative 5 is the next most permanent alternative. The estimated costs of Alternatives 5, 6, and 7 are very similar; the former is only $200K less than Alternative 6 ($7.8M vs $8M) and $400K less than Alternative 7. The primary differences between Alternative 5 and the other two alternatives are:

a) Alternative 7 includes a 300' ISCR treatment "line" at 1st Ave. S., which is not included in Alternative 5 (or Alternative 6);

b) Alternatives 6 and 7 include a 450' ISCR treatment "line" at East Marginal Way S. Alternative 5 does not. The line of treatment at East Marginal Way more directly targets elevated TCE concentrations observed at wells MW25-50, 26-40, and 26-55, and elevated vinyl chloride levels at MW21-50 and 25-75. It may also

actively treat elevated levels of vinyl chloride in areas migrating from the vicinity of well CG-141-40 and -50);

c) All three alternatives include a 300' treatment "line" along the western end of S. Fidalgo St. However, Alternatives 6 and 7 propose ISCR treatment, while Alternative 5 would implement enhanced anaerobic is situ bioremediation;

d) Alternative 5 includes a 300' sparge curtain, located just east of the riverbank. Neither Alternative 6 or 7 include this measure;

e) the time to achieve VI-based groundwater cleanup levels (20 years), site-wide, are the same for all three alternatives. However, Alternative 5 will require 10 more years to achieve surface water-based cleanup levels site-wide (50 vs 40 years);

f) the time to achieve surface water-based cleanup levels at the Duwamish shoreline is five years faster with Alternatives 5 and 7, than with Alternative 6; and,

g) Alternatives 6 and 7 are apparently (assuming this is what Table C-7 purports to indicate) predicted to meet surface water-based *remediation levels* at Fidalgo St. 10 years faster than Alternative 5 (30-35 vs 40-45 years).

Alternative 5 is, in our view, one of the most protective alternatives. We have also rated it the 2nd-to-most effective of the FS alternatives over the long term. It would be difficult to implement for the same access-related reasons Alternatives 6 and 7 would encounter, and it relies more heavily – than either Alternative 6 or 7 – on natural attenuation to achieve surface water-based CVOC cleanup levels east of East Marginal Way S. But compared to all other alternatives evaluated in the SU1 FS, it has the greatest potential to quickly and sustainably reduce TCE and vinyl chloride concentrations and mass discharging to the river. As noted above, this is one of Ecology's highest-priority SU1 remedial action objectives.

There is very little cost difference between Alternatives 5, 6, and 7. Alternatives 6 and 7 may be the more permanent of the three options. And, Alternatives 6 and 7 would be expected to meet groundwater CVOC cleanup levels site-wide faster than Alternative 5. But, Ecology believes Alternative 5 could meet these levels, or at least attain TCE and vinyl chloride concentrations approaching these levels, faster at the point of greatest concern – the shoreline receptor point. For this reason, compared to Alternative 5, we believe Alternatives 6 and 7 are disproportionately costly (i.e., they offer less environmental benefit for their estimated costs).

4. Alternative 8 vs Alternative 5

Ecology considers Alternative 8 to be the next most permanent alternative after Alternative 5. The estimated cost of Alternative 8 is $1M less than Alternative 5. The primary differences between the two alternatives are:

a) Both alternatives include a 300' treatment "line" along the western end of S. Fidalgo St. However, Alternative 8 proposes ISCR treatment, while Alternative 5 would implement enhanced anaerobic is situ bioremediation;

b) Alternative 5 includes a 300' sparge curtain, located just east of the riverbank. Alternative 8 does not;

c) Alternative 5 proposes ISCR treatment in the ABP source area. Alternative 8 would include a combination of ISCO and pump-and-treat to remediate groundwater contamination;

d) Alternative 5 proposes neutralization of groundwater pH in the ABP source area. Alternative 8 does not;

e) the two alternatives are predicted to achieve VI-based and surface water-based groundwater cleanup levels site-wide at about the same time (20 and 50 years, respectively). However, Alternative 5 is expected to attain surface water-based groundwater cleanup levels at the shoreline 15 years faster; and,

f) the PLPs believe that it will take more than 1000 years for Alternative 8 to achieve plating metal groundwater cleanup levels site-wide. The timeframe estimated for Alternative 5 is 280 years.

Ecology rated Alternative 8 less protective than Alternatives 5, 6, 7, and 9. We also believe it will likely be less effective than these alternatives (as well as Alternative 4). It may be more easily implemented than Alternatives 5, 6, 7, and 9, but the PLPs have concluded it has more potential short-term risk associated with its construction and implementation than every alternative save Alternative 9.

There is a significant cost difference between Alternatives 5 and 8. But there are also significant benefits expected from the former, compared to the latter. These include, as noted above, better and more confident protection of surface water and sediments, and a faster inorganic groundwater restoration timeframe. For this reason, compared to Alternative 5, we believe Alternative 8 is disproportionately costly (offers less environmental benefit for its estimated cost).

5. Alternatives 3 and 4 vs Alternative 5

Alternatives 3 and 4 are similar, and Ecology considers them to be the next most permanent alternatives after Alternative 8. Their primary difference is the type of groundwater treatment technology they would employ in the source area and downgradient (at Fidalgo St.). Although the respective treatment technologies – enhanced anaerobic bioremediation and ISCR, respectively – differ in cost and, potentially, in remedial efficacy as well as application consequences, the FS Report's modeling assumed they would have similar effects on CVOC concentrations and it seems reasonable to consider them at the same time as options to Alternative 5.

The estimated cost of Alternative 3 is $6M. Alternative 4 is estimated to cost $5.2M. The PLPs therefore believe that ISCR will be a cheaper technology to apply in SU1 than enhanced in situ bioremediation. Alternative 5 is more costly than both Alternatives 3 and 4: its estimated cost is $1.8M more than Alternative 3 and $2.6M more than Alternative 4.

The primary differences between Alternative 3 and 4, and Alternative 5, are:

a) both alternatives include a 300' treatment "line" along the western end of S. Fidalgo St. However, Alternative 4 proposes ISCR treatment, while Alternatives 5 and 3 would implement enhanced anaerobic is situ bioremediation;

b) Alternative 5 includes a 300' sparge curtain, located just east of the riverbank. Alternatives 3 and 4 do not; and,

c) the three alternatives are predicted to achieve VI-based and surface water-based groundwater cleanup levels site-wide at about the same time (20 and 50 years, respectively). However, Alternative 5 should attain surface water-based groundwater cleanup levels at the shoreline 15 years faster.

Ecology rated Alternatives 3 and 4 less protective than Alternatives 5, 6, 7, and 9. We also believe they are likely be less effective than these alternatives. Since Alternatives 3 and 4 do not incorporate an action located right at the shoreline, such as Alternative 5's sparge curtain, they should both pose fewer access challenges and, and hence, be potentially easier to implement.

The question for the DCA, then, is basically this: is the benefit of treating contaminated groundwater at the shoreline commensurate with an added cost of $1.8M to $2.6M? To answer this question Ecology considered the following. First, if Alternative 5 employed ISCR instead of enhanced in situ bioremediation at Fidalgo St., the cost differential between it and Alternative 4 is somewhat smaller. While Ecology understands why the PLPs chose to propose enhanced in situ bioremediation for Alternative 5, we have not concluded that ISCR could not be safely applied at this location.

Second, the estimated cost of Alternative 5's air sparging action may be reasonable, but 88% of that cost is due to O&M and an assumption that the system would need to operate for 35 years. While Ecology understands why this 35-year operation-period assumption was made, it seems likely to us that the system would not need to be operated continuously for this long.

Third, the cost differential between Alternative 5 and Alternatives 3 and 4 is $1.8M to $2.6M, as noted above. While it is true that much of this difference is due to the estimated cost of constructing and operating the sparge curtain (over $1.7M), the higher Alternative 5 cost is also due to more costly professional services and "contingency" assumptions. These amount to an additional Alternative 5 cost of almost $700K (i.e., some $700K of the alternative's total cost would not be included were the sparge curtain not an element of the action). While the added professional service estimate seems reasonable to us, we believe the sparging-related "contingency" estimate of over $500K is unlikely to be realized as an expenditure.

Fourth, the FS Report predicts that groundwater cleanup levels will not be met at the Duwamish shoreline for 35 years, despite implementation of Alternative 5's Fidalgo St. treatment "line" and operation of the sparge curtain. That is, the combination of these two cleanup actions will not be able to decrease discharging groundwater CVOC concentrations to levels as low as the PCULs soon after the actions are implemented or

within 34 years of continued applications of bio-enhancement (or ISCR) and downgradient sparging operation. Perhaps this would be the case; surface water cleanup levels are low concentrations. But at the least, Ecology expects that this combination of treatment technologies would have the effect of reducing concentrations substantially and very quickly dropping the elevated levels of cis-1,2-DCE and vinyl chloride in the vicinity of well MW-22-30 to concentrations approaching cleanup levels.

Fifth, as the FS Report suggests, Alternative 5's sparge curtain could be considered a contingency action for either Alternative 3 or 4. That is, it could be identified as a measure that would not be implemented immediately, but could be added to the selected West of 4th cleanup action at a later date should the cleanup action fail to meet shoreline-related groundwater-discharge objectives. Were Ecology to require it, financial assurance monies could also be set aside to implement the curtain at that later time. This, of course, would increase the true costs of Alternatives 3 and 4, since funds would need to be set aside for a number of years (even if not ultimately drawn upon), but the costs might still be less than those estimated for Alternative 5.

This contingency action proposal, from our perspective, would be an attractive option to Alternative 5 if: (1) discharging groundwater did not already significantly exceed cleanup levels, or (2) the line of treatment proposed for Fidalgo St. was expected to immediately reduce and maintain CVOC concentrations to levels below or close to the cleanup levels. Since condition (1) is not the case, and since the FS Report does not believe condition (2) is achievable, Ecology is not amenable to delaying operation of the sparging measure.

Ecology concludes that the benefit of treating contaminated groundwater at the shoreline is commensurate with the costs this would entail over those estimated for Alternatives 3 and 4. In our view the latter two alternatives do not incorporate permanent solutions to the maximum extent practicable.

6. Alternative 2 vs Alternative 5

Ecology considers Alternative 2 to be the next most permanent alternative after Alternatives 3 and 4. The estimated cost of Alternative 2 is $4.6M, $3.2M less than the PLPs' estimate for Alternative 5. The primary differences between the two alternatives are:

a) both alternatives include a 300' treatment "line" along the western end of S. Fidalgo St. However, Alternative 2 proposes ISCR treatment, while Alternative 5 would implement enhanced anaerobic is situ bioremediation;
b) Alternative 5 includes a 300' sparge curtain, located just east of the riverbank. Alternative 2 does not;
c) Alternative 5 proposes ISCR treatment in the ABP source area. Alternative 2 does not propose active treatment (for organic contamination) in the source area;

d) Alternative 2 is predicted to achieve VI-based groundwater cleanup levels site-wide within 25 years. Alternative 5 is expected to reach these levels five years faster; and,

e) both alternatives are expected to attain surface water-based groundwater cleanup levels site-wide at about the same time (50 years). However, Alternative 5 could attain these levels at the shoreline 15 years faster.

Ecology rated Alternative 2 less protective than every alternative but Alternative 1. We also believe it will likely be less effective than these alternatives. It may be more easily implemented than Alternatives 5, 6, 7, and 9, and perhaps Alternatives 3 and 4 as well.

As noted above:

- if Alternative 5 employed ISCR instead of enhanced in situ bioremediation at Fidalgo St., the cost differential between it and Alternative 2 would be somewhat smaller. It is possible that ISCR can be safely applied at this location;
- 88% of the estimated cost of Alternative 5's air sparging that cost is due to O&M and an assumption that the system would need to operate for 35 years. The system is unlikely to be operated continuously for this long;
- Ecology expects that Alternative 5's combination of treatment technologies near the Waterway would have the effect of reducing concentrations substantially and very quickly dropping the elevated levels of CVOCs; and,
- if a sparge curtain were considered a contingency action for Alternative 2, financial assurance monies would need to be set aside to implement it at a later date. This would increase the *true* costs of Alternatives 2. More importantly, discharging groundwater already significantly exceeds surface water-based cleanup levels. The "trigger" for implementing such a contingency measure has, in our view, been reached.

Ecology concludes that the benefits of treating contaminated groundwater at the shoreline are commensurate with the cost differential between Alternative 5 and Alternative 2, and we do not believe that the latter alternative incorporates permanent solutions to the maximum extent practicable. We are willing, however, to consider whether the benefit of implementing active CVOC remediation in the ABP source area is worth the costs of such an action (approximately $350K). As the FS Report correctly states, actively reducing CVOC concentrations at the water table in the source area has the benefit of hastening the attainment of VI-based groundwater cleanup levels and, at least at buildings downgradient of the ABP property, retiring mitigation systems at an earlier date. Plus, such an action should also reduce the restoration timeframe for at least certain areas of groundwater contamination. However,

a) according to the Report, a source area action will only reduce the time needed to achieve VI-based groundwater cleanup levels by 5 years (i.e., 20 vs 25 years);

b) the PLPs have already taken an action in this area (air sparging) that has significantly reduced groundwater TCE levels; and,

c) cessation of interim action sparging and implementation of the pH neutralization action should result in the return of water table geochemical conditions more conducive to CVOC natural attenuation.

Unless the PLPs believe it will significantly improve metals attenuation or plume shrinkage (as well as reducing CVOC levels), Ecology is willing to entertain modification of Alternative 5, relegating source area ISCR treatment to a contingency action. That is, source area ISCR would only be implemented if, following pH neutralization, CVOC concentration reductions at wells MW-7, 8, 9, 13, and 15 did not decrease at their expected rates).

7. Alternative 1 vs Alternative 5

Both Ecology and the PLPs consider Alternative 1 to be the least permanent FS alternative. Its estimated cost is $2.8M, $5M less than the PLPs' estimate for Alternative 5. The primary differences between the two alternatives are:

a) Alternative 5 includes a 300' treatment "line" along the western end of S. Fidalgo St. Alternative 1 proposes no active treatment of the downgradient CVOC plume;

b) Alternative 5 includes a 300' sparge curtain, located just east of the riverbank. Alternative 1 does not;

c) Alternative 5 proposes ISCR treatment in the ABP source area. Alternative 1 does not propose active treatment (for organic contamination) in the source area;

d) Alternative 1 is predicted to achieve VI-based groundwater cleanup levels site-wide within 25 years. Alternative 5 is expected to reach these levels five years faster; and,

e) Alternative 1 is expected to attain surface water-based groundwater cleanup levels site-wide in 55 years. Alternative 5 should attain these levels five years faster. Alternative 5 would also attain these levels at the shoreline 20 years faster.

Ecology and the PLPs rated Alternative 1 less protective than every alternative evaluated. We also believe it will likely be less effective than these alternatives. It should be the most easily implemented alternative, since it proposes the least amount of active remediation and would require the least amount of access to properties not owned by the PLPs.

As noted above:

- if Alternative 5 employed ISCR instead of enhanced in situ bioremediation at Fidalgo St., the cost differential between it and Alternative 1 would be somewhat smaller. It is possible that ISCR can be safely applied at this location;

- 88% of the estimated cost of Alternative 5's air sparging that cost is due to O&M and an assumption that the system would need to operate for 35 years. The system is unlikely to be operated continuously for this long;
- discharging groundwater currently exceeds surface water-based cleanup levels. Ecology expects that Alternative 5's combination of treatment technologies near the Waterway would have the effect of reducing concentrations substantially and very quickly dropping the elevated levels of CVOCs;
- while a sparge curtain and active Fidalgo St. remediation could both be contingency actions for Alternative 1, financial assurance monies would then need to be set aside to implement these actions at a later date. This would increase the *true* costs of Alternative 1. But more importantly, discharging groundwater CVOC concentrations are currently above surface water-based cleanup levels; the need for active treatment near the Waterway is already apparent; and,
- Ecology is willing to entertain the modification of Alternative 5, relegating source area ISCR treatment to a contingency action. This would reduce the total cost of the alternative by $300,000 or so.

Alternative 1 relies primarily upon the beneficial results of: ABP's source area interim action, now proposed for shutdown; MNA; and, controls. MNA is a component of all nine alternatives, and regardless of which alternative is selected, the SU1-area cleanup efficacy will be dependent on the degree to which future natural attenuation results in reductions of CVOC groundwater concentrations to cleanup levels. As the PLPs acknowledge, however, there is considerable uncertainty in predicting the rates at which CVOCs will naturally biodegrade and anticipating the site conditions under which the degradation of particular chloro-ethenes may stall. Likewise, although all nine alternatives are dependent to some degree on institutional controls, many of these "controls" are difficult and time-consuming to monitor, much less enforce. For these reasons, Ecology is generally less confident that alternatives relying predominantly on MNA and institutional controls will be protective and effective over the long term.

There is a large cost differential between Alternative 1, the PLPs' preferred alternative, and Alternative 5. However, Ecology believes the benefits of treating contaminated groundwater at the shoreline are commensurate with this cost.[16] In our opinion, Alternative 1's only attractive features are its low cost and ease of implementation. It clearly fails to incorporate permanent solutions to the maximum extent practicable. As

[16] It should be recognized that based on the PLPs' "benefit scoring" of Alternative 1 (resulting in a value of 4.8, lowest among the 9 alternatives) and the DCA methodology they chose to use, an alternative that was hypothetically rated a 10 (the highest rating) for each of the six FS evaluation factors, would have a lower "Relative Benefit to Cost Ratio" than Alternative 1 unless it cost less than $5.9M. This suggests that a $6M alternative that would be twice as protective and permanent, and three times as effective and acceptable to the public as Alternative 1, and was – aside from cost – arguably the ideal remedy for the site, should not be considered the cleanup action which uses permanent solutions to the maximum extent practicable. Since Ecology believes there are situations where we would disagree with a conclusion such as this, it indicates to us that the PLP's DCA methodology is better used as a *guide* to – rather than a recipe for – choosing cleanup actions.

we noted in our comments on the draft FS Report, at best Alternative 1 is a remedial option that only marginally meets cleanup action threshold requirements.

D. Cleanup actions must provide for a reasonable restoration time

Cleanup actions must achieve reasonable restoration timeframes (WAC 173-340-360(2)(b) and -360(4). To determine whether a cleanup action provides for a reasonable restoration timeframe, the regulations identify eight factors to consider. They also require that extension of restoration timeframes not be used as a substitute for active remedial measures, when such actions are practicable.

The FS Report contends that groundwater restoration timeframes for the nine alternatives will range from:

- 40 to 55 years, for organic contaminants, and
- 280 to over 1000 years for plating-related metals (e.g., nickel, copper, and zinc)

The PLPs believe these restoration periods are "reasonable," as that term in used WAC 173-340-360(4).

Ecology agrees that it may not be practicable to achieve a shorter CVOC restoration timeframe than 40 years, or a metals restoration timeframe less than 280 years. We also agree that there are natural processes occurring at the site that are capable of reducing the concentrations of hazardous substances of concern. Furthermore, for at least the foreseeable future, site groundwater will not be a source of drinking water. The primary potential risks posed by groundwater contamination are those associated with vapor intrusion, and the eating of fish and shellfish contaminated by groundwater discharges to the Waterway. The vapor intrusion concern is limited to the Water Table zone, and contamination of this zone currently extends no farther downgradient than 2nd Ave. S. The concern regarding surface water/sediment contamination due to groundwater discharges, though it must account for future migration of contaminated groundwater east of the river, from a risk-based perspective is focused solely on the points where site groundwater enters the Waterway. Hence, there are large areas of groundwater contamination in SU1 where – as long as the contamination remains at these locations and depths – poses no potential risks to human health or the environment as long as it is not pumped to the surface.

Ecology is therefore willing to accept a 20-25 year water table CVOC restoration timeframe if the VI assessment and mitigation program remains in place and the affected public concurs. We are also agreeable to a 280-year metals restoration timeframe if the plume shrinkage predictions presented in Appendix D of the FS Report are realized. However, in our opinion a 40-50 year CVOC restoration timeframe for the shallow and intermediate zone contamination in SU1 is only reasonable if the cleanup action includes those active remedial measures that are practicable and able to effectively control groundwater contaminant migration into surface water.[17] As discussed above in Ecology's DCA, this means

[17] The timeframes noted for the three groundwater zones are based on the FS groundwater PCULs, and the expectation that Ecology's preferred alternative attain these levels throughout the SU1 area. When the West of 4th CAP is prepared, however, the PCULs will need to be adjusted downwards to be compliant with new surface water-based ARARs. The PLPs did not estimate how long it would take any of the FS alternatives to achieve these new,

implementing active remedial measures that can quickly control and reduce groundwater migration into the Duwamish Waterway.[18] Measures evaluated during the FS to achieve this objective include a combination of shoreline and Fidalgo St. treatment.

E. Summary of Ecology's preferred alternative

When selecting a preferred alternative, Ecology is obligated by regulation to choose an action that utilizes permanent solutions to the maximum extent practicable. For SU1, we believe this action is Alternative 5. As discussed above, we have also concluded that Alternative 5 is one of the two most protective and effective remedies the PLPs' evaluated. Quickly reducing the concentrations and mass of TCE and vinyl chloride discharging to the river is one of Ecology's highest-priority remedial action objectives for SU1. Alternative 5 is capable of meeting this goal, in our opinion, with more assurance that Alternatives 1 through 4, and 6 through 8. While we would prefer that it be associated with a shorter site-wide groundwater restoration timeframe, Ecology is willing to forego the expensive active treatment of elevated groundwater CVOCs in areas at and east of East Marginal Way S. to reduce the timeframe by 10 years. The longer timeframe is justifiable if : (1) MNA is as effective as predicted in achieving cleanup levels over time in these more upgradient areas, and (2) as site-wide restoration proceeds, we can be better assured that contaminant levels discharging to the Waterway are being reduced to the maximum extent practicable.

As proposed, Alternative 5 would implement EAnB at the Fidalgo St. treatment line. Ecology agrees with this proposal. However, we are also amenable to employing ISCR at this location instead. Unless the application of ISCR is more likely to result in AS-well fouling or has other drawbacks not apparent to Ecology (from our review of the Report), we ask that the PLPs consider which of the two technologies would be most-effectively implemented along Fidalgo St.

In addition, Ecology agrees with the Alternative 5 source area CVOC treatment proposal. But we also believe the benefit of implementing this active CVOC remediation in the ABP source area may not be worth the costs of such an action. According to the Report, this action will only reduce the time needed to achieve VI-based groundwater cleanup levels by 5 years. Unless the PLPs believe the source action will significantly improve metals remediation, or the overall groundwater restoration timeframe, Ecology suggests that source area ISCR treatment be considered an Alternative 5 contingency action.

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lower groundwater cleanup levels. But Ecology assumes that restoration timeframes for TCE and vinyl chloride will be longer for each FS alternative, once the restoration targets are lowered to the new ARAR concentrations.

[18] Consistent with WAC 173-340-370(6) expectations regarding the need to take active measures to prevent/minimize releases to surface water via groundwater discharges in excess of cleanup levels.

ENCLOSURE C

Ecology's Comments on the August 2016 revised Site Unit 2 FS Report[19]

COMMENTS

1. Page 1, section 1.0. Minor comments, but:
   - it would have been more accurate to refer to this document as the **revised** Site Unit 2 (SU2) FS Report. It could then be more easily distinguished from its February 2016 ("draft") predecessor; and,
   - as Ecology noted in our comments on the draft FS Report, it should be clear that the site is "West of 4th" and that this document focuses on Site Unit (SU) 2. When referring to *the site*, then, the Report should be referring to West of 4th, not solely SU2 (as stated in the second paragraph).

2. Page 4, section 1.3.2. The Report states that available data indicate that groundwater discharging to surface water does not exceed screening levels within SU2. The statement is followed by a footnote, but the footnote (5) is blank. Ecology agrees that – with the exception of well CI-17WT – groundwater CVOC concentrations measured at SU2 wells very near the Waterway have been below PCULs. At 17WT, however, vinyl chloride detections in 2014 and 2015 exceeded the PCUL. We therefore disagree with the Report's statement.

3. Page 5, section 1.4. The FS Report utilizes a DCA scoring system that has been used at other Washington State cleanup sites. This is only one way to perform a DCA, however, and WAC 173-340-360 does not refer to this particular technique. Nor does it state that the preferred alternative should be the alternative with the "lowest cost-benefit ratio." Ecology's approach, described in Enclosure D, is based on a more qualitative evaluation. As the regulations note, the DCA "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."

4. Page 5, section 2.0. The first two paragraphs are confusing since they seem to be stating almost the same things (sometimes word-for-word). Ecology agrees that the PCULs were developed in the West of 4th FS to establish concentrations corresponding to acceptable site risk levels and non-carcinogenic threshold values. But the PLPs' additional reference to "interim mitigation measure" plans should have drawn the

[19] In this enclosure Ecology has used the term "active" to simply refer to treatment, or remediation, that requires human intervention. So "natural attenuation" is not, in this sense, active. We do not mean to imply that a cleanup action that includes natural attenuation and conforms to expectations set out in WAC 173-340-370(7) should not be considered an *active remedial measure* under the MTCA regulations.

distinction between *acceptable* site risk levels utilized during interim actions and those required in establishing MTCA-compliant cleanup standards.

5. Page 6, section 2.2. Ecology notes the following regarding RAOs described in the first through third bullets:

   a) the first bullet should have stated that this RAO is a site-wide objective, and is associated with a standard groundwater Point of Compliance (as stated in section 2.5.2);

   b) the second bullet, instead of referring to a Point of Compliance, should have ended the sentence with "...exceeding Method B surface water-based groundwater cleanup levels." And,

   c) the third bullet should have stated that this RAO is also a site-wide objective. The goal is to meet these groundwater PCULs at the water table throughout SU2 (as implied in section 2.5.2), not just "at and downgradient of the BDC and CI facilities."

6. Page 11, section 5.1.2. As noted in the comment above, achieving subsurface COC concentrations protective of indoor air quality is a site-wide objective, and is not limited to "downgradient structures." In addition, subsurface COC sources are not limited to just shallow groundwater. Vadose zone soil contamination can also pose an unacceptable vapor intrusion (VI) threat, if volatile COC levels are high enough to unacceptably contaminate soil gas.

7. Pages 13 and 14, section 5.2.2. Ecology assumes the discussion on page 13 concerning CVOC trends at Plant 2 monitoring wells refers primarily to those wells located at, or immediately downgradient of, Plant 2. Even among just these wells, vinyl chloride measurements in March 2016 (slightly) exceeded PCULs at CI-MW2 and 137WT. So it is unclear why the first sentence of the first full paragraph states that TCE is the only COC that exceeds PCULs.

   In addition, on page 14 and in other sections of the text the Report refers to environmental covenants, proposed for the CI and BDC properties. Ecology agrees with these proposals, but notes that covenants are not only used for the protection of current and future receptors located at the subject properties. Typically they also establish (above and below ground) land use restrictions designed to protect the integrity and continued effectiveness of the cleanup remedy.

8. Page 15, section 5.2.3. Similar to our comment above, Ecology assumes the discussion concerning CVOC trends at Plant 4 monitoring wells refers primarily to those wells located at, or immediately downgradient of, this Plant. Contaminant detections at well CI-MW7, however, do not appear to us to be decreasing over the past several years. TCE and PCE levels measured in March of this year were higher than concentrations detected in 2013-2015.

In addition, while Ecology agrees that RI/FS VI investigations have concluded that indoor air in the building south of Plant 4 is not being unacceptably impacted, the investigations detected elevated soil gas concentrations below that building. The Report should therefore have qualified its statement regarding the "vapor intrusion condition" downgradient of Plant 4 and noted that this conclusion regarding indoor air impacts only pertains to the existing building, its current use, and the degree of indoor ventilation that coincided with the past two air sampling events.

9. Page 16, section 5.2.4. The Report summarizes "Downgradient Groundwater" in one sentence. Because "downgradient" wells are not located close to the three SU2 "source areas" discussed previously, then, the section omits mention of elevated contaminated CVOC detections at wells BDC-6WT, CI-MW5, CI-9WT, CI-10WT, BDC-11-40, BDC-13-40, CI-10-35, CI-14-35, and CI-15-60. It is also silent about the contamination detected at well cluster 141 and direct push point CI-B28; the former is located within SU2 and the latter, apparently, right atop the SU1/SU2 boundary.[20] These areas of contamination should have been acknowledged and discussed.

10. Page 17, section 5.3. There seems to be some confusion on this page regarding how the PLPs would address Plant 4 soil and shallow groundwater contamination under Alternative 2A. At the top of the page, in situ chemical oxidation (ISCO) is proposed. At the bottom of the page the Reports states that soil-related RAOs would be achieved by excavation and off-site disposal. Ecology assumes that Table 2 is correct and that soil excavation is only a remedial element of Alternative 2B, not 2A.

11. Page 18, section 5.3.1. A minor comment, but the first paragraph refers the reader to Figure 3b. This figure depicts Alternative 1 remedial components. Figure 3c relates to Alternative 2 (A and B).

12. Pages 18 and 19, section 5.3.2. As noted above, Figure 3b depicts Alternative 1's remedial components, not Alternative 2's.

    In addition, it is unclear why:

    - Figure 4b appears to indicate a larger number of treatment wells for BDC Line 2 than Figure 3c shows; and,
    - the last three paragraphs of section 5.3.2 are included under the Plant 2 sub-heading. According to earlier parts of the text and Figure 3c, the enhanced in situ bioremediation proposed for Alternative 2A would also be applied north of Plant 2 and in the BDC source area. Seemingly, then, the treatment design and implementation details offered in section 5.3.2 should have also been supplied in section 5.3.1.

[20] The PLPs may believe that the contamination detected at these locations may be better addressed by remedial alternatives evaluated in the SU1 FS. But the contamination itself, its sources, and its expected impact on downgradient groundwater quality, should have been discussed in both Reports.

13. Page 21, section 5.4. The second paragraph states that some areas of soil contamination, at depths no greater than two feet below the Plant 4 slab, would not be excavated as part of Alternative 2B. The PLPs contend that this contamination will "continue to attenuate." Ecology does not anticipate that loss mechanisms in soils above the water table will be so significant that CVOC or inorganic concentrations currently well above cleanup standards will be attained via "natural attenuation." In our opinion neither the RI nor FS has demonstrated this. The PLPs should therefore assume that – short of a demonstration that residual Plant 4 soil contaminant concentrations are below indoor air- and groundwater-protective levels – this contamination will need to be covered/capped.

14. Page 24, section 5.5.3. The Report discusses Alternative 3A and the application of ISCO and ISCR at and near (respectively) Plant 4. In the second paragraph it is stated that RI/FS data collected to date indicate that "the water table interval is not sufficiently anaerobic to complete biodegradation of PCE and TCE to ethene…" The Report contends that this suggests "a deficiency or dormancy of the types of beneficial bacteria."

    Ecology agrees that we should not assume that natural biodegradation will necessarily result in the full reductive de-chlorination of COCs in the Water Table zone. But we also note that shallow groundwater geochemistry in the vicinity of Plant 4 does not appear to be uniquely non-conducive to the natural anaerobic biodegradation of chlorinated ethenes. The concern expressed in this paragraph, then, should also be a concern for other areas of the site with similar Water Table zone geochemical conditions. In SU2 this has implications, in our view, for the efficacy of Alternatives 1 and 4, neither of which propose active shallow groundwater treatment at the water table (even bioaugmentation) in any area except immediately below the Plant 4 building.

15. Page 28, section 5.7.5. The second bullet states that the groundwater restoration timeframe in the Plant 2 source area will be 10 to 40 years under Alternative 4. This is a shorter timeframe than predicted for Alternatives 2A, 2B, 3A, and 3B, all of which propose to actively treat contaminated groundwater immediately north and south of Plant 2. Since Alternative 4 contains no proposal for actively treating groundwater contamination in the vicinity of Plant 2, Ecology cannot concur that it is likely to achieve cleanup levels faster in this area than the four alternatives that do.[21]

16. Page 29, sections 5.8.2 and 5.8.4. There are two SU2 areas where known vadose zone contamination exceeds cleanup standards: below Plant 4 and on the BDC property. Only one of these areas is targeted for active treatment, the Plant 4 area. Residual soil contamination on the BDC property will therefore need to be capped/covered until the PLPs have demonstrated that soil CVOC concentrations are low enough to not pose a potentially unacceptable source of future groundwater contamination. Ecology also assumes that the Plant 4 area of soil contamination will need to be covered/capped until – following the implementation of the selected cleanup action – a similar demonstration has been

[21] Section 5.7.5 ends by stating that Alternative 4 remediation timeframe estimates are the same as those associated with Alternative 1 "for portions similar to Alternative 1." But according to page 13, Plant 2 restoration timeframes for Alternative 1 range from 20 to 85 years, not 10 to 40 years.

successfully made. As noted in Comment #13 above, Ecology does not expect natural CVOC loss mechanisms in the vadose zone to be so significant that concentrations well above cleanup standards will be attained via only these mechanisms.

In addition, the summary of monitoring included in 5.8.4 (and 5.1.1) should have also mentioned the expectation that the CAP will require the sampling of multiple media. In addition to groundwater monitoring, air and soil gas sampling is likely to be needed in the future as part of the site's VI program.

17. Page 30, section 5.9.3. The third and fifth bullets correctly identify two of the regulatory factors to be considered when evaluating the reasonableness of restoration timeframes. However,

    - WAC 173-340-360(4)(b)(iii) and (iv) refer to current or potential future "uses of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site." While the Report may be correct, and "future land uses within SU2" should not be "expected to adversely impact remediation," this is not the consideration the regulations are referring to. In judging whether the proposed site restoration timeframe is reasonable, we should be considering whether, or how, future land uses within SU2 will be affected by the continued presence of contamination. It is this consideration Ecology applied to our evaluation of restoration timeframe in Enclosure D's disproportionate cost analysis (DCA) and selection of a preferred alternative.

    - Ecology would not characterize Alternatives 1 or 4 as effectively controlling the migration of groundwater contamination. At best it seems to us that natural attenuation is probably controlling the three-dimensional boundaries of the plumes and acting to reduce the concentrations of certain COCs within the plumes at particular locations. Better migration control is, in our opinion, associated with Alternatives 2 and 3, and particularly Alternatives 2B and 3B.

18. Page 31, section 5.9.3. As Ecology noted in our comments on the draft Report, a distinction should routinely be made between: a) "incomplete" exposure pathways, and b) "complete" pathways, where risks are acceptable. We do not believe the PLPs have properly made this distinction in the first bulleted paragraph.

    In addition, the last paragraph on this page concludes that all six alternatives "fall within acceptable criteria for a reasonable time frame." In effect, then, the PLPs are contending that:

    - it may not be practicable in SU2 to attain all groundwater CVOC cleanup levels within a restoration timeframe shorter than 90 years,[22] and

[22] According to Section 5 of the Report, Alternative 1's estimated timeframe for attaining all groundwater PCULs in the Intermediate zone (associated with the Plant 2 area) is 40-85 years. The estimated timeframe for attaining all groundwater PCULs in the Water Table zone is 20-90 years for both Alternatives 2 and 3. Alternative 4 may require 20-55 years to achieve all groundwater PCULs in the Shallow zone at and downgradient of Plant 2.

- there is compelling evidence that natural degradation is occurring and will continue to occur at a reasonable rate at the site.

Ecology does not concur that a restoration timeframe as long as 90 years is reasonable, and we believe that shorter restoration timeframes are practicably achievable. Please see our discussion of restoration timeframe in Enclosure D.

The Report, in our opinion, fails to provide two pieces of information (estimates) that would help determine whether the timeframes per alternative should be considered reasonable. First, predicted groundwater restoration periods for Alternatives 2 and 3 are only provided (in the text) for the three source areas. Restoration periods *per groundwater zone* are only included in Section 5.2's description of Alternative 1; they should have been presented for all alternatives.

Second, the Report appears to be silent with respect to the restoration periods for any downgradient areas of contamination. The reader is provided only "source area" estimates; for each alternative the Report should have described what effect implementation would have on downgradient CVOC concentrations over time.

Please also see Comment #32 concerning Appendix A.

19. Pages 32 to 39, section 6, and Table 3. Section 6 presents the PLPs' DCA. Though we agree with many of the conclusions the PLPs have reached about the relative merits, and disadvantages, of the alternatives with respect to each other, Ecology has performed its own, separate DCA. We have therefore limited our comments on section 6, and refer the PLPs to the rationale provided for our DCA in Enclosure D.

20. Page 33, section 6.1. As noted in Enclosure D, "protectiveness" includes consideration of the time required to attain cleanup standards and improvement of the overall environmental quality. Ecology does not, therefore, agree that the six alternatives are "similar in their overall protectiveness…"

    In addition:

    a) the section's second sentence should have referred to SU2, not the West of 4th site (in describing direct contact-based PCULs);

    b) as discussed in Comment #2 above, detections of vinyl chloride in samples collected from well CI-17WT have exceeded the PCUL. This should have been mentioned in the section's second paragraph; and,

    c) as Ecology noted in our comments on the draft SU2 Report, "potentially unacceptable exposures to indoor receptors via inhalation (related to vapor intrusion) can often be reliably controlled in a physical sense. But usually this is only feasible if the affected receptors agree:

        - to allow their buildings to be mitigated,
        - to operate these systems continuously, and

- that it is reasonable to operate these systems for prolonged restoration periods, even though it would be possible to shorten the periods by implementing a more aggressive – if more costly – cleanup action."

In the revised Report these ramifications of the voluntary nature of mitigation do not appear to be acknowledged during the brief discussion of VI mitigation. They must be considered when evaluating remedy protectiveness and effectiveness.

21. Page 34, section 6.1. A minor comment, but Ecology has not concluded that the distance to groundwater from ground surface in SU2 is so great that construction workers (trenchers) could not (directly) contact it. In terms of potential health risks, however, we agree that should contaminated water be contacted for short durations, contaminant concentrations would need to be highly elevated to pose a health-related threat to these workers.

22. Pages 35 and 36, section 6.2. As noted in Enclosure D, "effectiveness over the long term" includes consideration of the degree of certainty that the alternative will be successful, and the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels. Ecology does not, therefore, agree that the six alternatives are "similar in their long-term effectiveness."

    In addition, it is unclear why the Report states that "Alternative 2A/2B includes excavation components in source areas…". Ecology assumes that the PLPs are not referring here to historic excavation of BDC and Plant 2 soils. As we've noted in comments above, Alternative 2A does not appear to propose excavation of Plant 4 soils – only Alternative 2B does.

23. Page 36, section 6.2. As discussed in Enclosure D, the "effectiveness" of the three different approaches to addressing Plant 4 contamination depends on the remedial objective. Excavation can be a very effective action for removing contaminated soils, and could be more effective and comprehensive in removing problematic vadose zone contamination than the other two technologies. If the objective is to also actively treat shallow groundwater near the water table, however, then ISCO and AS/SVE would obviously be more effective overall.

    In addition, while the PLPs are correct that AS/SVE effectiveness can be limited by flow channeling, it is also true that ISCO effectiveness can be compromised by oxidant distribution difficulties.

24. Page 36 and 37, section 6.4. In the discussion of short-term risk management the Report appears to be assuming that both Alternative 2A and 2B will include Plant 4 soil excavation. It is not clear why. Nor is it clear why any potential short-term risks associated with 2B's excavation proposal could not be effectively managed.

    In addition, it is not clear to Ecology why:

    - the second bullet refers to Alternative "2A/2B" when discussing Plant 4 soil excavation. Please see Comments #10 and 22 above; and,

- the PLPs – based on the 3-paragraph discussion – have concluded that Alternative 3B would be significantly more difficult to implement than Alternatives 3A and 2B. Ecology has not.

25. Page 38, section 6.7. WAC 173-340-360(3)(e)(vii) requires the DCA to factor-in "consideration of public concerns." Once the FS has been completed, a draft CAP will be issued for public comment, and during this comment period the public may also review and provide feedback on the approved FS Report.

    If other public comments are received prior to the draft CAP's formal comment period, the concerns expressed in those comments should be considered during the FS as part of the DCA's remedy evaluation process. This is why Ecology's comments on the draft SU2 FS Report identified a number of public concerns and preferences that have been communicated to us during the RI/FS and earlier. We expected that this information would then be used by the PLPs during Report revision. The reason for not waiting until later, when the public has an opportunity to review the draft CAP, to consider their concerns is that by waiting we ensure that the FS Report's conclusions must be revisited after the CAP's comment period. Any public concerns not recognized during the evaluation of alternatives should be incorporated into another revision of the Report.[23]

26. Page 42, section 8. This section presents the PLPs' FS conclusions. As we noted in Comments #3 and 19, Ecology has performed its own DCA. Based on this analysis we do not concur that Alternative 1 should be the preferred SU2 alternative. A description of Ecology's preferred alternative and our rationale for its selection is provided in Enclosure D.

27. Table 1. At the time the revised FS Report was prepared, the document properly identified the current surface water quality ARARs, which must be considered when selecting Method B surface water cleanup levels and groundwater cleanup levels based on surface water protection. However, the Washington State Water Quality Standards (WAC 173-201A) have been in the process of being revised this year. The significance of this revision to cleanup sites is that the Standards are an ARAR for the establishment of MTCA-site surface water cleanup levels. The West of 4th surface water cleanup levels, and groundwater cleanup levels based on those surface water concentrations, must therefore be at least as stringent as the WAC 173-201A Standards. Some FS PCUL values are currently this low, but others are not.

    In February 2016 Ecology issued a proposed Water Quality Standards rule which included revised Criteria for several West of 4th COCs. The proposed Criteria were adopted on August 1, 2016. For SU2 COCs the Criteria values are:

[23] If concerns expressed by the public during the CAP's comment period are significantly different than those considered in the approved FS Report, the Report's conclusions must be revisited in any case. The benefit to considering *likely* concerns at the time the FS Report is prepared is that if additional concerns are not raised during the CAP's comment period, there may be no need to revisit the FS Report's evaluation of the WAC 173-340-360(3)(e)(vii) criterion.

COC	Criteria	Proposed concentration (µg/l)	Adopted[24] concentration (µg/l)
1,1-DCE	Human Health Fish Consumption	4100 (much higher than the PCUL)	4100
Trans-1,2-DCE	Human Health Fish Consumption	5800 (higher than the PCUL)	5800
PCE	Human Health Fish Consumption	7.1 (lower than the PCUL)	7.1
TCE	Human Health Fish Consumption	0.86 (lower than the PCUL)	0.86
Vinyl chloride	Human Health Fish Consumption	0.26 (lower than the PCUL)	0.26

EPA has 60 days to approve, or 90 days to disapprove, Washington State's adopted rule language. During preparation of the draft West of 4th CAP the PLPs should therefore monitor the progress of EPA's approval (or disapproval) of the new State Water Quality Standards (WQS) rule. Cleanup levels eventually proposed in the draft CAP will need to be adjusted to be compliant with the new WQC. This means that the cleanup levels for COCs such as TCE and vinyl chloride will need to be adjusted (from PCUL values), and groundwater restoration timeframes associated with the preferred alternative(s) accordingly revised.

28. Table 4. Negative values are presented in the table that should have been better explained and qualified. These negative restoration times are also presented in Appendix A's text and Table 7 without any corresponding discussion to explain their meaning. Ecology believes that the negative restoration timeframe values are derived from negative SDRs based on best-fit curves to flat or slightly increasing data trends. In addition, the following values appear to be inconsistent with Appendix A tables:

    - Flushing times are calculated and presented in all three Tables, 7a, b, and c. The column heading should include table 7c.
    - SDR-2010+ Data column: for the BD-IN results, 739 years is not in Table 7b. Should this value be 47 instead? Also, 15 years seems to be an error in Table 7b (please see our comment on Table 7b).
    - SDR-2010+ Data column: for the C2-WT results, 24 years appears to be an error. The values from Table 7b should be 69 years.
    - SDR-2011+ Data column: for the C4-SH results, 41 years also appears to be an error. The values from Table 7c should be 71years.

29. Figure 3c. In the right-hand margin it is noted that "[i]njections target WT and SH intervals, except C4, which targets WT interval." However, on the figure at the C4 Line 1 location, "WT, SH" is added in parentheses. Based on the discussion on page 19 of the text, Ecology assumes the "SH" should not have been included in parentheses.

[24] Effective 9/1/2016.

30. Figure 4b. The figure's title purports to show Alternative 2A remedial components. However, in the legend the green area at Plant 4 is described as an area of soil excavation. According to the discussion in (some parts of) the text and Table 2, Alternative 2A does not include Plant 4 soil excavation. Should this figure, then, be instead a depiction of Alternative 2B?

    In addition, perhaps it is a minor comment but the alignment of BDC Line 2 on Figure 4b appears to be farther east than shown on Figure 3c. Which alignment is more representative of what the PLPs are proposing for Alternatives 2A and 2B?

31. Figure 4c. Similar to the question pose above, which BDC Line 2 alignment is more representative of what the PLPs are proposing for Alternatives 3A and 3B? The alignment shown here or on Figure 3d?

32. Appendix A. The PLPs' FS fate and transport analyses focus on three SU2 source areas (BDC, Plant 2, and Plant 4). Modeling predicts restoration timeframes for these three areas, and is used to calculate groundwater remediation levels (RLs) that are specific to each. Even though four of the six alternatives propose active groundwater treatment, targeted in additional areas, there are no calculated RLs for these additional areas. Nor did the PLPs model forward to predict downgradient CVOC concentrations over time, due to migration from groundwater contamination not currently located in the three source areas.

    The PLPs seem to assume that: (1) the COC levels at non-source area locations do not pose a threat to the Waterway, and (2) the overall site-wide groundwater restoration timeframe for SU2 – regardless of the alternative – will be driven by contamination presently located in the three upgradient source areas. Ecology remains unconvinced that these are both conservative assumptions.

    What would have been beneficial during the FS would have been best (and reasonably conservative) estimates of the:

    - time it may take for each SU2 groundwater zone to achieve groundwater cleanup levels site-wide, if we implemented Alternatives 1 or 4 (i.e., under essentially a natural attenuation-only scenario);
    - times it will likely take for each SU2 groundwater zone to achieve groundwater cleanup levels site-wide, if we implemented each of the other 4 alternatives (Alternatives 2A, 2B, 3A, and 3B). Alternatively, the likely reduction in restoration times (number of years or %s) for Alternatives 2A, 2B, 3A, and 3B could have been estimated; and,
    - likely effect on each area of SU2 groundwater contamination, per zone, if we implemented one of the other 4 alternatives (Alternatives 2A, 2B, 3A, and 3B). That is, estimates of what the 3-D picture of SU2-wide groundwater contamination would look like soon after these alternatives implemented, and over time.

In the revised FS Report the estimates referred to in the first bullet were provided, but basically by assuming that groundwater is not contaminated downgradient of the three source areas. No estimates, e.g., attempt to show how long groundwater contamination in areas approaching 1st Ave. S. and farther downgradient will remain above cleanup levels. The quantitative estimates of likely remediation benefit (were Alternatives 2A, 2B, 3A, or 3B implemented) described in the second bullet were not included in the Report at all. Nor were the estimates discussed in the third bullet.

More specific comments related to Appendix A are provided in Comments #33 through 39 below.

33. Appendix A, page 7.[25] All variables in the analytical solution (equation at the top of the page) should have been defined following the equation. It is unclear to Ecology what "Results" represents in the equation. It does not appear to be a variable.

    In addition, natural attenuation timeframes based on the SDR analytical solution are listed in the second set of bullets. The following apparent discrepancies between the text here and Tables 7a, b, c are noted below:

    - BDC source area should be 16 to 31, 86 to -259, and 15 to -222 years;
    - CI Plant 2 source area, WT zone, should be 26 to 69,years; and,
    - CI Plant 4 source area, Shallow zone should be 71years (only the one SDR value of 0.03 was used).

34. Appendix A, Table 3d. It is unclear to Ecology:

    - what the source of the 2011-and-later SDR values for BDC-6-60 was. The five values appear to be the same as those listed for 2010-and-later, and are not consistent with Table 3c SDR values.
    - what the sources of the 2010-and-later and 2011-and-later SDR values for CG-137-WT were. The 10 values are not consistent with Table 3b or 3c SDR values.
    - why the PLPs chose to list only one of the sets of 2006-and-later SDR values for CG-137-40.[26]

35. Appendix A, Table 4b. It is unclear to Ecology where the best-fit SDR value (0.03) for the C4-SH-Decay-1 run comes from (page 8 of 9). Also, on page 2 of 9, the sensitivity run for "seepage velocity x2" is not included; the result of 17 years is presented on Table 6.

36. Appendix A, Table 6. The following items in the table should have been better explained (or corrected):

[25] On page 10 of the Appendix, the first paragraph under the Sensitivity Analysis and Verification section appears to be incomplete. Also, it is unclear whether the bolded text was due to a formatting error.
[26] The value presented appears to be based on 2008 and later data, not 2006 and later data. This is also the best-fit SDR input value for C2-SH source modeling.

- For the BD-WT modeling run, the best-fit SDR is 0.2. But Table 6 indicates that the actual best-fit SDR is 0.24. This is inconsistent with Table 3d (SDR=0.21).
- For the C4-SH modeling run, the best-fit SDR of 0.03 should have been justified.
- For the BD-WT sensitivity modeling result, associated with the restoration time for the SDR best-fit value, the "biodegradation half-life x 2" should be 33 instead of 35 years (based on Table 4a).
- The Analytical Solution BD-IN for vinyl chloride is listed as 13 years. But Table 7a shows 18 years.
- The Analytical Solution C2-SH with SDR=0.05 is listed as 27 years. This is not presented in Table 7a. In addition, Table 7a shows the Analytical Solution C2-SH as 40 years with a SDR=0.09, and 80 years with a SDR=0.045 (close to 0.05). The apparent discrepancy of 27 versus 80 years should have been explained.
- The Analytical Solution C2-IN for vinyl chloride (best fit SDR=0.42) is listed as 8 years. Table 7a, however, indicates 9 years. Also, it is unclear why other analytical solutions for C2-IN VC (SDR=0.05, 0.1, 0.15, and 0.2) are not presented in Table 7a.

37. Appendix A, Table 7b. The analytical solutions for the BDC source area Intermediate zone use a best-fit SDR of 0.15. It is unclear where this value comes from. Table 3d indicates that the best-fit SDR is -0.04.

38. Appendix A, Table 7c. The second set of analytical solutions for the BDC source area Intermediate zone use an SDR equal to BIOCHLOR's maximum allowed value. Ecology is unclear why this set of the results is presented (here, and also in Tables 7a and 7b). While the value used in Tables 7a and 7b (SDR= 0.047) seems to be correct, Table 7c's SDR=0.4 does not.

    In addition, negative values presented in the table appear to be derived from a negative SDR. These values should have been changed to infinity, since concentrations will not decrease, and a note added to explain how the values were calculated. Presenting negative values for future years could be misleading.

39. Appendix A, Figures 2 through 4. These steady-state concentration versus distance curves from the three source areas are helpful. But the relationship between the curves and PCULs (dashed lines) is not clear, especially in downgradient areas near the Waterway. The vertical scale at the lower end should have been expanded or a logarithmic scale used for TCE/vinyl chloride concentrations.

40. Appendix B. The SU2 FS Report assumes that ISCR-related treatment costs will be more than the costs associated with EAB. However, in the SU1 Report the PLPs' assumed that ISCR-related treatment costs would be about 1.5 times the costs associated with EAB. Ecology noted this difference in assumptions in our comments on the draft FS Reports, and asked for the explanation. If the difference was explained in the SU2 Report, we

apologize for missing it. In any case, it should be provided in the PLPs' first draft of the CAP.

41. Tables B1, B2a, B3a, and B3b. Alternatives 1, 2A, 3A, and 3B all propose to implement ISCO in the Plant 4 source area. However, the estimated costs for this action vary. The cost assumed under Alternative 1 is $177K, under Alternatives 2A and 3A is $235K, and under Alternative 3B is $123K. The differences in cost are not large relative to the total costs of the alternatives. But since the expectation, on our part, was that there would not be any difference, the Report should have explained how the Plant 4 ISCO actions incorporated into Alternatives 1 and 3B differ from those in 2A and 3A.

42. Tables B2a and B2b. It is unclear why the Downgradient Line 2 Treatment Area Length notation refers to the water table and shallow zones instead of the shallow and intermediate zones (consistent with Figures 3c and 3d).

    It is also unclear why the PLPs chose the "treatment area length" dimensions presented for:

    - BDC Line 1. On Figure 3c this line looks to be about 100' long (not 70');
    - BDC Line 2. On Figure 4B this line looks to be about 240' long (not 150');
    - Plant 2 Line 1. On Figure 4B this line also looks to be about 240' long (not 180'); and,
    - Downgradient Line 1. On Figure 3C this line also looks to be about 240' long (not 290').

    Which lengths are more representative of what the PLPs are actually proposing for Alternatives 2A and 2B?

    These comments/questions also apply to Tables B3a and B3b.

    In addition, the $110K estimate for Alternative 2B's excavation of Plant 4 soils does not have a corresponding note, explaining whether this cost includes: a) sampling of excavated soils for disposal purposes, or b) sampling in the walls and floor of the excavation "hole" to confirm that target concentrations have been achieved. This was information Ecology requested in our comments on the draft Report, and should have been added to the revised Report.

43. Table B3b. It is unclear why the cost estimate for Alternative 3B assumes 60 years of monitoring, when only 40 years is assumed for Alternatives 2A, 2B, and 3A. The estimated cost under "total well costs" (for monitoring) is also higher for 3B than for 2A, 2B, and 3A, though the reason why is not explained or obvious. Perhaps these are editing errors.

44. The revised SU1 FS Report contained an appendix (F) discussing the beneficial use of site groundwater. A similar (or the same) discussion should have also been added to the revised SU2 Report.

ENCLOSURE D

Ecology's Site Unit 2 DCA and Preferred Alternative[27]

A. Cleanup action threshold requirements, WAC 173-340-360(2).

The revised Report states that all six Site Unit (SU2) alternatives meet the WAC 173-340-360(2)(a) threshold requirements, including protection of human health and the environment (-360(2)(a)(i)) and compliance with cleanup standards (-360(2)(a)(ii)). Ecology agrees this is possible, if:

1. controls are included in each alternative to protect:
   a) indoor receptors from vapor intrusion, and
   b) outdoor construction workers ("trenchers") working below grade in areas of soil and shallow groundwater contamination;
2. contaminated groundwater is not drawn from the aquifer for drinking water or other uses leading to contaminant exposures; and,
3. the alternatives are capable of reducing CVOC mass so effectively that concentrations in future groundwater discharging to the Waterway are below surface water-based cleanup levels.

Ecology's approach to evaluating the six FS alternatives has been to assume – at least initially – that each of them can meet protectiveness- and cleanup standard-related threshold requirements. We have then factored-in the different degrees of protectiveness the alternatives are likely to afford during the Disproportionate Cost Analysis (DCA).

The revised Report's six alternatives do not include alternatives that only propose active groundwater treatment at a subset of the "lines" proposed in Alternatives 2 and 3. That is, Alternatives 2 and 3 propose active groundwater treatment at five to six lines within SU2. Alternatives 1 and 4 only propose active treatment at Plant 4 (soils and shallow groundwater). There are no alternatives that only propose to treat one or two source areas, or only downgradient areas. For this reason, in the evaluation below Ecology has identified a seventh alternative. We refer to it as Alternative 1E. This alternative is essentially Alternative 1, coupled with the Downgradient treatment Line 2 proposed for Alternatives 2B and 3B.

B. Selected cleanup actions must use permanent solutions to the maximum extent practicable, WAC 173-340-360(2)(b)(i).

[27] In this enclosure Ecology has used the term "active" to simply refer to treatment, or remediation, that requires human intervention. So "natural attenuation" is not, in this sense, active. We do not mean to imply that a cleanup action that includes natural attenuation and conforms to expectations set out in WAC 173-340-370(7) should not be considered an *active remedial measure* under the MTCA regulations.

A DCA is used under the MTCA regulations to determine whether a cleanup action uses permanent solutions to the maximum extent practicable. The analysis compares the costs and benefits of the cleanup action alternatives evaluated in the FS by applying the seven evaluation criteria identified in WAC 173-340-360(3)(f). Costs are deemed disproportionate to benefits if the incremental costs of the alternative over that of a lower cost alternative exceed the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative.

The FS Report utilizes a DCA scoring system that has been used at other Washington State cleanup sites. This is only one way to perform a DCA, however, and WAC 173-340-360 does not refer to this particular technique. Ecology's approach, described in the discussion below, is based on a more qualitative evaluation. As the regulations note, the DCA "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."

1. *Protectiveness*, WAC 173-340-360(3)(f)(i)

Table 3 presents the PLPs' rankings of the six FS alternatives with respect to the criterion of protectiveness. Alternatives 1 and 4 are considered the least protective remedies, and Alternative 2A, 2B, 3A, and 3B ranked more protective.

These alternatives *could* be protective, but the degree of their expected protectiveness varies depending on how quickly the protection is afforded and the certainty that protectiveness will be adequately maintained over time. To better evaluate protectiveness within the context of the DCA, it is helpful to look at the primary potential exposure pathways and how each alternative will address them.

Potential exposures to COCs via Direct Contact (with soils and/or groundwater):

Based on sampling results, there do not appear to be any vadose zone areas/depths in SU2 that contain soil COC concentrations posing an unacceptable Direct Contact risk, even should soils be uncovered. In areas of SU2 groundwater contamination all six FS alternatives propose institutional controls (such as notifying utility companies about the risks associated with contaminated groundwater) to provide Direct Contact protection. For contaminated groundwater beneath the Capital Industries (CI) and Blaser Die Casting (BDC) properties, environmental covenants – which could include property restrictions related to contacting groundwater – are also proposed. From Ecology's perspective, then, there is little advantage to any of the alternatives in terms of Direct-Contact protection. This applies equally well to Alternative 1E, the alternative Ecology added to the DCA.

Potential exposures to COCs via inhaling contaminated soil particles (dust):

Ecology sees little advantage between the six FS alternatives, as well as Alternative 1E, with respect to this pathway. In both areas of SU2 soil contamination the alternatives propose to either maintain the existing cover or – as in the case of Alternative 2's Plant 4 proposal – replace it following excavation. Plus, there are few areas where soils currently

contain COC concentrations likely to pose an unacceptable dust-inhalation risk, even should the soils be uncovered. Alternative 2B's soil removal action, which may be more successful in reducing concentrations in the shallowest Plant 4 soils, may merit a somewhat higher *benefit* as part of the DCA.

Potential exposures to volatile COCs via inhaling contaminated indoor air due to vapor intrusion from soils:

According to the December 2014 Site Conceptual Model tech memo and the SU2 2016 RI Data Gap Resolution Report, soils posing a potential VI threat are limited to areas under the BDC property, under Plant 4, and south of Plant 4. The FS alternatives appear to address this pathway primarily via soil treatment in the Plant 4 area (Alternatives 1, 2A, 3A, 3B, and 4), excavation (Alternative 2B; Plant 4 area only), and/or controls. Controls include a continuation of the West of 4th VI Program, with VI mitigation as needed, and placing covenants on the CI and BDC properties. Controls would remain in place until soil gas CVOC concentrations attained levels protective of indoor air quality.

None of the alternatives proposes treatment of residual contamination on the BDC property. Controls would therefore be needed in perpetuity (or until soil gas CVOC concentrations decreased to levels no longer posing a potential VI threat). The Report does not seem to be confident that any of the alternatives will attain VI-based soil PCULs in all Plant 4 areas where COC concentrations are elevated. Nevertheless, if we assume that all six alternatives *could* achieve VI-based soil PCULs in the Plant 4 areas where treatment/excavation was applied, it appears that:

a) Alternative 2B's excavation of Plant 4 soils could attain these levels faster –if the action were implemented soon after the Engineering Design Report (EDR) was finalized;

b) the ISCO employed by Alternatives 1, 2A, 3A, 3B, and 1E could also, at least potentially, attain the PCULs relatively quickly. However, the draft Report does not propose to implement ISCO south of the Plant 4 building. VI-based soil PCULs (for TCE and PCE) have been exceeded in this area;

c) Alternatives 2A, 2B, 3A, and 3B propose to treat shallow groundwater contamination in the BDC and Plant 4 "source areas." This would likely enhance the reduction of CVOCs in those contaminated soils that are only saturated during high-water table portions of the year; and,

d) Alternative 4's SVE, while perhaps taking longer to attain soil PCULs, could be more likely to attain these levels in areas south (and east) of the Plant 4 building.

Ecology sees little significant advantage between the seven alternatives with respect to the soil-to-indoor air VI pathway. However, Alternative 4 may be somewhat more protective due to its proposed treatment of a larger area of soil contamination.

Potential exposures to contaminated groundwater (and/or, eventually, surface water) due to future migration of vadose zone soil contamination to the water table:

The areal extent of soils posing a potential threat to groundwater quality appears to be limited to the BDC property, and at and nearby CI's Plant 4. The alternatives propose to address residual soil contamination on the BDC property via controls (i.e., by maintaining the current "cover" of soils and an environmental covenant). Alternatives 1, 2A, 3A, 3B, and 1E propose to address Plant 4 soil contamination by treating soils via ISCO. Alternative 2B proposes to excavate the soil and dispose of it off-site. Alternative 4 includes an SVE remedial element that will be designed to reduce Plant 4-area soil COC concentrations.

The Report does not seem to be confident that its alternatives will attain groundwater-protective soil PCULs in all Plant 4 areas where COC concentrations are elevated. It appears that continued soil cover, if not actual capping, is proposed by all alternatives to minimize infiltration in this area.

Each of the alternatives would significantly reduce COC mass in the Plant 4-area vadose zone, minimizing the potential degree of transport into the saturated zone. For the soil-to-groundwater migration pathway, therefore, Ecology concludes that they are similarly protective. Alternative 4 may be somewhat more protective due to its proposed treating of a larger area of soil contamination.

Potential exposures to COCs in soil, soil gas, and/or shallow groundwater by subsurface construction workers ("trenchers"):

Alternatives 1 through 4 address this concern primarily via controls (notifications and other institutional controls). While controls may afford adequate protection, a greater degree of protection results from relying less on them and either reducing the length of time that COC concentrations in soil, soil gas, and shallow groundwater exceed health-based levels or reducing the physical extent of the areas of contamination. Since Alternatives 2A, 2B, 3A, and 3B propose to actively treat Water Table zone groundwater in a number of areas (in addition to addressing Plant 4 soil contamination), Ecology believes these four alternatives should be considered the most protective of subsurface construction workers. Alternative 1E does not propose to actively treat Water Table zone contamination in the downgradient area. Alternative 4 proposes to treat a somewhat larger area of Plant 4 soil contamination than other alternatives, and consequently should be considered marginally more protective of subsurface workers than Alternatives 1 and 1E.

Potential exposures to volatile COCs via inhaling contaminated indoor air due to vapor intrusion from shallow (Water Table zone) groundwater:

All alternatives appear to primarily address this pathway via a combination of groundwater treatment and controls (continued monitoring and a continuation of the West of 4th VI Program; VI mitigation where needed; and, placing a covenant on the BDC property). Controls would remain in place until groundwater remediation reduced water table CVOC concentrations to levels protective of indoor air quality.

The difference between the alternatives relates to how much reliance is placed on natural attenuation for the treatment of shallow groundwater COCs. Alternatives 1 and 4's active remedial elements only target contaminated shallow groundwater beneath Plant 4; otherwise, the alternatives rely upon natural attenuation to attain groundwater PCULs in all other parts of SU2. While Alternative 1E additionally proposes active treatment at a downgradient area, the targeted treatment depths are below the Water Table zone. Alternatives 2A, 2B, 3A, and 3B incorporate active in situ remedial elements (ISCR and enhanced ISB) that target groundwater contamination in multiple areas.

According to the FS Report, groundwater cleanup levels protective of indoor air will be attained in 20 to 35 years if Alternative 1 is implemented.[28] A similar timeframe is likely should Alternative 4 be chosen. Somewhat faster timeframes are expected for Alternatives 2A, 2B, 3A, and 3B.[29]

Indoor receptors can often be effectively protected from vapor intrusion impacts by the installation and continued operation of mitigation measures. All six alternatives include such measures, as needed. In our comments on the draft Report Ecology asked the PLPs to identify (by referencing a figure) the SU2 properties and buildings where VI is a concern, and where mitigation measures have already been installed. No such figure appears to be included in the revised Report, but Ecology understands that mitigation systems are currently operating at:

- multiple homes along S. Orcas St., west of 3rd Ave.;
- multiple homes along S. Mead St., west of 2nd Ave.;
- a commercial building at 5815 4th Ave. S.;
- a commercial building at 5900 1st Ave. S.; and,
- the BDC building at 5700 3rd Ave. S.

Based on the expectation that active treatment will speed the attainment of shallow groundwater CVOC levels protective of VI, mitigation systems could potentially be retired sooner and it is reasonable to rate Alternatives 2A, 2B, 3A, and 3B higher, in terms of protectiveness, that Alternatives 1, 1E, and 4.

Potential exposures to Waterway receptors (including humans who consume contaminated fish or shellfish) due to site-caused contamination of surface water and/or sediments:

All of the Report's alternatives address this pathway via a combination of groundwater treatment and controls. Among the "treatment" proposals, there is a greater or lesser

[28] On page 16 (Section 5.2.5) the Report estimates that it will take 16 to 26 years for Alternative 1 to attain "vapor intrusion screening levels." However, on pages 12 through 15 the Report estimates that groundwater PCULs will be achieved in the water table zone in about 23 years at the BDC source area, 20 years at Plant 2, and 35 years at Plant 4.

[29] Alternatives 2B and 3B include an additional line of active groundwater treatment, but the treatment in this area does not target the Water Table zone.

degree of reliance on future natural attenuation to reduce groundwater COC levels and achieve surface water-based cleanup levels in groundwater discharging to the Waterway.

Other than the active treatment of contaminated groundwater beneath Plant 4, the only groundwater treatment proposed by Alternatives 1 and 4 is natural attenuation. Alternatives 2A, 2B, 3A, and 3B incorporate active remedial elements (ISCR and enhanced ISB) targeting groundwater contamination in multiple SU2 areas. Alternative 1E proposes active groundwater treatment in one downgradient area. No alternative proposes to locate active groundwater remediation in areas west of 1st Ave. S.

The FS Report predicts that Alternative 1 may not achieve surface water-based groundwater cleanup levels site-wide for 51-85 years. The *driving* timeframes are the times to reach cleanup levels in the intermediate zone near Plant 2, which is predicted to range from 40 to 85 years, and the periods associated with restoration of the shallow and intermediate zones between BDC and CI. The predicted times to reach cleanup levels corresponding to Alternatives 2A, 2B, 3A, 3B, and 4 are similar to one another: 15-90 years. The Report states that the timeframes for these five alternatives should be "slightly shorter" than those predicted for Alternative 1. All six alternatives are predicted to keep CVOC concentrations in groundwater discharging to the Waterway below cleanup levels.

In rating the alternatives with respect to Waterway (surface water and sediment) protectiveness, Ecology believes the speed at which CVOC concentrations in groundwater approaching the Waterway can be sustainably and confidently reduced should be one of the primary considerations. Alternatives 2A, 2B, 3A, 3B, and 1E would, in our opinion, likely result in: a) more certain protection of the Waterway, and b) greater certainty that surface water-based groundwater PCULs will be attained within a reasonable timeframe, than Alternatives 1 and 4. We therefore conclude that, from most to least protective, the protectiveness of the alternatives should be perceived as follows:

- Alternatives 2B and 3B
- Alternatives 2A, 3A, and 1E
- Alternatives 4 and 1

Overall protectiveness of human health and the environment

Consistent with the reasoning and conclusions described above, Ecology rates the seven alternatives in the following descending order (from relatively more to less protective):

- Alternative 3B
- Alternative 2B
- Alternative 2A, 3A, and 1E
- Alternative 4
- Alternative 1

2. *Permanence*, -360(3)(f)(ii)

The PLPs consider Alternatives 1 and 4 to be the least permanent options among the six alternatives evaluated. Alternatives 2A, 2B, 3A, and 3B are deemed more permanent.

Alternatives 2B and 3B both propose six lines of active groundwater treatment, and primarily differ in the technologies they would employ (EAB and soil excavation [at Plant 4] for Alternative 2B, and ISCR and ISCO [at Plant 4] for Alternative 3B). In the DCA it is reasonable to consider them similarly permanent. Likewise, Alternatives 2A and 3A each propose five lines of active groundwater treatment. Alternative 2A would employ EAB and, at Plant 4, ISCO. Alternative 3A utilizes ISCR except at Plant 4, where ISCO is proposed. These two alternatives are similarly permanent, and both somewhat less so than Alternatives 2B and 3B. Alternatives 1 and 4 only propose to treat soils and the Water Table zone at Plant 4. They differ in how they would perform that treatment (ISCO for Alternative 1 and AS/SVE for Alternative 4). In our opinion, the degree of permanence associated with Alternative 4 does not appear to be significantly greater than Alternative 1's. Both alternatives are likely to be less permanent than the other four. Alternative 1E, because it would actively treatment downgradient groundwater contamination at 1st Ave. S., should be considered more permanent than Alternatives 1 and 4.

3. *Cost*, -360(3)f)(iii)

The revised FS Report estimates the costs of the six alternatives to be (from least to most expensive):

a. Alternative 1, $2.1M
b. Alternative 4, $2.8M
c. Alternative 2A, $5.2M
d. Alternative 3A, $7M
e. Alternative 2B, $8.1M
f. Alternative 3B, $11.1M

Ecology estimates that Alternative 1E will cost from approximately $5.1M (if Alternative 2B's EAB "DG Line 2" were implemented) to $7.1M (if Alternative 3B's ISCR "DG Line 2" were implemented).

4. *Effectiveness over the long term*, -360(3)(f)(iv)

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. Alternatives relying most heavily on institutional controls and monitoring should generally be viewed as relatively less effective over the long term. Alternatives capable of more confidently achieving the most important RAOs should typically be seen as relatively more effective.

The Report's estimated groundwater restoration timeframes are long periods and will require decades of: a) monitoring and plume-tracking, and b) controls and control-oversight/enforcement. Moreover, groundwater restoration timeframes for all

alternatives are expected to be longer than predicted in the revised Report once PCULs for TCE and vinyl chloride are adjusted downwards to be complaint with new Washington State WQS (see Comment #27 in Enclosure C). While the relative speed of restoration is not used directly in WAC 173-340-360(3)(f)(iv) to rate alternatives under "long-term effectiveness," longer timeframes have implications for the reliability of those alternatives that are relatively more dependent on controls. Institutional controls not established in environmental covenants, such as notifications to utility companies, and those related to informing and updating the affected public about the nature of site contamination and cleanup progress, do not legally bind behavior and have the potential to be ineffective (in ensuring adequate protection) over the long term. Engineered controls, such as VI mitigation systems installed on non-PLP properties, can also be ineffective over the long term. Whether mitigation systems, once installed, continue to operate and operate effectively, is not only dependent on continued actions by the PLPs to inspect, monitor, and maintain them. It also depends to a large degree on property owner/tenant decisions we have little control over. Owners/tenants can choose to turn their mitigation fans off. They can refuse access for inspections, monitoring, and repairs.

In addition, as part of the WAC 173-340-360(3)(f)(iv) evaluation, more aggressive cleanup actions may still be deemed more effective, even if they will only result in smaller areas or fewer zones where groundwater COCs exceed cleanup levels, and may not dramatically shorten the overall restoration timeframe for every area within the site. Quickly reducing COC levels in groundwater approaching the Waterway, for example, should be considered one of the primary SU2 cleanup objectives. When we are relatively more confident that this objective will met by an alternative, even if it may not quickly attain cleanup levels for all COCs, the alternative deserves to be credited as not only more protective but more *effective* (for at least this groundwater-to-surface water pathway).

The PLPs believe that Alternative 2B, 3A, and 3B would be the most effective remedies over the long term. Alternatives 4 and 1 would be the least effective. Alternatives 2A and 4 are rated more effective than Alternative 1, but less than Alternatives 2B, 3A, and 3B. Ecology generally agrees with these conclusions; we believe that Alternatives 2B and 3B would likely be the most effective over the long term, followed by Alternatives 3A, 2A, and 1E.

5. *Management of short-term risks*, -360(3)(f)(v)

The PLPs consider Alternative 1 to have the lowest associated risks during construction and implementation. Alternatives 3A and 3B are also associated with low risks. Alternatives 2A, 2B, and 4 are judged to have the highest construction/implementation-related risks.

Ecology generally agrees with these conclusions, though we would group Alternatives 2A and 4 with 3A and 3B (and 1E). That is, we believe these alternatives are similar with respect to their abilities to effectively manage the potential for short-term risks.[30]

6. *Technical and administrative implementability*, (3)f)(vi)

The PLPs believe that Alternative 1 is the most implementable remedial option. Alternative 3B is seen as most difficult to implement. The other four alternatives – 2A, 2B, 3A, and 4 – are expected to be harder to implement than Alternative 1, but easier than 3B.

Based on the information contained in the FS Report, Alternatives 2B and 4 appear to be the most difficult to implement, since they require major disruption of operations at Plant 4. Ecology agrees that Alternative 1 proposes to *do less* (in terms of active treatment or engineered-control implementation) than Alternatives 2A, 3A, 3B, and 1E, and can be viewed as more easily implementable. Among these latter four alternatives, Alternative 3B requires downgradient access from 700' of City Right-of-Way along 1st Ave. S., as well as from five other Right-of-Way locations. This likely justifies an assumption that it could be harder to implement than 2A or 3A. Alternative 1E also requires access to the 1st Ave. S. Right-of-Way, but would require access from fewer total Right-of-Way locations than 2A or 3A, and may therefore be easier to implement than those two alternatives.

7. *Consideration of public concerns*, -360(2)(b)(iii) and (3)(f)(vii)

The FS Report ranks all six alternatives equally high.

Based on comments we have received in the past on the West of 4th site, on the Stericycle Georgetown site east of 4th Ave., and on other sites in the same general locale, Ecology believes the public:

- strongly supports restoration of the Waterway's ecological habitat and its availability for fish and shellfish harvesting. For this reason, the PLPs should assume that remedial alternatives more likely to ensure minimal COC discharge to the river will be generally favored by the public;

- will support the use of exposure controls, such as VI mitigation and restrictions on land and/or resource use, but only to the extent that these controls are coupled with active measures to reduce contaminant levels and thereby hasten the ultimate achievement of conditions that no longer require such controls;

- expects shrinkage of the extent of groundwater contamination, as expeditiously as possible, so that properties above the current plume not owned by the PLPs can be freed from the "stigma" of contamination; and,

[30] The -360(3)(f)(v) evaluation factor is titled "management of short-term risks" because the emphasis is intended to be on the effectiveness of measures included in each alternative that will be taken to manage such risks. In our opinion the potential risks associated with all six SU2 alternatives could be effectively managed.

- will often be reluctant to grant free access to privately-owned property for the purposes of site remediation, monitoring, etc.

Alternatives 2B, 3B, and 1E are the only alternatives that incorporate an action designed to intercept downgradient groundwater contamination before it migrates past 1st Ave. S. and discharges into the Waterway. We assume the general public will view these actions as more likely to ensure minimal COC discharge to the river and thereby best protect the Waterway's eco-systems and on-going restoration. Alternatives 1 and 4, on the other hand, could well be viewed less enthusiastically. Neither propose new cleanup actions other than at Plant 4, and rely primarily on future natural attenuation to – eventually – protect the Waterway. We therefore rank the alternatives as follows: Alternatives 2B, 3B, and 1E; followed by Alternatives 2A and 3A; and lastly, Alternatives 1 and 4.

C. Comparison of alternatives to select the cleanup action that uses permanent solutions to the maximum extent practicable

FS alternatives are ranked from most to least permanent, based on the evaluation of the factors discussed in "B" above. The most permanent alternative is the baseline cleanup action alternative against which the other alternatives are compared. Ecology believes that the alternatives should be ranked as follows, from greatest to least permanence:

- Alternatives 2B and 3B
- Alternatives 2A and 3A
- Alternative 1E
- Alternatives 4 and 1

1. Alternative 3B vs Alternative 2B

Under the MTCA cleanup regulations, preference is given to permanent solutions to the maximum extent practicable. Alternative 3B would therefore be Ecology's preferred alternative unless we concluded the incremental costs of Alternative 3B over that of a lower cost alternative exceeded the former's incremental degree of benefits.

As discussed above, Alternative 3B may be the most protective of the FS alternatives over the long term. It is also one of the two most effective alternatives. Among the FS alternatives, it and Alternative 2B rely the least heavily on future natural attenuation to attain site-wide groundwater cleanup levels and reduce CVOC levels in groundwater migrating towards the Waterway.

Against these "benefits," the drawbacks associated with Alternative 3B include its high cost – over $11 million. This is about $3 million more than the estimated cost of Alternative 2B, the next most permanent alternative. The extra cost is essentially due to the PLPs' assumption that ISCR will be much more expensive to implement than EAB.[31]

[31] As noted in Comment #40 of Enclosure C, this is a different assumption than was made for SU1. In the SU1 Report the PLPs assumed the opposite (ISCR would be cheaper than EAB). The reasons for such a large discrepancy in assumptions are not provided in either Report.

Alternative 2B proposes to employ EAB groundwater treatment in the same areas as Alternative 3B. Instead of treating Plant 4 soils via ISCO, though, it proposes to excavate contaminated soil and dispose of it off-site. Under the protectiveness and effectiveness criteria, Alternative 2B is rated relatively higher than alternatives other than 3B. Due to its proposal to excavate Plant 4 soils, however, which would require that Plant 4 be shutdown, Ecology believes it is likely to be much less implementable than every alternative save – possibly – Alternative 4. In fact, were Alternative 2B chosen as the preferred alternative its Plant 4 proposal would be changed to the ISCO treatment included in Alternatives 1, 2A, 3A, 3B, and Ecology's 1E.

The very large cost difference between Alternative 3B and Alternative 2B does not, in our view, correspond to a commensurate difference in environmental benefit. Ecology therefore concludes that, while it may be the most permanent alternative, Alternative 3B is disproportionately costly and an impracticable remedy for the site.

2. Alternative 2B vs Alternative 3A

After Alternative 2B, Alternative 3A is the next most permanent alternative. The estimated costs of Alternatives 2B and 3A are similar; the former is about $1.1M more than the latter ($8.1M vs $7M). In our opinion, Alternative 3A is not as protective or effective as Alternative 2B, but is more easily implementable. The primary differences between the two alternatives are that:

a) Alternative 3A employs ISCR to actively treat groundwater; 2B proposes EAB.

b) Alternative 2B proposes an EAB treatment "line" at 1st Ave. S. Alternative 3A does not propose to actively treat groundwater this far west.

c) Alternative 3A proposes to treat Plant 4 soils via ISCO; 2B proposes to excavate the soil and dispose of it off-site.

Alternative 2B's primary advantage is its line of active treatment at 1st Ave. S., which can hasten the reduction of groundwater contamination migrating downgradient in the vicinity of well clusters 14 and 15. We believe this advantage offsets Alternative 2B's higher cost. In our view, between the two alternatives, 2B uses permanent solutions to the maximum extent practicable.

3. Alternative 2B vs Alternative 2A

After Alternative 3A, Alternative 2A is the next most permanent alternative. The estimated costs of Alternatives 2A are almost $3M less than those of Alternative 2B. The primary differences between the two alternatives are that:

- Alternative 2B proposes an EAB treatment "line" at 1st Ave. S. Alternative 2A does not propose to actively treat groundwater this far west, and
- Alternative 2B proposes to excavate Plant 4 soils and dispose of them off-site. Alternative 2A proposes to treat Plant 4 soils via ISCO.

In our opinion, Alternative 2A is not as protective or effective as Alternative 2B, but would probably be easier implement (should the Plant 4 soil excavation component remain as part of 2B). Alternative 2B's primary advantage is its line of active treatment at 1st Ave. S., which has significant benefit. We believe this advantage offsets much of Alternative 2B's higher cost. However, the cost differential is too great to justify the added degree of benefit. Between these two alternatives, we conclude that 2A uses permanent solutions to the maximum extent practicable.

4. Alternative 1E vs Alternative 2A

After Alternative 2A, Alternative 1E is the next most permanent alternative. The estimated costs of Alternatives 2A are about $1.9M less than those of Alternative 1E, if the latter's more downgradient line of active treatment utilizes ISCR and extends over 700 feet. The costs of the two alternatives are about the same if Alternative 1E's downgradient active treatment line uses EAB. The primary differences between the two alternatives are that:

- Alternative 1E proposes a treatment "line" at 1st Ave. S. Alternative 2A does not propose to actively treat groundwater this far west, and
- Alternative 2A proposes to actively treat groundwater at a number of source area locations. These include locations immediately south of Plant 4 and an area downgradient of Plant 2 (Downgradient Line 1). Alternative 1E does not.

In our opinion, Alternatives 1E and 2A are similarly effective. Alternative 1E's primary advantage is its line of active treatment at 1st Ave. S., which has significant benefit in terms of surface water protection. Alternative 2A's relative advantages are: a) its potential to reduce Water Table zone CVOC concentrations to VI-protective levels more quickly; b) its potential to achieve site-wide groundwater cleanup levels within a shorter timeframe; and, if ISCR is applied downgradient by Alternative 1E, c) its lower cost.

Alternative 2A's ability to potentially reduce water table zone CVOC concentrations to VI-protective levels more quickly than Alternative 1E is certainly an asset. Based on the location of the 2A treatment lines, however, the biggest benefit would probably be realized at:

- the 202 Mead building, immediately SW of the BDC property,
- the Plant 2 building,
- the building immediately south of Plant 4, and
- two buildings SW of Plant 2.

These are all commercial buildings. Four of them have been the subject of VI assessments, which concluded that indoor air was not being unacceptably impacted. The fifth has been mitigated for a number of years. So more quickly reducing water table CVOC concentrations may only result in a single mitigation system being retired earlier than it would otherwise be.

The potential ability of Alternative 2A to achieve site-wide groundwater cleanup levels faster than Alternative 1E is, as noted above, also to its credit. Faster attainment would

likely occur in areas that are currently contaminated east of 1st Ave. S., more than 900 feet upgradient of the Waterway/Slip 2. So, for example, under Alternative 2A there would likely be faster reduction of CVOC levels near wells BDC-6WT and CI-MW5, and cluster CI-137.

Ecology believes the advantage of greater river protection under Alternative 1E justifies its selection over Alternative 2A if the two alternatives have similar costs. This would be the case if:

a) Alternative 1E's treatment "line" at 1st Ave. S. employed ISCR, but its length was significantly shortened from the 700' proposed under Alternatives 2B and 3B; and/or,
b) Alternative1E's treatment line utilized EAB instead of ISCR.

Both technologies (ISCR and EAB) are potentially capable of meeting the objective of significantly reducing CVOC mass and concentrations at 1st Ave. Either would be acceptable to Ecology if determined to be effective, under SU2 conditions, at minimizing the downgradient generation and migration of vinyl chloride.

5. Alternatives 4 and 1 vs Alternative 1E

After Alternative 1E, Alternatives 4 and 1 are the next most permanent alternatives. Alternative 4 is predicted to cost $2.8M; Alternative 1 is estimated to cost $2.1. If we assume Alternative 1E is likely to cost about $5.1M, this is $2.3 to $3M more than Alternatives 4 and 1, respectively. The primary differences between the three alternatives are that:

- Alternative 1E proposes a treatment "line" at 1st Ave. S. Neither Alternative 1 nor Alternative 4 proposes groundwater treatment, except within the Plant 4 footprint, and
- Alternatives 1 and 1E propose to treat Plant 4 soils and shallow groundwater via ISCO. Alternative 4 proposes AS/SVE at Plant 4.

Ecology believes that Alternative 1E is much more protective and will be more effective over the long term than Alternatives 4 and 1. We also believe it better addresses public concerns. Alternative 4's Plant 4 AS/SVE proposal, while potentially effective, seems to us to be very difficult to implement. If AS/SVE is changed to ISCO, Alternative 4 basically becomes Alternative 1.

Alternatives 1 and 4 primarily rely upon the beneficial results of: BDC's past source area interim action; soil excavation following the Plant 2 fire (years ago); active Plant 4 soil treatment; MNA; and, controls. MNA is a component of all SU2 alternatives, and regardless of which alternative is selected, the efficacy of the cleanup action will depend on the degree to which future natural attenuation results in reductions of CVOC groundwater concentrations to cleanup levels. Among all the SU2 alternatives evaluated in the FS, however, Alternatives 1 and 4 rely the most heavily on MNA to protect the Waterway and achieve groundwater cleanup levels site-wide within a reasonable timeframe. As the PLPs acknowledge, there is considerable uncertainty in predicting the

rates at which CVOCs will naturally biodegrade and anticipating the site conditions under which the degradation of particular chloro-ethenes may stall.[32]

Likewise, although all SU2 alternatives are dependent to some degree on institutional controls, many of these "controls" are difficult and time-consuming to monitor, much less enforce. For these reasons, Ecology is generally less confident that alternatives such as Alternatives 1 and 4, relying predominantly on MNA and institutional controls, will be protective and effective over the long term.

As the FS Report suggests, Alternative 1E's downgradient treatment line could be considered a contingency action for either Alternative 1 or 4. That is, it could be identified as a measure that would not be implemented immediately, but could be added to the selected West of 4th cleanup action at a later date should the cleanup action fail to meet remedial action objectives. Were Ecology to require it, financial assurance monies could also be set aside to implement the curtain at that later time. This, of course, would increase the true costs of Alternatives 1 and 4, since funds would need to be set aside for a number of years (even if not ultimately drawn upon), but the costs might still be less than those estimated for Alternative 1E.

This proposal, from our perspective, would be a more attractive option if our preferred cleanup action was Alternative 2A or 3A (which incorporate multiple lines of active upgradient treatment) and if groundwater CVOC levels at 1st Ave. S. were not currently elevated. We might then wait to see if the actions implemented in the source areas resulted in the speedy reduction of contamination at and approaching 1st Ave. But Alternatives 1 and 4 do not include multiple lines of upgradient active treatment, and groundwater CVOC levels at 1st Ave. S. currently exceed cleanup levels. In fact, vinyl chloride concentrations at well CI-15-60 in March 2016 were more than 300 times the new WQS ARAR.

As discussed above, if Alternative 1E's treatment "line" at 1st Ave. S utilizes EAB instead of ISCR, and/or employs ISCR, but its length is significantly shorter than 700', the cost differential between Alternatives 1E and 1 would be a little more than $2M. This is a significant differential, but Ecology believes the advantage of greater river protection under Alternative 1E justifies its selection over Alternative 1.[33] In our opinion, the only

[32] Attempts to predict future groundwater conditions are associated with a number of sources of uncertainty. One source relates to estimating likely future decay rates in upgradient areas. In the SU2 FS these decay rates were estimated based on the past behavior of CVOC concentrations measured at particular wells (i.e., historic concentration trends at a number of SU2 source area monitoring wells). While this is a common approach to estimating what might be expected in terms of future decay, the resulting estimates are very dependent on accurately representing (in mathematical terms) the actual trends, per COC, at each location with a finite number of observations. They are therefore, in Ecology's opinion, inherently uncertain. Potentially adding to this uncertainty are influences on the apparent trends that are not easily accounted for in selecting a decay rate, but may not continue – or continue in the same manner – in the future. Changes in sampling technique over the period when data are collected for trend analysis are one such possible influence. In SU2, this in fact occurred. The means by which groundwater samples were collected for CVOC analysis changed in 2013 at a number of monitoring wells (to the use of peristaltic pumps, introducing the potential for a greater degree of VOC de-gassing).

[33] It should be recognized that based on the PLPs' "benefit scoring" of Alternative 1 (resulting in a value of 7.5, lower than the values for all alternatives except Alternative 4) and the DCA methodology they chose to use, an

attractive features associated with Alternative 1 are its Plant 4 proposal (which Alternative 1E shares), its low cost, and ease of implementation. Compared to Alternative 1E, it – and Alternative 4 –fails to incorporate permanent solutions to the maximum extent practicable.

F. Cleanup actions must provide for a reasonable restoration time

Cleanup actions must achieve reasonable restoration timeframes (WAC 173-340-360(2)(b) and -360(4). To determine whether a cleanup action provides for a reasonable restoration timeframe, the regulations identify eight factors to consider. They also require that extension of restoration timeframes not be used as a substitute for active remedial measures, when such actions are practicable.

The FS Report contends that groundwater restoration timeframes for the six alternatives it evaluated will range from 15 to 90 years. The PLPs believe these restoration periods are "reasonable," as that term in used WAC 173-340-360(4).

Ecology agrees that it may not be practicable to achieve a shorter CVOC restoration timeframe than 40 to 50 years. We also agree that there are natural processes occurring at the site that are capable of reducing the concentrations of hazardous substances of concern. Furthermore, for at least the foreseeable future, site groundwater will not be a source of drinking water. The primary potential risks posed by groundwater contamination are those associated with vapor intrusion, and the eating of fish and shellfish contaminated by future groundwater discharges to the Waterway. The vapor intrusion concern is limited to the Water Table zone, and contamination of this zone currently extends no farther downgradient than 1st Ave. S. The concern regarding surface water/sediment contamination due to groundwater discharges, though it must account for future migration of contaminated groundwater east of the river, from a risk-based perspective is focused solely on the points where site groundwater enters the Waterway. Hence, there are large areas of groundwater contamination in SU2 where – as long as the contamination remains at these locations and depths – poses no potential risks to human health or the environment as long as it is not pumped to the surface.

Ecology is willing to accept a 20-25 year water table CVOC restoration timeframe if the VI assessment and mitigation program remains in place and the affected public concurs. However, in our opinion a CVOC restoration timeframe as long as 40 to 50 years for SU2 shallow and intermediate zone contamination is only reasonable if the cleanup action includes those active remedial measures that are practicable and able to effectively control

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alternative that was hypothetically rated a 10 (the highest rating) for each of the six evaluation FS factors, would have a lower "Relative Cost to Benefit Ratio" than Alternative 1 unless it cost less than $2.8M. This suggests that a $3M alternative that was significantly more protective, permanent, and effective than Alternative 1, and was -- aside from cost -- arguably the ideal remedy for the site, should not be considered the cleanup action which uses permanent solutions to the maximum extent practicable. Since Ecology believes there are situations where we would disagree with a conclusion such as this, it indicates to us that the PLP's DCA methodology is better used as a *guide* to – rather than a recipe for – choosing cleanup actions.

contaminant migration towards the Duwamish Waterway.[34] As discussed above in Ecology's DCA, this means implementing active remedial measures that can quickly control and reduce groundwater contamination migrating from, and west of, 1st Ave. S.[35] Measures evaluated during the FS to achieve this objective include the Downgradient Line of treatment proposed in Alternatives 2B and 3B. This line of treatment is also incorporated into Alternative 1E.

G. Summary of Ecology's preferred alternative

When selecting a preferred alternative, Ecology is obligated by regulation to choose an action that utilizes permanent solutions to the maximum extent practicable. For SU2, we believe this action is Alternative 1E. As discussed above, we have also concluded that Alternative 1E is one of the more protective and effective remedies that could be implemented. Quickly reducing the concentrations and mass of TCE and vinyl chloride in groundwater moving west of 1st Ave. S. is one of Ecology's highest-priority remedial action objectives for SU2. Alternative 1E is capable of meeting this goal, in our opinion, with more assurance that Alternatives 1 and 4, and – to a lesser extent – Alternatives 2A and 3A. While we would prefer that it be associated with a shorter site-wide groundwater restoration timeframe, Ecology is willing to forego the expensive active treatment of elevated groundwater CVOCs in areas nearer the SU2 source areas to marginally reduce this timeframe. The longer timeframe is justifiable if: (1) MNA is as effective as predicted in achieving cleanup levels over time in these more upgradient areas, and (2) as site-wide restoration proceeds, we can be better assured that contaminant levels approaching the Waterway are being quickly reduced to the maximum extent practicable.

Alternative 1E, unlike Alternatives 2A, 2B, 3A, and 3B, does not include active upgradient groundwater source area remediation. It is therefore likely to take longer for Water Table zone CVOCs in these areas to meet groundwater cleanup levels protective of indoor air. As discussed in E.4 above, this has implications for how long existing mitigation systems installed at several commercial buildings will need to operate. With respect to mitigated homes along Orcas and Mead Streets, however, it is possible that these systems can be retired under all alternatives, including 1E, in the near future. Currently, TCE levels in shallow groundwater (WT Zone) appear to be less than 7 µg/l at and immediately upgradient of 128, 132, and 134 S. Mead St, and 215, 217, and 227 S. Orcas St. As part of Alternative 1E, therefore, the PLPs should initiate the Tier 5 process to determine if the mitigation systems in these homes need to continue to operate. The first step in this process should be the collection of soil gas samples immediately above the water table in the two areas. This is, in Ecology's opinion, the best and most cost-effective way to determine if subsurface CVOC sources are potentially capable of resulting in unacceptable indoor air concentrations.

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[34] The timeframes noted for the three groundwater zones are based on the FS groundwater PCULs, and the expectation that Ecology's preferred alternative attain these levels throughout the SU2 area. The PCULs will need to be adjusted downwards to be compliant with new surface water-based ARARs, however, when the CAP is prepared. The PLPs did not estimate how long it would take any of the FS alternatives to achieve these new, lower groundwater cleanup levels. But Ecology assumes that restoration timeframes for TCE and vinyl chloride will be longer for each FS alternative, once the restoration targets are lowered to the new ARAR concentrations.

[35] Consistent with WAC 173-340-370(6) expectations regarding the need to take active measures to prevent/minimize releases to surface water via groundwater discharges in excess of cleanup levels.