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April 30, 2018

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**
Site Unit 1, CVOC Pilot Study Field Investigation Work Plan

Dear Ms. Cannon:

On April 4, 2018, the Washington State Department of Ecology (Ecology) received an Emailed copy of the draft Site Unit 1 *CVOC Pilot Study Field Investigation Work Plan*. The draft Field Investigation Work Plan (FIWP) was submitted by the West of 4th PLPs in accordance with Agreed Order (AO) 10402, amended on November 21, 2017.

Thank you for submitting the document by its due date. Ecology agrees with many of the proposals contained in the draft FIWP. However, we have enclosed a number of comments that should be addressed prior to document approval.

Please submit a revised FIWP that satisfactorily addresses today's comments within 30 (thirty) days. If you have any questions, or would like to schedule a meeting or conference call to discuss Ecology's comments, please contact me at (425) 649-4449 or ejon461@ecy.wa.gov.

Sincerely,

Ed Jones
Environmental Engineer
Hazardous Waste and Toxics Reduction Program

Enclosure

By certified mail: 9171 9690 0935 0169 7335 70



Ms. Dana Cannon

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cc: William Joyce, SJZ
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Jeff Kaspar/Peter Jewett, Farallon
Ronald Taylor, CI
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ecc: Tong Li, GWS
Peter Hapke, ALG
Nels Johnson, AAG
Patty Foley/Sherell Ehlers, GTCC

ENCLOSURE

Site Unit 1, Draft CVOC Pilot Study Field Investigation Work Plan Ecology Comments

COMMENTS

1. Page 3, Section 2.1. The draft FIWP describes and depicts a main sewer line below Fidalgo St., with routing to the south as it approaches Waterway and a lateral extending to the north (near PSW-05). Information regarding the sewer lines' placement depths and construction material(s) should be included in the revised document.
2. Page 4, Section 2.1. The draft FIWP describes and includes a City street-use permit and traffic control plan that were obtained/prepared for the baseline fieldwork the PLPs have completed. The traffic control plan for the (new) work proposed in the FIWP should be included, if possible, in its revision. If the plan will not be finalized until the FIWP has been approved, it should be submitted to Ecology prior to injection mobilization (per a date identified in the project schedule [Figure 9]).
3. Page 8, Section 4.1. The FIWP states that injections will target depths from 20'-30' bgs. But later in the document the PLPs say they will target a 15' interval, between 17.5' and 32.5' bgs. The revised FIWP should be consistent in describing the targeted vertical treatment zone, and should explain why the new monitoring wells installed for the study are only screened over a portion of the 17.5' to 32.5' interval. Can these wells fully/effectively capture groundwater effects resulting from injections at depths shallower than 20' and deeper than 30' bgs?
4. Pages 10 through 13, Section 5.1. The FIWP's Design section provides information about which reagents and tracers will be used, how and where injections will be performed, and the basis for proposing reagent volumes per injection point. This discussion should be supplemented in the revision with figures/drawings/schematics/specifications depicting and describing all of the injection and process monitoring equipment (such as: all aboveground injection "skids"/manifolds, pumps, tanks, piping, valves, connectors, auxiliary equipment, containment features, and measuring devices [pressure gauges/indicators, flowmeters, flow totalizers, etc.]). Specifications should ensure chemical compatibility between the project's materials and the proposed reagents.¹ A Process and Instrumentation Diagram should indicate schematically the aboveground injection and process-monitoring apparatus.

SOPs should also be included in the document that describe the project's injection and injection-monitoring field activities, step-by step.²

¹ Besides the materials chosen and used during the project, the PLPs will need to ensure chemical compatibility between the injectant and any subsurface man-made features that may possibly come into contact with the reagent solution.

² Including how the materials will be delivered to the work site and received/certified, and how the reagents and tracer will be mixed.

5. Page 10, Section 5.1. According to the FIWP, EHC-Liquid has been selected as the ISCR reagent. ELS-microemulsion will be added to enhance CVOC biodegradation. EHC-Liquid is supplied in powder form (24.5 lb bags), while ELS-microemulsion comes as a liquid (diluted to 25% and supplied in 55-gallon drums). Does this mean that the PLPs intend to inject a solution with an EHC-Liquid concentration of ~0.05 lbs/gal?³ If so, why has this particular injectant concentration been chosen (i.e., why is this one-PV concentration of EHC-Liquid deemed ideal)?
6. Page 11, Section 5.1.3. The FIWP states that lower injection pressures will be “targeted,” but pressure will be increased if needed to attain target injection volumes and reagent delivery. Ecology agrees that lower injection pressures are desirable, but the FIWP should also include:
 - a) optimum, minimum, and maximum injection flowrates and injection pressures.⁴ If there are anticipated ranges for injection-parameter values (e.g., a range of injection pressures, injection flowrates, and/or volume/mass of reagent solution that may be delivered to groundwater per location), these should be clearly presented; and,
 - b) specific proposals describing how – and under what circumstances – flowrate and pressure measurements per injection event will be used to adjust applied flowrates/pressures.
7. Page 11, Section 5.1.3. The PLPs have chosen 5-foot injection screens and plan to inject the 15’ target interval (27.5-32.5’; 22.5-27.5’; 17.5-22.5’) from the bottom-up. Ecology would prefer a top-down approach, since this typically minimizes the amount of reagent solution “lost” from upper 5’ injection intervals via migrations to deeper portions of the direct-push hole. If the PLPs believe there are significant advantages to injecting bottom-up, we should discuss this issue prior to revision of the FIWP.
8. Pages 11 and 12, Section 5.1.5. The FIWP states that injections will utilize a “header system” so that multiple points can be simultaneously injected. Ecology agrees that no two adjacent points should be injected at the same time, and the “header system” should be instrumented to measure P and Q. However, the revised FIWP should also:
 - a) state how many points will be injected simultaneously,
 - b) note the minimum (spatial) spacing for simultaneous injections,
 - c) provide a detailed figure depicting the header manifold, and
 - d) include an SOP describing how the field staff will operate the manifold during injection activities.

³ One bag (24.5 lbs) of EHC-liquid per every 50 gals of ELS-microemulsion and 450 gals of water.

⁴ The study Design should hypothesize what combination of lowest pressure and highest injection flowrate is likely to be optimum.

P_{max} for the injections should be calculated as recommended by USACoE, 2013 (“In Situ Air Sparging Engineer manual”) – or other sources. A conservative “safety factor” (60% is often selected) should be applied.

9. Page 12, Section 5.1. Commonly a shakedown test with clean water precedes injections with reagent.⁵ The draft FIWP does not describe such a test, but there are advantages to obtaining some initial injection-related data before introduction of reagent. If the PLPs believe there are significant downsides to such a shakedown test, we should discuss this issue prior to revision of the FIWP. Otherwise, the revised document should include proposals for performing such a step.
10. Page 12, Section 5.1.5. Injections will be phased. During one phase, injections will be conducted at locations north of PSW-02, and Fidalgo traffic will be routed to the south. DR-1 will be the dose-response monitoring well. For the other phase, points south of PSW-02 will be injected, traffic will be routed to the north, and DR-2 will serve as the dose-response well. Each phase will begin with the injection point closest to its DR well. Ecology assumes that tracer will be added to the reagent solution for all injection points.
- In the revised FIWP the PLPs should state how long each phase will likely take, which of the two phases will be conducted first, and whether there will be an interval of no injections between the phases. In addition, when the northern phase is being conducted, PSW-05 should also be monitored. During the southern phase, it unclear if the PLPs intend to also monitor PSW-05 and PSW-02. Both PSW-02 and PSW-05 should be monitored during the southern phase if the 6-inch sewer line's bedding extends below the depth of the water table.
11. Page 12, Section 5.1.6. According to the FIWP, reagent solution will be prepared in 500 gallon batches for each injection point. Water will be obtained from a nearby hydrant and the solution will be mixed about 10 minutes prior to injection. The PLPs state they plan to use a 500 gallon tank, but may consider a tank twice as large.

During FIWP revision the PLPs should:

- consider that hydrant water will likely contain chlorine, which may affect tracer strength;
- explain how batches in a container as small as a 500 gallon tank will meet the needs of simultaneous injections;
- identify where – and how – mixing will be performed; and,
- describe those measures they will use to safeguard surface features and surface soils from a reagent/tracer release (this could be a spill or accidental discharge that occurs prior to, during, or after injections at or near the injection area).

Measures should be adequate to contain any surface releases, and should include:

- a) sufficiently-sized secondary containment;
- b) the placement of berming around all aboveground hoses, tanks, and injection points where reagent will be stored or handled; and,
- c) the covering of sumps, catch basins, or other “openings” in nearby surface cover.

⁵ Ecology is referring here to clean water *injections*. This goes beyond the apparatus leak-testing that is typically performed with water prior to the injections.

12. Pages 12 and 13, Section 5.1.7. The PLPs propose to use Rhodamine WT (RWT) as the project's groundwater tracer. Ecology agrees that this is likely to be a good selection. Since the FIWP states that the PLPs propose to inject a 10 mg/l RWT concentration, ~18 g of the dye will be added to each 500 gallon reagent batch. In the revised document:

- a) the *desired* peak RWT concentrations, and *desired* RWT mass arriving, at monitoring locations should be identified; and,
- b) the FIWP should explain how the 10 mg/l target injectant concentration relates to these desired downgradient concentrations/masses.

The revised document should also discuss RWT's *compatibility* with EHC-Liquid, ELS-microemulsion, tap water, and the anticipated pH of the injection solution.

13. Pages 13 through 17, Section 5.2. Operational (process) and performance monitoring are discussed in Sections 5.2.1 and 5.2.2, respectively. Section 5.2.3 is the project's contingency plan, which includes a discussion of both monitoring and contingency "actions."

Most of the pilot study monitoring data not being collected solely or primarily to indicate the possible need for a contingency action have no associated "metrics" identified in the FIWP. That is, while there is a good rationale for collecting these data, the document does not describe what concentration (or other) values most measurements will be compared to or, specifically, how they will be evaluated. The revised document should provide more information related to how the study's data will be used to meet the study objectives set out in Section 4.2.

14. Page 13, Section 5.2.1. The FIWP states that during operational monitoring two dose (batch) samples will be collected for TOC, total Fe, and RWT analysis. This is a reasonable proposal, but the revised document should clarify:

- whether this means that a minimum of two samples will be obtained from each batch (a total of 18 500-gallon batches), and
- what the target concentration levels of TOC and total Fe are (in the injected solution).

15. Page 13, Section 5.2.1. The FIWP states that during operational monitoring water levels will be measured manually at all monitoring wells and at "any injection points not being actively injected." Water levels will be measured twice daily at six of the seven new wells and at wells 24-30 and 24-50. In addition, transducers will be placed in DR-1 and PSW-04, which will record water levels every 10 mins. The transducers will stay in these wells after the injection period. PSW-04 was chosen as a transducer location so that *continuous* water levels could be obtained from an area "not hydraulically influenced by injections."

Ecology agrees that water levels should be manually measured at all wells in the project area, and that a subset should be measured via emplaced transducers. However,

- how will water levels be measured at DP *injection points not being actively injected*? Does this mean that the DP injection points for each phase will all be

installed with the drilling rods/pipes in place (and accessible for water level measurements)?

- the injections will be in 2 phases. During the southern injection phase why should DR-2 (or PSW-03) not have a transducer installed?
- manual water-level measurements should also include well PSW-05. It will be upgradient of injection locations, but could be within the radius of hydraulic influence; and,
- the FIWP should clearly state that if significant groundwater mounding is observed, injections will stop until the mounding has subsided.

16. Page 14, Section 5.2.1. During operational monitoring, tracer breakthrough at the DR wells will be measured hourly (or for every 50 gallons injected, whichever is more frequent). Groundwater samples will be compared to “visual standards” in the field, and when breakthrough is indicated visually at least one groundwater sample will be shipped to the lab for TOC and Fe analysis.

In the revised FIWP the PLPs should:

- explain the significance of the 50-gallon volume. Do the PLPs anticipate some injection points requiring as long as 10 hours to accept 500 gallons of reagent solution?
- identify the field-determined tracer concentration that will trigger sending the samples to the lab. That is, how will “breakthrough” be defined for this project?⁶ and,
- state whether, during operational monitoring (i.e., during the period before all injections have been completed), wells other than just DR-1 and DR-2 will be sampled for breakthrough if breakthrough is indicated at one of both DR wells.⁷

In addition, while hourly monitoring *may* be frequent enough to catch any rapid (and unexpected) breakthrough, the revised FIWP should explain why:

- a) charcoal packets (activated carbon samplers) are not proposed for certain monitoring wells. Water samples will provide tracer concentration estimates but are unlikely to be adequate, by themselves, for making reliable mass estimates. For this reason water samples are often supplemented with carbon samplers during tracer studies; and,
- b) field fluorometers and emplaced sondes are not proposed. Wouldn't more “real time” tracer data help anticipate the optimum times for groundwater sample collection?

⁶ Typically, tracer analysis includes the generation of “breakthrough curves.” From these curves the groundwater flow/transport velocity (based on the time to achieve a certain percentage [e.g., 50%] of the peak tracer concentration) and the average tracer transport velocity (often based on the time taken for half the total tracer mass to reach a given monitoring point) are estimated. The FIWP should describe the tracer analysis the PLPs intend to perform with the data they propose to obtain during the study.

⁷ Table 6 identifies the monitoring wells where tracer is proposed to be measured, and when. Section 5.2 should provide the rationale for these proposals. Please see Comment #26 below concerning Table 6.

17. Page 14, Section 5.2.2. The FIWP states that performance monitoring will include microbial analysis, conducted during the 6-month post-injection monitoring event. Table 5 presents the types of analyses proposed and Table 6 identifies the wells where samples will be collected for these analyses.

Ecology agrees that microbial analyses should be part of the pilot study and we appreciate the PLPs' addition of these analyses to the baseline sampling event conducted earlier this year. The revised FIWP should:

- better explain the baseline CENSUS and PLFA results. Please see Comment #24 below (concerning Table 3); and,
- additionally include post-injection analyses for reductive dehalogenase (RDase) genes *vcrA* and *bvcA*. This – i.e., the pilot study – is a good opportunity to gather additional lines of evidence for vinyl chloride biodegradation near the Waterway.

Please also see Comment #26 below, regarding microbial analytical proposals presented in Table 6.

18. Page 14, Section 5.2.2. The FIWP states that during performance monitoring samples from DR wells and wells PSW-01, 02, and 03 will be collected immediately following “injection completion.” Then a weekly, followed by a monthly, sampling regimen will be implemented.

Ecology agrees with the PLPs' proposed sampling frequency. However, the revised FIWP should clarify whether “injection completion” refers to the completion of all injections or just the injections associated with one of the two “phases.”

19. Pages 15 through 17, Section 5.2.3. The FIWP's contingency plan describes actions the PLPs will, or may, take if the study's monitoring results indicate “potential exposure risk.” While Ecology agrees that we should be prepared for unexpected outcomes that could potentially pose harm to human health or the environment, we suggest that the revised FIWP broaden Section 5.2.3 to a discussion of “what can go wrong?” (during the pilot study). From our point of view this would include:

- a) surface spills of reagents or tracer;
- b) daylighting (surfacing) of reagents, tracer, and/or contaminated groundwater;⁸
- c) other injection problems, such as foaming within the DP holes or DR wells, inability to inject reagent in a timely manner without applying high pressures, etc.;
- d) significant and persistent groundwater mounding, due to injections, that causes CVOC (and perhaps reagent/tracer) migration in unexpected and undesirable directions;
- e) the generation of higher methane levels in groundwater, which then contaminates soils gas to such a degree that it poses a potential safety risk to nearby buildings;

⁸ There are a number of old boreholes in this area. The effectiveness of some of their surface seals is questionable. In addition, there may be other preferential vertical conduits in the vicinity of the injection area that we are not aware of.

- f) increasing levels of certain metals in groundwater that persist long enough to travel as far as the Waterway;
- g) increasing levels of vinyl chloride (or cis-1,2-DCE) in groundwater that persist long enough to travel as far as the Waterway. This – as well as the potential increases in metals concentrations – could result, at least in part, from any injection-related lowering of groundwater pH; and,
- h) transport of reagent and/or tracer into unintended areas/depths. Preferential groundwater migration pathways, unknown to us at this time, could cause higher than desirable reagent/tracer levels in groundwater approaching the Waterway.

The PLPs discuss scenarios e), f), h) and – to a certain extent – g) in Section 5.2.3. But the FIWP would be improved by acknowledging other undesirable outcomes and explaining how their likelihood (or effects) will be minimized, even if there is not a designated “contingency action” identified in the document for each scenario.

20. Page 16, Section 5.2.3. The contingency plan proposes monitoring that will be used to determine if certain unanticipated conditions have occurred as a result of the injections that merit some type of action. The conditions are associated with particular monitoring parameters and specific *triggering levels* for those parameters. In the revised FIWP the PLPs should also:

- clarify that contingency actions may be deemed necessary due to observations/measurements beyond those associated with MW24-30 monitoring. That is, while at this time well 24-30 is *expected* to be a good sentinel measurement point for undesirable groundwater conditions in terms of Waterway protection, until we have conducted the study we will be uncertain as to that well’s ability to effectively “capture” conditions caused by a line of injections 75’ long, and 80’ to the east and northeast. This uncertainty should be acknowledged;
- re-consider the contingency trigger measurement for methane in groundwater.⁹ Baseline methane concentrations in groundwater ranged from 1500 to 11,500 µg/l. According to the State of Indiana (2015), methane safety concerns should be considered when groundwater concentrations exceed 10 mg/l. Such levels were measured during baseline sampling at MW-24 (the highest observed level, and at a Water Table Zone well) and PSW-01, a new Shallow Zone well. MW-24 is located more than 150 feet west of the injection arrays; no Water Table Zone monitoring wells are currently located in the immediate vicinity of the injection area.

Since there are at least some groundwater locations in the study area where methane is already elevated, since we expect methane concentrations to increase following the injections, and since there are buildings nearby (and vadose zone corridors, which could serve as preferential vapor pathways towards those buildings), it is prudent to incorporate vapor sampling into the pilot study’s monitoring program. Several soil gas sampling locations should therefore be identified in the revised FIWP, along with proposed sampling frequencies and

⁹ The text states that the contingency trigger will be 10 times the baseline methane result at each well. However, Table 6 appears to propose a single “trigger concentration” of 57 mg/l (10X the methane level measured at MW24-30).

sampling/analytical methodologies. Section 5.2.3 can then be modified to describe contingency actions that will be taken in the event soil gas methane levels exceed established trigger concentrations.

- clarify whether the first contingency “action,” re-sampling within a month, is intended to apply to only the well where the trigger concentration was detected;
- clarify that the evaluation of aquatic risk is pertinent only to those scenarios where a Waterway-protection trigger measurement has been exceeded; and,
- clarify that the third contingency “action,” installing and sampling a new shallow zone well near MW-24, is primarily relevant to those situations where a Waterway-protection trigger measurement has been exceeded. The FIWP should also state that contingency actions such as re-sampling and the installation of new wells may not be sufficient responses, by themselves. Before reaching the fourth “stage,”¹⁰ and depending on the severity of the scenario, immediate protective actions may be deemed necessary.

21. Page 18, Section 6.2. The FIWP states that the baseline fieldwork’s traffic plan will be “revisited and updated” before the injections begin. Ecology agrees. Please see Comment #2 above.
22. Page 19, Section 6.3. The West of 4th AO requires that pilot study Completion Reports contain “project information as established in each study’s preceding Final Field Investigation Work Plan.” The revised FIWP should therefore outline the proposed content of the CVOC study Completion Report in sufficient detail to allow Ecology to understand the types of evaluations the PLPs intend to perform on the operational and performance monitoring data they collect.
23. Table 2. Question: Why is the baseline tracer analysis RL stated as “0U” ppb? What was the detection limit?
24. Table 3. According to the table, DHC was not detected at MW24-30. At 142-40 it was detected at 5 cells/bead (below the RL). At DR-1, 33 cells/bead were detected. Samples from only these three wells were apparently analyzed for CENSUS counts.
- The revised FIWP should, even if briefly, discuss what a *good* –in terms of anaerobic CVOC biodegradation – cell/bead count is considered to be. If possible, it should also explain how units of cells/bead correspond to cells/ml.¹¹
25. Table 5. Monitoring program analytes are identified in this table, as well as parameters that will be measured in the field. In the revised FIWP’s table, tracer (RWT) analyses/measurements should also be included.

¹⁰ The 4th contingency “action” states (on p.17) that if problematic groundwater conditions are observed at the newly installed well, an action will be proposed to Ecology within 10 days.

¹¹ In response to Ecology’s inquiry about CENSUS reporting units, on April 12 Kate Clark of Microbial Insights emailed the following information: “If the units are reported in cells/bead, it is because a bio-trap sampler was analyzed rather than a water sample. Although there is not a direct conversion between cells/mL and cells/bead, in our experience, they typically fall within 1-2 orders of magnitude. Both 10⁴ DHC cells/mL and 10⁴ DHC cells/bead are likely to be sufficient concentrations for a useful rate of reductive dechlorination.”

26. Table 6. The pilot study's monitoring program is described here, well by well. This is a good table, but in the revised FIWP:

- the PLPs should consider adding volatile fatty acid (VFA) and alkalinity analyses for certain wells during some of the post-injection groundwater monitoring events;
- as discussed in Comment #17, microbial analyses should also include quantification of RDase genes *vcrA* and *bvcA*;
- microbial analyses should be additionally performed on 6-month samples collected from DR-2, PSW-02, PSW-03, and PSW-05. The pilot study is a good opportunity to initially assess whether or not DHC bioaugmentation may be needed in this area in the future; and,
- PSW-05 should also be sampled for possible tracer presence (within the first three months after injections).

27. Table 7. The table presents injection-related RD information. A revised Table 7 was emailed to Ecology on April 19, which corrects assumptions related to the number of injection points and injectant tracer concentration. In the revised FIWP:

- the target treatment interval of 20-30' bgs in the revised table should be re-visited. Why is this different than the 15' interval (between 17.5 and 32.5' bgs) discussed in the text?
- an explanatory note should be added to the ELS-microemulsion dilution value (11% by vol). The FIWP text says that ELS-microemulsion is a liquid, diluted to 25%. 500-gallon batches of reagent solution will contain 450 gallons of water and 50 gals of this liquid ELS-microemulsion. Does 11%, then, simply refer to the volumetric ratio of the liquid ELS-microemulsion product to the amount of water mixed for a 500-gallon batch? and,
- a note should be added for the total ELS-microemulsion mass value (1337 lbs), explaining how the value was derived.

28. Figure 8, injection transect detail. This is a good figure, but the fenced area south of the transect lines should be demarcated and labeled when the FIWP is revised.

29. Figure 9, pilot study implementation schedule. The schedule should explicitly include a "pre-final inspection," to be conducted just prior to the injection events. Ecology plans to visit the project site at this time.

SAP (Appendix C)

30. Page C-1. The SAP refers to SOPs in the Art Brass Plating RIWP (2018) and Supplemental SAP (2014). These SOPs primarily include procedures for groundwater water level measurements, groundwater sampling (for various analytes), and monitoring well installations. As Ecology noted in our comments on the pilot study Work Plan, injections, injection QA/QC, and operational monitoring and its related QA/QC should be

performed per SOPs. The SOPs may be included in the SAP or some other part of the revised FIWP.

31. Page C-2. In the revised FIWP's SAP:

- it should be stated that during operational and performance monitoring the PLPs will record whether any groundwater parameters have not stabilized prior to the end of purging;
- it should be clarified whether the tracer mixing referred to here (to make visual standards) means the "mixing" that occurs after dye has been added to one of the 500-gallon batches of water and reagents; and,
- an estimate of the RWT concentration should be provided, per "visual standard."

32. Page C-3. Reagent samples will be collected for TOC and dissolved Fe analysis. Ecology agrees, but the SAP should state how many samples will be collected and what the PLPs will use the resulting concentration data for.

QAPP (Appendix C)

33. Page C-4. The PLPs state here that this is a *supplemental* QAPP, so it is limited to only those QA/QC objectives, organization, and "functional activities" not covered in the Art Brass Plating RIWP QAPP (2008) and 2014 Supplemental SAP QAPP. It is true that these older documents contain QA/QC proposals related to water level measurement and CVOC and metals sampling/analysis. But the QA/QC objectives in the RI documents are not necessarily the same as those for the pilot study. Plus, there will be tracer, reagent, and microbial sampling/analysis that will have associated QA/QC objectives and related tasks that are not envisaged in older QAPPs. The revised FIWP's QAPP should include pilot-study QA/QC objectives and comprehensively describe the proposed tasks associated with meeting those objectives.
34. Page C-5. The PLPs state here that QA/QC tasks related to microbial sampling and analysis will follow procedures in "Microbial Insights QA Manual (2013)." The revised FIWP should specify the pertinent procedures (in the QAPP) and a copy of the Manual should be submitted to Ecology for review.

In addition,

- while it may be the case that the lab "typically achieves" Table C-1's MDLs for RWT, the pilot study's QAPP and/or SAP should also state what sensitivity – and data quality – this project needs to be successful. This comment applies to all analyte and parameter measurements; and
- the data quality assessment and management performed during the Art Brass Plating RI was designed to meet the investigation's characterization and risk-based objectives. As noted in Comment #33 above, the pilot study has different goals. The data are being collected for different purposes and will be assessed differently. The QAPP should acknowledge these difference and provide project-specific data quality assessment proposals. Likewise, SOPs generated during the RI period did not cover activities such as tracer injection/monitoring, reagent

injection/monitoring, or microbial-sampling/analyses. The revised FIWP must attach SOPs that include step-by-step procedures for performing the study's fieldwork, and assuring the quality of the work and resulting data.

35. Page C-5. Ecology is aware that other West of 4th site documents (the Groundwater Monitoring Plan, for example) include a listing of all QC samples that will be collected and analyzed for the data-collection activities they include proposals for. Previously prepared and submitted QAPPs also include discussions of how PARCC parameters will be evaluated. But the QAPP in the revised FIWP should also include this information, modified as needed for the specific purposes of the pilot study. This includes:
- a) a description and listing of QC samples that will be collected during groundwater monitoring for all analytes/parameters identified in Table 5. It should be clear how many equipment blanks, trip blanks, cooler temperature blanks, field duplicates, matrix spikes (MS), and MS duplicates are envisaged per sampling event and analyte group; and,
 - b) a discussion of pilot study data quality (PARCC) needs/targets, and how the PLPs will later determine if these needs/targets have been successfully met.
36. Table C-1, summary of chemical analyses for the tracer and microbial sampling. In the revised FIWP's QAPP:
- the table should not include dyes other than RWT;
 - the anticipated reporting limits should be provided for all analytes;
 - the "visual" (field) RWT detection limit, and the expected accuracy of the field methodology, should be estimated; and,
 - the detection limits and the expected accuracies of other critical parameters that will be measured in the field (such as Fe+2/Fe+3) should be estimated.

Please also see Comments #17 and #26 above concerning additional microbial analyses.

Data Validation Report (Appendix E)

37. The baseline sampling report mentions that precision and accuracy were "acceptable." But precision and accuracy values do not appear to be included in the report. Nor does the RPD between the DR-1 and DR-1-dup VOC results seem to be included. These values should either be included in the revised FIWP or submitted to Ecology separately.

H&SP (Appendix F)

38. Ecology has the following suggestions for improving the H&SP:
- The Site Control Plan and Site Work Plan refer to the ABP facility's address. We suggest referring to the project location here. There are conditions at the Fidalgo project location that are significantly different than those at the ABP facility's address (e.g., the former is not "closed to public;" is not "historically...a metal plating facility..."; etc.).

- The Hazard Analysis' potentially hazardous chemical list should mention ELS-microemulsion and the RWT tracer, even if these materials are relatively innocuous.
 - Under the PPE section the H&SP states that traffic vests are not needed if certain other types of clothing are worn. We strongly suggest that any personnel working in the street wear vests. The H&SP should also describe any specific eye/face, or dust inhalation, protection for personnel working near (or cleaning up spills related to) reagents and tracer.
 - The Air Monitoring section says that a PID will be used when collecting soil samples. No soil samples are proposed for collection in the FIWP. The H&SP should, however, mention any air protection (PPE or actions) and monitoring for workers performing: water level measurements, groundwater CVOC/metals sampling, microbial-sampling, and aboveground tracer and reagent work (handling, mixing, injecting, sampling, etc.).
 - The H&SP should describe any worker-safety concerns and/or precautionary procedures related to spills and spill containment.
39. As the H&SP states, the document has been prepared to safeguard the health and safety of workers conducting and monitoring the proposed study. However, the project will be carried out in an area where other workers will be present at business locations nearby. There are also likely to be visitors in the area during the project's injection and monitoring phases. Besides the establishment of exclusion zones, the revised FIWP should therefore describe and discuss the fact sheets, notifications, signage, and other measures the PLPs will undertake to ensure that individuals likely to be present in the pilot-study vicinity will be properly informed and adequately protected.