

## 5. Responses to Written Comments Received From PACAAR, Inc.

### **Preface by EPA:**

In this section, EPA summarizes its responses to written comments provided by PACAAR, Inc. PACCAR, Inc. (PACCAR) reports that it is associated with the property located at 120 West 196th Street immediately adjacent to the former Del Amo plant property. The comments refer to the firm Hart Crowser, which served as PACCAR's consultant for the comments.

Where appropriate, responses are given both within the body of a comment as an issue arises, as well as at the end of an overall comment. The commenter's text is shown in normal text. The summary of EPA's response is given in **bold and back-shaded text**.

For ease of reference, the original comments have been numbered, with the exceptions of Sections 5 and 6. Sections 5 and 6 of PACCAR's comments present information and data summaries regarding liability allocation with respect to potential source(s) of TCE and other chlorinated solvents. EPA notes that liability allocation is not part of and therefore is irrelevant to the remedy selection. For brevity, the original text in these two sections is not repeated in the response summary. The text of comments which require a response from EPA are otherwise incorporated verbatim.

The EPA responses are in the same order as the original comments on the following sections listed below:

- Section 2 - Groundwater Flow Model
- Section 3 - Contaminant Transport Model
- Section 4 - Proposed Remedial Approach
- Section 5 - Potential Chlorinated Solvents Source Areas
- Section 6 - Extent of TCE Groundwater Contamination
- Section 7 - Conclusions

### **2.0 Groundwater Flow Model**

This section presents Hart Crowser's comments on the MODFLOW model developed for the Joint Groundwater Feasibility Study (JGWFS). **We conclude that the JGWFS groundwater flow model is inadequately calibrated, primarily because of the assumption of steady-state groundwater flow conditions and the decision to perform only a steady-state calibration.** Accurate model calibration is critical for this site because the modeling data are being used to assess the potential effectiveness of very expensive and prolonged remediation methods which have a distinct potential for spreading chemical constituents into previously uncontaminated areas, including the Gage Aquifer. Specific issues are discussed below.

**365 EPA Response:**

EPA disagrees that the model is inadequately calibrated for the purposes for which the model has been used. The commenter is correct that model flow calibration can be essential to interpreting modeling results. However, the adequacy of model calibration cannot be evaluated without an understanding of the applications for which the model was developed. No model can be used for all purposes; all models have limitations. A model is not “inadequate” as long as uses of the model are not made which lie outside its acknowledged limitations.

In this case, EPA recognized the limitations of the model for evaluating the “*potential for spreading chemical constituents into ... the Gage Aquifer,*” and did not use the model to evaluate remedial alternatives with respect to the potential for mobilizing contaminants into the Gage Aquifer. Instead, EPA developed criteria for all remedial alternatives that require the minimization of adverse effects of these alternatives on other contaminants, including potential spreading of contaminants into the Gage Aquifer. The optimization of remedial alternatives to achieve these criteria will be performed at the remedial design stage, and will likely require additional, more detailed modeling. The use of the existing numerical model of the Joint Site was limited to the comparative evaluation of the conceptual scenarios to (1) contain and clean (reduce the volume of) the chlorobenzene plume; and (2) contain the benzene plume. In fact, the JGWFS did not solely rely on the model in the evaluation of the benzene plume containment (e.g., the evaluation of the effectiveness of biodegradation to prevent the vertical migration of benzene into the Gage Aquifer). Specifically, the hybrid containment of the benzene plume in the MBFC Sand was proposed by EPA even though the model predicted that the benzene plume could be contained vertically in the MBFC Sand by only intrinsic biodegradation.

With respect to flow calibration, very reasonable root-mean-square head differences were achieved between observed and simulated conditions in every hydrostratigraphic unit simulated, while keeping hydraulic parameters constrained within reasonable site-specific ranges. This is an indicator of good flow calibration. Contrary to the comment, the use of steady-state assumptions in this case is appropriate given the intended and actual uses of the model (see responses to later comments).

The model used in the JGWFS was highly adequate and fully appropriate when used within its limitations. The model was only one tool used by EPA in the remedy selection process; EPA accounted for the limitations of the model and did not use the model outside the confines of its limitations. More specifically, the degree to which the current model is calibrated is considered sufficient for the use of the model in the JGWFS.

**2-1 Non Steady-State Groundwater Flow System.** There are two issues related to the assumption of steady-state flow:

a) Water levels in the water-bearing zones beneath the site have risen approximately 25 feet since 1965. Data collected by Dames & Moore indicate that water levels rose 2 feet between 1993 and 1996. By definition, this is not steady-state.

**366 EPA Response:**

**As stated in the JGWFS, a rising trend in the groundwater elevations appears to be uniform and similar in all the units of the Bellflower Aquitard and the Gage Aquifer. Therefore, the horizontal and vertical components of hydraulic gradient in these units do not change significantly with respect to time. In addition, the model of the Joint Site is used for the comparative evaluation of remedial scenarios that primarily rely on hydraulic stressing (i.e., pumping and injection) of the aquifers for containment and contaminant removal purposes. The effects of these hydraulic stresses will likely exceed any potential changes in natural gradients that could be caused by rising water levels. Therefore, the ability of the model to predict future changes in natural gradients is not of great importance. Based on the aquifer test data at the Joint Site, the drawdowns and mounding in the remedial extraction and injection wells, respectively, are expected to stabilize in a short period of time (i.e., days to weeks), relative to the duration of the overall remedy implementation (i.e., on the order of 100 years). Therefore, the assumption of steady-state flow is considered appropriate for the simulation of remedial scenarios in the JGWFS.**

(b) The modelers note that horizontal groundwater gradients and flow directions have remained roughly constant during the period of the RI. It does not appear that any attempt was made to assess whether different flow directions prevailed during historic operations of the Del Amo and Montrose facilities.

**367 EPA Response:**

**Only limited site-specific water level data are available for the time of operations of the Del Amo and Montrose facilities. It is possible that highly localized pumping from industrial wells that might have been located on the former Montrose and Del Amo facilities historically may have had some effect on local flow directions, although these wells have not been identified. The historic changes in water levels due to historical recharge is not expected to be significant because the West Coast Basin is overlain by the low-permeability fine-grained Bellflower Aquitard, and seasonal changes in the amount of recharge do not significantly affect groundwater levels.**

Thus, the accuracy of the contaminant transport model calibration is questionable if different groundwater flow directions and gradients prevailed historically, and vertical water levels are

changing.

**368 EPA Response:**

EPA is well-aware that the accuracy of the transport calibration is affected by the numerous uncertainties including the historic groundwater flow directions. This is why the transport calibration is referred to as a “quasi-calibration” in the JGWFS. However, the uncertainties associated with the transport calibration do not significantly effect the comparative analyses of conceptual alternatives performed in the JGWFS because these uncertainties equally affected all remedial alternatives. Additionally, the quasi-calibration of the transport portion of the model (i.e., an attempt to reproduce contaminant distributions from the known sources) actually helped to assess the historic flow conditions. A relatively good match between the observed and simulated contaminant distributions achieved by the quasi-calibration of solute transport throughout most of the modeling domain provides some indication that the historic flowfield reproduced by the model is reasonable. As stated in the response to the comment above, EPA does not claim that the degree of transport calibration allows for any use of the model, only that it is sufficient for the purposes to which the model has been used.

**2.2 Non-Unique Calibration.** The groundwater flow model was calibrated to assumed steady-state flow conditions. In a steady-state model, there are an infinite number of combinations of hydraulic conductivity values that will yield the same head distribution. This means that errors in estimated hydraulic conductivity values cannot easily be detected, resulting in erroneous estimates of groundwater flow rates and subsequent contaminant migration velocities.

**369 EPA Response:**

The non-uniqueness of solutions to the equations of groundwater flow is typically more significant when solving “inverse” problems (i.e., determination of the hydraulic parameters given a particular flowfield). In the case of the Joint Site, however, values of hydraulic conductivity for the units of concern were thoroughly assessed by numerous aquifer tests and laboratory analyses (JGWFS, Appendix B, Section 2.5, May 18, 1998). Therefore, a number of solutions for the calibration of the model for groundwater flow was limited by the small range of hydraulic conductivity values obtained in the field. Because of a reasonably good agreement between the observed and simulated flowfield that was achieved during calibration using the hydraulic conductivity values estimated in the field, the model is considered adequate for estimating contaminant migration velocities.

The model must be calibrated to transient conditions, e.g., time-drawdown data from one of the aquifer tests conducted at the site or sequential water level data from operation of the groundwater extraction system at the Mobil Refinery southwest of the site. A transient calibration will improve confidence in hydraulic conductivity estimates. Transient calibration also provides data regarding aquifer storativity which is needed to assess effects of water level rise and drawdown.

**370 EPA Response:**

**As discussed in response to Comment 2-1, a steady-state numerical model is sufficient for simulating remedial alternatives, given conditions at the Joint Site. The simulation of transient conditions does not add any value to the model with respect to the “confidence in hydraulic conductivity estimates,” because the existing model is based on the reasonably accurate estimates of these parameters from the aquifer tests. The storativity of the aquifers beneath the site is not a critical parameter for the simulation of the remedial alternatives because drawdowns and mounding in the vicinity of the remedial extraction and injection wells, respectively, will likely stabilize in a short period of time, relative to the duration of the overall remedy. Storativity, while useful to assess a short-term transient drawdown (or mounding), is not necessary in the calculations of the stabilized drawdown (or mounding). Again, the model is being used as one tool among many for a feasibility study, not the optimization of a remedial design or action.**

**2-3 Vertical Groundwater Flow Poorly Calibrated.** Predicting vertical groundwater flow will become critical if groundwater is extracted from the Gage Aquifer. Artificially increasing downward groundwater flow could induce contaminant migration from the Bellflower B and C Sands downward into the Gage Aquifer. Because of the steady-state calibration issue discussed above, the existing model is poorly calibrated with respect to vertical groundwater flow. Vertical groundwater flow rates can only be assessed by pumping one unit and monitoring the response to pumping in adjacent hydrogeologic units. We recommend that the model be calibrated to time-drawdown data from one of the aquifer tests conducted at the site to improve the vertical groundwater flow calibration.

**371 EPA Response:**

**EPA disagrees that the groundwater model is poorly calibrated for the uses that have been made of the model. Because drawdown/mounding caused by the pumping/injection wells will likely stabilize in a relatively short time frame, reasonable estimates of vertical flow can be and have been generated by the steady-state model, given the accurate estimates of vertical hydraulic conductivity performed in the field using the ratio method by Newman and Witherspoon (1972). For this reason, the vertical flow simulated with the existing model is considered reasonable for most of the site, with the exception of a few areas that are identified and discussed in the JGWFS.**

EPA agrees that the model is limited in its ability to simulate the vertical migration of contaminants into the Gage Aquifer. These limitations, however, are not caused by the steady-state nature of the model, but by the uncertainties associated with the sources of contaminants in the MBFC Sand and likely contaminant migration pathways in the Lower Bellflower Aquitard (LBF) which cannot be simulated. For these reasons, EPA does not rely on model simulations for evaluating the potential for vertical migration of contaminants into the Gage Aquifer. Instead, EPA proposes the performance-based hydraulic containment of contaminants in the MBFC Sand to prevent contaminants from migrating into the Gage Aquifer. The commenter should understand that all components of the remedial system will still be subject to optimization during the remedial design phase of the project; the remedial action has not yet been designed. The model was sufficient for the purposes of evaluating and comparing the long-term performance and feasibility of alternatives, however.

**2-4 Adequacy of Site Pumping Tests.** As a result of time constraints, we were not able to assess the adequacy of existing site pumping test data for use in transient model calibration. In particular, we were not able to determine whether there were sufficient observations to assess response to pumping in different water-bearing zones. These data should be reviewed and additional aquifer tests conducted as needed to address data gaps.

**372 EPA Response:**

See responses to Comments 2-1 through 2-3. The procedures used by the modelers for the aquifer tests were appropriate for collecting reliable data on hydraulic conductivity and were approved by EPA. Only a few pump tests performed by Montrose Chemical Corporation used observation wells (i.e., in most tests, drawdowns were measured only in a pumping well), because of the small radius of influence that could be achieved in the low-permeable sediments of the Bellflower Aquitard. Most of these tests, therefore, did not allow for the estimation of storativity. However, as discussed in response to Comment 2-2, the storativity of the aquifer is not considered in the calculations of the steady-state flow, which is sufficient for the purposes of the JGWFS. Additional aquifer testing could be conducted at the remedial design stage, if needed, based on the requirements of the design.

### **3.0 Contaminant Transport Model**

In this section Hart Crowser presents comments on the contaminant transport model developed to support remedial alternative evaluation for the JGWFS. We conclude that the contaminant transport model is inadequately calibrated to support critical evaluation of the proposed remedial alternatives and cannot provide a defensible estimate of the duration of cleanup.

**373 EPA Response:**

EPA disagrees with the conclusion that “the transport model is inadequately calibrated to support critical evaluation of the proposed remedial alternatives.” This comment does not consider the purpose of the modeling (See Responses to Comment 2). For example, the model was never intended to “provide a defensible estimate of the duration of cleanup.” Instead, the JGWFS considered only the relative rates of approaching to clean up for different scenarios, which were evaluated using the values of pore-volume flushing rates (Section 5 and Appendix B of the JGWFS, May 18, 1998). In fact, few long-term models, if any, are capable of providing reliable estimates of clean-up times because of numerous uncertainties associated with transport parameters and the general difficulty in determining potential spatial and temporal changes in these parameters given the existing technology (although, we admit, many model users inappropriately take such modeling estimates as if they were reliable, anyway).

Few models can be calibrated with a high degree of certainty with respect to contaminant transport. While a reasonable and approximate (“quasi-”) transport calibration should be (and was, in this case) performed in a modeling effort, it is unusual that a modeler can claim that highly accurate vertical transport calibration has been obtained for large, complex, and deep aquifer systems because the degree of uncertainty associated with contaminant source terms and release patterns/timing is typically substantial. This model is no exception. The transport calibration is suitable for certain purposes, and not for others. While EPA fully recognizes the limitations of the transport calibration, the accuracy of this calibration is considered to be sufficient for the uses made of the model (i.e., for the relative comparison of remedial alternatives) given the complexity of geologic and environmental conditions at the Joint Site.

**3-1 Porosity Variation.** A uniform value of 30% was selected for porosity for all layers of the model. In reality, porosity varies with the texture and depositional environment in which the soils were deposited indicating that porosity should vary from unit to unit and possibly from location to location. Although the geotechnical testing data indicate that porosity values greater than [sic] 30% may occur at the site, the effective porosity (pore space capable of transmitting fluid) is likely to be as much as an order of magnitude lower. Lower values for effective porosity increase average groundwater flow velocities for transport. Thus, in our judgment the chosen [sic] porosity of 30% is too high. **Selection of an erroneously high value for porosity could be the primary factor in the modelers' reported difficulty in calibrating the model to the chlorobenzene plume migration distance.** These data should be reviewed and field tests such as groundwater tracer studies should be performed as needed to assess effective porosity.

**374 EPA Response:**

The selected porosity value of 30 percent is not “erroneously high” when the site-specific data are carefully considered. As described in Appendix B of the JGWFS, the measured total porosity in the soil samples from the Del Amo Site ranged from 36.5 percent to

**41.8 percent. Physical tests conducted as part of the MW-20 pilot program showed that effective porosity ranged from 24.1 percent to 50.4 percent. Samples collected at the former Montrose Property indicated that the values of total porosity ranged from 33.7 percent in the Lynwood Aquifer to 52.1 percent in the Middle Bellflower Muds (MBFM). Therefore, the use of an average value of 30 percent is considered reasonable.**

**In addition, even if the values of effective porosity are overestimated for some areas of the Joint Site, the effect of this overestimate on the relative comparison of remedial scenarios would be minimal for the following reasons:**

- 1. The overestimate of effective porosity likely would have an equal effect on all the remedial scenarios.**
- 2. All remedial scenarios (other than no-action) included containment of the chlorobenzene plume. Consequently, the rate of uncontained chlorobenzene migration, which could be affected by the potential overestimation of porosity, is not of great importance in the evaluation of the remedial scenarios.**

**We agree that chlorobenzene migration under the no-action alternative could be greater than predicted if true porosity were, in fact, higher. However, the movement of the chlorobenzene plume under no-action was deemed unacceptable; hence, a greater estimate for porosity would not have an appreciable impact on the outcome of the evaluation of remedial alternatives.**

- 3. In the case of the benzene plume, intrinsic biodegradation is the predominating parameter that controls the rate of benzene migration. Therefore, any potential overestimation of effective porosity is not expected to have a significant effect on the benzene migration.**

**3-2 Incorrect Treatment of NAPL Dissolution.** The model overestimates NAPL dissolution by using a constant concentration boundary in areas of the site where NAPL is suspected. This assumption by the modelers implies that regardless of the groundwater flow rate, the concentration of constituents dissolving from the NAPL phase remains fixed. Numerous EPA studies and remedial investigations have indicated that this is not the case. At low groundwater flow rates, the dissolved concentration may approach the aqueous solubility of the constituent. At higher groundwater flow rates (i.e., as would occur for progressively more aggressive groundwater extraction scenarios) lower dissolved concentrations will be observed because the rate of diffusion from trapped NAPL phases into groundwater is limited. This is a conservative assumption for risk assessment related to the no action alternative. It is not conservative for remedial design because it overestimates the effectiveness of pump & treat remediation by overestimating the rate at which NAPL dissolves in response to pumping. The EPA should use a transport model designed to simulate rate-limited NAPL dissolution such as MOTRANS or T2VOC.

**375 EPA Response:**

The commenter fails to observe that all remedial alternatives, other than no action, hydraulically isolate a region surrounding the NAPL which remains contained indefinitely. The effectiveness of the reduction of the chlorobenzene plume is evaluated based on the percent reduction in mass and volume of the portion of the chlorobenzene plume that is isolated from (i.e. *outside*) the containment zone (Section 5 of the JGWFS, May 18, 1998). With the NAPL isolated hydraulically, NAPL dissolution is no longer able to feed the larger dissolved plume with contaminant mass. The evaluation of remedial scenarios for the benzene plume focused only on containment, not reduction, of the plume because the entire plume fell within the containment zone. Therefore, the rate of NAPL dissolution does not affect the evaluation of alternatives in any way.

The statement that “a constant concentration boundary” for NAPL “overestimates the effectiveness of pump and treat remediation” is therefore incorrect. In addition, the existing model was not used for the remedial design, which was apparently misunderstood by the commenter based on the statement that the constant concentration boundary “is not conservative for remedial design.” The modeling was used exclusively for the feasibility study-level comparative evaluation of the remedial alternatives. Additional, more detailed modeling may be conducted at the remedial design stage, if necessary. The assumption of the constant concentration source boundary is reasonable for the comparative evaluation of remedial alternatives.

The JGWFS did not make estimates of the time required for the NAPL to entirely dissolve *inside* the containment zone. While the rate of NAPL dissolution will strongly influence *that* time period, the JGWFS appropriately considers the time to be indefinite and it has little implication for the purposes of remedial selection in this case. This remedial action imposes indefinite hydraulic containment of NAPL and dissolved phase cleanup, and can be designed regardless of the rate the NAPL dissolves.

**3-3 Incomplete NAPL Characterization.** As noted in the JGWFS, existing data to characterize the locations and mass of material present in suspected NAPL are incomplete. It is not clear how EPA will achieve closure on this site unless NAPL areas are delineated. EPA should collect additional data as needed to confirm areal extent of suspected NAPL areas.

**376 EPA Response:**

The scope of this remedial action addresses hydraulic isolation of NAPL and dissolved phase cleanup. Known and suspected locations of NAPL are considered in the JGWFS and the selection of this groundwater remedial action. The existing data on NAPL are sufficient for assessing the remedial alternatives and evaluating the impracticability of cleaning NAPL-contaminated areas to the MCLs. It is true that insufficient information on NAPL exists to evaluate the potential for NAPL recovery and, as the comment states, to

**“achieve closure” on both sites. More detailed characterization of NAPL will be completed by subsequent soil and NAPL feasibility studies that are ongoing at this time and will lead to the selection of additional remedial actions, as necessary.**

**As noted in the discussion in response to Comment 3-2, “the locations and mass of material present” as well as the rate of LNAPL dissolution do not affect the evaluation of remedial scenarios for the benzene and chlorobenzene plumes. These factors will affect the later studies and remedial selections just mentioned, however.**

**3-4 Natural Attenuation Inadequately Characterized.** The final remedy for this site must rely on natural attenuation (and/or more aggressive source removal, discussed below) or the proposed groundwater extraction system can never be shut down. EPA should conduct site specific natural attenuation evaluations such as those described by Istok et al (1997) to evaluate biodegradation rates for benzene and chlorobenzene [sic] for use in the final remedy for the site and remedial alternatives evaluation. The references cited do not consider recent developments in the study of TCE biodegradation which indicate increased degradation rates are possible in the presence of benzene and petroleum hydrocarbons. More recent literature such as the Symposium on Natural Attenuation of Chlorinated Organics in Ground Water (EPA, 1996) need to be consulted for estimates of biodegradation rates for TCE and chlorinated organics in multiconstituent groundwater plumes.

**377 EPA Response:**

**The remedial action cannot rely on monitored natural attenuation (i.e., monitored intrinsic biodegradation)<sup>1</sup> for cleaning all groundwater to in-situ groundwater (drinking water) standards (ISGS) given the site-specific nature of the multiple NAPL sources at the site (it is assumed that the term “natural attenuation” used in the comment refers to intrinsic biodegradation). As discussed in Appendix E of the JGWFS, “more aggressive source removal” to achieve MCLs in groundwater in NAPL-contaminated areas is not technically practicable (See Appendix E of the JGWFS; May 18, 1998). Therefore, while “the proposed groundwater extraction system” (assuming this refers to the wellfield targeting the chlorobenzene plume outside the containment zone) will be shut down after achieving ISGS levels outside of the TI waiver zone, wells containing the benzene and chlorobenzene plumes within corresponding TI waiver zones will most likely pump indefinitely. Due to the uncertainty associated with the TCE sources, the time frame for operating the source control wells for TCE is not known at this time.**

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<sup>1</sup>EPA note: Intrinsic biodegradation is a specific form of natural attenuation referred to in this ROD (See Section 7.3 of the Decision Summary). However, the terms *monitored intrinsic biodegradation* and *monitored natural attenuation* are consistent terms in the context of the EPA Policy, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, OSWER Directive 9200.4-17, December 1997.

It is noted that “contain indefinitely” is not synonymous with “contain forever” as implied in the comment. Logically, there will come a time at which the need for containment/NAPL isolation will be exhausted; presumably when the mass of NAPL is no longer in the ground (due to long-term dissolution or physical recovery). If significant biodegradation of any of the Joint Site contaminants should exist that could not be estimated reliably or accounted for in the remedy selection, this will affect the actual time that containment pumping will have to remain in place. Such distinctions, however, will come into play during the course of the remedial action, and not at the point of remedy selection.

As EPA discussed in this ROD regarding the potential for intrinsic biodegradation of chlorobenzene, in remedy selection processes the key issue is not whether intrinsic biodegradation exists, but whether it can be *relied upon* as a remedial mechanism. If it cannot, then even if it is occurring to some degree, it will serve to promote the effectiveness of, but cannot obviate the need for, other remedial measures which will have to be implemented regardless.

As stated in the JGWFS, EPA intends to collect more data on the distribution and sources of TCE at the remedial design stage. A reasonable degree of information on intrinsic biodegradation of TCE will be also collected at this time.

EPA will take the information sources cited by the commenter under advisement for the remedial design phase. EPA was aware of the recently reported potential for TCE to biodegrade more quickly in the presence of other hydrocarbons. The remedy selected by this ROD addresses the TCE plume in a performance-based manner (i.e., it must stay contained within the TI waiver zone). Therefore, if intrinsic biodegradation of TCE is enhanced by the coincident degradation of benzene, the TCE may stay within the TI waiver zone and no contingent actions will be necessary. If it does not, then contingent actions will be necessary. The actions selected for TCE in this ROD are consistent with whatever degree of intrinsic biodegradation of TCE may be occurring.

3-5 Biodegradation Over Simplified. The EPA modelers specified a single degradation rate for each constituent modeled. In reality, geochemical conditions vary greatly across the site with strong anaerobic conditions likely in the interior of the benzene and chlorobenzene plumes and aerobic conditions likely on the fringes of those plumes. Because aerobic degradation rates are likely to be an order of magnitude or more greater than anaerobic degradation rates for benzene, the single value selected is likely to be a poor compromise. The situation is reversed for TCE which is unlikely to degrade in the aerobic conditions outside the benzene and chlorobenzene plumes but may experience substantial degradation inside those plumes. The reducing conditions combined with a substantial carbon source (benzene) support mineralization of TCE by cometabolic degradation. The modelers should use spatially varying degradation rates to account for varying geochemical conditions in the water-bearing zones underlying the site.

**378 EPA Response:**

The statement in the comment that “the EPA modelers specified a single degradation rate for each constituent modeled” is incorrect. Spatially variable biodegradation rates (half-life values) were assigned to benzene based on the calibration of the benzene transport. The benzene half-life used in the model ranged from 100 to 9,000 days as shown on Figures B-2.6a through B-2.6d, Appendix B of the JGWFS. Due to reasons listed in Section 2.7.4 of Appendix B of the JGWFS, intrinsic biodegradation of chlorobenzene was assigned to zero.

One conceptual simulation was performed for the TCE no-action scenario. For this limited simulation, which did not affect the evaluation of remedial alternatives, a literature value for half-life of TCE was used in the model. The data on the TCE distribution and sources, however, are not sufficient for any meaningful evaluation of the site-specific TCE biodegradation rates. The TCE scenario, which is proposed in the JGWFS, is performance-based, and does not preclude any further optimization after more information is collected at the remedial design stage, including information on the TCE biodegradation.

**3-6 Possible Incorrect Treatment of Dispersion.** In the introduction to Appendix B the authors noted that the upstream finite difference solver preserves mass balance and minimizes numerical dispersion. MT3D's finite difference solver does minimize mass balance error, but it is notorious for having numerical dispersion problems with sharp contamination fronts (such as occur here). The text doesn't say which solver the authors used but if they used the finite difference solver, the model wouldn't be sensitive to small values of dispersion coefficient. The modelers reportedly used a dispersion value of 1 ft but noted that the model was insensitive to this parameter. A larger dispersion coefficient would tend to disperse contaminants (e.g., chlorobenzene farther downgradient than predicted by advective flow alone). Most authors note that dispersion seems to be scale dependent. Based on the EPRI report (Waldrop, 1985), a dispersion value on the order of 30 to 50 feet may be more appropriate. EPA should review which solver was used for the transport modeling and whether a larger value for dispersion coefficient may be appropriate.

#### **379 EPA Response:**

The solute transport simulations were performed using the MT3D finite-difference solver. EPA concurs that, while the simulated values of dispersivity are based on the best match between the observed and simulated concentrations achieved during transport calibration of benzene as well as chlorobenzene, the potential underestimation of this parameter, especially in the case of chlorobenzene, is possible. However, the uncertainty associated with the parameter of dispersivity is not of a great concern because it would have an equal effect on all the remedial scenarios. Alternative performance is compared on a relative, not absolute, basis.

In addition, the assumption of the relatively low dispersion for the calibration of the benzene transport model is the conservative approach. The higher value of dispersion would have resulted in the larger benzene historic migration during calibration. Therefore, the smaller values of benzene half-life would have had to be used to offset the

**effect of larger dispersion, and to match the simulated results with the observed limited migration of the benzene plume. The use of the smaller half-life for benzene is not conservative, however, for simulating the future conditions (i.e., for “forward” simulations), because it could potentially result in the underestimation of the benzene migration.**

#### **4.0 Proposed Remediation**

The groundwater remediation alternatives discussed in the JGWFS rely on groundwater extraction to slowly remove organic constituents from the vicinity of suspected NAPL areas. Because the transport models use a constant concentration term to represent NAPL dissolution, they cannot be used to represent NAPL removal or estimate the duration of cleanup. Because the transport models oversimplify and use nonsite-specific data to represent biodegradation processes, they cannot be used to assess natural attenuation. As a result, the groundwater flow/contaminant transport modeling described in the JGWFS can only be used to qualitatively assess plume containment and the relative effectiveness of different groundwater extraction schemes in cleaning up groundwater outside of the suspected NAPL areas. Aggressive destruction/removal of NAPL combined with carefully documented and/or enhanced natural attenuation are crucial to developing a realistic closure plan for the JGW site. EPA should aggressively pursue evaluation of these approaches.

Specific comments on the remedial alternative evaluation are presented below.

##### **380 EPA Response:**

**EPA concurs that the model can only be used “to qualitatively assess plume containment and the relative effectiveness of different groundwater extraction schemes in cleaning up groundwater outside of the suspected NAPL areas.” As discussed in response to Comment 3, the model was never intended to “represent NAPL removal or estimate the duration of cleanup.” Again, it is noted that the scope of this remedial action is hydraulic isolation of NAPL and dissolved phase cleanup outside the containment zone. The rate of NAPL dissolution does not influence the alternatives framed under this approach. EPA is in fact aggressively pursuing the evaluation of alternatives for NAPL recovery and this will be the subject of a second phase of remedy selection related to groundwater.**

**If the term “realistic closure plan “ refers to the selection of this groundwater remedial action, the statement that “aggressive destruction/removal of NAPL” is critical for developing of this remedy is incorrect. The remedy for groundwater can be developed assuming that the NAPL sources will be contained, and the subsequent soil and NAPL feasibility study and remedy selection processes will determine whether and to what extent the NAPL sources could be recovered (removed). As discussed in Appendix E of the JGWFS, the existing data on NAPL are sufficient, however, for recognizing the technical impracticability of cleaning these sources to ISGS levels (e.g. MCLs). Therefore, the TI**

waiver for LNAPL and DNAPL sources was proposed by EPA for this remedial action.

EPA concurs with the commenter's statement that groundwater models cannot be used to assess natural attenuation<sup>2</sup> (i.e. intrinsic biodegradation) in the absence of other factors such as geochemical evidence, monitoring data, etc. The data on the biodegradation of the benzene plume are sufficient, however, to consider the intrinsic biodegradation of benzene for the containment-only purposes in the remedy selection. The commenter will note that the Del Amo Groundwater RI Report and the JGWFS considered multiple lines of evidence, including those cited by the commenter, before concluding that monitored natural attenuation (i.e. monitored intrinsic biodegradation) of benzene could be relied upon as a remedial mechanism for the benzene plume. EPA did not merely use the model for this purpose.

4-1 Inconsistent Reliance on Mass Transfer Mechanisms. Section 4 of the JGWFS presents inconsistent reliance on contaminant mass transfer mechanisms. Specifically, aggressive NAPL destruction/removal technologies such as in situ oxidation are ruled out in Table 4-5 because "mass transfer limitations of heterogeneous aquifer prevent distribution of oxidizing agents to contaminated zones". The retained remedial technology, groundwater extraction and treatment is implicitly a mass transfer limited process particularly in heterogeneous aquifers.

**4.381 EPA Response:**

Under extraction conditions, mass transfer is toward extraction wells, hence containing contaminants and effecting their ultimate removal. Under in-situ oxidation conditions, mass transfer of oxidant toward contaminant is significantly more difficult to effect with hydraulic injection mechanisms than mass transfer of contaminant toward an extraction well. Additionally, once an oxidant is consumed or otherwise lost, the contaminant mass may still exist and continue to affect groundwater. Other limitations of in-situ oxidation at the Joint Site are explained in Section 4.3.1.3 of the JGWFS. These limitations suggest that in-situ oxidation is not likely to be particularly effective at the Joint Site.

4-2. New Remedial Technologies Ignored. As noted above, the JGWFS ruled out aggressive NAPL destruction/removal technologies such as in situ oxidation. Without considering new in situ oxidation technology developments (e.g., see Levin et al, 1997), groundwater recirculation and treatment wells (Schrauf et al, 1994), and sparging/soil vapor extraction.

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<sup>2</sup>EPA note: Intrinsic biodegradation is a specific form of natural attenuation referred to in this ROD (See Section 7.3 of the Decision Summary). However, the terms *monitored intrinsic biodegradation* and *monitored natural attenuation* are consistent terms in the context of the EPA Policy, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, OSWER Directive 9200.4-17, December 1997.

**4-382 EPA Response:**

Once again, the commenter fails to observe that NAPL recovery/destruction is not within the scope of this remedial action. NAPL is being hydraulically contained and dissolved-phase contamination outside the containment zone is being cleaned up.

If the commenter intended that EPA evaluate the technologies mentioned for *dissolved phase* cleanup of the entire contaminant distribution, then EPA did consider these technologies and they were appropriately rejected for this purpose. Groundwater recirculation and treatment wells are referred to as “vacuum-vaporizing wells” in the text of the JGWFS. As discussed in the JGWFS, groundwater recirculation and treatment (i.e., vacuum-vaporizing wells) is not expected to be effective due to the significant extent of groundwater contamination (covering several square miles and occurring to a depth of up to 400 feet bgs and across several aquitards). The significant vertical extent of contamination in conjunction with the presence of the low-permeable units (i.e., aquitards) would prevent in-situ recirculation of injected groundwater, which is an essential aspect for the performance of this technology. The costs of employing the technology over so large an area would be prohibitive.

EPA is open to considering such technologies with respect to NAPL recovery at the sources, to be evaluated in the second phase remedy selection processes.

4-3 Failure to Evaluate Potential Mobilization of Onsite/Offsite Plumes. Aggressive groundwater extraction could mobilize groundwater contamination identified at other sites north and west of the JGW site such as those identified at the Douglas facility. EPA should evaluate potential effects on other groundwater contamination sites in the vicinity, possibly with assistance from the RWQCB to identify sites.

**4-383 EPA Response:**

The potential effects of the remedial alternatives on other existing groundwater contamination have been taken into consideration by the JGWFS. For this very reason, the development criteria for the remedial alternatives require the minimization of the potential adverse effects of remedial actions on other contaminants. Injection of treated water back into the aquifer in conjunction with the containment of the benzene plume in the MBFC Sand, and source control actions for TCE, are aimed to achieve compliance with these criteria. Additional remedy optimization will be performed at the remedial design stage, if needed, upon the collection of the additional data on contaminant distribution and sources within the radius of influence of remedial wellfields at the Joint Site. EPA concurs with the commenter that coordination with the RWQCB is essential and that attention to possible interferences from the sources mentioned (including McDonnell Douglas) should be paid during the remedial design and action. Should interference occur, EPA has authorities which it can, at its discretion, use to mitigate the interference.

4-4 Failure to Acknowledge Potential Operational Issues. The JGWFS noted the potential for groundwater extraction to cause undesirable migration of the contaminant plumes but did not discuss potential operational issues as a consequence of operating multiple pumping and injection wells in multiple aquifers. Balancing groundwater extraction and injection is likely to be more difficult than indicated by the numerical model. Treatment of contaminated groundwater may alter groundwater chemistry sufficiently to cause precipitation or fouling problems in the reinjection wells. EPA should identify and discuss options for addressing potential operational issues. A treatability study or examination of operational issues at similar facilities, e.g., the treatment system at the Mobil refinery southwest of the site may be appropriate.

**384 EPA Response:**

**Operational issues were evaluated in the JGWFS with respect to the implementability and cost criteria. The JGWFS acknowledged that fouling of injection wells could cause operational problems, which would affect the cost and implementability of injection. As discussed in Sections 6, 7, and 8 of the JGWFS, ancillary technologies would be evaluated and applied for the expressed purpose of reducing the potential for fouling of injection wells. Testing of such ancillary technologies, including determining optimal concentrations of polyphosphate to prevent fouling, will be conducted during the remedial design stage. EPA agrees that balancing hydraulic extraction and injection, and maintaining injection rate, present challenges in remedial design and action which are not reflected by the model. Again, the model was not the only tool used by EPA in performing the JGWFS. Despite the challenges noted, EPA believes the remedial action is feasible. The commenter is referred back to the JGWFS for more information on these topics.**

**The commenter's suggestion to review the operational issues at the Mobil refinery is well taken and will be considered in the remedial design phase. Treatability studies, as necessary, can be performed during the remedial design phase.**

4-5 Failure to Evaluate Effect of Water Level Rise. There is no discussion of how rising water levels may affect operation of the proposed groundwater extraction and injection system. Rising water levels will increase the transmissivity of the water table zone in direct proportion to the increase. Increasing transmissivity will lead to reduced effectiveness of groundwater containment systems or a need to increase groundwater extraction rates. A rising water table could also mobilize contaminants currently bound in soil above the water table.

**385 EPA Response:**

**The potential effects of future water level rises are expected to be minimal, compared to stresses imposed to the natural flowfield by the extraction and injection wells. However, these effects will be further evaluated during the remedial design phase, if deemed necessary. The goal of a feasibility study, as the name implies, is to assess feasibility and**

**not to perform a design. The proposed remedial alternatives are conceptual with respect to the number of wells, pumping rates, and locations, and could change upon the full consideration of the remedial design issues.**

4-6 No Evaluation of Duration of Cleanup. As noted previously, the JGWFS model cannot be used to evaluate the duration of cleanup. EPA should implement aggressive source removal technologies and perform monitoring and analysis as needed to develop an estimate of the cleanup duration. EPA should also have a plan in place for procedures if TI waivers are approved for NAPL areas at the site.

**386 EPA Response:**

**Again, the groundwater remedial action is being evaluated and selected in two phases. The present phase does not evaluate NAPL recovery/removal; it addresses hydraulic isolation of NAPL and dissolved phase cleanup. As such, source removal (NAPL recovery) technologies are not pertinent to the present effort. The TI waiver referred to by the commenter is, in fact, approved with the selection of this remedial action. The requirements, contingencies for transgressions of containment, etc. are all evaluated and incorporated in this remedial action.**

**In the case of the Joint Site and the JGWFS computer model, development of a reliable absolute estimate of cleanup duration is not feasible and therefore not appropriate at this time. Even increasing the model's sophistication would not erase the uncertainties inherent in the long-term modeling of these complex systems. Also, it is unlikely that the increased data needed to support more sophisticated assessments would be available. The model could, of course, produce values for "total cleanup time." However, EPA believes it is disingenuous to represent that estimate as the cleanup time because the uncertainty associated with it is too high. There are too many uncertainties in both existing and future conditions to make a modeling estimate reliable over a time frame on the order of centuries.**

**The amount of time for all NAPL to be dissolved so that NAPL isolation is no longer necessary is the most uncertain, and EPA has not modeled this value. The cleanup duration for this is "indefinite." The time to achieve reduction of the plume outside the containment zone is likely to be on the *order* of a century.**

## 5.0 Potential Chlorinated Solvents Source Areas

In this section PACCAR presents a summary of available data on TCE and other chlorinated solvents in soil and groundwater at the following sites:

- Trico
- Del Amo Site

- American Polystyrene (formerly AMOCO)
- Douglas Aircraft Company
- Lawson Chemical

[Note: the original information supplied by PACCAR is not repeated here.]

**387 EPA Response:**

**EPA acknowledges the need for collecting additional data on chlorinated solvents, including distribution and sources of TCE. The additional data will be collected during the remedial design phase before finalizing the design of the TCE remedy. The information provided by PACCAR will be reviewed by EPA, and considered during the remedial design stage for the development of additional data collection programs.**

## **6.0 Extent of TCE Groundwater Contamination**

[In this section, PACCAR presents the results of the review of two reports.

These two reports are the groundwater RI for Del Amo Site dated May 15, 1998, prepared by Dames & Moore and the final groundwater feasibility study dated May 18, 1998, prepared by CH2M HILL for EPA. The original text supplied by PACCAR is not repeated here for brevity.]

**388 EPA Response:**

**See response to Comment 5.0 above. The existing TCE data are considered sufficient for the conceptual and performance-based approach to the remedial action components for TCE presented in the JGWFS. However, this approach will be further optimized during remedial design upon collection of additional data.**

## **7.0 Conclusions**

7.1 The following conclusions have been drawn about the proposed remedy.

The groundwater flow model used by EPA has the following deficiencies:

7.1.1 The groundwater flow system is not steady-state. Water levels have risen 25 feet since 1965 and 21 feet between 1993 and 1996. In addition historic groundwater flow directions and gradients are unknown; and

**389 EPA Response:**

**See responses to Comments 2 through 2.3.**

7.1.2 Vertical groundwater flow was poorly calibrated. The ability to predict vertical flow is critical if groundwater is extracted from the Gage Aquifer.

**390 EPA Response:**

**See response to Comment 2-3.**

7.2 The following conclusions have been drawn about the contaminant transport model:

7.2.1 The effective porosity values used are too high;

**391 EPA Response:**

**See Response to Comment 3-1.**

7.2.2 NAPL dissolution rates are overestimated, resulting in an overestimate of the effectiveness of pump and treat remediation;

**392 EPA Response:**

**See Response to Comment 3-2.**

7.2.3 Natural attenuation has been inadequately characterized. This is important because the final remedy will depend on natural attenuation; and

**393 EPA Response:**

**See Response to Comment 3-4.**

7.2.4 Biodegradation has been oversimplified. The single degradation rate used for each constituent does not appropriately reflect the variation in geochemical conditions across the site.

**394 EPA Response:**

**See Response to Comment 3-5**

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7.3 The following conclusions pertain to the proposed groundwater remedial strategy:

7.3.1 The proposed remedial approach ignores developments in aggressive remedial technologies such as in situ oxidation.

**395 EPA Response:**

See response to Comment 4-2

7.3.2 In addition the potential to mobilize onsite and offsite plumes does not appear to be adequately addressed. Specifically contaminant plumes at Douglas Aircraft and International Light Metals which are to the northwest of Del Amo have not been addressed.

**396 EPA Response:**

See Response to Comment 4-3.

7.3.4 The effect of rising water levels on the groundwater extraction and injection system have not been evaluated, and most importantly no duration of cleanup has been developed.

**397 EPA Response:**

See Response to Comment 4-5.

7.3.5 Inadequate details about the basis for TCE plume remediation have been provided. What is the basis for using 9 extraction wells and 1 injection well in the B Sand in the TCE/PCE areas, etc?

**398 EPA Response:**

**The absence of full characterization does not preclude the FS-level development of the remedial scenario for TCE. The proposed source-control remedy for TCE is based on the limited data on TCE distribution, and is therefore conceptual and performance-based as explained in the JGWFS. The performance-based remedy specifies general remedial actions (i.e., pump-treat-inject), and assumes that the remedy will be optimized at the remedial design phase to achieve the required performance. The number, locations, and pumping rates for the TCE source-control scenario were specified only for the preliminary order-of-magnitude cost estimate based on the general understandings of the hydrogeologic conditions and fate and transport of TCE. Because the TCE-remedy component is the same for all remedial alternatives, the cost of the TCE remedy does not affect the relative comparison of the remedial alternatives and selection of the final remedy. As stated in the JGWFS, the TCE remedy may be modified at the remedial design phase, as necessary, upon collection of additional data.**

7.3.6 Failure to acknowledge potential operations issues.

**4399 EPA Response:**

**See Response to Comment 4-4.**

7.4 The following comments are provided pertaining to the existence of potential source areas:

7.4.1 We strongly believe that the EPA needs to evaluate the impact on known and potential TCE source areas adjacent to the Joint Sites, before implementing an aggressive pump and treat program with no defined end point.

**4400 EPA Response:**

**See Response to Comment 4-3. EPA concurs that the sources and extent of chlorinated solvents at the Joint Site need to be further assessed prior to the design of the Joint Site remedy. However, the existing data are sufficient for the feasibility-study-level evaluations such as the comparative evaluation of different remedial alternatives. The selected remedy for the dissolved contaminants at the Joint Site, such as pump-treat-inject approach for the (1) containment of dissolved contaminants, (2) containment of the chlorobenzene and TCE sources (i.e., DNAPL), and (3) removal of the chlorobenzene mass, will not likely change based on the potential findings on TCE distribution and sources.**

7.4.2 Completely define the sources of TCE/PCE in this area in light of the discrepancies noted in concentration of TCE/PCE in soil vs. groundwater, prior to implementing groundwater remediation for the Joint Sites. There is reason to believe that additional sources may exist in the area of concern.

**4401 EPA Response:**

**See Response to Comment 7.4.1.**

7.4.3 Inadequate soil sampling and groundwater quality data exist for the former "pits and trenches" located on the northwestern portion of the Del Amo Site. This area should be further investigated.

**4402 EPA Response:**

**Additional investigation will be performed as part of the ongoing RI/FS process for soils and NAPL at the Del Amo Site that may include the Pit and Trench Areas.**