Water & Sewer District, and Tahoma School District No. 409, as indicated in those entities' previous public comments regarding proposed Site activities. Note that the discussion of anticipated permits in the Proposed Consent Decree's Exhibit G ("Remedial Action Permits") is incomplete (e.g., no references to Tahoma School District No. 409 or Soos Creek Water & Sewer District; no references to the necessary amendment of the Soos Creek Sewer District Comprehensive Plan or its approval by the King County Council as indicated in King County's letter dated February 15, 2006, that is included in the Proposed Consent Decree's Exhibit E, Part C, Appendix A). All steps necessary to accomplish the contingency plan must be clearly and completely defined in the Final CAP documents, preferably in one document and in one place. If repeated in more than one document, the text should be comprehensive and consistent throughout. As drafted, the requirements are incomplete and confusing.

6. Section 1.3.1, entitled "Additional Investigation Since DCAP Submission," third paragraph, fourth sentence, Page 3, which states "By having the infrastructure components installed ahead of time, if groundwater treatment becomes necessary at some future time, an appropriate modular treatment system can be efficiently installed at the Site and brought into operation in a relatively short time." See previous comments regarding clarification of incomplete infrastructure installation and inappropriate emphasis upon the treatment component of the Contingent Groundwater Containment System. The reference to "a relatively short time" reflects a fatal flaw in the Proposed Plan, in that it is based upon speculation and assumptions that a Contingency Plan without adequate information (e.g., extraction rates and durations) and without defined performance standards could be designed, acquired, approved, constructed, and operated all within "a relatively short time." As indicated in our general comments, the Proposed Plan must be revised to require design, approval, permitting, installation, and testing of extraction infrastructure to reliably determine groundwater extraction rates necessary to achieve defined containment performance standards at each portal of the Site within defined and enforceable deadlines that are necessary to ensure remedy protectiveness.

7. Section 1.3.1, entitled "Additional Investigation Since DCAP Submission," third paragraph, last sentence, Page 3, which states "The treatment system will be designed, built, and operated only if groundwater from the Site exceeds the MTCA Cleanup Levels at the established points of compliance." As indicated in our general comments, it is our opinion that a protective remedy requires that operation of the Contingent Groundwater Containment System be triggered by any contaminant detection at 0.5 or more of MTCA Cleanup Levels at any compliance monitoring well located at the north or south portal of the Site. Therefore, the referenced sentence should be revised to reflect that more conservative and protective approach.

8. Section 2.2, entitled "Site History," text on Page 7. The text acknowledges the "limited" sampling of some media and should acknowledge that sampling of "drum contents and soils" was limited too. The text's description of the RI/FS is misleading: "The RI/FS, which consisted of a comprehensive investigation of site environmental conditions..." The investigation was focused and limited, and should be accurately

described as such. See our general comments—if relied upon in the Final CAP, the "Black Box Approach" must be clearly described to explain how it caused the RI/FS to be focused and limited, and how the "Black Box Approach" was relied upon to produce a more conservative and protective remedy.

9. Section 3.2, entitled "Source Characteristics," Page 9. This section regarding "Source Characteristics" contains more speculation and unproven assumptions as quoted in the following text: (a) "...any potential remaining wastes appear to be confined to the northern half of the trenches..."; (b) "...wastes potentially remaining include a significant number of drums buried at some depth"; and (c) "The amount of waste remaining at the Site is unknown, but a significant portion may have been burnt during historical fires..." As repeatedly indicated in these comments, such speculation and unproven assumptions are inappropriate, undermine the supposed "Black Box Approach," and create the misimpression that the Proposed Plan is adequately conservative to be protective. See our general comments.

10. Section 3.3.1, entitled "Geology," fifth paragraph, Page 10. The description of the "numerous faults" at the Site and the "[a]pproximately 75 feet of displacement" along a fault in the mine demonstrate the need for a more protective remedy than required by the current Proposed Plan, including monitoring in perpetuity and post-earthquake special monitoring requirements. See our general comments. See also our specific comments below regarding the need for post-earthquake special monitoring requirements.

11. Section 3.3.2, entitled "Hydrogeology," second paragraph, Page 11. The statement "Groundwater flows in the lateral direction away from the mine (across bedding or via faults) are considered negligible." is speculative and based upon unproven assumptions. Groundwater elevation mapping (Figure 3-19 in the 1996 RI) shows that groundwater is moving radially from the mine (enhanced recharge location) into surrounding bedrock (Puget Group). Local domestic wells produce groundwater from fractured zones in the bedrock, providing empirical evidence that groundwater moves through the fractured bedrock, albeit not as quickly as within the highly permeable mine workings. The sentence in this paragraph that refers to wells installed in the Puget Group materials and located laterally away from the mine as "hydraulically isolated" from the mine workings is speculative and should be deleted or corrected to acknowledge that the degree of connection with the mine, via fracture flow, is not known. Based on the RI groundwater elevation mapping, the adjacent bedrock domestic wells are downgradient of the mine workings. These wells are presumably pumping groundwater daily for domestic purposes; therefore, we expect that they are pumping groundwater at least partly derived from the mine workings recharge area. These facts are not accounted for at all in the Proposed Plan. This is another example of how, contrary to the "Black Box Approach," the Proposed Plan relies upon speculation and unproven assumptions to justify an inadequate remedy—see our general comments.

12. Section 3.3.2, entitled "Hydrogeology," last paragraph, Page 11, makes statements regarding the location of a groundwater divide occurring within the southern portion

of the Site, and culminates with "All groundwater flow beneath the subsidence trenches that were utilized for waste disposal is toward the north." In our opinion, and indicated our previous specific comments, the current information is not conclusive as to whether a groundwater divide is present in the southern portion of the mine. There are no monitoring wells currently, nor proposed in the Proposed Plan, completed within the mine workings beneath the trenches that were used for waste disposal; therefore, groundwater elevations and groundwater quality in that most important portion of the Site are completely unknown. Such monitoring wells should be required under the Proposed Plan to better define the presence/absence of a groundwater divide within the mine workings, as we previously proposed.[8] The last sentence in Section 3.7 (Page 16), which states "...there is a slight potential for contaminant migration from the southern end of the trenches" inappropriately speculates about the magnitude of that potential—the word "slight" should be deleted. However, it should be noted here that the quoted sentence appropriately confirms there is a potential for southward contaminant migration from the former mine. This potential needs to be acknowledged consistently throughout the documents comprising the Proposed Plan in order to adhere to the "Black Box Approach."

13. Section 3.4.3, entitled "Mine Stability," Page 12. This section regarding "Mine Stability" contains many more speculative statements and unproven assumptions.

14. Section 3.4.3, entitled "Mine Stability," first paragraph, Page 12. The text states, "...the overall volume of remaining voids was estimated to be less than 10%." This total porosity is significantly less than the effective porosity assumed for the BIOSCREEN modeling analysis, conducted by the PLP Group at Ecology's request, to establish long-term confirmational groundwater monitoring frequencies. As indicated in our general comments, the BIOSCREEN model is a mathematical simulation of a "Black Box" and is constructed entirely upon speculative assumptions. For example, the disparity between the porosity assumed in developing the Proposed Plan and the porosity assumption used for modeling calls into question the Proposed Plan's reliance upon BIOSCREEN to establish monitoring frequencies.

15. Section 3.5, entitled "Nature and Extent of Contamination," eighth paragraph and ninth paragraph, last sentence, Pages 14 and 15, which over-state conclusions to be drawn from historical groundwater sampling activities. For example the text states: "Therefore, based on groundwater sampling results, there are no contaminants in the groundwater directly attributable to waste disposed of in the trenches at the Site." Because no groundwater monitoring within the waste disposal areas has been conducted, this over-statement needs to be revised to read more factually: "Based upon groundwater sampling results from monitoring wells located outside the waste disposal areas at the Site, contaminants directly attributable to waste disposed of in the trenches have not been detected; however, no groundwater monitoring has been conducted within the mine workings beneath the waste disposal areas." Such over-statements occur in many places in the Proposed Plan and should be qualified to

[8] Email communication from Kelly Peterson (Kent) to Jerome Cruz (Ecology), dated November 12, 2009 (Ecology Site File).

accurately describe the limitations of the Site investigation. Collectively, these and other over-statements create the misimpression that the Proposed Plan is adequately conservative to be protective.

16. Section 3.5, entitled "Nature and Extent of Contamination," first sentence of first paragraph under the heading "Soil," Page 15, which over-states, "There are no contaminants of concern for soils outside the trenches." Because soil sampling was very limited in number of samples and in geographic area and soil depth, this over-statement needs to be qualified to read: "No contaminants of concern were detected in soil during limited soil sampling accomplished along part of the trench rim perimeter and the drainage areas immediately adjacent to the north and south portals. Other soils outside the trenches were not sampled."

17. Section 3.5, entitled "Nature and Extent of Contamination," second sentence of first paragraph under the heading "Soil," Page 15, which states "Within the trenches, chromium, lead, PCBs, bis-(2-ethylhexyl)phthalate, methylene chloride, trichloroethylene (TCE), and total petroleum hydrocarbons (TPH) exceeded Method B standards..." Lead and TPH do not have Method B cleanup levels. References to Method B should be checked and corrected as appropriate throughout the documents comprising the Proposed Plan.

18. Section 3.5, entitled "Nature and Extent of Contamination," second paragraph under the heading "Soil," Page 15, which over-states, "Therefore, apart from soils located within the subsidence trenches in the area of known prior waste disposal activities, soil, groundwater, and surface water media in the Study Area do not exhibit concentrations of chemical constituents above naturally occurring background levels." This over-statement cannot be justified by the limited investigation accomplished at the Site. This over-statement erroneously relies upon the fact that actual sampling was very limited to reach the unsupportable conclusion about chemical composition of all such media.

19. Section 3.6, entitled "Risks to Human Health and the Environment," Pages 15-16, which in the context of "Risks to Human Health and the Environment" repeats several over-statements that cannot be justified by the limited investigation accomplished at the Site (see previous specific comments). The text states: "As noted above, the only locations where chemicals were observed at concentrations above MTCA Method B are within the trenches in the vicinity of where waste disposal occurred in the past....no chemical (in concentrations exceeding federal or State of Washington standards) are known to have migrated off the Site in air, surface water, or groundwater; nor has soil outside of the trenches been impacted. In summary, there are no operative exposure pathways from the Site for chemicals directly attributable to disposal of waste in the trenches. Given the absence of exposure pathways, the Site does not pose a significant risk to human health or the environment under current conditions." Such over-statements and "conclusions" completely undermine the "Black Box Approach" which is supposed to presume the worst case (significant risk to human health and the environment) within the uninvestigated "Black Box", and which is supposed to provide very conservative measures to protect against the very

significant risks of the unknown. See also our general comments regarding these matters.

20. Section 3.7, entitled "Potential Contaminant Transport," first paragraph, Page 16. The first sentence states "No contaminant migration is occurring from the Site." This over-statement needs to be revised to read: "Based on the available data, contaminant migration has not been detected to date at the Site monitoring points."

21. Section 3.7, entitled "Potential Contaminant Transport," last paragraph, Page 16, second sentence, which states "The Clark Springs facility is approximately 2,500 feet from Portal #3." Add a new sentence to clarify the circumstances: "Portal #3 is within the Washington Department of Health-approved 6-month-time-of-travel wellhead protection zone for the Clark Springs facility and Portal #3 is less than 300 feet from the shallow unconfined aquifer of the Rock Creek drainage area encompassing Kent's Clark Springs facility."

22. Figure 5 – Well Locations. Figure 5 should be revised to differentiate between "private wells" and "public water supply wells" including Kent's Clark Springs facility. Add to Figure 5 the wellhead protection areas for public water supply wells. Kent can provide a file containing the Clark Springs wellhead protection area boundary. The approximately 20 new water wells that have been installed since 1998 (described in Section 3.8.2, second paragraph, Page 18) should be mapped on Figure 5.

23. Section 3.8.2, first paragraph entitled "Surface Water," Page 18. Kent's Clark Springs facility is a groundwater source; therefore, it should be mentioned in the "Groundwater" subsection that follows the text.

24. Section 3.8.2, second paragraph entitled "Groundwater", Page 18. Consistent with statements for other water supplies, reference the 120,000+ people in Kent served in part by Kent's Clark Springs facility.

25. Section 4.2, entitled "Cleanup Levels and Points of Compliance," second paragraph, Page 20, which repeats the following over-statements: "For the Site, the only contaminants identified are associated with soils in the trenches where wastes were disposed. No contaminants attributable to wastes disposed of in the trenches were identified in groundwater, surface water, or air." Groundwater in the mine workings beneath the waste disposal area, where groundwater contamination is most likely, has never been investigated, and this needs to be acknowledged in this section and in other relevant places in the Final CAP.

26. Section 4.2, entitled "Cleanup Levels and Points of Compliance," fifth paragraph, Page 21, which discusses application of Method B groundwater cleanup levels. Method B groundwater cleanup levels also need to protect beneficial uses of adjacent surface waters (Cedar River and Rock Creek) in accordance with WAC 173-340-720(4)(b)(ii); therefore, those ARARs should be considered when setting numeric standards (e.g., state and federal ambient freshwater quality criteria, Method B Surface Water Cleanup Levels, etc.). To not do so is to not comply with MTCA. The

Compliance Monitoring Plan must define (i.e., tabulate) the Method B Groundwater Cleanup Levels for reference during compliance monitoring. Because the Compliance Monitoring Plan includes decisions based on detections above 0.25 of the Cleanup Levels, the analytical reporting limits for the compliance groundwater monitoring will need to be at or below those concentrations, and that comparison needs to be presented in the Quality Assurance Project Plan.

27. Section 4.2, entitled "Cleanup Levels and Points of Compliance," first paragraph beneath bullet number 6, Page 22, which states "For groundwater, WAC 173-340-720(8)(c) and (d) provide that if it is not practicable to meet groundwater cleanup levels..., Ecology may approve a conditional point of compliance for groundwater cleanup..." WAC 173-340-720(8)(c) also requires that all practicable methods of treatment be used in the Site cleanup if proposing a conditional point of compliance for groundwater. The Proposed Plan does not include the practicability demonstrations required by MTCA to justify the approval of a conditional point of compliance at the Site. Furthermore, existing Site data cannot substantiate such practicability demonstrations. As such, the standard point of compliance must be established throughout the Site at all monitoring wells (including all "sentinel" wells).

28. Section 5.4, entitled "Reasonable Restoration Time Frame," Pages 30-31. The discussion of the "reasonable restoration time frame" evaluation should acknowledge the "Black Box Approach" and the fact that "restoration" is neither an objective of the Proposed Plan nor will Site "restoration" ever be evaluated. As is, the discussion is misleading to the general public, and conveys the misimpression that "restoration" will occur (e.g., "The selected remedy, Alternative 5, has a reasonable restoration time frame for the mine site conditions, because shorter restoration time frames are not technically practicable."). The text's reference on Page 31 (second full paragraph) to indefinite monitoring should be revised to indicate monitoring will occur in perpetuity—see our general comments. The last sentence of the section on Page 31 regarding the "Contingent Groundwater Extraction and Treatment System" should be revised to be consistent with our other comments regarding that component of the Proposed Plan.

29. Section 5.5, entitled "Proposed Cleanup Action Plan," Pages 31–43. Prior to backfilling for cap construction, the estimated 70 cubic yards of chlorinated solvent sludge pond at the surface of the Area 2 trench must be removed to comply with MTCA and WAC 173-340-360(2)(c)(ii)(A). See our general comments.

30. Section 5.5, entitled "Proposed Cleanup Action Plan," steps #4 and #5, Pages 31-32. Monitoring and maintenance must occur in perpetuity—see our general comments.

31. Section 5.5, entitled "Proposed Cleanup Action Plan," second bullet point, Page 32, which states "groundwater quality in the mine, including the southern portion of the mine, is not currently impacted from waste disposal..." The statement is misleading in that the groundwater quality in the mine has not been adequately investigated, consistent with the "Black Box Approach". The statement also is yet another example of false statements, over-statements and inappropriate "conclusions" used in the

Proposed Plan to undermine the "Black Box Approach" which is supposed to presume the worst case within the uninvestigated "Black Box" and, as a consequence, is supposed to provide very conservative measures to protect against the risks of the unknown.

32. Section 5.5, entitled "Proposed Cleanup Action Plan," third bullet point, Page 32, which states "the groundwater divide in the southern portion of the Rogers Seam keeps groundwater in the northern portion that is beneath the deposited waste materials from migrating toward the south and toward the City of Kent water supply watershed..." The location and effect of the groundwater divide is currently speculation, given the incomplete information about the hydrogeology of the Site. Such speculation undermines the "Black Box Approach"—see our previous comments regarding these matters.

33. Section 5.5, entitled "Proposed Cleanup Action Plan," last sentence, Page 33. The Proposed Plan provides here, and in Part B of the Proposed Consent Decree's Exhibit E (the Draft Operation and Maintenance Plan), that trees and large brush will be removed. As discussed in our general comments, such removal demonstrates the practicability of removing the surficial chlorinated solvents sludge from Area 2 prior to capping.

34. Section 5.5.3, entitled "Contingent Groundwater Infrastructure Components," Pages 35-36:

    a. The Most Important Component, and the Most Fatal Flaw in the Proposed Plan. As communicated previously to Ecology and as discussed in our general comments above, the Contingent Groundwater Containment System is the most important element of the Proposed Plan—especially if Ecology is determined to proceed with the "Black Box Approach" to the Site and its remedy without addressing the other deficiencies in the Proposed Plan identified in these comments. To rely upon the "Black Box Approach" (which must "assume the worst" and "hope for the best,") the remedy must include the ability to respond immediately if contaminants threaten to migrate beyond where the groundwater use restriction can provide protectiveness. As drafted, the Proposed Plan's Contingency Plan is vague and unenforceable - lacking any enforceable performance standards or deadlines for the contingency implementation. As such, if and when the Contingency Plan must be implemented, Ecology will lack the enforcement tools necessary to oversee the activities that must be required to achieve compliance with MTCA. While the Proposed Plan contains many flaws, the Contingency Plan is its most fatal flaw.

    b. Performance Standards for Contingency Plan—Demonstrating Hydraulic Containment With Specificity that Can Be Enforced. The Proposed Plan fails to delineate any performance standards for the Contingency Plan. It is critical that the contingency plan (Proposed Consent Decree Exhibit E, Part C) and this section of the Final CAP define performance standards for demonstrating hydraulic containment if the Contingent Groundwater Containment System needs to be operated. Necessary performance standards for achieving hydraulic containment are: (1) at the north portal, continuously maintain groundwater levels in all north portal monitoring wells at an elevation below that of the Cedar River (elevation approximately 500 feet); and (2) at the south portal, continuously maintain groundwater levels in all south portal monitoring wells at an elevation below that of Rock Creek (elevation approximately 580 feet). These standards equate to drawdowns of approximately 110 feet in the mine workings at the north portal and approximately 65 feet in the mine workings at the south portal. The drawdowns would be measured in non-pumping monitoring wells, not in the pumping wells. These standards are technically necessary for protecting off-site receptors (reversing the hydraulic gradient currently toward the adjacent outwash aquifer/surface water body) and are easily verified in the field.

c. Performance Standards for Contingency Plan—Enforceable Timeframes and Deadlines for Achieving Hydraulic Containment. It is critical that the Proposed Plan define the timeframe for achieving hydraulic containment (at demonstrated performance standards) after the Contingency Plan is triggered. The Proposed Plan includes no such information despite prior assurances from Ecology that it would. In 2008, the PLP Group submitted responses to Ecology's review comments on a 2002 draft cleanup action plan, in which the PLP Group stated, "The emergency groundwater capture and pump-back system could be installed and operational in less than a month." Ecology responded, "Ecology suggests a response time within a week to get the needed groundwater capture system in place and operating."[9] Subsequently, Ecology's October 7, 2008 letter to the City,[10] and Ecology's January 25, 2010 email to the PLP Group and Kent,[11] stated that the CAP would include the time to initiate groundwater extraction for containment. No such information is provided in the Proposed Plan, which is a fatal flaw as written. The Final CAP should clearly define all of the specific steps necessary to design, approve, permit, construct, test, and install all of the remaining components of the Contingent Groundwater Containment System. The Final CAP should include enforceable deadlines for achieving hydraulic containment once system operation is triggered. As drafted, the Proposed Plan includes no such deadlines and provides no mechanism for Ecology enforcement of the Contingency Plan.

[9] The 2008 exchange of comments by the PLP Group and Ecology were summarized in a document entitled "Technical and Administrative Comments on the March 20, 2002 draft of the Landsburg Mine Consent Decree and Exhibits" that was enclosed in the Ecology Letter dated August 5, 2008, from Jerome B. Cruz to Douglas Morell of Golder Associates (Ecology Site File SIT5.2.3). In particular, see page 12 of the enclosure.

[10] Ecology Letter from Robert W. Warren, Section Manager, Toxics Cleanup Program, Northwest Regional Office to Larry Blanchard, Public Works Director, City of Kent (October 7, 2008), p. 2 (Ecology Site File).

[11] Email on January 25, 2010, from Jerome Cruz to several recipients entitled, "Ecology's decision on long term groundwater monitoring frequency at Landsburg Mine Site, Ravensdale." The email stated that the DCAP will incorporate "appropriate response times to initiate groundwater pumping or containment, treatment, and safe disposal at the portal wells if Contingency Plans are triggered at the site....".

d. Performance Standards for Contingency Plan—One Month Deadline for Achieving Hydraulic Containment. In order to establish the deadline for hydraulic containment, Ecology needs to know how long it will take to achieve hydraulic containment at each portal (i.e., achieve remedy protectiveness), not just a time to start the system. However, at this point, Ecology and the PLP Group have no idea how long it will take (or even whether it can be achieved at the Site). Based upon speculation and unproven assumptions, the Proposed Plan merely hopes that system installation/operation and hydraulic containment will be quick and easy to accomplish "in a relatively short time." (Final Draft CAP, p. 3). Such optimism is completely unfounded at this point. Groundwater flowing from the north and south ends of the Site can reach surface water bodies containing Endangered Species Act (ESA)-listed salmonids and, from the south end, the primary water supply source serving the sixth largest city in the state—and do so within a matter of weeks. Therefore, it is our opinion that, to ensure protection of human health and the environment as MTCA requires, hydraulic containment needs to be achieved (not just pumping started) within one (1) month of the trigger date—as Ecology previously indicated would be required (see Comment #34(c) immediately above).

e. Speculation About Pumping Rates Needed to Achieve Hydraulic Containment—Anecdotal 40 GPM Pumping Rates is Contradicted by RI Testing Information. Based on information in Part C of the Proposed Consent Decree's Exhibit E (the "Contingent Groundwater Extraction and Treatment System Plan"), the Proposed Plan bases the design of the Contingent Groundwater Containment System's pumping rates up to 40 gpm on anecdotal dewatering rates during historical mining operations. It is important to understand that dewatering of the mine occurred gradually over many years, and took decades to reach the bottom. If the system is designed to replicate the anecdotal 40 gpm pumping rate, it could take years to achieve hydraulic containment at the Site. Such a long delay (i.e., years) would not be protective of human health and the environment under MTCA. Furthermore, the anecdotal information from historical mining is not of suitable reliability for constructing an extraction system that needs to achieve hydraulic containment within one (1) month of the trigger for operation of the Contingent Groundwater Containment System. Note that, during the RI, limited short-term pumping tests were done at portal monitoring wells (6 gpm for 3 to 4 hours), but "...the tests did not produce any significant stress on the water-bearing capabilities of the coal seam." and "...the data are generally not considered useable from an analytical perspective." (Pages F-4 and F-5 in Appendix F of 1996 RI). While the pumping test information in the RI is insufficient for design-level analysis, it is sufficient to indicate that a 40 gpm pumping rate would be inadequate to achieve containment in the necessary short time period. The fact that pumping 6 gpm produced a drawdown of less than 0.2 feet during testing (30 gpm/foot specific capacity) at both portals indicates that pumping rates far greater than 40 gpm would be needed to achieve the large drawdowns (approximately 65 and 110 feet) that are necessary to ensure effective hydraulic containment, particularly in the requisite short timeframe. In short, there are no reliable hydraulic data currently available upon which to design the physical capacity of the contingent containment system (i.e., extraction, conveyance, or treatment). Furthermore, we understand that the PLP Group's consultant referred to pumping rates of 5 to 10 gpm at the October 24, 2013, public meeting regarding the Proposed Plan convened by Ecology. Whether the pumping rate is guessed to be 5 to 10 gpm, or 40 gpm, this is yet another example of the Proposed Plan relying upon speculation and unproven assumptions. This is not acceptable given the need for rapid implementation of containment pumping if and when it is needed. This critical element of the remedy needs to be proven—such proof can only be obtained by installing and testing the system up-front, before it is needed. The ability to respond quickly and effectively to contaminated groundwater migrating from the mine is a necessary consequence of the "Black Box Approach" adopted by Ecology in 1993. For the remedy to be protective, a reliable understanding of the pumping rate and duration needed to achieve hydraulic containment at each portal needs to be determined now. It is a standard practice in establishing MTCA remedy requirements to determine something as significant as this during remedial design.

f. Reasonable Assurance that Contingency Plan Can Achieve Groundwater Containment—Installation and Testing. Based on the large uncertainties outlined above, the entire Contingent Groundwater Containment System (except water treatment components) must be installed and tested during remedial design (after Consent Decree is executed) to provide reasonable assurance that the Contingency Plan can achieve the requisite groundwater containment at the Site. Testing of the installed system must be required to demonstrate achievement of the specific performance standards discussed in these comments (i.e., draw down groundwater levels at/near the portals as measured in non-pumping monitoring wells to elevations below the groundwater levels of the Cedar River and Rock Creek for at least one week). As written, the Proposed Plan provides no assurance that the Contingency Plan would actually work if it is needed, which is a blatant fatal flaw.

35. Section 5.5.3, entitled "Contingent Groundwater Infrastructure Components," first two sentences, Page 35, which state "Groundwater currently meets cleanup levels. Therefore, no groundwater containment or treatment is necessary." This over-statement needs to be qualified to read: "Based upon the available data gathered from existing monitoring wells located outside the known waste disposal areas, groundwater sampling has not detected exceedances of cleanup levels; no monitoring of groundwater in the mine workings beneath the waste disposal areas has been conducted. Monitoring in perpetuity will determine whether groundwater containment will be necessary in the future." Combined with other speculative and misleading text, this is another example of over-statements that undermine the "Black Box Approach" and create the misimpression that Site risks are minimal and need not be addressed by the Proposed Plan. It is a fact that groundwater quality within the

waste disposal area has intentionally not been characterized; therefore, statements regarding Site-wide conditions cannot be made.

36. Section 5.5.3, entitled "Contingent Groundwater Infrastructure Components," fourth sentence, Page 35. The reference to "long-term groundwater monitoring" should be revised to "groundwater monitoring in perpetuity." See general comments.

37. Section 5.5.3.2, entitled "South Portal Infrastructure," sixth sentence, Page 36, which states "At such time, a temporary pipeline leading from the south portal to the treatment system at the north portal will be used to transport contaminated groundwater to the north portal for treatment and disposal.". If a temporary discharge pipeline running across the surface for nearly a mile from the south portal will initially be used for up-front testing of the system or temporarily in its operation (not ideal—the pipeline should be buried), provisions will need to be made to ensure it is operable in freezing conditions. This needs to be stated in the Final CAP, with design details provided in the Engineering Design Report. In addition, a temporary discharge pipeline running across the surface would need frequent inspection to ensure its integrity, given its susceptibility to damage from falling trees, vandalism, etc. The text should clarify the requirements for converting the temporary discharge pipeline to a protective underground pipeline as that likely would be necessary for long-term containment.

38. Section 5.5.4, entitled "Sentinel Wells, Pages 36-37. As indicated elsewhere in these comments, the Proposed Plan does not include the practicability demonstrations required by MTCA to justify the approval of a conditional point of compliance at the Site. Furthermore, existing Site data cannot substantiate such practicability demonstrations. As such, the standard point of compliance must be established throughout the Site at all monitoring wells (including all "sentinel" wells).

39. Section 5.5.4.1, entitled "South Sentinel Well System," Page 36:

    a. We disagree that the proposed south "sentinel" well located immediately south of the cap will provide effective monitoring of the hydraulic effects of the cap ("dual purpose"). The cap performance monitoring wells need to be positioned beneath the cap to observe directly the hydraulic effects of reduced recharge created by the cap. Consistent with our comments dating back to June 2009, we continue to recommend that two (2) cap performance monitoring wells be installed beneath the cap, both north and south of the fault where the "rock bridge" is located.

    b. The stated timing for installation of new "sentinel" wells ("This sentinel well will be installed after the CAP is finalized and remedial actions are completed.") is inconsistent throughout the Proposed Plan documents. The four new "sentinel" wells anticipated by the Proposed Plan must be installed prior to trench backfilling, as Ecology indicated would be required on page 2 of the January 21, 2010 Ecology letter to Golder Associates ("[The wells] will be installed after the CAP is finalized but before the remedial action (trench filling, low permeability capping) is implemented.").[12] Prior to and during cap construction, the new "sentinel" wells must be included in the protection monitoring program as discussed in subsequent comments.

40. Section 5.5.4.2, entitled "North Sentinel Well System," Page 37:

    a. As previously conveyed to Ecology, we disagree that the proposed northern "sentinel" wells, positioned downgradient of the portal, will necessarily serve as effective "sentinel" wells. In fact, they may not be within the primary groundwater flow path discharging from the north end of the Site. Documented information regarding groundwater flow in the north portal area is as follows:

        i. Existing wells LMW-2 and LMW-4 are installed "...at the northernmost point downgradient of the mine workings..."[13]. In other words, they are not screened within the permeable mine workings, which is depicted in the Site cross section (Figure 13 of Final Draft CAP);

        ii. Strong upward hydraulic gradients are documented, with artesian flowing heads at deep well LMW-10 that are at least 10 feet above those in shallower wells LMW-2 and LMW-4;

        iii. The inclined mine shaft surfacing as the north portal, upgradient of the proposed northern "sentinel" wells, provides a permeable flow conduit for groundwater to move upward toward the north portal in response to the strong upward gradient; and

        iv. Groundwater drains subsurface from the north portal via a 25-foot-deep gravel-filled trench, which is "above the valley gravels and does not receive water from the gravel aquifer"[14]. Groundwater in the gravel-filled trench may represent a primary groundwater northern discharge pathway from the mine workings, but it has never been investigated.

    Based on the collective information, it is probable that some and potentially most of the groundwater discharging from the north end of the Site is via the mine shaft/portal to the gravel-filled trench—thus missing the existing monitoring wells and proposed new "sentinel" wells. To have value for early warning, the northern "sentinel" wells need to be located between the source area and the north portal.

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[12] Ecology Letter from Jerome B. Cruz to Douglas Morell (January 25, 2010), p. 2 (Ecology Site File).

[13] Remedial Investion and Feasibility Study for the Landsburg Mine Site, Volume I (February 1996), pp. 2-18 (Ecology Site File).

[14] Page 3 of Golder Associates' May 23, 1997, "Response to City of Kent Letter dated March 17, 1997, Concerning Landsburg Mine Site Remediation Project" (Ecology Site File).

If the proposed shallow north "sentinel" well is intended to be screened within the gravel-filled trench, that intent needs to be specified. If not, a third new monitoring well needs to be installed within the gravel-filled trench (depth less than 25 feet) since that appears to be a predominant northern discharge pathway from the mine that would otherwise not be monitored. Because of the high permeability of the gravel within the trench, we expect that groundwater can flow via that pathway from the portal to the Proposed Plan's conditional compliance boundary (less than 300 feet) in a matter of months. Consequently, irrespective of where in the gravel trench a new monitoring well is sited, it should be considered a "compliance" well, not a "sentinel" well (even in the framework of the Proposed Plan's conditional points of compliance, the well could not provide early enough warning to function as a "sentinel" well, given the distance involved and given the Proposed Plan's inadequate monitoring frequencies).

41. Section 5.5.5, entitled "Monitoring," Pages 37-42. The introductory paragraph of the section continues the use of speculative text ("...the unlikely event that groundwater contamination is detected at the Site."). This is yet another example of speculation used to undermine the "Black Box Approach" and to create the misimpression that Site risks are minimal and need not be addressed by the Proposed Plan. As discussed below, the requirements of the Proposed Plan's monitoring are not clearly presented in this section.

42. Section 5.5.5.1, entitled "Protection Monitoring," Pages 37-38. This section refers to "short-term groundwater monitoring" but does not describe its requirements. It appears, but it is not clear, that such "protection monitoring" is described in the first bullet on Page 40. This section should clearly refer to the details of "Protection Groundwater Monitoring" which are described in Section 1.5.3 of Part A (entitled "Compliance Monitoring Plan") of Proposed Consent Decree Exhibit E (pages A-5 and A-6).

43. Section 5.5.5.2, entitled "Performance Monitoring," Page 38. This section does not describe the monitoring requirements. This section should clearly refer to the details of "Performance Monitoring" which are described in Section 1.6 of Part A (entitled "Compliance Monitoring Plan") of Proposed Consent Decree Exhibit E (pages A-6 and A-7).

44. Section 5.5.5.3, entitled "Confirmational Monitoring," Pages 38-39. The first paragraph of this section states "Long-term confirmational groundwater monitoring and Site inspections and maintenance will continue until residual hazardous substance concentrations no longer exceed cleanup or remediation levels described in the CAP resulting from either (1) the application of new remediation technologies currently unavailable or (2) other circumstances or conditions that affect residual concentrations such that they no longer pose a risk to human health or the environment." This sentence must be replaced with "Confirmational groundwater monitoring and cap inspections and maintenance will continue in perpetuity." See our

general comments. This is a global comment throughout the Proposed Consent Decree exhibits because the referenced statement occurs in several places.

45. Section 5.5.5.3, entitled "Confirmational Monitoring," Page 38. The third paragraph of this section describes activity that would occur in the event of an earthquake of "Intensity IV or greater (Modified Mercalli Intensity Scale) in the area." The Proposed Plan indicates that the PLPs will discuss with Ecology conducting groundwater monitoring after a seismic event, but does not require that any such monitoring will be done, does not specify the monitoring that will be required, and does not define deadlines for the necessary activities (other than notification of Ecology within seven (7) days of the seismic event). Changes in groundwater systems and damage to wells in response to seismic events are well documented, including during the 2001 Nisqually earthquake. Earthquakes have the potential to cause further collapse of the mine workings, potentially increasing contaminant mobility and/or changing groundwater flow paths. The extreme instability of the mined-out portion of the Site – which the Proposed Plan cites in part to justify the selected remedy – makes this a critical issue for the Site cleanup remedy. Therefore, this section of the Proposed Plan must require, within two (2) weeks of any earthquake potentially impacting the Site, inspection of all Site monitoring wells to ensure they remain functional and initiation of monthly groundwater monitoring (VOCs, TPH, 1,4-dioxane in all wells) for one (1) year. Following that monitoring, then consultation between Ecology and the PLP Group regarding appropriate monitoring requirements thereafter. The seismic events "triggering" these requirements should be considered carefully, and should be conservative. The Proposed Plan anticipates relying upon the Mercalli Intensity Scale—that scale is based on strength of seismic shaking, and we agree it is an appropriate measure for the purpose of determining a trigger to initiate emergency inspection and monitoring (vs. the Richter scale). However, an intensity value for a location is based on information gathered from people who have experienced the quake, so is purely subjective and not routinely reported for rural areas like where the Site is located. The Proposed Plan anticipates applying the Mercalli Intensity Scale to "the area" without defining what that vague concept means. Therefore, to avoid future uncertainty, the Final CAP must more clearly define how the determination of earthquake intensity will be made, by whom, and using what specific criteria. In our opinion, any damage to structures within 10 miles of the Site would be a valid trigger for the post-seismic inspection and monitoring program.

46. Section 5.5.5.3, subsection entitled "Groundwater Monitoring," Page 39:

    a. The second sentence states "Site groundwater currently meets remediation goals, so…" Consistent with previous comments, this over-statement needs to be qualified. It is a fact that groundwater quality within the waste disposal area has not been characterized; therefore, statements regarding Site-wide conditions cannot be made.

    b. Second-to-last sentence, which states "Additionally, four sentinel wells will be installed before the remedial action is complete…" See Comment #39b regarding the requirement to install these wells prior to the start of the remedial action.

47. Section 5.5.5.4, entitled "Groundwater Monitoring Program," Pages 39–40:

   a. First paragraph, first sentence, which begins "If a release were to occur, ..." The release, as defined in MTCA, RCW 70.105D.020(32), occurred when waste materials were disposed of at the Site and entered the environment. References to "release" in this paragraph and in other instances in the Proposed Plan need to be changed to "increased migration of contaminants" or similar language. This is a global comment pertinent to many instances in the documents.

   b. Three bullets regarding groundwater monitoring program elements are unclearly presented and confusing. As indicated above, this information should be presented more simply and clearly than it is (e.g., present the protection monitoring, then the confirmational monitoring, etc.) with appropriate references to section of Part A (entitled "Compliance Monitoring Plan") of Proposed Consent Decree Exhibit E.

   c. First bullet, listing monitoring wells in the groundwater monitoring program. The four new wells anticipated by the Proposed Plan are omitted and must be included. See our previous comments above regarding the inadequacy of the proposed monitoring network and the need for additional monitoring wells in locations other than those anticipated by the Proposed Plan.

   d. Second bullet (protection monitoring):

      i. The four new wells anticipated by the Proposed Plan must be included in the protection monitoring program. The Proposed Plan's new "sentinel" wells are the closest monitoring locations to the cap, so would be best positioned (but not optimally positioned) to reveal a chemical impact from construction, if one occurs. We expect that the wells would be angle-drilled from outside the trenches, so should not interfere with cap construction once installed. The addition of new wells within the cap area (as we believe should be required) would also not interfere with cap construction. The planned identification numbers for all new wells should be included so they can be referred to consistently throughout the Final Consent Decree documents.

      ii. Fourth sentence, stating "On a monthly basis, the samples would also be screened for total petroleum hydrocarbons and VOCs." Specify that the monthly "screening analysis" includes laboratory analyses meeting MTCA requirements, as indicated in Part A of Exhibit E. We recommend use of a term other than "screening analyses" for TPH and VOCs since the term implies a field screening method (e.g., a photoionization detector), which is not being proposed.

iii. Because of the known presence of chlorinated solvent wastes at the Site, 1,4-dioxane, a highly mobile compound typically found with chlorinated solvents, needs to be added to the monthly sampling and analysis (i.e., for all groundwater monitoring elements, TPH, VOCs, and 1,4-dioxane are more mobile contaminants requiring most frequent monitoring). Ecology required BIOSCREEN modeling of 1,4-dioxane to assess and define the monitoring frequencies; therefore, it must be included in the resulting monitoring program. If 1,4-dioxane will be quantified as part of the VOC analysis (EPA Method 8260), please state that.

iv. Global comment throughout the Proposed Plan: In our opinion PCBs can be dropped from the standard groundwater monitoring program. Given their highly hydrophobic nature, PCBs would not migrate significantly within Site groundwater unless facilitated by a carrier, such as petroleum, for which analyses are being required. If TPH concentrations are detected in the groundwater monitoring, PCB analyses should be added at that time. Meanwhile, the money spent on PCB analyses is much better spent on more frequent monitoring and on 1,4-dioxane analyses in our opinion.

e. Third bullet (confirmational monitoring), Page 40. Table A-2 of the Compliance Monitoring Plan indicates TPH is an analyte for the screening-level monitoring analyses, and we assume its omission in this paragraph is an error. Among the industrial wastes dumped at the Site, according to historical records, were "about 200,000 gallons of oily wastewater,"[15] therefore, TPH analyses (NWTPH-Dx and NWTPH-Gx) need to be included. For reasons stated above, 1,4-dioxane needs to be added to the screening-level analyses, if it is not a component of the VOC analysis planned. TPH, VOCs, and 1,4-dioxane should consistently constitute the suite for more-frequent monitoring throughout the monitoring phases.

f. Sub-bullet beneath third bullet regarding confirmational monitoring frequencies. We reiterate our previously presented opinions regarding the need for more frequent and protective monitoring frequencies as indicated in the table below.[16] See our general comments.

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[15] Final Draft CAP, p. 6.

[16] Aspect Consulting Memorandum dated November 9, 2009, letter to Kent regarding *Comments on PLP Group's BIOSCREEN Modeling Results and Proposed Monitoring Frequencies, Landsburg Mine Site*—submitted by Kent to Ecology via email from Kelly Peterson to Jerome Cruz on November 9, 2009 (Ecology Site File).

Protective Confirmational Monitoring Frequencies

Contaminants	Southern Pathway	Northern Pathway
VOCs; Diesel-range and Gasoline-range TPH; 1,4-Dioxane	0.25 year	0.25 year
Metals; SVOCs; Pesticides	5 years	2 years

If operation of the Contingent Groundwater Treatment System is triggered, groundwater monitoring should be conducted until groundwater at all monitoring wells at the affected portal(s), and the pumped groundwater effluent, contain contaminant concentrations less than 0.5 MTCA cleanup levels for four consecutive quarterly monitoring events.

48. Section 5.5.5.5, entitled "Response if Remediation Levels are Exceeded," Pages 40–42.

   a. In this section and elsewhere in the exhibits it needs to be specified that the results of any alternative source evaluation will be reported in writing to Ecology within defined timelines/deadlines, and that Ecology will make the determination regarding the source of the contaminant(s) of concern detected in a well(s). Given the lack of investigation within the Site, the Final CAP should provide specific criteria for the alternative source evaluation that would be used to determine whether or not a contaminant detection is attributable to the Site. On page 40 of the Final Draft CAP (Section 5.5.5.4, last sentence of second square bullet), it is stated that "More in-depth analysis would then be performed if screening analysis indicated that constituents may be present in groundwater at levels of concern (at least 50 percent of the respective MTCA Cleanup Level)." However, the section entitled "Sentinel Well Detections" (Page 41), and Figure A-8 in the Compliance Monitoring Plan (Proposed Consent Decree Exhibit E), indicate that no response action would be conducted if that occurs. The absence of any requirement to respond in those circumstances completely invalidates the concept of "sentinel" wells. The Proposed Plan needs to require immediate (i.e., within seven (7) days) commencement of a more frequent monitoring schedule for the monitoring well where the detection occurred if the alternative source evaluation (accomplished within defined timeframes/deadlines) cannot confirm a source other than historical waste disposal in the mine trenches. In addition, we request that the Data Management Plan (Appendix DMP to the Compliance Monitoring Plan, Part A of Exhibit E) require posting of each round of groundwater monitoring data to Ecology's EIM as soon as it is validated, so as to make it readily accessible to Kent and the public. We also request that the Final CAP require that the PLP Group notify both Ecology and Kent immediately as soon as any detection exceeding 0.5 of a cleanup level is verified in any Site monitoring well. See RCW 70.105D.010(6) (" Because releases of hazardous substances can adversely affect the health and welfare of the public, the environment, and property values, it is in the public interest that affected communities be notified of where releases of hazardous substances have occurred and what is being done to clean them up."); WAC 173-340-130(2) ("It is the policy of [Ecology] to make information about releases or threatened releases available to owners, operators or other persons with potential liability for a site in order to encourage them to conduct prompt remedial action. It is also the policy of [Ecology] to make the same information available to interested members of the general public so they can follow the progress of site cleanup in the state."); WAC 173-340-130(7) ("If [Ecology] is conducting remedial actions or requiring remedial actions under an order or decree, [Ecology] shall ensure appropriate local, state, and federal agencies and tribal governments are kept informed and, as appropriate, involved in the development and implementation of remedial actions. The department may require a potentially liable person to undertake this responsibility.").

b. The subsection entitled "Compliance Well Detection Over 0.25 MTCA Cleanup Levels". We request that the Final CAP require that the PLP Group notify both Ecology and Kent immediately as soon as any detection exceeding 0.25 of a cleanup level is verified in a south portal monitoring well.

c. The subsection entitled "Compliance Well Detections Over 0.5 MTCA Cleanup Level". As previously discussed above in our general comments, the Proposed Plan provides in this subsection that the Contingent Groundwater Containment System will not be designed, approved, permitted, and installed until re-sampling confirms detection of a contaminant above 0.5 MTCA cleanup level at a "compliance" monitoring well (i.e., at the edges of the Site). And, the Proposed Plan provides no defined timelines/deadlines for those activities. When the system is installed, the Proposed Plan does not require any testing of the installed system to demonstrate hydraulic containment (and does not define the performance standards for achieving containment). If Ecology is intent upon implementation of the "Black Box Approach," the Final CAP must comply with MTCA's requirements for protectiveness. MTCA protectiveness requires a Contingent Groundwater Containment System that is designed, approved, permitted, installed, and tested up-front to demonstrate its ability to extract groundwater and to achieve groundwater containment per defined performance standards and timeframes/deadlines for action (see our general comments). Also as previously discussed above in our general comments, the Proposed Plan provides in this subsection that the operation of the Contingent Groundwater Containment System will not be "triggered" unless and until groundwater concentrations of contaminants exceed MTCA cleanup levels at a "compliance boundary well(s)." Thus, this means that the Proposed Plan would allow contaminated groundwater to migrate off-Site into adjacent water resources—perhaps for years given the long intervals between sampling events—before containment would even be attempted using an untested system. Instead of allowing the consequences anticipated by the Proposed Plan to occur (degradation of off-Site water resources), the Final CAP must require that the "trigger" for operation of the Contingent Groundwater Containment System be the detection of any contaminant of concern at or above 0.5 MTCA cleanup levels, not exceeding the cleanup levels, at a monitoring well located near the portals of the Site. This is a reasonable and a necessary precaution to comply with MTCA's protectiveness requirements—and particularly necessary if the "Black Box Approach" to remedy selection is to be consistently applied at this Site.

d. The section entitled "Groundwater Monitoring During Operation of the Contingent Groundwater Treatment System" should refer to a containment system not treatment system (see prior comments) and should be revised as follows:

   i. First bullet. It is inappropriate to make a blanket statement that "All other wells will be monitored as per the long-term monitoring program", in the event that contaminants are detected at a particular well triggering the operation of the Contingent Groundwater Containment System. If this does occur, Ecology needs to determine the appropriate monitoring frequency for wells other than the wells where the exceedance occurred. For example, if the highest contaminant concentrations occur at one of the "sentinel" wells designated by the Proposed Plan and a well located near a portal exceeds cleanup levels, it would be technically inappropriate to maintain very long monitoring frequencies (e.g., up to 10 years) for that "sentinel" well. Additional information must be collected as needed to understand contaminant transport, and this likely would involve adding additional monitoring wells and increasing monitoring frequencies in wells that are appropriate. The referenced statement needs to be replaced with language giving Ecology the discretion to require appropriate action such as: "In the event of any detection of a contaminant(s) of concern in any monitoring well, the migration of impacted groundwater would be evaluated, groundwater monitoring would be increased, and additional wells would be sampled and analyzed as necessary to determine the fate and transport of the contaminants and to evaluate associated risk." Again, the Final CAP should define timeframes/deadlines for such activities, in order to provide for Ecology oversight and enforcement.

   ii. Second bullet, which states "Contingency groundwater extraction and treatment will continue until groundwater at the points of compliance and the pumped effluent are below MTCA Cleanup Levels for four consecutive monitoring periods or a minimum of one (year) *(sic)*." The text should be revised to require that groundwater monitoring be conducted quarterly if and when the Contingent Groundwater Containment System operates, and the Contingent Groundwater Containment System must operate until groundwater at all monitoring wells at the affected portal, and the pumped groundwater effluent, are below 0.5 MTCA Cleanup Levels for four consecutive monitoring periods (and for not less than one (1) year).

49. Section 5.5.6, entitled "Institutional Controls," second paragraph, last sentence, Page 43, which states "Site use restrictions would remain in force indefinitely." To comply with MTCA, indefinitely" needs to be replaced with "in perpetuity", which is the commitment Ecology and the PLP Group previously provided. this change must also be made to Exhibits F-1 and F-2 (see comments below). See our general comments above, as well as additional specific comments below.

50. Section 5.5.6, entitled "Institutional Controls," last paragraph, first two sentences, Page 43, which state "Groundwater at the Site's points of compliance currently meets remediation goals. Therefore, no groundwater containment or treatment is currently

necessary." This over-statement needs to be revised consistent with our prior comments above.

51. Section 5.5.6, entitled "Institutional Controls," last paragraph, last sentence, Page 43, which states "...groundwater containment treatment (if necessary) and discharge to the King County Metro POTW sewer would be readily implemented." See our general comments regarding the need for requirements establishing timeframes and deadlines for the design, approval, permitting, installation, testing, and operation of the Contingent Groundwater Containment System.

52. Section 5.6, third paragraph, Page 44, which acknowledges that "WAC 173-340-380(1)(a)(ix) requires specification of the types, levels, and amounts of hazardous substances remaining on Site for containment alternatives." The required specification cannot be included in the Proposed Plan because the inadequate Site investigation and characterization has not revealed the types, levels, and amounts of hazardous substances remaining in the Site. The text purporting to make the required specification is based upon speculation and unfounded assumptions. The text acknowledges that "...the amount of waste remaining at the Site within the Roger Seam trenches is uncertain." As indicated in our comments above, if Ecology is intent upon implementing the "Black Box Approach," the text should clearly explain the "Black Box Approach" to Site investigation and remedy selection, and justify how the selected remedy is consistent with the "Black Box Approach" (i.e., assumes the worst case scenario given the Site's unknowns and provides conservative protective remedy components to address the worst case scenario).

53. Section 5.6, entitled "Evaluation of Cleanup Action With Respect to MTCA Criteria," fifth paragraph, last sentence, Page 44, which states "Cleanup levels are appropriate for the highest beneficial use of groundwater as a potential drinking water source." As stated in previous specific comments above, Method B groundwater cleanup levels need to incorporate surface water standards (ARARs) in addition to potable groundwater standards.

Exhibit C: Schedule

54. This schedule fails to address many aspects of Site activities that are required by the Proposed Plan, as discussed elsewhere in these comments; the schedule should be revised to define many timeframes/deadlines that should be required by the Final CAP. As drafted, Ecology cannot effectively oversee or enforce the Proposed Plan. Timeframes/deadlines for submission of data to Ecology are not established. Timeframes/deadlines for the contingency plan are not established. Timeframes/deadlines for addressing seismic events are not established. The schedule needs to be specific and comprehensive for all Site activities.

55. The start of cleanup construction phase should be required within 1 year of Ecology approval of the EDR and associated documents (i.e., in the next construction season).

56. We request that the Data Management Plan (Appendix DMP to the Compliance Monitoring Plan, Part A of Exhibit E) require posting of each round of groundwater

monitoring data to Ecology's EIM as soon as it is validated, so as to make it readily accessible to Kent and the public.

Exhibit E: Part A (Compliance Monitoring Plan), Part B (Operation and Maintenance Plan), and Part C (Contingent Groundwater Extraction and Treatment System Plan)

57. Much of the information in the Introduction to this Exhibit repeats information provided in the Final Draft Cleanup Action Plan or Parts A, B, and C of Exhibit E, so can be deleted, in our opinion. In any event, Exhibit E's contents should be consistent with the comments set forth above.

Part A to Exhibit E: Compliance Monitoring Plan

58. The Compliance Monitoring Plan must state that analytical data will be reported to the method detection limit (MDL), not just the reporting limit, to provide the best possible detection capability, as has been previously agreed to by Ecology (January 21, 2010 letter to Golder Associates).

59. Section 1.1.1.2, subsection entitled "Performance Monitoring," Page A-1. Re-word the statement "...no media are exposed above cleanup levels..." The statement is false, misleading, minimizes Site conditions and risks, and undermines the "Black Box Approach." Soils and waste sludges at the Site are known to exceed cleanup levels. The Proposed Plan anticipates containment via soil capping to eliminate exposure to the contaminated soils. Furthermore, the statement is misleading in that the groundwater in and below the known hazardous waste disposal area has not been investigated.

60. Section 1.1.3, subsection entitled "Confirmational Monitoring," last sentence, Page A-2. As stated in our general comments above, the timeframes, deadlines, and performance standards for achieving hydraulic containment must be delineated. The statement that "A contingent groundwater extraction and treatment system has been designed (Part C) which could be installed quickly if needed." is false. The extraction system as presented in the Proposed Plan has not been designed. To the extent the extraction system has been preliminarily conceptualized, the concept is not based on reliable data as outlined in previous comments above. More importantly, hydraulic containment of groundwater contamination, <u>not</u> system installation, will achieve protectiveness. We reiterate our opinion that hydraulic containment must be achieved within one (1) month of the operational "trigger." See our general comments regarding these matters.

61. Section 1.3, entitled "Sentinel Well," third sentence, Page A-3, stating "Four new sentinel wells will be installed prior to the completion of the remedial action construction activities." This statement needs to be revised here and elsewhere in the Proposed Plan to state that "Four new wells will be installed as the first step of the remedial action construction activities." As Ecology stated in their January 21, 2010 letter to Golder Associates, the four new wells need to be installed <u>prior</u> to trench filling for the cap construction, and that prior installation needs to be clearly stated here (not limited to Page C-4 in Part C of Exhibit E). The two northern "sentinel"

wells and the northernmost of the two southern "sentinel" wells are the monitoring wells located closest to the known waste disposal area and proposed soil cap. As such, they are the most critical of the proposed monitoring wells for protection water quality monitoring (i.e., to detect increased contaminant migration in response to the trench backfill and cap construction activities). They are also the critical wells for monitoring the hoped-for local reduction in recharge; to that end, a minimum of one (1) year of water level data in these and other Site wells is needed prior to start of cap construction to provide a baseline data set against which to compare post-construction water levels. There is no justification to not have these critical monitoring points in place prior to the start of the soil capping earthwork. The new wells must be installed and their baseline water level monitoring started immediately after the effective date of the Consent Decree (i.e., within a defined timeframe/deadline). See previous comments above regarding the necessary locations of new wells.

62. Section 1.5.3, entitled "Protection Groundwater Monitoring," Page A-5:

    a. The four new wells must be included in the short-term monitoring program (refer to previous specific comments above).

    b. 1,4-dioxane must be included in the suite of monthly analytes, i.e., any time TPH and VOCs are analyzed (refer to comment 25d(iii) above). PCBs can be dropped from the monitoring program (refer to previous specific comments above).

63. Section 1.5.3, entitled "Protection Groundwater Monitoring," Bullet 6, Page A-6, which states "If exceedance of groundwater MTCA cleanup levels is verified at a compliance well, then appropriate corrective action will be determined and proposed for Ecology approval. If the alternative source of the detected analyte is not identified, the Group will take correction action by installing and starting operation of the groundwater extraction and treatment system discussed in Part C, the Contingent Groundwater Extraction and Treatment Plan." There is only one corrective action in the scenario outlined, and this is inconsistent with the Final Draft CAP's text (see its Section 5.5.5.5, Pages 40-42). The Final Draft CAP requires that concentrations exceeding 0.5 the cleanup level at a "compliance" well would trigger installation of the Contingent Groundwater Containment System, and an exceedance of a cleanup level at a "compliance" well would trigger its operation. As indicated in our general comments, the trigger for operation of the Groundwater Containment System should be the detection of any contaminant of concern at or above 0.5 MTCA cleanup levels at any monitoring well located near the portals of the Site. In addition, since "sentinel" wells must be included in the short-term monitoring program, if the "compliance" and "sentinel" well distinction and "conditional compliance boundary" anticipated by the Proposed Plan are included in the Final CAP, decision criteria should be defined for confirmed exceedances of cleanup levels at "sentinel" wells. If Ecology is intent upon that approach the response action for that situation should be initiation of quarterly monitoring at the exceeding "sentinel" well and downgradient "sentinel" and "compliance" wells.

64. Section 1.7, entitled "Confirmational Monitoring," first paragraph, fourth sentence, Page A-7. The statement regarding strategic location of monitoring points along preferential flow paths is not justified technically, is based upon speculation and unfounded assumptions, and should be deleted. The depths for preferential groundwater flow paths at the Site are unknown, given the lack of Site investigation. In reality, the monitoring wells have been placed at arbitrarily selected depths to provide partial coverage across the great depth of the mine workings.

65. Section 1.7.1, entitled "Monitoring Parameters and Frequency," Pages A-7 and A-8:

    a. TPH (NWTPH-Dx and NWTPH-Gx) and 1,4-dioxane need to be added to each screening-level monitoring event (refer to previous specific comments above). Quarterly monitoring for TPH is indicated in Table A-2 although the TPH analytical method is erroneously stated in the table as Method 418.1, which is not an approved method under MTCA (refer to Table 830-1 in MTCA). TPH analyses should be performed using NWTPH-Gx and NWTPH-Dx analytical methods to quantify gasoline, diesel, and heavy oil petroleum hydrocarbon ranges.

    b. Regarding the semi-annual monitoring, reference to the "full GC/MS analysis" should be replaced with the specific analyses (VOCs, SVOCs, etc.). TPH analyses need to be included for each round (as specified in Table A-2 of Part A) and 1,4-dioxane analyses need to also be included for each round.

    c. See previous specific comments regarding additional monitoring requirements after earthquakes.

66. Section 1.7.1, entitled "Monitoring Parameters and Frequency," two bullets, Page A-8. See General Comment E regarding the need for more protective monitoring frequencies in order to protectively implement the "Black Box Approach" to remedy selection as required by MTCA.

67. Section 1.7.2, entitled "Response If Remediation Levels Are Exceeded," Pages A-9 to A-11. See General Comments F through I. In addition:

    a. First paragraph, first sentence, which states "The contingent groundwater treatment system will be installed after confirmed remediation levels (>0.5 MTCA cleanup levels at a compliance monitoring well) are exceeded, but before groundwater concentrations reach cleanup levels at the compliance boundary wells." As drafted, the sentence is speculative given the unknowns and uncertainty (due to lack of investigation) regarding how quickly contaminants migrate in the highly permeable mine workings, and potentially the very small difference between MDLs (i.e., level of detection capability) and cleanup levels (e.g., for vinyl chloride). Because it is speculative, the sentence should be revised to delete the phrase "..., but before groundwater concentrations reach cleanup levels at the compliance boundary wells."

b. First paragraph, second sentence, which states "…the contingent groundwater treatment system cannot be designed or installed until the specific mine waste contaminants requiring treatment are identified." We agree that the treatment component of the Contingent Groundwater Containment System cannot be designed or installed until specific contaminants breaking through are known. However, see our general comments regarding the need for up-front design, approval, permitting, installation, and testing of the extraction/conveyance components of the System during remedial design, after execution of the Consent Decree.

c. Our comments regarding the subsections entitled "Sentinel Well Detections", "Compliance Well Detections Over 0.25 MTCA Cleanup Levels", and "Compliance Well Detections Over 0.5 of the MTCA Cleanup Level" are stated previously in our specific comments above.

68. Table A-2. The table subtitle, which lists monitoring wells, should list the four new wells also. Method 418.1 needs to be replaced with MTCA-compliant TPH analytical methods, as stated above. We suggest that pH, specific conductance, dissolved oxygen, and turbidity be grouped onto a single line as "Field Parameters", with the specific parameters defined in the footnotes (i.e., revise footnote c which is currently incomplete).

Part B to Exhibit E: Operation and Maintenance Plan

69. Sections 1.1 (entitled "Routine Inspections") and 1.3 (entitled "Schedule"), Pages B-1 and B-3. Since erosion is a concern for this Site, larger storm events (e.g., 0.5 inch of rain within 24 hours) outside of a planned monitoring schedule should trigger a cap inspection during the first year following cap construction. Rainfall amounts should be determined by data obtained from a defined local rain gauge location—the USGS gauging station 12118400 for Rock Creek at Highway 516 provides real time rainfall data. Likewise, a cap inspection should occur within one (1) month following a potentially significant seismic event (see previous specific comments re: monitoring after seismic events), if such an event occurs outside of a planned monitoring schedule.

70. Sections 1.1 (entitled "Routine Inspections") and 1.2 (entitled "Cap Geodetic Surveys"), Pages B-1 and B-3. A defined inspection checklist(s) should be developed and approved by Ecology during remedial design to keep inspectors consistent regarding their field observations over the long term.

71. Section 1.3, entitled "Schedule," first sentence, Page B-3, which refers to "…completion of the post-closure period." Because contaminants will remain beneath the cap in perpetuity, the cap inspections need to occur in perpetuity, consistent with the confirmational groundwater monitoring program, consistent with MTCA, and consistent with Ecology's previous assurances to the public. See our general comments.

72. Section 1.4, entitled "Maintenance," Page B-1. Maintenance specifications to be developed should reference suitable seed mixes, soil type, compaction, etc. to be used for cap repair so as to keep the cap functioning as intended.

Part C to Exhibit E: Contingent Groundwater Extraction and Treatment System Plan

73. See all comments above regarding the Contingency Plan.

74. Section 1.0, entitled "Purpose and Scope," second paragraph, Page C-2. Ensure that Method B groundwater cleanup levels are established to incorporate surface water ARARs, as discussed in previous specific comments above.

75. Sections 2.1 (entitled "Compliance Monitoring") and 2.2 (entitled "Sentinel Wells"), Pages C-3 and C-4, can be deleted since they repeat information provided in Part A of Exhibit E and are not pertinent to the Contingent Groundwater Containment System. However, Section 2.2.1, Pages C-3 and C-4, is the one spot in the collective exhibits which clearly states that a new well will be installed prior to start of filling the waste disposal trenches. That is appropriate, but, as Ecology has previously indicated in Ecology's January 21, 2010 letter to Golder Associates, all of the new wells need to be installed prior to cap construction because they are critical for effective protection monitoring, as discussed in previous specific comments above. This is a critical revision to be made throughout the Proposed Plan.

76. Section 2.3.1, entitled "North Portal Infrastructure," second-to-last sentence, Page C-5. The reference to "relatively short" lead times to get the necessary infrastructure in place for the Contingent Groundwater Containment System is speculative and unacceptably ambiguous, given its critical importance for remedy protectiveness. See our general comments regarding the need for up-front installation and testing of a robust system with delineated and enforceable performance standards, timeframes, and deadlines.

77. Section 2.3.2, entitled "South Portal Infrastructure," Page C-5. See General Comment G regarding the need to delineate timeframes/deadlines to achieve hydraulic containment.

78. Section 2.3.2, entitled "South Portal Infrastructure," Page C-5. The subsequent Engineering Design Report needs to detail how a very long temporary discharge pipeline from the south portal for up-front testing of the system or temporarily in its operation (not ideal—the pipeline should be buried) would be protected from freezing and damage, and delineate the requirements for replacing the temporary pipeline with a more permanent one, as stated in previous specific comments above.

79. Section 3.0, entitled "Design Basis and Process Selection," Pages C-6 and C-7:

    a. First sentence, stating "The design flow rate for the treatment system ranges from 10 to 40 gpm." See our general comments and the previous specific comments above, indicating that the statement is contradicted by information in the RI/FS. Given its critical importance for remedy protectiveness, the

Contingent Groundwater Containment System design flow rates that would achieve hydraulic containment at each portal must be justified during remedial design with reliable pumping test data collected from the actual extraction wells to be used for containment.

b. Third paragraph, third sentence, which states "The treatment system effluent discharge pipeline has been installed, but does not currently connect to the King County Metro POTW sanitary sewer adjacent to the Tahoma Junior High School." The reason for not currently connecting the effluent discharge pipeline to the King County Metro sewer line must be explained. Is there an issue preventing its connection without active discharge, and, if so, how/when does that issue get resolved? Have previous objections asserted by Tahoma School District No. 409 been overcome, and, if not, how/when do those objections get resolved? Have all other necessary steps been identified and addressed? All necessary steps should be delineated in the Proposed Plan—they are not currently. Figuring out such issues after the system is needed is not acceptable. In addition, trucking water to the sewer is not a realistic nor reliable solution, even in the short term. Even with a 40-gpm system flow rate (which is likely too low to be effective; see specific comments above), a 6000-gallon tank truck would provide for only 2.5 hours of pumping time. Pumping needs to be continuous to maintain hydraulic containment. To reiterate, this system needs to be operational within a timeframe of one (1) month to provide reasonable assurance of remedy protectiveness; therefore, all of these operational issues need to be worked out in advance of it being needed – i.e., worked out in remedial design. The cavalier approach to the Contingent Groundwater Containment System currently presented in the Proposed Plan fails to comply with the requirements of MTCA and fails to implement the "Black Box Approach" to remedy selection adopted by Ecology for this Site. See our general comments.

80. Section 5.1, entitled "Initiate Completion of North Discharge Pipeline," third sentence, Page C-9, which states "This also requires obtaining the necessary permits and discharge authorization from King County Metro POTW to discharge pre-treated water into the sewer system." Permits or approvals other than a King County Metro discharge authorization (DA) will be needed to discharge to sanitary sewer. Some of those permits and approvals are listed in the Proposed Consent Decree's Exhibit G, but the list is incomplete in its failure to include the King County Council, Soos Creek Water & Sewer District, Tahoma School District No. 409, and possibly other entities. King County has previously indicated that the King County Council will need to approve an amendment to the Soos Creek Water & Sewer District Comprehensive Plan, and that approvals from Soos Creek and the Tahoma School District will be necessary.[17] Tahoma School District No. 409 has previously objected to the proposal to connect to the facilities they constructed.[18] All necessary steps

[17] King County Letter dated February 15, 2006, from Karen Wolf to Jerome Cruz (included in Proposed Consent Decree Exhibit E, Part C, Appendix A).

[18] Ecology's Responsiveness Summary for Agreed Order Amendment, State Environmental Policy Act (SEPA) and Determination of Non-Significance (DNS) to Address Infrastructure for a Contingent

should be clearly delineated in the Proposed Plan—they are not. And, the processes necessary to obtain all permits and approvals need to be identified clearly in the Proposed Plan—they are not. Waiting to figure out the necessary permits and approvals until an emergency situation arises is not acceptable. See our general comments.

81. Section 5.2, entitled "Install South Extraction Pipeline (if needed),"Page C-9, regarding the temporary above-ground pipeline from the south portal to the treatment system. See previous specific comments above.

82. Section 5.4, entitled "Install Extraction Well and Pump,"Page C-10:

    a. Second sentence, which states "The pump that will be installed will have a flow rate of approximately 10 to 40 gallons per minute capacity." See our general comments and specific comments above regarding the need to determine the Contingent Groundwater Containment System extraction flow rate and related requirements.

    b. Fifth sentence, which states "The extraction well(s) will only be installed at optimum location and depth (for *(sic)* the screened interval within the site where contaminated groundwater is encountered and emanating from the Rogers Seam." The extraction well locations appear pre-determined based on Figure C-3. The extraction well depth need not be based on depth where contaminated groundwater is observed. The extraction well needs to be screened deeply enough to accommodate drawdown that achieves the hydraulic containment performance standards while accommodating expected well losses. Therefore, the extraction well depth/sizing required to achieve the necessary drawdown at each portal can be, and must be, determined now (i.e., conduct hydraulic testing during remedial design and installation—not in an emergency situation after detection of migrating groundwater contamination). See our general comments.

    c. Figure C-6. Equipping the extraction wells with a shrouded variable speed pump is a good plan. Each extraction well also needs a flow meter to monitor instantaneous pumping rates. The flow meter for discharge to sewer meets King County Metro's monitoring needs, but, depending on how the full containment system would be operated, may not be an accurate measure of groundwater extraction rates. The plan must specify monitoring of the well(s) extraction rates.

Groundwater Treatment System for the Landsburg Mine Site (June 2006), pp. 14-15 (Ecology Site File SIT8.5.2).

Two Exhibits F: Restrictive Covenant

83. The draft documents contain two Exhibits F that need to be revised as Exhibits F-1 and F-2, to be consistent with the Proposed Consent Decree's Section XX.

84. In both Exhibits F ("Restrictive Covenant"), Environmental Covenant, Section 6, the two draft covenants state: "The Owner of the Property reserves the right under WAC 173-340-440 to record an instrument that provides that this Covenant shall no longer limit use of the Property or be of any further force or effect." Section 6 should be deleted from the draft covenants in both Exhibits F.

85. The Proposed Plan applies the institutional control to properties owned by the PLP Group and which encompass the Site as currently defined. However, if the Site is to be considered a "Black Box" relying upon perimeter monitoring and, if the Final CAP is to be consistent with Ecology's "Black Box Approach" to cleanup, the worst case scenario must be assumed and anticipated by the remedy. Therefore, the Proposed Plan and its environmental covenants must be revised to include provisions for expanding the geographic scope of the institutional control if off-Site contaminant migration occurs outside of the current properties covered by the institutional controls, such that all affected areas are protected. This could involve applying the institutional control on private or public property not owned by the PLP Group.

86. The Proposed Plan's boundary for the environmental covenant does not encompass the Site and must be expanded to provide the protectiveness required by MTCA. The boundary for the environmental covenant is aligned arbitrarily with the external boundary of real property currently owned by the landowner PLP (Palmer Coking Coal Company). The arbitrary nature of the boundary is apparent by its southeast boundary, which excludes adjacent private property not owned by the PLP and excludes a portion of the Site immediately west of the south portal. The mined-out coal seam dips toward the west and underlies the adjacent private property; that portion of the Site is therefore outside of the boundary of the environmental covenant. The fact that monitoring well LMW-5 on that private property was drilled vertically, not inclined, to intercept the mine workings clearly demonstrates this fact, and clearly demonstrates the inadequacy of the environmental covenant boundary as developed in the Proposed Plan.

Thank you for your consideration of these comments. As appropriate, we can be available to discuss these comments with Ecology, in hopes of accomplishing the revisions to the Proposed Plan necessary to achieve the certainty for long-term protectiveness required by MTCA.

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Aspect CONSULTING

STEVE GERMIAT, LHG Senior Associate Hydrogeologist

Steve Germiat has 25 years of experience in the full MTCA cleanup process, including RI/FS and risk-based remedy selection/implementation. Steve has acted as technical lead and project manager for a number of regulated environmental cleanup sites spanning a broad range of historical operations and contaminants. His responsibilities have included managing RI/FS and risk assessments; negotiating with regulatory agencies regarding cleanup levels and remedy selection; developing Cleanup Action Plans (CAP) and engineering design reports (EDR) for remedial actions; participating in community involvement; and following up with remediation bid packages and cost estimates, cleanup oversight, monitoring, and optimization, and institutional controls management. He is a licensed professional geologist/hydrogeologist and a nationally-certified groundwater professional, has been licensed as a well driller in Washington State, and has written expert testimony for the Washington State Pollution Control Hearings Board for the water rights permitting process. Steve has also served as a book/software reviewer for the national journal *Ground Water*.

EDUCATION

MA, Geology (Hydrogeology program), University of Texas at Austin, 1988

BS, with Distinction, Geology, University of Wisconsin-Madison, 1985

PROFESSIONAL LICENSURE

Licensed Hydrogeologist, WA

Certified Groundwater Professional

RI/FS and interim Action, GP West Site, Port of Bellingham

Steve is managing the RI/FS and interim action for the key property in the Port of Bellingham's revitalized Waterfront District. The RI/FS is focused on exposure pathways of greatest concern under the future land use - controlling groundwater contaminant migration to protect the adjacent marine environment and addressing intrusion of contaminated vapors into future site structures. During the RI/FS, an interim action to remove highly contaminated source areas, including liquid elemental mercury, is being conducted. The project has involved considerable interaction with the Bellingham Bay Action Team resource agencies.

RI/FS/CAP/EDR/Cleanup, Former Riverside Lumber Mill Property, Everett

Steve managed the RI/FS/CAP and cleanup for a 90-acre former mill property on the Snohomish River waterfront contaminated with TPH, PCP, and cPAHs, quickly achieving NFA determinations for more than ¾ of the tax parcels. For the remaining cleanup site within the property, he completed all phases of the MTCA cleanup process (RI/FS through remedial design, supporting SEPA/shoreline permitting, and construction management) including reporting and communications with Ecology VCP throughout the process. Part of the FS assessment included fate/transport modeling to demonstrate that intrinsic biological degradation of PCP is occurring in the aquifer, albeit slowly. The project achieved an NFA for all site soils and, following 15 months of active groundwater treatment, an NFA for groundwater. The project won awards from both the Association of Washington Businesses and the Northwest Environmental Business Council.

RI/FS and interim Action, K-C Worldwide Site Upland Area, Everett

Steve is managing the RI/FS and interim action for the upland portion of this waterfront 60-acre former pulp and paper mill, planned for industrial redevelopment. To date, the work has involved completion of a comprehensive independent Phase 2 environmental site assessment, preparation of an Interim Action Work Plan included with the Agreed Order, and implementation of the interim action to remove highly concentrated contaminant areas representing potential sources to groundwater or vapor, and with concurrent initiation of the RI data collection program.

STEVE GERMIAT, LHG Senior Associate Hydrogeologist – page 2

Central Waterfront RI/FS, Port of Bellingham
Steve is providing senior technical and strategic support in updating the RI/FS for the Port of Bellingham's Central Waterfront Site, just across the Whatcom Waterway from the Waterfront District Phase 1 development area. While the planned future use of this site is different than that of the Phase 1 development area, it has comparable contaminants, subsurface conditions, and waterfront redevelopment constraints being considered for the upland cleanup remedy.

Contaminant Transport Modeling, Gas Works Park Sediments, Seattle
Steve managed the groundwater contaminant transport modeling effort supporting evaluation of remedial alternatives for PAH-impacted lake sediments on the shoreline and offshore of Gas Works Park. The model served as an effective tool to assess cap recontamination (breakthrough) and changes to groundwater flow patterns for conventional sand caps, carbon-enhanced caps, and impermeable barriers as remediation options achieving long-term protection of Lake Union.

RI/FS/CAP and Interim Remedial Actions, Former Pacific Powder Site, Port of Tacoma
Steve managed the RI/FS/CAP for a 1,625-acre property that included an explosives manufacturing facility for more than 40 years. Within 6 months of authorization, he completed focused sampling and reporting, and received formal Ecology concurrence to remove more than 90 percent of the property from the site, allowing for its unrestricted redevelopment. Concurrent with the subsequent RI/FS, Steve oversaw a pair of interim remedial actions that achieved unrestricted soil cleanup levels site-wide, allowing the FS and CAP to address groundwater only. The remediated site is currently being developed for aggregate mining while groundwater monitored natural attenuation proceeds.

RI, CAP, and Cleanup Oversight of former Mill, Dickman Mill Park, Tacoma
The Dickman Mill Park is a constructed intertidal wetland and public park developed from a timber mill with 100-year industrial history on the Tacoma waterfront. Steve successfully negotiated with Ecology for a dramatically reduced scope of sampling and analysis that focused on potential exposures under the future site use as a park. He developed a CAP that made use of the cover materials included in the park design (for habitat reasons) as the sediment containment for the cleanup action. Steve provided coordination with Ecology throughout cleanup implementation and follow up reporting.

Sitcum Waterway Remediation Project, Port of Tacoma
Under contract to Port of Tacoma, Steve managed the CERCLA long-term groundwater quality monitoring program to assess potential changes in groundwater quality adjacent to a contaminated sediments nearshore confined disposal facility (CDF). His responsibilities include assessment of post-construction hydrogeologic conditions (with comprehensive tidal monitoring study), direction of baseline groundwater quality monitoring program, statistical evaluation/reporting of performance data, estimation of soil:water partitioning coefficients from batch leading data, and negotiation of long-term monitoring program.

Georgia Pacific MNA Assessment of Former Paper Manufacturing Facility, Redmond
Steve was Aspect's project manager for assessment to document that, following source removal, residual concentrations of ketones in groundwater are attenuating naturally to below cleanup levels in a reasonable timeframe. He developed weight-of-evidence approach to document the efficacy of groundwater natural attenuation in a reasonable timeframe, based on plume stability and geochemical indicators that intrinsic biodegradation is occurring.

STEVE GERMIAT, LHG Senior Associate Hydrogeologist – page 3

Groundwater Remediation System Pilot Testing and Tracer Testing, Confidential Site, Spokane
Steve oversaw and evaluated pilot test performance of an oxygen enhancement system (OES) designed to facilitate biodegradation of petroleum contamination in groundwater within the highly productive Spokane Aquifer. The OES involved pumping aerobic groundwater from deep within the aquifer (2,700 gpm) and recirculating that water via horizontal and vertical well screens above the water table, where the recirculated water was further oxygenated before infiltrating back to the water table where the petroleum contamination is concentrated. Testing of system performance included detailed monitoring of groundwater mounding from recharge, and changes in downgradient groundwater dissolved oxygen content. In addition, a bromide tracer test, involving injecting bromide into the recirculation water, was completed as a second means to evaluate the OES's area of influence. The pilot testing confirmed that the OES effectively improves groundwater treatment more than 100 feet downgradient of the recirculation locations.

Groundwater Remediation, Naval SUBASE Bangor, Site F
Steve was the project hydrogeologist for development and design of interim and final (enhanced) groundwater remediation systems, and project manager for oversight, monitoring, and optimization of system operation. Project activities included drafting portions of the Record of Decision for final remedial action, managing groundwater modeling to guide design of the extraction and reintroduction components of the interim and enhanced systems, and evaluating performance data from the interim system to guide design of the final system enhancements. He directed 3-D numerical groundwater flow and contaminant transport modeling to assess optimal design configuration of extraction and reintroduction wells (for treated water disposal). The objectives of the design optimization were to: 1) prevent further migration of contaminated water; 2) restore the aquifer to drinking water standards; and 3) maintain maximum flexibility for adjusting operation based on performance monitoring data. Use of high-capacity (to 150+ gpm) reintroduction wells is an innovative component of the system design, allowing enhanced contaminant flushing, better hydraulic control on contaminant migration, and no net loss in the groundwater resource, all at lower cost than off-site water disposal options.

RI/FS, Former Munitions Manufacturing Facility, DuPont
Steve was the project hydrogeologist and deputy project manager for one of the largest and most involved cleanup projects in Washington State. His responsibilities included supervising an exceptionally large-scale field program, characterizing a unique multi aquifer system, and evaluating contaminant distribution and transport for more than 25 operable units covering 800 acres. He used site-specific leachability information and soil-to-water transfer models in a probabilistic framework to establish defensible soil screening levels protective of groundwater. Steve also applied this probabilistic methodology and risk evaluations to assess the practicability of alternative groundwater remediation alternatives.

5-Year Review, Institutional Controls Plan, and NPL Delisting Support, Naval Magazine Indian Island
Steve was the project manager for the first 5-year review of the ROD's selected remedy for Naval Magazine Indian Island. The selected remedy included capping of a waterfront landfill, including shoreline protection and comprehensive monitoring of shoreline erosion, and monitoring quality of shellfish tissue, sediment, and groundwater. As part of the Review, Steve prepared a remedy-specific Institutional Controls Management Plan to comply with EPA guidance. In addition, he developed the Final Close Out Report as the first step in the NPL delisting process.

Aspect CONSULTING

PETER BANNISTER, PE Senior Water Resources Engineer

Peter Bannister has 15 years of experience in environmental hydrogeology, with special emphasis on groundwater modeling design and review applied to contaminated site evaluation, remedial design, and cost allocation and litigation support. He also has experience applying groundwater modeling to address water resource issues, such as dewatering system design, stormwater infiltration design, and irrigation projects. His analytical modeling experience includes extensive knowledge and application of MOUNDHT and BIOSCREEN software. His numerical modeling experience includes extensive knowledge and application of MODFLOW and chemical transport (e.g., MT3D) software. He has a thorough understanding of Washington State's Model Toxics Control Act (MTCA) and effectively interacts with regulatory agencies and stakeholders.

EDUCATION

MS, Civil and Environmental Engineering: Water Resources Engineering, Duke University, 2001

BS, Environmental Science and Regional Planning, Washington State University, 1997

REGISTRATION

Registered Civil Engineer, WA

Lewis County Central Shop, Chlorinated Solvent Plume RI/FS, Chehalis

Peter conducted and managed field activities, data management, and groundwater modeling for a remedial investigation and feasibility study of a chlorinated solvents groundwater plume at a site in Lewis County under an Agreed Order with the Department of Ecology. Field activities included monitoring well installation, aquifer testing, groundwater and soil sampling, and installation and operation of pilot remediation system. The pilot remediation system involved the recirculation of permanganate-amended groundwater to reduce residual source concentrations on-property. Predictive groundwater modeling was conducted to compare the cleanup timeframes for various levels of source removal and residual source treatment.

Pasco Landfill Site, Focused Feasibility Study, Pasco

Peter provides technical and engineering support at this National Priorities List site that includes large unlined industrial waste cells, which have historically impacted groundwater with high concentrations of VOCs. Site cleanup is proceeding under MTCA, and Peter is drafting portions of a Focused Feasibility Study to inform the draft Cleanup Action Plan. Peter provided an alternative site conceptual model that identified the dominant vapor-to-groundwater pathway, and demonstrated the benefits of optimizing landfill gas extraction, which resulted in over 99 percent reduction in groundwater impacts. He is currently working to increase landfill gas collection to address low-level VOC impacts to groundwater without inducing atmospheric air intrusion.

Art Brass Remedial System Design/Construction for Chlorinated Solvents, Seattle

Peter pilot-tested and designed a air sparging and soil vapor extraction system for a shallow aquifer contaminated with chlorinated solvents in the Georgetown commercial/industrial neighborhood. Design included vertical air sparging wells, horizontal soil vapor extraction trenches, and vertical SVE wells within an active industrial facility. System performance monitoring included sub-slab vapor intrusion monitoring. Peter coordinated construction requiring high levels of coordination and clear communication. The system has performed well, and has significantly reduced groundwater concentrations.

PETER BANNISTER, PE Senior Water Resources Engineer – page 2

South Park Custodial Landfill Monitoring, Seattle
Peter measured soil gas concentrations of methane, carbon dioxide, oxygen, hydrogen sulfide, and photoionizable constituents, as well as groundwater levels in gas probes on and adjacent to the landfill. He compiled and summarized landfill gas conditions required for post-closure reporting. During property transfer, he reviewed and assessed the application of the BIOCHLOR model to evaluate monitored natural attenuation of chlorinated solvents in downgradient groundwater.

LNAPL Remediation for former Greyhound Bus Fueling and Maintenance Facility, Seattle
Peter was responsible for optimizing a LNAPL remediation system that involved total fluids pump-and-treat technology and enhanced fluids recovery using a vacuum truck. Representing new property owners with a restricted remediation budget, Peter was able to coordinate on-going monitoring, operation, and regulatory reporting of the LNAPL remediation effort. LNAPL recovery rates increased significantly as a result of targeted system maintenance and coordinated field support.

Cedar Hills Landfill Hydrogeologic Analysis, Maple Valley
Peter has been involved in multiple phases of evaluating hydrogeologic conditions and enhancing design of groundwater monitoring system at this 800,000 ton/year facility. This has included analysis of the potentiometric surface and groundwater velocities, evaluation of groundwater transport, and support for site-wide hydrogeologic evaluation. Peter helped verify the conceptual model of groundwater flow near the landfill by simulating flow across a major aquitard using numerical methods. He also helped identify areas of gas-to-groundwater impacts.

EIS Support for Aggregate Mining Project, DuPont
Peter developed a detailed MODFLOW-SURFACT groundwater model to characterize wetland/groundwater interaction in the vicinity of a proposed aggregate mine. To assess seasonality, the model simulated groundwater conditions for each month of a 7-year hydrologic period. Modeling results will be used to establish a monitoring program for mining and post-mining periods.

Duvall Custodial Landfill Hydrogeologic Analysis, Duvall
Peter has worked extensively at the Duvall Landfill, participating in the long-term study of the performance of a vegetative cover installed to minimize leachate production. He managed monthly field activities, data management, analysis, and reporting. He was the primary contact for transferring the database and field activities to King County. He also conducted and analyzed a pumping test for a leachate extraction well.

Landfill P-Map and Groundwater Velocity Calculations, King County
Peter managed the analysis and production of potentiometric surface map and groundwater velocity calculation reports for multiple King County landfills. Quarterly reports were delivered for Vashon and Cedar Hills Landfills. Annual reports were delivered for Cedar Falls Landfill, Enumclaw Landfill, and Hobart Landfill, and included analysis based on observations of high- and low-water level conditions.

Landfill Gas Evaluation and Optimization, Port Angeles
Peter evaluated the City's landfill gas collection and control system following flare shutdown events which caused nuisance odors. He identified over-extraction as the primary cause, and provided monthly flow balancing recommendations. Since enacting recommendations, flare operation has remained reliable with lower overall flow rates, and landfill gas migration has not been observed.

PETER BANNISTER, PE Senior Water Resources Engineer – page3

Federal Water Rights Support for Lummi Tribe, Whatcom County
Peter developed MODFLOW-SEAWAT sea-water intrusion model of the Lummi peninsula to evaluate sustainability of domestic well use vs. centralized water supply. Recharge estimates were based on watershed hydrologic monitoring and long-term correlation analysis. He performed stream flow gaging, flume installation and repair, climate station calibration and maintenance, and groundwater level monitoring.

Barrier Wall Failure Simulations, Port of Longview
Peter analyzed the potential tidal/river influence within a barrier wall at a former wood treatment facility using MODFLOW and MT3D. He evaluated various failure scenarios and the subsequent tidal/river influence within the barrier wall and developed a groundwater level monitoring plan to identify barrier wall failures based on model results.

Groundwater Management Plan Model, Soboba Band of Luiseño Indians, San Jacinto, CA
A groundwater management plan proposed by a large municipal supplier potentially violated the priority water rights of the Soboba Nation. Highly infrequent recharge events result in droughts lasting up to tens of years. Peter developed a HSPF model that adjusted a 20-year water balance to discard river recharge in favor of a correlative relationship between groundwater levels and river flow. Historic water levels were compared to a water balance to establish a relationship between water level and available storage. The resultant water balance provided a better tool in estimating available aquifer storage.

Duck Valley Groundwater Investigation, ID-NV
Peter completed transient groundwater flow analysis to support work performed as part of the Snake River water rights adjudication. He modified the 40-year predictive MODFLOW model of the Duck Valley groundwater system to accommodate spatially and temporally variable pumping and recharge rates based on intensive irrigation scenarios.

Gila River Groundwater Investigation, Central AZ
Peter developed a MODFLOW-SURFACT model of the Gila River Indian Reservation and surrounding areas for strategic and operational planning of conjunctive use of surface water and groundwater resources. The model was calibrated using pre-development and 1900 to 2004 periods. Long-term predictive simulations of on-reservation irrigation expansion seek maximum sustainability and economic benefit. Results showed infrequent but major recharge events mitigate aquifer storage losses; however, groundwater quality degradation threatens to be the limiting factor in future irrigation plans. This analysis led the Tribe to seek more answers through numerical modeling.

ATTACHMENT G

Previous Submittals to Ecology by Kent and Kent's Independent Experts Regarding The Site (Chronological Order)

1. City of Kent and Udaloy Environmental Services Comments on the Landsburg Mine Studies (May 27, 2004)

2. City of Kent Landsburg Mine Technical Meeting Presentation to Ecology (September 29, 2004)

3. City of Kent Request of a Supplemental Remedial Investigation for the Landsburg Mine Cleanup Site (October 6, 2004)

4. City of Kent and Udaloy Environmental Services Evaluation of Chlorinated Solvents Occurring as DNAPL and Recommendations for Supplemental Remedial Investigations to Address the Landsburg Mine Site (November 8, 2004)

5. City of Kent Comments Regarding Landsburg Mine Draft Cleanup Action Plan Dated 2002 (June 21, 2006)

6. City of Kent Letter Providing Time Travel Memorandum (January 29, 2009)

7. City of Kent Transmittal of Aspect Consulting's Comments on PLP Group's BIOSCREEN Modeling Results and Proposed Monitoring Frequencies (November 9, 2009)

8. City of Kent Transmittal of Aspect Consulting's Analysis of Proposed Wells to be Installed (November 12, 2009)

9. City of Kent Letter Regarding Ecology Letter Dated January 21, 2010 – Ecology Decision Regarding Proposed Groundwater Monitoring Program (March 5, 2010)

KENT
WASHINGTON

PUBLIC WORKS
Don Wickstrom, P.E.
Director of Public Works

Phone: 253-856-5500
Fax: 253-856-6500

220 Fourth Ave. S.
Kent, WA 98032-5895

May 27, 2004

Landsburg Mine Site PLP Group
c/o William Kombol
Project Coordinator
31407 HWY 169
P.O. Box 10
Black Diamond, WA 98010

RE: City of Kent Comments on the Landsburg Mine Studies

Dear Mr. Kombol,

The City of Kent has completed an in depth review and analysis of the all work completed on the Landsburg Mine Site. We continue to reiterate concerns that have been expressed about the potential impact to water quality in the Cedar River Drainage Basin, most notably the Rock Creek Watershed, a major source of water supply for the City of Kent.

Please find attached comments our consultants have presented to the City.

Sincerely,

Don E. Wickstrom, P.E.,
Public Works Director

c: Mr. William S. Wolinski, P.E., Environmental Engineering Manager
Mr. Kelly B. Peterson, Environmental Engineer
Mr. Jerome Cruz, WA Dept. of Ecology
Mr. Doug Morrell, Golder Associates
File

UES

Udaloy Environmental Services

May 27, 2004

Mr. Bill Wolinski, P.E.
Environmental Engineering Manager
City of Kent
220 Fourth Avenue South
Kent, Washington 98032-5895

Re: UES Comments Regarding the *Remedial Investigation and Feasibility Study for the Landsburg Mine Site, Ravensdale, Washington*

Dear Mr. Wolinski:

The City of Kent and its consultant team have, since the early 1990s, reviewed and commented on activities related to the investigation and remediation of the Landsburg Mine Site. The City of Kent and its consultant team have repeatedly raised many concerns to the Washington State Department of Ecology (Ecology) and the Potentially Liable Parties (PLPs) regarding data gaps, the inadequacies of site characterization, the lack of appropriate responses to data developed during site characterization, and related questions.

However, neither the PLPs nor Ecology have yet provided meaningful responses to the numerous specific questions raised. At this time, potential site remedies are being evaluated with the understanding that a preferred remedy may be selected in the near future. Therefore, it is essential for the City of Kent to again present to Ecology the critical site characterization issues which have yet to be addressed but upon which remedy selection would be based.

Per your request, I have reviewed the *Remedial Investigation and Feasibility Study for the Landsburg Mine Site, Ravensdale, Washington* (RI/FS Report) prepared in February 1996 by Golder Associates, Inc. (Golder). I have also reviewed the *Landsburg Phase I Remedial Investigation/Feasibility Study (RI/FS) Work Plan* (Phase I RI/FS Work Plan) (Golder, 1992).

The potential risk to human health and the environment posed by waste discharged into the Rogers Seam is significant and has not been adequately characterized. The site is within the 1-year zone of contribution to Clark Springs, which provides the primary drinking water supply for the City of Kent. Numerous other citizens rely upon the regional aquifer for their primary drinking water supply. The disposal of large volumes of contaminants directly into mine workings that penetrate the regional aquifer has been documented at this site: the RI/FS

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Report states that "an estimated 4,500 drums and about 200,000 gallons of oily waste water and sludges were disposed into the trench. . . some of the drums contained wastes that included paint wastes, solvents, metal sludges and oily water and sludge" (RI/FS Report, Pages 6-4 and 6-5). The RI/FS Report further notes that "Given that up to 4,500 drums were reportedly placed in the trench and approximately 100 were recovered during the ERA, it is reasonable to expect that wastes potentially remaining include a significant number of drums buried beneath the trench bottom surface at some depth" (RI/FS Report, Page 6-5). In addition, the geochemical data presented in the RI/FS Report, Section 3.2.2.2, include demonstrations that residual waste in excavated drums tested positive for chlorinated compounds and other contaminants (see Attachment A, Issue 1). The reported concentrations suggest that chlorinated dense, non-aqueous phase liquids (DNAPLs) were present in liquid form (either as "free product" or its residual) within the sludge at the time of sampling; this in turn suggests that chlorinated solvents were discharged in liquid form to the Rogers Seam mine workings.

The purpose of a remedial investigation (RI) is "to collect data necessary to adequately characterize the site for the purpose of developing and evaluating cleanup alternatives" (Washington Administrative Code [WAC] Chapter 173-340-350 [7a]). The final RI/FS Report is a public record that provides the basis for all future regulatory decisions under the Model Toxics Control Act (MTCA). Therefore, the final RI/FS Report should:

- Provide an accurate and complete baseline summary of the site status at this point, including definition of incomplete or unavailable relevant data
- Provide a complete and accurate public record of the technical data and analyses, and known site conditions, relied upon by Ecology to conclude that site characterization is adequate, that the selected remedy is appropriate, and that the approved performance monitoring is appropriate
- Reference only reliable data and interpretations

When the site has been sufficiently characterized, it will be possible to accurately answer the following fundamental questions:

- Exactly where are the primary contaminant source areas?
- Do contaminants remain in place and, if so, what and where are they?
- Has site groundwater been contaminated?
- If site groundwater has been contaminated, then have all primary contaminant flow paths between source areas and sensitive receptors been identified and are they being monitored?

The current site characterization cannot answer any of these questions with reasonable scientific certainty. Unexamined, and consequently unresolved, data gaps preclude any reasonable scientific analysis of critical issues. For example, the current characterization of the nature and extent of wastes within the source area relies entirely upon a few soil and sludge samples collected during an expedited response action during August and September 1991. Source areas at this site were not characterized during the RI because contaminants (including DNAPLs) were presumed present within the mine workings (Phase I RI/FS Work Plan, Page 6). A critical reason for using indirect evaluation methods was stated as: "An important consideration, if the decision is made to attempt mine characterization, is the difficulty in drilling and sealing boreholes through open workings and voids. An exploratory borehole program could open new avenues for contaminants to migrate within the mine" (Phase I RI/FS Work Plan, Page 6). Consequently, no groundwater samples have ever been collected directly from the contaminant source areas, and potential groundwater flow paths through the source areas have not been evaluated.

The existing groundwater monitoring network does not permit any evaluation of groundwater quality within the mine workings or the regional aquifer adjacent to known waste placement areas. No contaminant flow paths have been defined; instead the RI/FS Report suggests, without technical basis, that none can exist. Although Golder noted that "the primary purpose of this evaluation was to identify the chemical compounds potentially posing a human or environmental health risk and/or which exceed potential regulatory criteria, and which are the result of the prior waste disposal activities" (RI/FS Report, Page 6-14), the RI could not and did not accomplish this "primary purpose."

The City of Kent has repeatedly advised Ecology and the PLPs that the application of a "Black Box" concept is only as good as the understanding of the contents of the "box," the nature of the box, and the mechanisms through which the contents can leave the box. For these and other reasons, the City of Kent has never fully concurred with reliance on indirect rather than direct testing of the nature and extent of contamination within the Rogers Seam and has insisted that appropriate testing be performed before a final CAP is developed.

During the RI, Golder demonstrated (by successfully installing LMW-6 and LMW-7) that boreholes can be successfully advanced into mine workings at this site. Inasmuch as the RI/FS Report currently concludes that there are no wastes present within the Rogers Seam, or that any such wastes are immobilized by coal, the previously proposed rationale for relying on indirect evaluations rather than direct physical testing are no longer valid. The mine workings can be readily accessed; because they dip westward, boreholes can be advanced to the base of the mine workings from stable areas west of the subsidence trench. These boreholes could be advanced into or alongside the mine workings at depths consistent with the potential flow paths of contaminants (such as the DNAPLs) within the regional aquifer. Groundwater samples from monitoring wells installed in these borings would permit the confirmation of the critical conclusion that there are no significant impacts at depth and that "there are no measurable impacts within . . . the Study Area from prior waste disposal activities" (RI/FS Report, Page 6-15).

This review also has identified seven critical hypotheses or conclusions presented in the RI/FS Report that are not supported by the data provided in the RI/FS Report and two additional critical issues (the selection of contaminants of concern for groundwater monitoring and the selected remedy) that are based on these unsupported hypotheses and conclusions. Critical concepts essential to the RI/FS Report that are not supported by data presented in the RI/FS Report are:

1. Rogers Seam wastes were destroyed by fire.
2. Rogers Seam wastes discharged through the mine ends and are gone.
3. Rogers Seam contaminants are immobilized by coal.
4. Rogers Seam groundwater is hydraulically separate or isolated from the regional aquifer.
5. Rogers Seam waste is not the source of documented offsite well contamination.
6. Rogers Seam waste does not impact groundwater.
7. Current characterization of the nature and extent of Rogers Seam contamination is sufficient.
8. Appropriate contaminants of concern for groundwater can be defined.
9. Selected remedy will protect human health and the environment from impacts related to Rogers Seam waste.

A detailed review of each issue is presented in Attachment A to this letter. These key hypotheses and conclusions are intended to provide the basis for evaluating and selecting an appropriate remedy for sites under MTCA in accordance with WAC 173-340-360, 370, and 380. If these key points are invalid, then the nature and extent of contamination at the site cannot be defined, contaminants flow paths are not understood, and it is consequently inappropriate to select a remedy based on the conceptual model of the site presented in the RI/FS Report because the selection cannot conform to the requirements of the MTCA.

As demonstrated in Attachment A, none of these hypotheses and conclusions are supported by the data presented in the RI/FS Report, and most are directly contradicted by the data. Alternative hypotheses that are consistent with the data are proposed in Attachment A; in all cases, these are more protective of human health and the environment than the interpretations and conclusions presented in the RI/FS Report.

These unsupported hypotheses were repeatedly advanced despite the absence of supporting data and the presence of directly contradictory data. The City of Kent has repeatedly questioned these hypotheses but to date has received no meaningful response. Alternative hypotheses that contradict the original conceptual model but more reasonably explain site characteristics are never posed or evaluated. Even when data from the RI clearly demonstrated that the original conceptual model of the site proposed in the Phase I RI/FS Work Plan was critically flawed, the data were interpreted instead to support the original conceptual model and conclude that the site was well-understood. For example, wells LMW-2, LMW-3, LMW-4, and LMW-5 were installed within preferential (primary) contaminant flow paths predicted by the original conceptual model (Phase I RI/FS Work Plan, Page 6 and Table 2-2). Detection of contaminants in groundwater samples from these wells would have supported this original conceptual model. When contaminants were not detected in any groundwater samples collected from these wells, the absence of impacts was not interpreted as suggesting that the conceptual model was in any way flawed. Instead, the absence of contaminants was interpreted to indicate that the intercepted flow paths were so very preferential that all of the contaminants from the source areas had already discharged, which meant that wastes were no longer present within the Rogers Seam (RI Report, Page 6-16). The RI/FS Report did not consider the more reasonable explanation that absence of detectable contaminant concentrations in existing monitoring wells demonstrated the wells has obviously not been installed in primary contaminant flow paths, that no contaminant flow paths had yet been identified, and that the original conceptual model was therefore seriously flawed. Curiously, the absence of detectable contaminants in these wells was not only used to support the conclusion that flow paths with undetectable concentrations of contaminants were primary contaminant flow paths, it was also used to support the (otherwise unsupported) hypothesis that the coal immobilizes the contaminants so none can reach the wells, and the speculation that much of the residual waste is inert, and the speculation that some of the waste may be retained within intact drums (RI/FS Report, Page 6-16). These interpretations suggest that there were virtually no outcomes to the site investigation that would have prompted re-evaluation of the original conceptual model. As a result, the contaminant flow path analysis presented in the RI/FS Report amounted to an exercise in circular reasoning: the absence of detectable contaminants was interpreted to prove that there was no waste remaining, and the absence of remaining waste was cited in explanation of the absence of detectable contaminants in groundwater. This reasoning encircles one of the most significant site characterization data gaps: no geochemical data whatsoever have been collected from soils or the regional aquifer within the deeper portions of the mine seam.

Conclusions and Recommendations

The conceptual hydrogeologic model for the Landsburg Mine site posed in the RI/FS Report is flawed and does not support the effective selection of a site remedy as required under Chapter 173-340-350 (6) of MTCA. Data and analyses upon which selection of the site remedy is based have been examined in detail. Critical conclusions upon which the conceptual model relies and upon which the remedy selection is based are not supported, and are directly contradicted, by the data and analyses presented in the RI/FS Report.

It is critical that site characterization be sufficient to constrain the conceptual model of the site and permit the evaluation of the actual risks posed by the site. When the conceptual model of the site cannot answer the most basic questions regarding the nature and extent of impacts at the site, it is inappropriate to select a site remedy. Such is the case for this site; therefore, it is premature and inappropriate to define risks posed, or select a site remedy, using the existing inadequate site characterization. Instead, it is absolutely essential to perform sufficient additional investigations, such as those proposed in Attachment A, to permit development of a scientifically reasonable conceptual model for this site.

It is essential to the integrity of MTCA implementation that the RI process develop a reasonable and scientifically defensible conceptual model of site contamination and relevant contaminant transport processes. From the premise that waste placed in the Rogers Seam can no longer impact groundwater to the concept that Rogers Seam groundwater is hydraulically separate from wells elsewhere in the regional aquifer, this RI process to date has been unsuccessful, fails to meet the requirements of the MTCA, and cannot be used as an effective basis for remedy selection.

The City of Kent has repeatedly maintained that if the nature and extent of contaminants remaining in the Rogers Seam are not defined, then effective characterization of the quantity and quality of groundwater leaving the Rogers Seam is essential; otherwise, there is no rationale basis for remedy selection. Resolution of these issues is essential to provide assurance that the City of Kent water supply is protected. At this time these key issues have not yet been addressed: the nature and extent of contaminants within and outside the "Black Box" (particularly within the mine at depth) remain undefined, there is no assurance that flow paths from Rogers Seam contaminant source areas to potential receptors have been defined or are monitored, and there is no assurance that contamination from the Rogers Seam site has not and will not impact potential receptors- including the City of Kent water supply.

Thank you again for the opportunity to assist with this project. Please feel free to contact me at any time should you have questions related to these comments.

Sincerely,

Anne Udaloy

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Attachment A

Detailed Review of Issues
Critical to the Landsburg Mine Site Conceptual Model
and to the
Selection of a Site Remedy

This attachment provides a detailed discussion of the issues raised in the accompanying cover letter, including a summary of data presented in the RI/FS Report that either support or directly contradict the hypotheses and conceptual site model presented in the RI/FS Report. This effort is not intended to be comprehensive; instead, only the most critical hypotheses and conclusions have been evaluated at this time.

For each unsupported hypothesis, conclusion, or data interpretation, this review:

- Presents the technical basis (or lack thereof) for these critical concepts or conclusions
- Identifies a more probable alternative hypothesis consistent with existing site data
- Provides a brief discussion of the ramifications of accepting the hypothesis or conclusion presented in the RI/FS Report versus the alternative proposed in this letter report
- Discusses the implications of these concepts and conclusions on the conceptual model of the site and the selection of the remedy
- Recommends activities that would clarify and constrain actual site conditions

Please also note that additional investigations are currently being performed at the site, and that the conceptual model of the site developed by the PRP group may be updated based on data derived from these new studies. In addition, there are several discrepancies within the RI/FS Report that preclude a "100% complete" review of selected site data, examples of which are discussed below.

- Data presented in the figures cannot be reconciled with data sources presented in the tables (e.g., the potable water supply well groundwater levels illustrated on Figure 3-19 are not consistent with the field-checked data presented in Table 2-1; groundwater elevations above 614 feet for LMW-1A are interpreted as "dry" on Figure B-2, although Table 2-4 indicates that the screen for this well extends from 607.8 to 627.8 feet, etc.).
- Data developed during the site investigations are not included in the documentation (e.g., the boring and construction log for LMW-1A was not provided; if the geochemical testing of coal samples required in the Phase I RI/FS Work Plan was performed, then the test results were not provided).
- Critical analyses and summaries that would facilitate the review and evaluation of site hydrogeology are omitted (e.g., basal elevations of mine levels are not noted, the physical dimensions of the mine cannot be readily determined, geochemical data for potable water supply wells are not presented on a figure that would facilitate spatial evaluation of the data).
- Relevant data, such as the amount and direction of fault offset defined by mining records or site inspections is not presented

As a result, the evaluations presented in this attachment will focus only on evaluating the fundamental data, data analyses and interpretations, and conclusion used to develop the current conceptual model of the site and support selection of the site remedy. A complete listing of specific report discrepancies will be reserved and can be presented separately.

Issue 1. Hypothesis Directly Contradicted by Site Data: Rogers Seam Wastes Were Destroyed by Fire

RI/FS Report Statement: One hypothesis proposed in explanation of the "apparent lack of chemical residues in groundwater" (RI/FS Report, Page 6-16) is that "Wastes disposed in the trench are no longer present, either because they were consumed in fires known to have occurred or have discharged through the highly permeable mined out Rogers Seam" (RI/FS Report, Page 6-16).

Data Presented in Support of the Statement: The site history states "Summer of 1971: Fires occurred in the trench on June 16 and 28, July 22, and August 2 and 3" (RI/FS Report, Page 3-3).

Data Presented in Direct Contradiction of the Statement: The site history also states: "May/June 1978: A complaint was filed with Ecology that on May 18, 1978, a double-unit tanker truck was observed entering the Mine property. As a result of the complaint, it was determined that approximately 30,000 gals of oily sludge had been disposed of in the trench in an operation which commenced in May 1978. Operations were halted in June 1978 by Ecology" (RI/FS Report, Page 3-3). This statement demonstrates that wastes were discharged to the Rogers Seam subsequent to the last reported fire; therefore, not all waste could be "consumed in fires known to have occurred."

In addition, sludge samples were collected from the trench during an expedited response action performed during August and September 1991. Concentrations of chlorinated dense, non-aqueous phase liquids (DNAPLs) in Area 1-A sludge were reportedly at water saturation for 1,1,2-trichlorotrifluoroethane, 1,1,1-trichloroethane, and trichloroethene, and 10 percent or more of water saturation for methylene chloride and trichlorofluoromethane (RI/FS Report, Section 3.2.2.2, Page 3-8). It is obvious from these data that significant concentrations of contaminants remained in site soils during 1991, regardless of any site fires. If combustible liquids such as trichloroethene located at or near the ground surface were not destroyed by the fires, it is reasonable to conclude that contaminants at depths below the soil surface were largely unaffected by the fires.

These reported concentrations indicate that chlorinated DNAPLs were present in liquid form (either as "free product" or its residual) within the sludge at the time of sampling; this in turn suggests that chlorinated solvents were discharged in liquid form to the Rogers Seam subsidence trench. Due to their unusual physical properties (high density and low viscosity), these compounds would have swiftly penetrated beneath the ground surface as they were being discharged to the trench (the contaminants remaining at ground surface would be residual and would likely represent only a small portion of the original waste).

The RI/FS Report also states that "Given that up to 4,500 drums were reportedly placed in the trench and approximately 100 were recovered during the ERA, it is reasonable to expect that wastes potentially remaining include a significant number of drums buried beneath the trench bottom surface at some depth" (RI/FS Report, Page 6-5).

Alternative Hypothesis: The site data demonstrate that wastes disposed in the trench are still present. Although site fires may have reduced the total volume of waste that actually penetrated surface soils and conceivably destroyed wastes in soils within a few feet of ground surface, significant volumes of waste were completely unaffected by the fires. It is inconceivable that surface fires would have any effect on contaminants that had migrated more than a few feet below the ground surface or beneath the water table.

Ramifications: The unsupported hypothesis that significant volumes of waste were destroyed by fire supports a conclusion that additional characterization of the nature and distribution of contaminants within the mine workings and site groundwater is unnecessary, inasmuch as there are no remaining wastes to characterize. In addition, there would be no value in carrying out remedial actions because there would be no waste to remediate.

However, if wastes are still present within the mine workings, then characterizing the nature and distribution of impacts to the regional aquifer and defining flow paths by which impacted groundwater could reach sensitive receptors would be essential. Similarly, an evaluation of remedial measures to address the source area(s) would be appropriate.

The unsupported hypothesis that impacts are not detected in groundwater because the sufficient volumes of waste have been "consumed in fires" that the remainder is insignificant also distracts attention from other possible (and far more probable) explanations for the absence of detectable contaminant concentrations in groundwater samples collected from site wells. For example, it is possible that the existing detection monitoring wells are not properly placed to detect contaminants; this explanation is not offered or examined in the RI/FS Report (see Issue 7).

Recommendations: The hypothesis that "Wastes disposed in the trench are no longer present, either because they were consumed in fires known to have occurred" should be rejected, and it should be acknowledged that significant volumes of waste were unaffected by any fires and are therefore expected to remain in place within the Rogers Seam.

Characterizing the nature and extent of contaminants remaining in known and suspected source areas by performing direct physical testing is recommended.

Issue 2. Unsupported Hypothesis: Rogers Seam Wastes Discharged Through the Mine Ends and are Gone

RI/FS Report Statement: Another hypothesis proposed in explanation of the "apparent lack of chemical residues in groundwater" (RI/FS Report, Page 6-16) is: "Wastes disposed in the trench are no longer present, either because they were consumed in fires known to have occurred or have discharged through the highly permeable mined out Rogers Seam" (RI/FS

Report, Page 6-16). The focus of this section is the assertion that wastes would have "discharged through the highly permeable mined out Rogers Seam"; the potential influence of fire is considered separately (see Issue 1).

The RI/FS Report also states that "the mined out Rogers Seam is highly conductive and has the potential to transmit large quantities of water. Movement through the unsaturated zone would be very rapid also since the material present above the water table consists of loose, mined out debris which is essentially similar to the material present below the water table. Liquids discharged to the trench therefore would move rapidly downward to the water table where they would then travel quickly downgradient and exit from the mine" (RI/FS Report, Page 6-16). Confirmation of this hypothesis requires demonstration that within the area where contaminants are present, horizontal gradients other than the gradient towards the mine ends are insignificant and groundwater flow through the mine sidewalls is negligible.

Data Presented in Support of the Statement: The discussion of site hydraulic properties is presented in Section 3.6.3.3. of the RI/FS Report, with hydrographs being presented in Appendix B and well testing results and analyses being presented in Appendix F. These data evaluate the question of whether groundwater flows preferentially through the coal at the ends of the mined-out area and not whether wastes would have "discharged through the highly permeable mined out Rogers Seam" (the "highly permeable mined out" portion does not actually daylight to the north or south). Inasmuch as the mined-out portion of the Rogers Seam terminates in the surrounding bedrock, the potential flow through intact bedrock at the sides and ends of the mined-out area and through highly permeable conduits continuous with the mined-out area (such as discharge to the portals) will be evaluated instead.

The RI/FS Report states that "the conductivity of this disturbed zone [the mined-out zone] is certainly orders of magnitude greater than the conductivity of the original undisturbed layers paralleling the mine" (RI/FS Report, Page 3-33). Inasmuch as there are no wells completed in the mined-out portion of the Rogers Seam, there are no data demonstrating that the mined-out portion of the Rogers Seam has a relatively high hydraulic conductivity. However, it is reasonable to assume that a great deal of the Rogers Seam coal was removed during mining and that, although some residual coal remains within the mine workings and as pillars, fill within the mined-out area includes a significant volume of waste rock (i.e., sandstone or associated sedimentary deposits) and also contains voids. Although the "overall volume of remaining voids was estimated to be less than 10%" (RI/FS Report, Page 6-7), interconnected voids would greatly increase the hydraulic conductivity of the mined-out workings, and it would be reasonable to expect that groundwater flow through such interconnected voids would be rapid.

Hydrograph data are interpreted to demonstrate that "water at portal #2 represents a surface expression of the water table surface and is fed by groundwater" (RI/FS Report, Page 3-32). Surface water levels at portal #3 were apparently not gauged, although discharges were measured; evaluation of discharge rates at portal #3 are interpreted to "confirm that bedrock groundwater is recharged through direct precipitation of rainfall" (RI/FS Report, Page 3-32).

Data Presented in Direct Contradiction of the Statement: Demonstration that groundwater flow through the mine sidewalls must be significant would contradict the hypothesis that virtually all groundwater flows through the mine ends. Although this demonstration was not presented in the RI/FS Report, the data needed to develop the demonstration were provided. An evaluation of existing data, and demonstration of an alternative conceptual model using these data, is presented in this section.

Re-evaluation of Existing Data:

Darcy's Law states that:

$$Q = KiA$$

where:

- Q = discharge (volume per unit time)
- K = hydraulic conductivity (length per unit time)
- i = hydraulic gradient (length per unit length)
- A = cross-sectional area (length by length)

This demonstration will re-evaluate the anticipated discharge through the mine ends and the mine sidewalls (for the purpose of this evaluation, and because vertical gradients in the vicinity of the mine are small, flow through the mine floor is neglected).

The demonstration will define a baseline condition and evaluate flow in response to recharge. Conceptual models of the mined-out workings, highly permeable conduits, and the intact mine sidewalls and ends are evaluated separately. A revised conceptual model based on this data re-evaluation is presented as the "Alternative Hypothesis".

<u>Baseline Condition for Data Re-evaluation:</u> The baseline condition for this demonstration is one where water levels within the mine workings and surrounding regional aquifer are low (for example, at the end of the summer), and significant precipitation occurs. The RI/FS Report notes that "The presence of the trench, which naturally serves as a surface water collection point and lacks any overlying layers of low permeability till which would restrict infiltration, probably accelerates recharge to bedrock materials in the immediate vicinity of the Mine" (RI/FS Report, Page 3-32). It is likely that during recharge events, the mined-out workings receive significant surface water runoff. The combined incident precipitation and directed runoff would cause water levels within the mined-out portion of the mine workings to rise swiftly.

<u>Conceptual Hydrogeology of the Mined-Out Workings for Data Re-evaluation:</u> The hypothesis provided in the RI/FS Report (Page 3-33) that the hydraulic conductivity of the mined-out workings "is certainly orders of magnitude larger than the hydraulic conductivity of individual undisturbed layers paralleling the mine" is accepted for the purposes of developing a conceptual hydrogeologic model. The basis for this assumption includes the understanding that large interconnected voids remain present within the mined-out workings, as suggested in the analysis of trench stability (RI/FS Report, Page 6-7). The demonstration

presented in this section assumes that the hydraulic conductivity of the mined-out workings significantly exceeds that of the undisturbed surrounding rock due to the presence of interconnected voids that result from incomplete infilling of the mined-out workings.

The hydraulic gradient within the mined-out workings will be inversely proportional to the hydraulic conductivity of the mined-out workings. To the degree that the mined-out workings are in fact highly permeable, the hydraulic gradient within the mined-out workings will approach zero (horizontal). Therefore, it is unnecessary to define whether or where a single "highest point" or a linear "divide" feature occurs within the mined-out workings for the purpose of this demonstration. Instead, the hydraulic gradient within the mined-out workings is presumed to be small and the mined-out workings of the Rogers Seam are presumed to act as a "constant head source" (i.e., if wells were constructed to screen the water table in the mined-out workings, water levels in those wells would be similar at all times)

Using this conceptual model, the unmined sidewalls and intact ends of the mine would serve as permeable "bathtub walls" enclosing the elevated water levels within the mined-out workings. Groundwater levels within the mined-out workings would rise as precipitation infiltrated into and accumulated within the mined-out workings. As groundwater levels within the mined-out workings rose, groundwater would discharge from the mined-out workings. If the mined-out workings were circular and if the bedrock surrounding the mined-out workings were uniform, flow from the mined-out workings would be generally radial and the hydraulic gradient between the mined-out workings and surrounding bedrock would be symmetrical. However, the mined-out workings are best envisioned as a very skinny rectangular prism (which is about 250 times longer than it is wide and about 25 times deeper than it is wide). In addition, the hydraulic conductivity of bedrock surrounding the mined-out workings varies spatially, and it is likely that features such as the portals or other fractures act as highly permeable conduits that permit accelerated flow in some areas.

Before any recharge event, groundwater levels in the regional aquifer surrounding the mined-out workings are assumed to be generally equal. During any recharge event, water levels within the mined-out workings are presumed to be equal. Therefore, the gradient from the mined out workings to the regional aquifer would be generally equal during a recharge event. As a result, an assumed gradient value can be used for discharge estimates as long as it is applied equally to both rock types. For this demonstration, the value of the uniform gradient from the mine workings to the regional aquifer is assumed to be 1 (although this value overestimates actual discharge rates, it simplifies the calculations). Consequently, the rate at which groundwater discharges from the mined-out workings will be constrained by:

- The hydraulic conductivity of the surrounding bedrock (which varies within and among bedrock types)
- The cross-sectional area of bedrock of any given hydraulic conductivity
- The hydraulic conductivity of the highly permeable conduits
- The cross-sectional area of highly permeable conduits (such as the portals)

Data that support this conceptual model include the results of pumping tests and slug tests, observations of the responses of water levels in wells to Baker tank discharge, hydrographs for wells LMW-2, LMW-3, LMW-4, and LMW-5 (installed near the ends of the mine workings), and hydrographs for LMW-1 and LMW-1A (installed adjacent to the mine workings). For example, the rapid seasonal increases in water levels observed in these wells (LMW-1, LMW-1A, LMW-2, LMW-3, LMW-4 and LMW-5) suggest that groundwater in these wells rises swiftly in response to precipitation, with the groundwater being derived from discharge through the sidewalls of the mined-out workings (RI/FS Report, Page 3-38 and Appendix B). Similarly, the rapid response of groundwater levels in wells LMW-1 and LMW-4 to Baker tank discharge suggests that groundwater monitored in these wells is in direct hydraulic connection with groundwater in the mined-out workings (RI/FS Report, Page 3-35).

Given the thickness of the vadose zone above wells LMW-1 and LMW-1A, water level increases in these wells would be derived almost entirely from recharge through the mine workings sidewalls. Groundwater levels in LMW-1A are always higher than synoptic levels in LMW-1, demonstrating that a downward gradient exists at this location and suggesting that recharge is flowing out of the mined-out workings and down into the surrounding bedrock. Water level increases in LMW-2, LMW-3, LMW-4 and LMW-5 would be primarily derived from recharge through the intact ends of the mine workings, with a small additional component from infiltration of incident precipitation.

The conceptual hydrogeology of the highly permeable conduits, and of the intact mine sidewalls and ends, are evaluated separately below.

Conceptual Hydrogeology of Highly Permeable Conduits for Data Re-evaluation: The hydrographs for wells LMW-1, LMW-1A, LMW-2, LMW-3, LMW-4 and LMW-5 show that infiltrating precipitation does not instantaneously discharge from the mine workings; instead, some reasonable time period is required (RI/FS Report, Appendix B, Figures B-1 through B-4). These data constrain the hydrogeologic character of any highly permeable conduits through which groundwater collected within the mined-out workings might discharge. For example, a review of precipitation data for the National Oceanic and Atmospheric Administration (NOAA) Landsburg station indicates that about 7.3 inches of precipitation were recorded for the period of February 13 through March 4, 1994, with less than 0.3 inch recorded during the following nine days (March 5 through 19, 1994). The hydrographs for onsite wells show that water levels in onsite wells LMW-1, LMW-1A, LMW-2, LMW-3, LMW-4 and LMW-5 rose rapidly throughout the rainy period of February 13 through March 4, 1994 (presumably in response to this storm event). These hydrographs also show that water levels in these wells declined steadily during the nine-day period following the storm. These hydrographs are interpreted as showing that although groundwater levels within the mined-out workings rise swiftly in response to infiltrating precipitation, groundwater drainage from the mined-out workings requires significant time (for this example, more than nine days).

The RI/FS Report states that "water at portal #2 represents a surface expression of the water table surface and is fed by groundwater," and discharge rates at portal #3 are interpreted to "confirm that bedrock groundwater is recharged through direct precipitation of rainfall" (RI/FS Report, Page 3-32). If the cross-sectional area of one or more highly permeable conduits were large, or if the conduit(s) were sufficiently permeable, then the elevated groundwater levels within the mined-out workings would swiftly decline to the elevation of the lowermost effective base level and then slowly decline to the elevation of the regional aquifer. The gauged elevations of portal #2 discharge indicate that the base level for portal #2 is at an elevation of about 612 feet (RI/FS Report, Figure B-7). Seasonal low groundwater levels of 613.5 feet measured in LMW-1 are consistent with this value (RI/FS Report, Appendix B, Figure B-2 and Table B-1). The base level for portal #3 must be at or above the approximate 630-foot elevation of the portal #3 flow station (RI/FS Report, Figure 2-15). Seasonal low groundwater levels of 640.7 feet measured in LMW-3 and 640.5 feet measured for LMW-5 are consistent with this value (RI/FS Report, Appendix B, Figure B-4 and Table B-1).

During and immediately after the February 13 through March 4, 1994, storm event where about 7.3 inches of precipitation were recorded, groundwater levels reported for well LMW-1 consistently exceeded 616 feet and peaked around 624.6 feet (RI/FS Report, Table B-1); these levels are above the 612-foot elevation of portal #2. Groundwater levels in LMW-1 are presumably equal to or lower than groundwater levels in the mined-out workings, therefore the groundwater levels in the mined-out workings were presumably always higher than the elevation of portal #2. The hydrographs for onsite wells show that groundwater levels declined slowly (over the course of days and weeks) after this (and other) storm events ended (RI/FS Report, Appendix B, Figures B-1 through B-4 and Table B-1). In addition, the data show that groundwater levels in LMW-1 generally exceeded the 612-foot elevation of portal #2, except during summer months (August through early October 1994) (RI/FS Report, Appendix B, Figure B-2 and Table B-1). These data demonstrate that either the cross-sectional area of any highly permeable conduits leading to these portals must be strictly limited or that the conduits aren't "highly" permeable in comparison to the surrounding bedrock. Given the understanding that portal discharge rates increase swiftly in response to precipitation, it is more likely that the conduits are highly permeable but have strictly limited cross-sectional areas.

During seasonal low-groundwater periods, groundwater within the regional aquifer flows through the mined-out workings in response to the regional gradient. When precipitation and storm water infiltrate through the mined-out workings and reach the water table of the regional aquifer within the mined-out workings, the infiltrating water drains to the regional aquifer, where it encounters and displaces existing groundwater. The infiltrating precipitation does not flow directly out of the sidewalls or ends of the mined-out workings; instead, it locally raises the groundwater elevation, which in turn locally increases the gradient from groundwater within the mined-out workings to groundwater within the surrounding bedrock. In response to the locally modified gradient, groundwater discharges from the mined-out workings through the sandstone sidewalls of the mine and the intact coal of the mine ends. Until groundwater levels within the mined-out workings rise above the ground surface elevation of the springs north and south of the mine workings (including those at portal #2 and portal #3, and smaller springs that reportedly daylight north of portal #2), all groundwater within the mined-out workings discharges through the sidewalls and intact ends of mine into the surrounding bedrock, and mine workings act as a recharge area for the regional aquifer.

When the level of the regional aquifer rises above the ground surface elevation of the springs north and south of the mine workings (including those at portal #2 and portal #3), additional flow paths are established as groundwater discharges from those springs as surface water. Groundwater discharging through the highly permeable conduits likely includes only that water which has recently infiltrated, with flow paths being generally constrained to that portion of the mine workings above the elevation of the discharge points. During all periods when these additional flow paths from the mined-out workings to the springs are established, the existing flow paths from the mined-out workings through the sandstone sidewalls of the mine and the intact coal of the mine ends persist. To the degree that groundwater levels within the mined-out workings rise above the ground surface elevation of the springs north and south of the mine workings (including those at portal #2 and portal #3), the hydraulic gradient between groundwater within the mined-out workings and groundwater within the surrounding bedrock increases, and the discharge rate through the sandstone sidewalls and intact ends of the mine necessarily increases.

Conceptual Model of the Intact Mine Sidewalls and Ends for Data Re-evaluation: After mining was completed, the mine hanging wall and footwall generally consisted of "massive sandstone" (RI/FS Report, Figure 3-13 and associated discussion on Pages 3-19 through 3-23). For example, the RI/FS Report notes that near the ground surface "The walls of the trench are steep-sided and composed of massive sandstone" and "In most areas, the sandstone hanging wall forming the western side of the trench is intact" (RI/FS Report, Page 3-23). In addition, the schematic illustration of the mining method (RI/FS Report, Figure 3-13) shows that coal would be completely removed from the hanging wall and foot wall, with the exposed sidewalls consisting of sandstone. Therefore, coal is likely present as the floor of the lowermost level and at the "ends" (horizontal extremes) of the mine workings.

The data presented in the RI/FS Report do not include the elevation of the mine levels (or the base of the mine) or allow accurate calculation of the actual area of the mine sidewalls. Therefore, generalized assumptions of the saturated thickness, length, and width of the mine workings are used to estimate a general area of the mine ends and sidewalls. These estimates, and the results of discharge calculations, are summarized in Table 1.

The mine was about 16 feet wide, more than 500 feet deep, and about 4,600 feet in length. Therefore, the width of the coal seam at the mine ends is estimated to be 16 feet, the mine sidewalls area estimated to be 4,600 feet long, and the saturated thickness of the mine is estimated to be 400 feet high (the bottom mine level is omitted for simplicity; if included, the relative cross-sectional area of sandstone relative to coal would increase). The cross-sectional area of the sidewalls greatly exceeds the combined cross-sectional area of the bottom and ends of the mine workings. Therefore, the majority (more than 99 percent) of the rock exposed within the mine workings would be sandstone (or related sedimentary deposits) and not coal (see Table 1). Consequently, the cross-sectional area of the regional aquifer that intercepts sandstone and related sedimentary rocks within the mine exceeds the cross-sectional area that intercepts coal by about two orders of magnitude.

Well testing data suggest that the hydraulic characteristics of the unmined coal vary spatially by at least three orders of magnitude (RI/FS Report, Table 3-10). Comparisons between the hydraulic conductivity of the coal and the adjacent sandstone, as presented in the RI/FS Report, are limited. The hydraulic properties of the sandstone were tested only at LWM-1, only once, and only by introducing a slug into the well (the well was not tested using pumping methods). The hydraulic conductivity of the sandstone measured using this well may underestimate the hydraulic conductivity of the sandstone elsewhere, given that this well was intentionally located in a known fault zone (RI/FS Report, Table 3-10 and Figure 3-9) that is interpreted in the RI/FS Report as not being highly permeable (RI/FS Report, Pages 3-16 and 3-38). (The concept that the hydraulic conductivity of bedrock at LMW-1 represents "an upper bound" and "is not representative of undisturbed bedrock" is rejected because direct connection with the tunnel or significant permeable fractures within the bedrock would have yielded hydraulic conductivity values greater than 4×10^{-6} feet per second). Given the limitations of testing, the hydraulic conductivity of the sandstone at LMW-1 is quite similar (within 0.5 orders of magnitude) to that of the Rogers Seam coal as tested at LMW-3. These data indicate that in at least some areas of the mine, the hydraulic conductivity of the sandstone and coal are nearly equal (in these areas, groundwater would flow as readily through the sandstone as through the coal). In other areas where the hydraulic conductivity of the coal exceeds that of the single value derived for the sandstone, groundwater would flow more readily through the coal.

For the entire system, groundwater will flow more readily through coal than sandstone in some areas, and at equal rates through either coal or sandstone in other areas. As shown in Table 1, if the hydraulic conductivity of the sandstone is generally equal to that of the intact coal mine ends in all areas, then total discharge through the sandstone sidewalls would be more than 100 times (two orders of magnitude) greater than the total discharge through the coal mine ends. If the hydraulic conductivity of the coal is generally about three orders of magnitude less than that of the sandstone in all areas, then total discharge through the coal mine ends would be about 30 times that of the discharge through the sandstone sidewalls. The actual system will fall somewhere between these endpoints. Therefore, groundwater flow through the sandstone sidewalls is predicted to be significant, with flow rates through the sandstone sidewalls expected to equal those for the coal mine ends in at least some areas. This interpretation is supported by the interpreted piezometric surface contours shown in the RI/FS Report, Figure 3-19.

Groundwater-level data from potable water supply wells supports this conclusion (RI/FS Report Table 2-1 and Figure 3-19). For example, the 544-foot groundwater elevation in PW-6 (screened in bedrock east of the Landsburg Seam) is consistent with the 552-foot groundwater elevation reported for LMW-7, which is screened in a void within the former Landsburg Seam mine workings. This suggests that groundwater levels in the bedrock east of the Landsburg Seam are in equilibrium with groundwater levels within the Landsburg Seam workings, which in turn suggests that the hydraulic conductivity of the sandstone is sufficient to permit relatively rapid equilibration in at least some areas. This interpretation is also supported by the interpreted piezometric surface contours shown in the RI/FS Report, Figure 3-19.

This data re-evaluation concludes that discharge through the sandstone sidewalls is significant and cannot reasonably be neglected or dismissed. This demonstration also concludes that data presented in the RI/FS Report do not support, and indeed contradict, the RI/FS conclusion that "Wastes disposed in the trench are no longer present . . . because they . . . have discharged through the highly permeable mined out Rogers Seam."

Alternative Hypothesis: A regional aquifer exists within the bedrock and in glacial deposits beneath the entire study area. Cedar River and Rock Creek are hydraulically continuous with, and surface expressions of, this regional aquifer. Groundwater within bedrock beneath the Landsburg Mine site is hydraulically continuous with groundwater in alluvial and glacial deposits beneath the Cedar River and Rock Creek. The regional recharge area is the Cascade Mountains; the regional discharge area is Lake Washington. The bedrock is recharged by lateral flow from upgradient portions of the aquifer and by infiltration from precipitation and storm water. The Rogers Seam Mine extended from ground surface to an elevation of about 50 feet, and was excavated into the regional aquifer. After the mine was closed and active dewatering ceased, regional aquifer groundwater levels within the mine recovered. At all times, groundwater within the regional aquifer flows through the mined-out workings of the Rogers Seam in response to the regional hydraulic gradient.

Periodically, precipitation and storm water runoff flow into the mined-out workings of the Rogers Seam. Such recharge is focused into the mined-out workings by surface topography, including a linear subsidence trench above the mined-out workings. When the recharge from precipitation and surface water runoff reaches the regional water table within the mined-out workings, it locally raises the groundwater elevation, which in turn locally increases the gradient from groundwater within the mined-out workings to groundwater within the surrounding bedrock. In response to the locally modified gradient, groundwater discharges from the mined-out workings through the sandstone sidewalls of the mine and the intact coal of the mine ends. Until groundwater levels within the mined-out workings rise above the ground surface elevation of the springs north and south of the mine workings (including those at portal #2 and portal #3), all groundwater within the mined-out workings discharges through the sidewalls and intact ends of mine into the surrounding bedrock, and mine workings act as a recharge area for the regional aquifer.

Where the hydraulic conductivity of the sandstone sidewalls equals that of the coal within the mine ends, groundwater flow through the sandstone sidewalls equals flow through the coal mine ends. Although the hydraulic conductivity of the sandstone is, in other areas, less than that of the coal in the intact mine ends, the saturated cross-sectional area of sandstone greatly exceeds that of the intact coal mine ends (see Table 1). Therefore, groundwater and contaminant flow through the mine sidewalls likely exceed groundwater and contaminant flow through the "mine ends."

During periods where regional aquifer groundwater levels are higher than the ground surface elevation of springs that are hydraulically continuous with the mined-out workings, a local flow system is established. The local flow system discharges both to the regional aquifer and through highly permeable conduits to the springs. The cross-sectional area of these highly permeable conduits is strictly limited; therefore, groundwater levels within the mined-out workings exceed the elevation of the springs, except during summer months.

Flow paths extending from the mined-out workings to the springs are likely constrained to elevations above the 612-foot elevation of portal #2. Therefore, flow paths discharging to the springs at portal #2 and portal #3 cannot pass through most of the likely residual source area within the mined-out workings of the Rogers Seam. These flow paths are likely short, and travel times along these flow paths are likely short (requiring less than two years). As a result, the groundwater flow paths that discharge to the mine portals have likely been repeatedly "rinsed" by groundwater flow consequent to seasonal precipitation. Therefore, these local flow paths are by definition the least likely flow paths to contain residual impacts from waste disposal in the Rogers Seam (recharge focused through these flow paths has been diluting and attenuating contaminants along these pathways since mine closure in 1975). These flow paths are the nearly singular focus of the RI and current investigations.

The Rogers Seam Mine was operating, and the mined-out workings were dewatered, during the time when most of the waste was discharged into the Rogers Seam. A large volume of liquid waste (including DNAPLs) was discharged to the subsidence trench above the mine workings, either directly from tankers or in drums; most of the drums subsequently ruptured (see Issue 1). The ground surface elevation within known waste disposal areas is currently about 720 feet (RI/FS Report, Figure 3-3). The basal elevation of the mine workings beneath these areas is apparently about 50 feet, and virtually all of rock materials between ground surface and the base of the mine were removed (RI/FS Report, Figure 3-9). When discharged to the Rogers Seam, these wastes (including DNAPLs) presumably drained readily through the highly permeable mined-out workings towards or to the base of the workings at the deepest level of the mine (at the south end), which at that time had been dewatered to facilitate mining (RI/FS Report, Section 3.2.1). It is likely that most of the liquid waste discharged to the Rogers Seam flowed downward through the dewatered collapse zone of the former mine workings to below the 612-foot elevation. When mining stopped, groundwater from the adjacent regional aquifer, infiltrating precipitation, and infiltrating storm water filled the mined-out workings and immersed the wastes. Regional aquifer groundwater in the mined-out workings is presumably in equilibrium with and impacted by the residual wastes. The mined-out workings within the regional aquifer likely contain virtually all of the wastes that were originally discharged to the Rogers Seam Mine.

Groundwater levels within the mined-out workings are at seasonal lows (and are presumably equivalent to the regional aquifer) during summer months. During these periods, impacted groundwater will flow from the mined-out workings into the regional bedrock aquifer in response to the regional hydraulic gradient. Groundwater levels within the mined-out workings rise whenever precipitation and storm water collect in the Rogers Seam trench. Although some of the recharge discharges through highly permeable conduits to surface water, the remainder discharges through the sandstone sidewalls and intact ends of the mine workings. Near the mined-out workings, the regional gradient is increased by the elevated groundwater levels maintained within the mined-out workings throughout each winter. Within the regional aquifer, potentially impacted groundwater moves from the mined-out workings through surrounding bedrock in response to the increased gradient. Regional aquifer flow is likely generally radial to the mined-out workings for some distance around the workings. Significant discharge through the sandstone mine sidewalls, as wells as the intact coal seam at the ends of the mine workings, is predicted.

The primary contaminant flow paths for this hydrogeologic system are predicted as being within the regional aquifer through residual contaminant source areas at depth within the mined-out workings. There also may be contaminant flow paths extending from the local Rogers Seam recharge area through residual wastes within the mined-out workings and above the seasonal low-water level of the regional aquifer; these include flow paths from the recharge area through highly permeable conduits to surface water (the local flow system).

It is likely that groundwater flow paths from the mined-out workings to surface water (such as those discharging at or near portal #2 and portal #3) represent flow through highly permeable materials with limited cross-sectional area. Therefore, these flow paths are likely short, and travel times along these flow paths are likely short (less than two years). These flow paths are apparently established seasonally and were first established subsequent to mine closure in 1975 after regional aquifer groundwater levels in the mined-out workings recovered from dewatering. These flow paths apparently pass through only a subset of the known contaminant source areas, specifically, those residual contaminants that were retained within the vadose zone above seasonal low-water levels in the regional aquifer. These flow paths therefore represent only a small subset of the potential flow paths through the Rogers Seam residual contaminant source areas. Flow paths through the residual waste would include those that extend through the shallow portions of the workings to the springs north and south of the mine workings (including those at portal #2 and portal #3) and also flow paths through residual waste in the mined-out workings below the 612-foot elevation and into the surrounding bedrock.

This conceptual model is supported by the geochemical data from existing onsite wells. Preferential flow through the mine workings with discharge towards the mine ends was hypothesized in the Phase I RI/FS Work Plan. Four wells (LMW-2, LMW-3, LMW-4 and LMW-5) were installed in intact coal near the ends of the Rogers Seam mine workings to evaluate contaminant concentrations in groundwater at these locations. If at least some mine-derived contaminants were detected, then the geochemical data from these wells would support the hypothesis that these wells were placed into contaminant flow paths and that preferential flow through the coal at the ends of the mine workings may occur. However, groundwater samples from the four wells installed in coal at the ends of the Rogers Seam (LMW-2, LMW-3, LMW-4, LMW-5) did not contain detectable concentrations of any anticipated contaminants. These data demonstrate that these wells are not located in primary contaminant flow paths.

Ramifications: It is important to differentiate flow within the mined-out workings, flow through intact bedrock sidewalls and ends, and flow through highly permeable conduits. It is also important to differentiate flow within the local recharge zone and flow within the regional aquifer.

The hypothesis that there is preferential flow through the mine workings and that this flow discharges towards the mine ends was proposed in the Phase I RI/FS Work Plan. The unsupported hypothesis that "Wastes disposed in the trench are no longer present, either because they… have discharged through the highly permeable mined out Rogers Seam" explains the "apparent lack of chemical residues in groundwater" (RI/FS Report, Page 6-16) suggests that additional site characterization and site remediation is unnecessary because no wastes remain, and therefore there are no impacts to investigate or remediate.

The concept that "Wastes disposed in the trench are no longer present, either because they… have discharged through the highly permeable mined out Rogers Seam" remains unsupported until it is demonstrated that the sampled monitoring wells were installed in primary contaminant migration pathways. Installation of monitoring wells into intact coal at the ends of the mine workings should have permitted testing of the hypothesis that these mine ends are preferential flow paths. However, the finding that contaminants were not detected along the predicted primary contaminant flow paths demonstrates both that these are not the actual primary contaminant flow paths, and that those primary contaminant flow paths have not yet been defined. Therefore, the RI data indicate the original conceptual model of "preferential flow through the mine ends" is seriously flawed and should be significantly modified if not rejected entirely.

The conceptual hydrogeologic model proposed in the Phase I RI/FS Work Plan did not address the regional aquifer or regional hydraulic gradient and instead focused entirely on a seasonally established local flow system. While this local flow system does need to be evaluated (and has not yet been fully characterized), it is unlikely to contain significant contaminant migration flow paths simply because it is shallow and likely constrained to elevations above 612 feet (between seasonal high and low groundwater elevations) and is therefore too shallow to evaluate flow paths passing through the bulk of the residual contamination.

It is reasonable to expect that the RI would have been designed to permit testing of hypotheses critical to the conceptual hydrogeologic model, such as the concept that groundwater flows preferentially through the ends of the mine workings, either via highly permeable conduits or via the coal itself. If preferential flow through coal at the ends of the mine could be proven, and if a detailed water balance demonstrated that all input water discharged to surface water through the highly permeable conduits at the portals, then flow through the mine sidewalls could be neglected and detection monitoring could be focused at the mine ends. Similarly, if it could be demonstrated that flow paths discharging to the springs were representative of flow through residual contaminants, then detection monitoring could be limited to the springs. However, these hypotheses were never effectively tested during the RI. Consequently, hydrogeologic characterization of the regional aquifer is insufficient to permit evaluation of potential contaminant flow paths through the mine workings at depth.

Had contaminants been detected in these wells, the data would have been used to support the original conceptual model that groundwater flowed preferentially from the source areas through the coal and that these preferential flow paths were now satisfactorily monitored. In fact, the absence of detectable contaminants in wells installed within coal at the mine ends made proof of this "preferential flow path" hypothesis impossible. However, these data were inappropriately interpreted in the RI/FS Report as supporting a hypothesis that the flow paths were not merely preferential, they were indeed so very preferential that all the contaminants at the site (and not merely along those limited flow paths) have already flowed away and are no longer present. Although re-evaluation of the site data shows that preferential flow paths discharging to springs may be present, it also demonstrates that the existing monitoring wells are simply not located in primary contaminant flow paths.

The statement that "Wastes disposed in the trench are no longer present, either because they were consumed in fires known to have occurred or have discharged through the highly permeable mined out Rogers Seam" inappropriately suggests that additional characterization of the nature and distribution of contaminants within the mine workings and site groundwater is unnecessary because there are no remaining wastes to characterize. In addition, there would be no value to remedial actions because there would be no waste to remediate.

The suggestion that impacts are not detected in groundwater because all the wastes "discharged through the highly permeable mined out Rogers Seam" also distracts attention from other possible (and far more probable) explanations for the absence of detectable contaminant concentrations in groundwater samples collected from site wells, such as the hypothesis that the existing detection monitoring wells are not properly placed to detect contaminants (see Issue 7).

If it were proven that wastes disposed in the trench only discharged through the ends of the trench, then only a limited portion of the aquifer could be affected by impacted groundwater discharging from the Rogers Seam. As a result, the following conclusions would be supported.

- Monitoring of only the limited portion of the aquifer that could be affected by impacted groundwater would be sufficient to determine whether groundwater is impacted or whether there is any risk to potential receptors.
- Additional characterization of the contaminant source and the regional aquifer are unnecessary because the groundwater flow paths via which waste could affect potential receptors are entirely constrained.

However, if (as it appears) wastes remain in place within the Rogers Seam, then effectively characterizing the nature and distribution of those wastes, and the flow paths through which impacted groundwater could flow to sensitive receptors, would be essential. Similarly, evaluation of remedial measures addressing the source area(s) would be appropriate.

If (as it appears) groundwater impacted by the waste discharges through the sidewalls of the trench in addition to the trench ends, then it is probable that significant volumes of impacted groundwater have been discharged to the regional aquifer. The impacted groundwater would flow in response to the regional gradient towards offsite potable water supply wells and other sensitive receptors. Characterizing the nature and distribution of impacts to the regional aquifer, and defining flow paths by which impacted groundwater could reach sensitive receptors, would be essential. Again, evaluation of remedial measures addressing the source area(s) would be appropriate.

Re-evaluation of data presented in the RI/FS Report demonstrates that effective investigation of groundwater and contaminant flow at depth within the regional aquifer is essential in order to determine the nature and extent of groundwater contamination and also to identify appropriate positions for detection monitoring wells. These issues have not yet been addressed in any meaningful way. The RI/FS Report instead focuses on potential contaminant flow through the shallow portion of the hydrogeologic system at the ends of the mine workings. Near the areas where waste discharge to the Rogers Seam was documented, the groundwater elevation is about 619 feet (reported for February 23, 1994, at LMW-1A [RI/FS Report, Table 2-4]). In this same area, the base of the Roger Seam mine workings is at an elevation of about 50 feet (the actual mine workings elevations are not provided in the RI/FS Report; this value is estimated from the RI/FS Report, Figure 3-9). Therefore, the saturated thickness of the regional aquifer within the Rogers Seam mine workings adjacent to known waste disposal areas is at least 569 feet. However, groundwater flow paths within the regional aquifer in sandstone bedrock adjacent to Rogers Seam are evaluated using only LMW-1, which is screened to sample groundwater at an elevation of 597.1 to 582.1 feet. Monitoring well LMW-1, the only well located near a known contaminant source area, is therefore screened only about 25 feet below the water table; groundwater flow paths and quality in bedrock adjacent to the Rogers Seam source areas below this elevation had not been investigated at all during the RI (additional investigations are reportedly in progress). Other than the limited number of samples collected from LMW-1, there are no data demonstrating that groundwater within the regional aquifer adjacent to waste disposal areas has not been impacted by site contaminants, and no groundwater or soil quality data whatsoever have been collected from beneath the regional aquifer water table within known waste disposal areas or other portion of the Rogers Seam mine workings. The potential hydraulic influences of fractures, including the major fault mapped within the known waste disposal areas, have not been evaluated. Flow paths through these known source areas within the regional aquifer are potentially as or more significant with respect to contaminant fate and transport (and potential risks to public water supply wells) than the flow paths through the ends of the mine.

Recommendations: The hypothesis that "Wastes disposed in the trench are no longer present" is unfounded and should be rejected. The only direct investigations of the nature and distribution of wastes in the trench concluded that wastes remained in place (RI/FS Report, Section 3.2.2) and that the expedited response action did not remove or remediate all of those documented wastes. The nature and extent of impacts within the Rogers Seam not effectively investigated or defined during the RI; these investigations were intentionally omitted because of the understanding that existing data suggested the presence of chlorinated solvents and the perceived risk that "An exploratory borehole program could open new avenues for contaminants to migrate within the mine" (Phase 1 RI/FS Work Plan, Page 6). There are no actual data demonstrating that "wastes are no longer present" in known source areas. It is inappropriate to conclude that "wastes. . . are no longer present" when there are no data to support such a contention and particularly when efforts to collect such data were deliberately excluded from the RI.

Consequently, the hypothesis that "the wastes have discharged through the mine ends and are now gone" is similarly unfounded and should be rejected. It is highly likely that the bulk of the contamination remains in place. Comparison of potential groundwater flow through the mine sidewalls with potential flow through the mine ends indicates that significant flow through the mine sidewalls is expected. It is therefore highly likely that the regional aquifer has been impacted by those contaminants, and that impacted groundwater has discharged through the sandstone sidewalls. It is reasonable to expect that waste remaining in place within the trench will continue to release contaminants to the regional aquifer.

Therefore, the following activities are recommended.

- Characterizing the nature and extent (including the depth) of waste remaining in place within the Rogers Seam by direct physical testing
- Characterizing the nature and extent of impacts to the regional aquifer adjacent to contaminant source areas
- Evaluating groundwater flow and geochemistry within the regional aquifer at appropriate depths and locations between defined contaminant source area(s) and sensitive receptors
- Evaluating the physical characteristics of the regional aquifer, including additional evaluations of the hydraulic conductivity of the sedimentary bedrock at locations distant from known faults and the tunnel
- Evaluating the hydraulic interactions between groundwater in the mine workings, groundwater in bedrock adjacent to the mine workings, and surface water
- Identifying all primary flow paths through which impacts from wastes placed into the Rogers Seam could affect sensitive receptors and identifying those potential receptors
- Developing a revised conceptual hydrogeologic model for the site that incorporates the new and existing data and identifying an effective detection monitoring approach for the site based on the revised conceptual model

Issue 3. Unsupported Hypothesis: Rogers Seam Contaminants are Immobilized by Coal

RI/FS Report Statement: Another hypothesis proposed in explanation of the "apparent lack of chemical residues in groundwater" (RI/FS Report, Page 6-16) is that "The residual coal remaining in place, with its high sorptive capacity, has immobilized the wastes in-place" (RI/FS Report, Page 6-16). The specific mechanism is explained as "Adsorption is where soluble substances are removed from solution by binding to the surface of a solid. Activated-carbon treatment of wastewater is a standard treatment technology to remove dissolved organic matter. Coal is commonly used in the production of activated carbon because it has a high sorptive capacity. The mine probably offered a significant capacity to adsorb (and absorb) organic contaminants due to the presence of coal and the large amounts of surface area which was likely available for such interactions" (RI/FS Report, Page 6-16).

Basis of Statement: The hypotheses that "Coal may have a high absorption affinity for organic compounds and would thus tend to bind and immobilize organic contaminants" and that "[t]he coal seam may limit the migration potential for organic contaminants within groundwater by adsorption" were postulated in the Phase I RI/FS Work Plan (Page 6). The source(s) of these hypotheses were not referenced, and no technical studies providing a basis for these hypotheses were cited. In apparent recognition that these hypotheses were entirely unsupported and therefore not scientifically reliable, the work plan noted that "Samples of the Rogers Seam coal will be obtained and tested in a laboratory during the Phase I RI/FS to confirm its absorptive capacity with respect to contaminants of concern" (Phase I RI/FS Work Plan, Page 6). The Phase I RI/FS Work Plan specified the collection of coal samples under Activity 9C (Page 29) and laboratory testing of coal samples for sorption, porosity, and carbon content under Activity 9G (Page 32). However, as discussed below, there is no record of this work being done, and no results are reported in the RI/FS Report.

Data Presented in Support of the Statement: The RI/FS Report does not provide any data to support this statement. Specifically, the RI/FS Report does not include any documentation of coal sample submittal to a testing laboratory or laboratory testing results (the RI/FS Report does note that although core recovery was poor due to "the presence of voids and the soft friable nature of the coal" [RI/FS Report, Page 2-19], samples of coal were successfully recovered [RI/FS Report, Appendix D, core photographs]). The RI/FS Report also does not provide or reference Ecology agreement that testing would not be performed. Given that coal samples were collected and that testing of coal samples was required under the Phase I RI/FS Work Plan, the absence of laboratory data proving that the coal will act to "immobilize" contaminants is a data gap.

The RI/FS Report does not reference any literature or testing that supports the hypothesis that Rogers Seam coal is chemically comparable to activated carbon or that coal similar to the "high volatile bituminous" coal of the Rogers Seam has been successfully used in the remediation of chlorinated solvents at other facilities.

Data Presented in Direct Contradiction of the Statement: The suggestion that the geochemical or physical properties of residual Rogers Seam coal are sufficiently similar to those of activated carbon that residual Rogers Seam coal would adsorb contaminants like chlorinated solvents is not scientifically credible. Activated carbon is a man made product that does not occur in nature. The specific properties of activated carbon that permit effective contaminant sorption (e.g., high porosity, controlled pore size, and large internal surface area) are created during the manufacturing process, which includes crushing selected coal to a uniform size, carbonizing the coal at low uniform heat in a kiln or furnace to remove volatiles, then passing the product through high-temperature kiln in the presence of a carefully controlled flow of steam to create a highly porous and sponge-like form of carbon. In this state, the activated carbon can physically adsorb contaminants. Many forms of activated carbon are subsequently treated to provide additional chemical sorption properties. The suggestion that the chemical or physical properties of raw high volatile bituminous Rogers Seam coal are in any way similar to those of activated carbon is specious.

Alternative Hypothesis: The Rogers Seam coal does not "immobilize contaminants" in the manner that activated carbon might. Residual coal in the Rogers Seam does not noticeably retard the migration of contaminants within the Rogers Seam.

Ramifications: The unsupported suggestion that residual Rogers Seam coal "has immobilized the waste in place," as wells as the suggestion that the geochemical properties of the residual coal are somehow similar to those of activated carbon, supports the inappropriate conclusions that:

- Additional characterization of the nature and distribution of contamination within the mine workings and site groundwater is unnecessary, inasmuch as any contaminants present within the mine workings cannot migrate from the workings.
- There is no value to remedial actions to remove or control the contaminant source(s) within the Rogers Seam because it would be difficult if not impossible to improve on the existing fortuitous condition wherein the contaminants are simply immobilized.
- There would be no need for additional characterization of the regional aquifer because there would be no pathway or mechanism by which regional groundwater could be impacted by Rogers Seam waste.
- There would be no need for detection monitoring because contaminants could not escape the Rogers Seam or discharge to the regional aquifer.

The suggestion that impacts are not detected in groundwater because Rogers Seam coal has "immobilized the wastes in place" also distracts attention from other possible (and far more probable) explanations for the absence of detectable contaminant concentrations in groundwater samples collected from site wells, such as the hypothesis that the existing detection monitoring wells are not properly placed to detect contaminants (see Issue 7).

If (as expected) the Rogers Seam coal does not "immobilize contaminants" in the manner that activated carbon might, then contaminants placed into the Rogers Seam could discharge and presumably would have discharged from the Rogers Seam. As a result, characterizing the nature and distribution of contaminants, defining the nature extent of contaminant impacts to the regional aquifer, and identifying flow paths by which impacted groundwater could reach sensitive receptors, would be essential. Similarly, evaluation of remedial measures addressing the source area(s) would be appropriate.

Recommendations: The unsupported hypothesis that the Rogers Seam coal will serve to "immobilize" contaminants of concern should be rejected, and the more conservative hypothesis that coal has no effect on contaminant distribution should be adopted. As a consequence, it must be assumed that contaminants discharged to the mine workings have impacted groundwater in the regional aquifer. Consequently, it would be appropriate to perform the investigations recommended under Issue 2.

Issue 4. Unsupported Data Interpretation: Rogers Seam Groundwater is Hydraulically Separate from the Regional Aquifer Monitored Elsewhere

RI/FS Report Statement: The RI/FS Report states that "Water levels at LMW-6 fluctuate considerably more than the Mine wells during the summer months. This suggests that wells installed away from the mine communicate poorly, if at all, with mine groundwater. This is supported by the large difference in hydraulic head (approximately 50 to 70 feet) observed between the mine wells and well LMW-7 (RI/FS Report, Figure B-1). This difference in head suggests that geologic materials between LMW-7 and the mine (including the fault) are tight and do not provide a permeable pathway for the flow of groundwater away from the mine. The water level variation observed at LMW-6 and the large difference in hydraulic head seen between LMW-7 and the mine wells suggest that groundwater flow away from the mine across bedding (lateral flow) is negligible" (RI/FS Report, Page 3-31).

Data Presented in Support of the Statement: The discussion of site hydraulic properties is presented in Section 3.6.3.3., hydrographs are presented in Appendix B, and well testing results and analyses are presented in Appendix F (RI/FS Report).

Alternative Hypothesis: The Rogers Seam intercepts the regional aquifer, and the regional aquifer is hydraulically continuous beneath the Study Area. The variations in groundwater levels among regional aquifer wells identified in the RI/FS Report result from proximity to recharge areas, proximity to discharge areas, and variations in the hydraulic conductivity of the bedrock between the wells.

This alternate hypothesis is consistent with the conceptual model of the site as stated elsewhere in the RI/FS Report.

"Groundwater flow at the Mine site occurs within the following geologic units:

- sedimentary bedrock of the Puget Group,
- the glacial outwash materials present in the lower portion of the study area, and
- the relatively thin glacial drift (till) which mantles the Puget Group bedrock along the hill sides.

The first two of these comprise the primary groundwater flow system at the Study Area" (RI/FS Report, Page 3-30). This hypothesis also is consistent with the hydrogeologic cross-sections presented in the RI/FS Report, where the regional aquifer water table can readily be extrapolated east and west of the Rogers Seam (RI/FS Report, Figures 3-9 through 3-12).

Review of the hydrographs presented in the RI/FS Report supports this alternative hypothesis. For example, the hydrograph for well LMW-6, screened in the Frazier Seam, suggests that, as with the Rogers Seam, the Frazier Seam receives the bulk of its recharge from precipitation that is apparently collected and concentrated as surface runoff. This concentration of precipitation is likely a result of mining. Groundwater levels in the Frazier Seam are not expected to rapidly equilibrate with groundwater levels in the Rogers Seam, and the hydraulic conductivity of the sedimentary bedrock between the mines will affect the rate at which water levels within these mines equilibrate. Therefore, although its is reasonable to interpret the hydrographs as demonstrating that water levels in the Frazier Seam do not respond immediately to water level changes in the Rogers Seam, it is inappropriate to subsequently conclude that groundwater within the Frazier Seam is therefore hydraulically distinct or separate from groundwater within the Rogers Seam.

In addition to illustrating groundwater response to recharge, the hydrographs also show that both the Rogers Seam and the Frazier Seam discharge groundwater to one or more unidentified discharge areas (sumps). These discharge areas presumably include the regional aquifer and, for the Rogers Seam, surface water. Given that each of the mined-out workings likely acts as a local recharge zone (see Issue 3), inspection of the hydrographs allows evaluation of the base level to which each mine discharges. The Frazier Seam clearly discharges to a significantly lower discharge area base level (about 582 feet) than does the Rogers Seam (about 606 feet at LMW-2 and LMW-4 and about 641 feet at LMW-3 and LMW-5).

<u>Review and Interpretation of LMW-6 Hydrograph:</u> During periods of recharge, groundwater levels in LMW-6 are consistent with groundwater levels in LMW-1 (a well installed in sandstone bedrock adjacent to the Rogers Seam and between the Rogers Seam and the Frazier Seam). The observation that water levels in LMW-6 are significantly lower than water levels in well LMW-1 or Rogers Seam wells during periods of little or no recharge (May through late-October 1994) does not imply that "wells installed away from the Mine communicate poorly, if at all, with Mine groundwater." It does suggest that the hydraulic conductivity of the sedimentary bedrock between the Frazier Seam and the Rogers Seam constrains the rate of flow between these points.

Therefore, the primary conclusion supported by these data is that the hydraulic conductivity between LMW-6 and the discharge area of the Frazier Seam significantly exceeds the hydraulic conductivity of the bedrock between the Frazier Seam and the Rogers Seam, and that the hydraulic conductivity of the Frazier Seam itself may significantly exceed that of the surrounding bedrock. As a result, water levels in the Frazier Seam equilibrate with the base level of a discharge sump more rapidly than they equilibrate across the approximate 900-foot separation between the mines.

The LMW-6 hydrograph data do not support the conclusion that groundwater within the Frazier Seam is hydraulically discontinuous from groundwater within the Rogers Seam.

Review and Interpretation of LMW-7 Hydrograph: According to the LMW-7 well log, (RI/FS Report, Appendix E), well LMW-7 is completed in a void within the Landsburg Seam. The hydrograph for LMW-7 demonstrates that water levels in this void do not vary significantly over time. These data also suggest that water levels in the well are controlled by a "base level," which is consistent with the elevation of the Cedar River. The data presented on Figure 3-19 of the RI/FS Report suggest that water levels in LMW-7 are generally consistent with those reported for offsite well PW-8, which is completed in fractured bedrock near the Cedar River east of LMW-7 and between LMW-7 and the Cedar River.

The observation that water levels in LMW-7 are always significantly lower than water levels in the Rogers Seam does not imply that "wells installed away from the Mine communicate poorly, if at all, with mine groundwater." It does suggest that the hydraulic conductivity of the sedimentary bedrock between the Frazier Seam and the Rogers Seam constrains the rate of flow between these points.

Therefore, the primary conclusion supported by these data is that the hydraulic conductivity between LMW-7 and the discharge area of the Landsburg Seam significantly exceeds the hydraulic conductivity of the bedrock between the Frazier Seam and the Rogers Seam and that the hydraulic conductivity of the Landsburg Seam itself may significantly exceed that of the surrounding bedrock. As a result, water levels in the Landsburg Seam equilibrate more rapidly with regional aquifer groundwater levels to the northeast than with regional aquifer water levels in the Rogers Seam.

The LMW-7 hydrograph data do not support a conclusion that groundwater in the Landsburg Seam is hydraulically isolated from groundwater in the Rogers Seam or that "wells installed away from the Mine communicate poorly, if at all, with Mine groundwater."

Ramifications: Wells LMW-7 and LMW-6 are located within 600 and 1,000 feet of the Rogers Seam, respectively. The inappropriate interpretation that data from these wells shows that "wells installed away from the Mine communicate poorly, if at all, with Mine groundwater" suggests that impacted groundwater is present within the mine workings cannot even flow 1,000 feet from the Rogers Seam. If true, this interpretation would support the following inappropriate conclusions:

- Groundwater discharge through the mine sidewalls is minimal.
- The potential for contaminants to have discharged to the regional aquifer is trivial in all areas except the ends of the mine workings (see Issue 3), and groundwater monitoring can be restricted to a small area near the ends of the mine. If no groundwater impacts are detected in this area, then waste discharged to the Rogers

Seam has not affected the quality of regional aquifer groundwater, and potential sensitive receptors cannot be impacted via this pathway.

- Additional characterization of the nature and distribution of contamination within the mine workings and site groundwater is unnecessary, inasmuch as any contaminants present within the mine workings cannot migrate any significant distance away from the workings.
- Remedial actions to remove or control the contaminant source(s) within the Rogers Seam would have little or no value because the waste is hydraulically isolated from the regional aquifer.
- Additional detection monitoring in the regional aquifer is unnecessary because there is no pathway or mechanism by which regional groundwater could be impacted by "Mine groundwater."

The inappropriate concept that "wells installed away from the Mine communicate poorly, if at all, with Mine groundwater" also suggests that the reason groundwater impacts are not detected in samples collected from the monitoring wells LMW-1, LMW-6, and LMW-7 is because impacts cannot migrate from the Rogers Seam to these wells. This concept distracts attention from other possible (and far more probable) explanations for the absence of detectable contaminant concentrations in groundwater samples collected from site wells, such as the hypothesis that the existing detection monitoring wells are not properly placed to detect contaminants (see Issue 7).

However, if the regional aquifer is hydraulically continuous beneath the Study Area, then groundwater screened by wells outside the Rogers Seam is hydraulically continuous with water within the Rogers Seam. Consequently:

- Groundwater would likely flow through the mine sidewalls (see Issue 2).
- Groundwater in wells distant from the Rogers Seam could be impacted by wastes discharged to the Rogers Seam.
- Potential travel times for flow paths through the regional aquifer to potential receptors have not been defined.
- The absence of detection monitoring of major flow paths through which impacted groundwater might flow, including virtually all flow paths between the Rogers Seam and potable water supply systems, could place human receptors at risk.
- Additional characterization of the nature and extent of contamination within the Rogers Seam and the regional aquifer, and additional characterization of the regional aquifer in support of defining a detection monitoring network, would be essential.
- It would be appropriate to evaluate the potential benefits of additional remedial measures, potentially including measures addressing the removal or containment of contaminant sources.

Recommendations: The inappropriate and unsupported data interpretation that "wells installed away from the Mine communicate poorly, if at all, with Mine groundwater" should be corrected to describe the demonstrated relationships between groundwater in the Rogers, Frazier, and Landsburg Mines and the regional aquifer, and between the Rogers, Frazier, and Landsburg Mines and their respective recharge and discharge areas.

Currently, no groundwater monitoring wells have been installed in this portion of the regional aquifer at the site. Groundwater adjacent to the Rogers Seam has not been characterized. Potential flow paths between the Rogers Seam and potable water supply wells have not been defined (instead, the report essentially concludes that these flow paths cannot exist).

The evaluation of potential impacts to the regional aquifer, definition of potential contaminant flow paths, and evaluation of flow paths between the contaminant source areas and sensitive receptors is recommended. Such efforts should include the installation of groundwater monitoring wells at depth adjacent to the Rogers Seam in areas where contaminant sources are likely.

Issue 5. Unsupported Hypothesis: Contamination of Nearby Offsite Wells is Unrelated to the Rogers Seam

RI/FS Report Statement: The RI/FS Report states that "The observed distribution of chemical constituents in groundwater around the Study Area indicate that waste disposal activities at the Mine are not the source of these compounds. Maximum levels of some compounds occur in wells which are hydraulically isolated from the Mine with no apparent pathway for chemical migration" (RI/FS Report, Page 6-14).

The exact "chemical constituents" addressed by this statement are not defined. However, given the context of the preceding paragraph of the RI/FS Report the statement apparently refers to the volatile organic compounds (VOCs) detected in groundwater samples collected from potable water supply wells completed in the regional aquifer near the site.

(Note: there are additional statements suggesting that "levels observed at the Mine are consistent with reports in literature which indicate that coal is a natural and well-known source for these chemical constituents," etc. [RI/FS Report, Pages 6-14 and 6-15]. However, it is again unclear which "chemical constituents" are being discussed, and the "literature" supporting this claim is not cited. It seems unreasonable that the RI/FS Report would attempt to conclude that all VOCs detected in area groundwater – with the possible exception of *bis* (2-ethylhexyl) phthalate – are naturally derived from the bituminous Rogers Seam coal and unrelated to documented site waste disposal activities; therefore, these statements are disregarded pending clarification of the text and identification of relevant references).

Data Presented in Support of the Statement: There are no data presented in support of the statement. The statement may rely on unsupported hypotheses and data interpretations discussed previously in Issues 1, 2, 3, and 4.

Data Presented in Direct Contradiction of the Statement: Fourteen potable water supply wells were identified within the study areas and used to evaluate regional groundwater quality. Geochemical samples were collected from these wells (PW-1, PW-2, PW-3, PW-4, PW-5, PW-6, PW-7, PW-8, PW-9, PW-10, PW-12, PW-13, PW-14, and PW-15 [RI/FS Report, Figure 3-19]) on either three or four different occasions and submitted for laboratory testing. The results are briefly summarized below:

- Eleven of the sampled potable water supply wells were located within about 2,000 feet of the Rogers Seam. Groundwater samples from six of these wells (PW-2, PW-5, PW-7, PW-9, PW-10, and PW-13) contained detectable concentrations of at least one VOC in at least one groundwater sample.
- Diethyl phthalate was detected in at least one surface water samples collected from portal #3.
- Two of the impacted potable water supply well systems (PW-9, which apparently includes two wells, and PW-10) are located immediately south of and potentially downgradient of the area where Rogers Seam groundwater discharges through the ends of the mine seam at portal #3. At least two unique groundwater samples from each of these potable water supply systems contained one or more VOCs (benzene, 1,3,5-trimethyl benzene, and diethyl phthalate).
- Potable water supply well PW-13 is located in an area potentially downgradient of the area where Rogers Seam groundwater discharges through the ends of the mine seam at portal #3. One groundwater sample from this well contained diethyl phthalate.
- 1,1-dichloroethane was detected in at least one surface water sample collected from portal #2.
- Four additional potable water supply wells are located immediately east of the Rogers Seam (PW-5, PW-6, PW-7, and PW-8). At least one groundwater sample from two of these (PW-5 and PW-7) contained one or more VOCs (*bis* [2-ethylhexyl] phthalate, diethyl phthalate, or 1,3-dichlorobenzene).

The RI included a review of available groundwater quality data (RI/FS Report, Section 2.2.3), a review of government records (RI/FS Report, Section 2.2.4), an aerial photograph review (RI/FS Report, Section 2.2.5), and a site reconnaissance (RI/FS Report, Section 2.2.6). No source(s) of impacts to area groundwater other than the Rogers Seam Mine were defined through these reviews or identified in the RI/FS Report. Wastes containing VOCs consistent with those identified in potable water supply well groundwater samples were discharged to the Rogers Seam (RI/FS Report, Section 3.2.2).

The potable water supply wells tested and found to contain VOCs are completed within the regional aquifer, which is hydraulically continuous with the Rogers Seam (see Issue 4).

The RI/FS Report notes that the Puget Group bedrock is saturated and is hydraulically continuous with the bedrock aquifer beneath the Landsburg Mine site (RI/FS Report, Page 3-30) (this interpretation is also supported by the site hydrographs [see Issue 4]). The

RI/FS Report also concludes that the groundwater within the glacial outwash materials is hydraulically continuous with the bedrock aquifer: "In general, then discharge of water from the Mine site bedrock is primarily to the Cedar River (via glacial drift materials before reaching the Cedar River) with some discharge at the southern end to the Rock Creek alluvium and outwash materials" (RI/FS Report, Page 3-33). The RI/FS Report also notes that wells installed in the regional aquifer provide the primary water supply for numerous households surrounding the Study Area (RI/FS Report, Page 2-5 and supporting documentation). The RI/FS Report did not provide any data that document a hydraulic boundary or separation between the regional aquifer within the Rogers Seam and the regional aquifer penetrated by these potable water supply wells (see Issue 4).

Alternative Hypothesis: The regional aquifer is hydraulically continuous throughout the Study Area. In some areas, the regional aquifer occurs in both sedimentary bedrock and overlying glacial deposits, including drift and outwash soils. In other areas, the regional aquifer occurs entirely or almost entirely within sedimentary bedrock. Although the hydraulic conductivity and thickness of the aquifer materials vary, there are no "boundaries," "discontinuities," air gaps, or other constraints that "hydraulically isolate" local potable water supply wells from the regional aquifer.

The only source of impacts identified within the study area is the Rogers Seam. The contaminants identified in groundwater samples collected from potable water supply wells near the Rogers Seam are consistent with wastes discharged to the mine workings. Diethyl phthalate was identified in at least one surface water sample collected from portal #3; this same compound was detected in groundwater samples from wells PW-5 (located adjacent to the Rogers Seam) and wells PW-9 and PW-13 (located adjacent to portal #3).

Therefore, the presumptive source of VOCs in regional aquifer groundwater near the Rogers Seam is the waste that was discharged to the Rogers Seam. Data presented in the RI/FS Report suggest that there is a direct contaminant transport pathway from the Rogers Seam to nearby potable water supply wells and that waste placed in the Rogers Seam has degraded the regional aquifer water quality.

This hypothesis is also consistent with the site hydrogeology illustrated in RI/FS Report, Figure 3-12, which shows groundwater elevations in bedrock adjacent to the mine workings being higher than the elevations in the PW-9 wells. Although the data are insufficient to define actual flow paths, the data permit an interpretation of contaminated groundwater flow from the Rogers Seam to PW-9.

Ramifications: The RI/FS proposes the hypothesis that "The observed distribution of chemical constituents in groundwater around the Study Area indicate that waste disposal activities at the Mine are not the source of these compounds. Maximum levels of some compounds occur in wells which are hydraulically isolated from the Mine with no apparent pathway for chemical migration." (RI/FS Report, Page 6-14). If the regional aquifer penetrated by potable water supply wells near the Rogers Seam Mine were "hydraulically isolated" from the regional aquifer penetrated by the Rogers Seam Mine (into which wastes were discharged), then it would be impossible for contaminants to migrate from the mine workings to these nearby potable water supply wells. If these potable water supply wells cannot be impacted by mine discharges, then additional monitoring of offsite wells is inappropriate, and additional investigations to determine how mine discharge flows to these wells or to define appropriate remedial measures would be unnecessary. This (inappropriate) hypothesis would also support the concept that, if any contaminants were identified in offsite wells in the future, these contaminants would be appropriately attributed to sources other than waste discharged to the Rogers Seam.

However, if the regional aquifer is hydraulically continuous and the contaminants detected in the offsite potable water supply wells are derived from waste discharged to the Rogers Seam, then:

- Area residents would have consumed and may still be consuming groundwater contaminated by waste discharged to the Rogers Seam.
- There would be an urgent need to conduct additional sampling of potable water supply wells and evaluate potential risks to receptors in order to protect human health.
- Additional investigations of the nature and extent of impacts to area groundwater would be necessary and should be prioritized.
- Installation of an effective detection monitoring network would be essential and should be prioritized.
- Evaluation of additional remedial measures, including measures addressing the removal or containment of the contaminant source, would be appropriate.

Recommendations: The inappropriate and unsupported hypothesis that "The observed distribution of chemical constituents in groundwater around the Study Area indicate that waste disposal activities at the Mine are not the source of these compounds. Maximum levels of some compounds occur in wells which are hydraulically isolated from the Mine with no apparent pathway for chemical migration" (RI/FS Report, Page 6-14) should be rejected.

The hydraulic continuity of the regional aquifer near the Rogers Seam and the potential that the contaminants detected in the offsite potable water supply wells are derived from waste discharged to the Rogers Seam, should be evaluated by:

- Collecting additional samples from nearby potable water supply wells to determine whether current conditions are consistent with those described in the RI/FS Report
- Characterizing the nature and distribution of contaminants within the Rogers Seam
- Characterizing the hydrogeology and geochemistry of the regional aquifer within the study area

Issue 6. Unsupported Data Interpretation: Groundwater is Not Impacted by Rogers Seam Waste

RI/FS Report Statement: The RI/FS Report states that "no chemical constituents are migrating off of the site in surface water or groundwater above naturally-occurring background levels. Chemicals are present above background and regulatory limits only in soils within the trench itself, and these occurrences are confined to the areas of known waste disposal. Other than these occurrences in soil, there are no observed measurable impacts within or outside of the Study Area from prior waste disposal activities" (RI/FS Report, Page 6-15). The RI/FS Report also states that "The results of groundwater sampling indicate that no federal drinking water standards (Maximum Contaminant Levels) are being exceeded at the Mine itself or amongst any of the private wells sampled in the study area" (RI/FS Report, Page 6-14).

Data Presented in Support of the Statement: The RI/FS Report provides results for geochemical analyses of groundwater samples from on-site monitoring wells (RI/FS Report, Table 5-3).

Data Presented in Direct Contradiction of the Statement: Groundwater sampling of Study Area wells documents that impacts potentially resulting from waste discharge to the Rogers Seam have been detected in offsite potable water supply wells (see Issue 5). As noted in that discussion, the existing data from offsite wells suggest that waste discharged to the Rogers Seam is the source of impacts identified in offsite potable water supply wells. One VOC detected in surface water discharging from portal #3 was also detected in nearby potable water supply wells. No potential source of impacts other than the Rogers Seam was identified or postulated in the RI/FS Report. Therefore, waste discharged to the Rogers Seam is the presumptive source of impacts identified in the offsite potable water supply wells.

Site contaminants include DNAPLs, such as chlorinated solvents. These contaminants were discharged to the Rogers Seam as liquid waste (see Issue 1). Chlorinated solvents such as those identified in Rogers Seam sludge samples have unique characteristics: they are denser and less viscous than water. Subsequent to their discharge to subsidence trench soils, such compounds would have swiftly flowed downwards into the former workings, possibly penetrating to the base of the workings. It is highly probable that, upon reaching the base of the workings, they also flowed south along the sloping mine floor (although this was reportedly not observed during active mining operations, blasting operations during mine closure, or post-mining settlement could have mobilized contaminants).

The stated purpose of the groundwater monitoring wells installed during the RI was "to be capable of monitoring groundwater quality and horizontal head within the site area, possibly within the Landsburg seam and Frazier seam mines" (Phase I RI/FS Work Plan, Page 6). During development of the Phase I RI/FS Work Plan, reliance on indirect evaluations rather than physical testing was proposed because contaminants (including DNAPLs) were presumed present within the mine workings (Phase I RI/FS Work Plan, Page 6). A critical reason for using indirect evaluation methods was stated as: "An important consideration, if the decision is made to attempt mine characterization, is the difficulty in drilling and sealing boreholes through open workings and voids. An exploratory borehole program could open new avenues for contaminants to migrate within the mine" (Phase I RI/FS Work Plan, Page 6). As a result, no wells were installed in contaminant source areas. In addition, wells were installed only within the uppermost portion of the aquifer; no effort was made to characterize head or contaminant distribution at depth. Therefore, it was not possible to effectively test critical hypotheses used to define the original conceptual model of the site, such as the hypothesis that groundwater flows preferentially through the coal mine ends (see Issue 2). It also is not possible to prove that the regional aquifer has not been impacted by Rogers Seam wastes or that any such impacts cannot reach potable water supply wells or other sensitive receptors.

The constraints imposed in the RI were likely derived, in part, from the conceptual model that was current at the time the work plan was prepared, which "envisions most groundwater flow occurring through the coal seams and not through the tight sandstones and shales" (Phase I RI/FS Work Plan, Page 6). Subsequent evaluations, including definition of the mine layout and testing of the hydraulic conductivity of the coal and sandstone, have shown that this conceptual model was inappropriate and unreliable (see Issue 2).

The placement of shallow and intermediate-depth monitoring wells at the ends of the mine workings, coupled with the minimal investigation of groundwater quality within the sedimentary bedrock adjacent to the mine workings, does not permit testing of the validity of the original conceptual model. The RI/FS Report did not include a demonstration that the wells constructed during the RI were in fact positioned to intercept primary contaminant flow paths. The absence of detectable contaminants in wells intended to intercept primary contaminant flow paths suggests that the wells are do not intercept primary contaminant flow paths and that the positions of those primary contaminant flow paths are not actually known (see Issue 2).

As a consequence of decisions made during the scoping and implementation of the RI, no groundwater wells have been installed into known contaminant source areas, and the only groundwater monitoring well installed adjacent to a known contaminant source area is screened near the regional aquifer water table and would therefore be unable to detect contaminated groundwater at depth (see Issue 2).

Alternative Hypothesis: The primary reason that contaminants are not detected in groundwater samples from the existing monitoring wells is that these wells are not placed in contaminant flow paths. Although characterization of the contaminant source area is incomplete and limited to a small number of surface soil and sludge samples collected during previous site investigations, these limited data suggest that significant volumes of DNAPLs and other contaminants were discharged to the Rogers Seam. Due to their physical nature, DNAPLs would flow to significant depths within the mine workings and could flow along the base of the workings to the lowermost (southern) reaches.

Characterization of head and contaminant distribution within the regional aquifer is incomplete. The extent of DNAPLs and related contaminants in the source areas has not been evaluated. The absence of detectable contaminant concentrations in groundwater samples from existing site monitoring wells provides the sole foundation for the conclusion that "no federal drinking water standards (Maximum Contaminant Levels) are being exceeded at the Mine" (RI/FS Report, Page 6-14). However, groundwater within the mine workings in areas where waste was discharged has never been sampled or tested for contaminants. Data from sludge samples collected during previous site investigations suggest that contaminant concentrations in trench soils were sufficient to yield groundwater concentrations in excess of federal drinking water standards for several contaminants, including known and potential carcinogens and compounds that degrade into known and potential carcinogens (e.g., arsenic and trichloroethene).

The existing groundwater monitoring wells do not permit effective characterization of head distribution and groundwater geochemistry in the bedrock aquifer. Therefore, the absence of detectable concentrations of contaminants in the existing wells cannot be extrapolated to predict an absence of contaminants site-wide.

Detections of diethyl phthalate in both mine discharge and in nearby potable water supply wells suggest that impacted groundwater has migrated off site and that measurable impacts from prior waste-disposal activities have been identified in both surface water and groundwater within the Study Area.

Ramifications: The statements (based on an inappropriately limited data set) that "no chemical constituents are migrating off of the site in surface water or groundwater above naturally-occurring background levels. Chemicals are present above background and regulatory limits only in soils within the trench itself, and these occurrences are confined to the areas of known waste disposal. Other than these occurrences in soil, there are no observed measurable impacts within or outside of the Study Area from prior waste disposal activities." (RI/FS Report, Page 6-15) suggests that:

- The nature and extent of contaminants within the Rogers Seam mine workings have been characterized and are therefore known.
- The nature and extent of contamination in the regional aquifer have been characterized and are therefore known.
- Relationships between the regional aquifer and surface water have been characterized and are understood.
- Contaminant flow paths between Rogers Seam contaminant source areas and potential receptors have been characterized and are understood.

If these statements were accepted, then:

- Additional source area characterization would be unnecessary.
- Additional evaluations of the nature and extent of groundwater contamination would be unnecessary.
- Design and construction an effective detection monitoring network would be unnecessary.

- It would be reasonable to conclude that the site poses low risks to potential receptors.

However, if impacts potentially resulting from waste discharge to the Rogers Seam have been detected in offsite potable water supply wells and if the existing detection monitoring network does not effectively target predicted contaminant flow paths, then these conclusions are entirely unfounded. Consequently, the potable water supply wells of downgradient users would become, by default, the primary "detection monitoring system" for the site.

Recommendations: The conclusion that "no federal drinking water standards . . . are being exceeded at the Mine itself" is unsupported and should be rejected because groundwater within the mine workings has never been sampled or tested. The consequent conclusions that that "no chemical constituents are migrating off of the site in surface water or groundwater above naturally-occurring background levels," that "Chemicals are present above background and regulatory limits only in soils within the trench itself, and these occurrences are confined to the areas of known waste disposal," and that "Other than these occurrences in soil, there are no observed measurable impacts within or outside of the Study Area from prior waste disposal activities" should be rejected as unproven because apparent offsite migration of contaminants to nearby potable water supply wells has been documented and because the existing detection monitoring network does not effectively address probable contaminant flow paths.

Appropriate additional investigations that would permit the effective characterization of contaminant flow paths are recommended. These would be developed to support the design and installation of an effective detection monitoring network. Specifically, wells would be installed to monitor groundwater quality in and adjacent to areas where contaminants, including dense chlorinated solvents, may have migrated in liquid form.

Issue 7. Unsupported Conclusion: Current Characterization of the Nature and Extent of Rogers Seam Contamination is Sufficient

RI/FS Report Statement: The RI/FS Report evaluates the nature and extent of chemical constituents that exceed regulatory criteria (RI/FS Report, Section 5) and reviews, develops, and evaluates remedial actions (RI/FS Report, Sections 7, 8, and 9, respectively). A draft cleanup action plan (Draft CAP) based on the current characterization of the nature and extent of contamination at this site has been developed (Golder, 2002). Inasmuch as these studies cannot be effectively undertaken or successfully completed unless the site characterization is sufficient to constrain selection of the site remedy, the existence of the final RI/FS Report and Draft CAP inappropriately suggests that the current characterization of the nature and extent of Rogers Seam contamination is considered to be adequate by Ecology and the PRPs.

Data and Conclusions Presented in Support of the Hypothesis: The RI/FS Report states that "The approach taken during the RI was to focus environmental sampling efforts on potential pathways of chemicals leaving the mine, and not to focus on the mine itself. Therefore, what is known regarding the contents of the mine is based on visual reconnaissance, records searches, and geophysical surveys" (RI/FS Report, Page 6-5). The data supporting these statements are presented in the RI/FS Report, Section 2.6 (Geophysical Investigation), Section 2.11 (Geologic Reconnaissance), and Section 3.2 (Source Characteristics). Data from these sections are summarized in Section 6.3.2.

Numerous data and a series of conclusions were also presented in the RI/FS Report in support of the conclusion that site characterization is adequate. For example, the RI/FS Report concludes that "no chemical constituents are migrating off of the site in surface water or groundwater above naturally-occurring background levels. Chemicals are present above background and regulatory limits only in soils within the trench itself, and these occurrences are confined to the areas of known waste disposal. Other than these occurrences in soil, there are no observed measurable impacts within or outside of the Study Area from prior waste disposal activities" (RI/FS Report, Page 6-15). The RI/FS Report also states that "The results of groundwater sampling indicate that no federal drinking water standards (Maximum Contaminant Levels) are being exceeded at the Mine itself or amongst any of the private wells sampled in the study area" (RI/FS Report, Page 6-14).

Data Presented in Direct Contradiction of the Statement: It is unclear that all relevant potential source areas have been identified. For example, an "old clothes dryer" and "2 tires with hubs" in an area about 1,000 feet south of LMW-1 is noted on the data presented in the appendix, but not noted in the report. The observation of the "old clothes dryer" is significant as it implies waste disposal via wheeled access in an area significantly south of the limits defined in the RI/FS Report. However, no additional evaluation of this area was performed.

More critically, the RI/FS Report states that "an estimated 4,500 drums and about 200,000 gallons of oily waste water and sludges were disposed into the trench. Available interviews with waste haulers indicate that some of the drums contained wastes that included paint wastes, solvents, metal sludges and oily water and sludge" (RI/FS Report, Pages 6-4 and 6-5). The RI/FS Report further notes that "Given that up to 4,500 drums were reportedly placed in the trench and approximately 100 were recovered during the ERA, it is reasonable to expect that wastes potentially remaining include a significant number of drums buried beneath the trench bottom surface at some depth" (RI/FS Report, Page 6-5).

The geochemical data presented in the RI/FS Report, Section 3.2.2.2, include demonstrations that residual waste in excavated drums tested positive for chlorinated compounds and other contaminants (see Issue 1). These reported concentrations are significant because they suggest that chlorinated DNAPLs were present in liquid form (either as "free product" or its residual) within the sludge at the time of sampling; this in turn suggests that chlorinated solvents were discharged in liquid form to the Rogers Seam subsidence trench. No intact drums were recovered during previous site actions (RI./FS Report, Page 3-6), or identified during the RI (RI/FS Report, Section 3.2.3). This suggests that most of the waste placed into the trench remained after the expedited response action was completed.

Only a limited characterization of site groundwater was performed. No groundwater samples have ever been collected directly from the contaminant source areas. The existing groundwater monitoring network includes only one well installed in sandstone bedrock adjacent to a source area and does not permit any evaluation of groundwater quality within the lower 90 percent of the mine workings adjacent to known waste placement areas. Nevertheless, the RI/FS concludes that groundwater in the regional aquifer is not impacted by Rogers Seam waste because:

- Groundwater contamination was not detected at one location near the water table adjacent to a source area, in coal near the ends of the mine workings, or in adjacent mine workings, and
- There is no waste remaining in the Rogers Seam, and
- All groundwater within the Rogers Seam discharges through the ends of the mine workings; therefore, there has not been and cannot be a significant contaminated groundwater flow path through the mine sidewalls, and
- Rogers Seam groundwater is hydraulically separate from the regional aquifer monitored in wells elsewhere, including wells within 1,000 feet of the Rogers Seam, and
- The documented contamination of nearby offsite wells with compounds detected in mine discharge is unrelated to the Rogers Seam.

The RI/FS Report suggests that there is no waste remaining in the Rogers Seam because it either:

- Was destroyed by fire, and/or
- Discharged through the mine ends and is gone, and/or
- Is immobilized by coal

Each of these potential explanations has been carefully reviewed in this letter report. None of these conclusions is supported by the data presented in the RI/FS Report. The circular reasoning that the absence of detectable contaminants proves that there is no waste remaining, and that the absence of waste explains the absence of detectable contaminants in groundwater, is rejected.

Alternative Conclusion: Site data that were presented in the body of the RI/FS report but omitted from the summary chapter demonstrate that DNAPLs and other contaminants were discharged to the Rogers Seam over a period of years. In the complete absence of data to the contrary, it is reasonable to expect that significant volumes of these wastes remain present at or near their original disposed volumes at some depth within the mine workings and that impacts from these wastes persist within the regional aquifer. The absence of demonstrated groundwater impacts results from the limitations of the existing detection monitoring network and does not imply that no impacts occur.

Ramifications: If the characterization of the nature and extent of impacts within the Rogers Seam is sufficient, then it should be possible to accurately answer the following fundamental questions:

- Exactly where are the primary contaminant source areas?
- Do contaminants remain in place and, if so, what and where are they?
- Has site groundwater been contaminated?
- If site groundwater has been contaminated, then have all primary contaminant flow paths between source areas and sensitive receptors been identified and are they being monitored?

The current site characterization cannot answer any of these questions with reasonable scientific certainty. Instead, the RI/FS Report presents a series of unsupported hypotheses that cannot be scientifically defended using the existing site data. As a result, it is inappropriate to base an evaluation of risks posed by this site, or select a site remedy, on the existing site characterization.

It is essential to the integrity of MTCA implementation that the RI process develop a reasonable and scientifically defensible conceptual model of site contamination and relevant contaminant transport processes. From the premise that waste placed in the Rogers Seam can no longer impact groundwater to the concept that Rogers Seam groundwater is hydraulically separate from wells elsewhere in the regional aquifer, this RI has been unsuccessful.

When the conceptual model of the site cannot answer the most basic questions regarding the nature and extent of impacts at the site, it is inappropriate to evaluate or select a site remedy.

Recommendations: Additional site investigations must be performed to substantiate the current conclusions of the RI/FS Report. These investigations must address the nature and extent of contaminants within the source area, and the potential that any residual wastes have impacted groundwater in areas not currently evaluated using the existing groundwater monitoring wells.

During the development of the Phase I RI/FS Work Plan, reliance on indirect evaluations rather than physical testing was proposed because contaminants (including DNAPLs) were presumed present within the mine workings (Phase I RI/FS Work Plan, Page 6). A critical reason for using indirect evaluation methods was stated as: "An important consideration, if the decision is made to attempt mine characterization, is the difficulty in drilling and sealing boreholes through open workings and voids. An exploratory borehole program could open new avenues for contaminants to migrate within the mine." (Phase I RI/FS Work Plan, Page 6). Subsequently, Golder has demonstrated (by successfully installing LMW-4, LMW-5, LMW-6, and LMW-7) that boreholes can be successfully advanced into mine workings at this site. Therefore, the only concern related to direct mine characterization would be the potential to open avenues for DNAPL migration.

The City of Kent has repeatedly advised Ecology and the PLPs that the application of a "Black Box" concept is only as good as the understanding of the contents of the "box," the nature of the box, and the mechanisms through which the contents can leave the box. For these and other reasons, the City of Kent has never fully concurred with reliance on indirect rather than direct testing of the nature and extent of contamination within the Rogers Seam and has insisted that appropriate testing be performed before a final CAP is developed.

Inasmuch as RI/FS Report currently concludes that there are no wastes present within the Rogers Seam, the previously proposed rationale for relying on indirect evaluations rather than physical testing is no longer valid. The mine workings can be readily accessed; because they dip westward, boreholes can be advanced to the base of the mine workings from stable areas west of the subsidence trench. These boreholes could be advanced into or alongside the mine workings at depths consistent with the potential flow paths of contaminants such as the DNAPLs. Groundwater samples from monitoring wells installed in these borings would permit the confirmation of the hypothesis that there are no significant impacts at depth and that "there are no measurable impacts within . . . the Study Area from prior waste disposal activities" (RI/FS Report, Page 6-15). Therefore, it is essential that this critical conclusion be proven by direct exploration of the known and suspected source areas, including the base and south end of the mine workings where DNAPLs would presumably have migrated.

This same field investigation program would permit testing of the hypothesis that contaminants remain in place at significant concentrations and affect groundwater quality and support the selection and implementation of the site remedy. It would be appropriate to consider that VOCs in groundwater likely serve as an excellent geochemical tracer for flow paths from the Rogers Seam to the regional aquifer.

Issue 8. Unsupported Conclusion: The Contaminants of Potential Concern Are Appropriate

RI/FS Report Statement: The RI/FS Report states that chemicals of concern (COCs) are those "resulting from waste disposal activities conducted at the time which potentially pose a human or environmental health risk and/or which exceed potential regulatory criteria (RI/FS Report, Page 5-1). These compounds are then screened to define contaminants of potential concern (COPCs), which are "defined for each media and represent those compounds which exceed the regulatory screening values and whatever background data are available for the site. It is important to note, however, that the COPC do not necessarily represent compounds resulting from mine waste disposal activities since site-specific background data are limited" (RI/FS Report, Page 5-2).

Data Presented in Support of COC and COPC Selection: The first step in the screening process is to eliminate invalid data. The second step is to eliminate "compounds which do not exceed regulatory screening criteria."

Analysis of COC and COPC Selection: No groundwater samples have been collected from contaminant source areas. As a consequence, only organic compounds detected in groundwater samples collected from offsite private water supply wells are evaluated as COCs. Inasmuch as the concentrations of these compounds in offsite wells did not exceed limits identified in the applicable or relevant and appropriate requirements (ARARs), no organic compounds were selected as COPCs for groundwater. Using the method presented in the RI/FS Report, VOCs cannot be defined as COCs or COPCs for groundwater unless groundwater data are collected from contaminant sources areas and flow paths downgradient of those source areas.

Few soil samples have been collected from contaminant source areas. As a consequence, it is uncertain whether existing samples adequately characterize impacted soils within the source areas.

Ramifications and Recommendations: The conclusion of the identification of COCs is that "apart from soils within the trench located in the area of known prior waste disposal activities, soil, groundwater and surface water media in the Study Area do not exhibit concentrations of chemical constituents above the naturally occurring background levels" (RI/FS Report, Page 5-18). These results are used to support the proposed site remedy, because the only site contamination identified through the RI is impacted soils within the trench. It is noteworthy that not even these impacts were actually identified through this RI. Therefore, only data collected during previous site investigations support the conclusion that contamination is present at this site.

Source area characterization was explicitly omitted from the RI (see Issue 8). The only source area characterization data included are therefore data from previous studies that were not designed to fully characterize the source areas. As a result, it is not possible to identify or subsequently select source area contaminants as COCs or COPCs because nothing is known about the nature of the source area contaminants. This significant data gap renders the selection of COCs and COPCs ineffective at best and may in fact cause the most serious contaminants of concern to be entirely neglected. It is unreasonable to refrain from direct investigation of groundwater quality within or near the source area because it would entail a high risk of contaminant mobilization and then conclude that there are no significant groundwater quality concerns because there are no data derived from the source area. It is also unreasonable to extend this conclusion as support for the position that only limited groundwater monitoring need be proposed for the site remedy because "site groundwater currently meets remediation goals" (Draft CAP, Page 31).

Recommendations: Collection of actual groundwater and soil data from onsite contaminant source areas is recommended. Use of these additional data in conjunction with data from previous studies as the basis for identifying COCs and COPCs is also recommended.

Issue 9. Unsupported Conclusion: The Selected Remedy Will Protect Human Health and the Environment from Impacts Related to Rogers Seam Waste

RI/FS Report Statement: The RI/FS Report states that "although it is most probable that Alternative 5 is the best alternative, Alternative 6 should be retained as a contingency" (RI/FS Report, Page 9-15).

Alternative 5 specifies the following:

- Backfill the trench as required for capping.
- Allow the backfill to consolidate.
- Place a low-permeability cap over the trench backfill, including grading and surface water management.
- Maintain the cap for 20 years.
- Implement and maintain institution controls (deed restrictions, site restrictions, and fencing), periodic visual inspection of the cap, and periodic groundwater and surface water monitoring using some of the existing installations.

Alternative 6 differs from Alternative 5 only in that a flexible membrane liner (FML) cap is prescribed in place of the low-permeability soil cap. For both alternatives, only a portion of the trench would be capped.

The Draft CAP adopts Alternative 5 and provides additional details regarding cap construction and monitoring (Draft CAP, Section 5.3). The Draft CAP also defines the specific area of the trench for which capping and related construction activities are proposed (Draft CAP, Figure 12).

Data Presented in Support and Direct Contradiction of the Statement: The entire RI/FS Report supports selection of either Alternative 5 or Alternative 6. Alternative 5 was selected based on the assumption that implementation of the remedy will protect human health and the environment, achieve compliance with cleanup standards, and achieve compliance with applicable or relevant and appropriate requirements (ARARs). Conclusions critical to the selection of this alternative include those essential to the conclusion that the current characterization of the nature and extent of Rogers Seam contamination is sufficient (see Issue 7):

- There is no waste remaining in the Rogers Seam because it:
  - Discharged through the mine ends and is gone, and
  - Was destroyed by fire, and
  - Is immobilized by coal
- Groundwater is not impacted by Rogers Seam waste, and the potential for groundwater contamination does not need to be evaluated further because:

- There is no waste remaining in the Rogers Seam.
- All groundwater within the Rogers Seam discharges through the ends of the mine workings; therefore, there has not been and cannot be a significant contaminated groundwater flow path through the mine sidewalls.
- Rogers Seam groundwater is hydraulically separate from the regional aquifer monitored in wells elsewhere, including wells within 1,000 feet of the Rogers Seam.
- The documented contamination of nearby offsite wells with compounds detected in mine discharge is unrelated to the Rogers Seam.

The Draft CAP also implies that the nature and extent of waste within the Rogers Seam need not be evaluated further and that (even though the discharge of organic compounds to the mine workings is documented and there are no groundwater samples from contaminant source areas demonstrating the absence of impacts) site groundwater can be assumed to contain no organic compounds.

Analysis of Selected Remedy: The proposed remedy would likely be successful for a site where there was no residual contamination and where groundwater has not been impacted. However, the data presented in the RI/FS Report indicate that the Rogers Seam does in fact have residual contamination and that Rogers Seam waste has, in fact, impacted groundwater quality. The proposed remedy does not acknowledge or address the groundwater impacts. Contaminant flow paths from Rogers Seam waste to sensitive receptors have not been defined because they are presumed to not exist. Therefore, it is difficult to conclude that the proposed remedy will protect human health or the environment. Potential remedies that might do so by addressing actual site conditions were not proposed or evaluated among the "Assembly of Remediation Alternatives" (RI/FS Report, Chapter 7). Consequently, the selected remedy does not effectively address groundwater impacts, long-term monitoring needs, source removal actions or source control actions. In addition, fundamental aspects of the conceptual site model presented in the existing RI/FS Report are not scientifically defensible and therefore do not support selection of an appropriate remedy.

Placing a cap over the trench in areas of known waste disposal will reduce the direct infiltration of precipitation and surface water runoff through soils immediately overlying the waste. However, the mine workings are presumed to be highly permeable, and groundwater within the mine workings is presumed to equilibrate quickly throughout the workings (see Issue 2). Therefore, the actual effect of any cap over the trench will be to:

- Reduce infiltration through the vadose zone directly beneath the capped area.
- Direct a portion of the surface water runoff currently entering the trench from the trench, which may reduce the elevation to which groundwater rises during recharge events.

However, surface water runoff and incident precipitation will continue to enter the trench in uncapped areas. Groundwater levels will continue to rise in response to such recharge events, the groundwater can be expected to quickly equilibrate through the mine workings, and the mine workings will therefore continue to act as a local recharge area to the regional aquifer. Therefore, the proposed remedy is not expected to significantly affect the groundwater flow through the mine workings. In addition, the proposed remedy does not address wastes remaining in place within the mine workings (consistent with the unsubstantiated RI/FS Report conclusion that no waste remains in the Rogers Seam) and does not include additional characterization of groundwater contamination and flow paths (consistent with the unsubstantiated RI/FS Report conclusion that groundwater is not impacted by Rogers Seam waste, and the potential for groundwater contamination does not need to be evaluated).

Ramifications and Recommendations: Data and analyses upon which selection of the site remedy is based have been examined in detail. Many critical conclusions upon which remedy selection is based are not supported by the data and analyses presented in the RI/FS Report. Alternative hypotheses, which are both more plausible and more protective of human health and the environment given the limitations of site data, have been proposed. It is critical that site characterization be sufficient to constrain the conceptual model of the site and permit the evaluation of the actual risks posed by the site. Numerous recommendations have been provided in this letter report; implementation of these recommendations would permit the development of a more complete and scientifically reasonable conceptual model for this site.

Summary Discussion

Based on this review of the RI/FS Report and Draft CAP, the conceptual model posed in the RI/FS Report is flawed and does not support the effective selection of a site remedy as required under Chapter 173-340-350 (6) of MTCA. Specifically:

- The RI/FS Report proposes that Rogers Seam wastes are not present because they were destroyed by fire. No site-specific data (or even literature references) supportive of this hypothesis were provided; data that directly contradict this hypothesis were presented in the report. Rejection of this hypothesis is recommended.
- The RI/FS Report proposes that Rogers Seam wastes are not present because they were discharged through the mine ends and are gone. No data demonstrating this hypothesis were provided; instead the data presented in this report directly contradict this hypothesis. Rejection of this conclusion is recommended.
- The RI/FS Report proposes that Rogers Seam wastes are not present because they are immobilized by coal. No data supportive of this hypothesis, or the concept that Rogers Seam bituminous coal is physically or geochemically comparable to activated carbon, were provided. Rejection of this hypothesis is recommended.
- The RI/FS Report proposes that the on-site monitoring wells are installed in primary contaminant flow paths and that the absence of detectable contaminants in on-site monitoring wells therefore demonstrates that the wastes originally discharged into the

Rogers Seam are either destroyed by fire, completely removed via discharge through the mine ends, or immobilized by coal. Rejection of this hypothesis, definition of primary contaminant flow paths, and the installation of monitoring wells in primary contaminant flow paths, is recommended.

- The RI/FS Report interprets site data as indicating that Rogers Seam groundwater is hydraulically separate from the regional aquifer monitored elsewhere (including at wells located within 1,000 feet of the Rogers Seam). Flaws in the RI/FS Report data analysis are identified. An alternative interpretation consistent with site data and fundamental hydrogeologic principles is proposed. Rejection of the RI/FS Report interpretation and adoption of the alternative that the regional aquifer beneath the Study Area is hydraulically continuous is recommended.
- The RI/FS Report proposes that the contamination of nearby offsite wells is unrelated to the Rogers Seam. No data supportive of this hypothesis were provided; data that directly contradict this hypothesis were presented in the report. Rejection of this hypothesis is recommended.
- The RI/FS Report interprets site data as indicating that groundwater is not impacted by Rogers Seam waste. Flaws in the RI/FS Report data analysis are identified. An alternative interpretation consistent with site data and fundamental hydrogeologic principles is proposed. Rejection of the RI/FS Report interpretation and adoption of the interpretation that Rogers Seam waste is the presumptive source of impacts to at least some nearby potable water supply wells is appropriate and recommended.
- The RI/FS Report concludes that characterization of the nature and extent of Rogers Seam contamination is sufficient to permit the development and selection of a site remedy. The limits of the existing data (such as the absence of geochemical test results beyond those developed for an expedited response action and the complete absence of source area groundwater quality data) were reviewed; data indicating that existing source characterization is insufficient were presented in the report. Rejection of this conclusion, and instead requiring effective characterization of the source (particularly given that the RI/FS Report concludes that source characterization in fact poses little or no risk), is recommended.
- The RI/FS Report concludes that appropriate COPCs can be and have been selected. The limits of existing geochemical data (such as the complete absence of source area groundwater quality data) were reviewed; data indicating that existing source characterization are insufficient to permit effective selection of COPCs were presented in the report. Rejection of this conclusion, and the performance of additional source characterization to define appropriate COPCs, are recommended.
- The RI/FS Report concludes that an appropriate remedy protective of human health and the environment can be selected based on the existing site conceptual model and the conclusions presented in the RI/FS Report. Inadequacies of the assumptions fundamental to remedy selection, and the consequent implications regarding the

expected performance of the selected remedy, have been reviewed. Rejection of this conclusion and performance of the recommendations listed throughout this letter report are recommended.

This review finds that the RI/FS Report presents an inadequate and technically flawed conceptual model of the hydrogeology and geochemistry of the Landsburg Mine site. Therefore, the RI/FS Report does not support selection of a remedy for the site. Additional site characterization will be required before an appropriate remedy can be identified. Therefore, it would be premature for the City of Kent to concur with the Draft CAP.

References

Golder Associates, Inc. 1992. *Landsburg Phase I Remedial Investigation/Feasibility Study (RI/FS) Work Plan*. Completed with assistance from SubTerra, Inc. November 18, 1992.

Golder Associates, Inc. 1996. *Remedial Investigation and Feasibility Study for the Landsburg Mine Site, Ravensdale Washington*. Volumes I and II. February 1996.

Golder Associates, Inc. 2002. *Draft Cleanup Action Plan, Landsburg Mine Site, Ravensdale, Washington.*

Table 1
Estimate of Discharge Through Mine Ends and Sidewalls

Rock Type	Saturated Thickness of Mine Workings (feet)[a]	Width Within Mine Workings (feet)[a]	Calculated Saturated Area Within Mine Workings (square feet)[a]	Minimum Hydraulic Conductivity (feet per second)[b]	Maximum Hydraulic Conductivity (feet per second)[b]	Minimum Discharge if Only Minimum Hydraulic Conductivity Values Are Used (cubic feet per second)[c]	Maximum Discharge if Only Maximum Hydraulic Conductivity Values Are Used (cubic feet per second)[c]
Coal	400	16	12,800	1.00×10^{-05}	0.036	0.13	461
Sandstone	400	4,600	3,680,000	4.14×10^{-06}	4.14×10^{-06}	15	15

Notes:
The text discussion of this table is presented in "Rogers Seam Wastes Discharged Through the Mine Ends and are Gone" (Issue No. 2). These calculations cannot be considered separately from the text discussion. These calculations provide very general estimates that permit comparison of the total discharge through mine sidewalls with the total discharge through mine ends under a uniform gradient.

[a] Saturated thickness and width of each rock type are estimated based on measurements from the RI/FS Report, Figure 3-9; although these values are necessarily inaccurate, they provide a general basis for the comparison of discharge rates. The actual saturated area of sandstone is likely significantly greater than the calculated area inasmuch as the area of the deepest level was omitted from these calculations. Saturated areas include both of the ends and both of the sidewalls of the mine workings.

[b] The hydraulic conductivity estimates are from the RI/FS Report, Table 3-10. Reported values for LMW-1 are used as the estimate for both the minimum and the maximum hydraulic conductivity of sandstone as no other values are available (Well LMW-1 is located near a subsurface tunnel in the mine. Test results indicate that the tunnel did not influence the hydraulic conductivity measurements, inasmuch as the hydraulic conductivity of the tunnel would most certainly exceed the reported value and no recharging boundary was noted during testing). The minimum and maximum hydraulic conductivity values for coal are based on the values reported for wells LMW-2, LMW-3, LMW-4, and LMW-5, all of which are completed in Rogers Seam coal, except that the maximum value for LMW-2, which was an order of magnitude higher than other reported values for coal and could not be replicated in subsequent testing, was rejected.

[c] The calculated discharges presented in these tables do not represent actual site conditions because they were calculated using an assumed gradient of 1. These values are useful for the purpose of comparing the total estimated discharge through the different rock types.

City of Kent Presentation
Topic #1

Landsburg Mine Technical Meeting

September 29th, 9:00 AM Meeting
Between
Ecology/PLPs/Golder/
City of Kent/Interested Parties

2004

City of Kent Representatives:

- Gary Gill, P.E., City Engineer
- Bill Wolinski, P.E., Manager of Environmental Engineering
- Brad Lake, Water Superintendent
- Kelly Peterson, Environmental Engineer
- John Littler, P.E., LEC, Inc.
- Anne Udaloy, L.H.G., UES

Topic 1: Should Deep Contaminant Flow Paths Be Defined and Monitored?

- Yes
- This will require a Supplemental Remedial Investigation

Deep Contaminant Flow Paths to Receptors Must Be Defined and Monitored to:

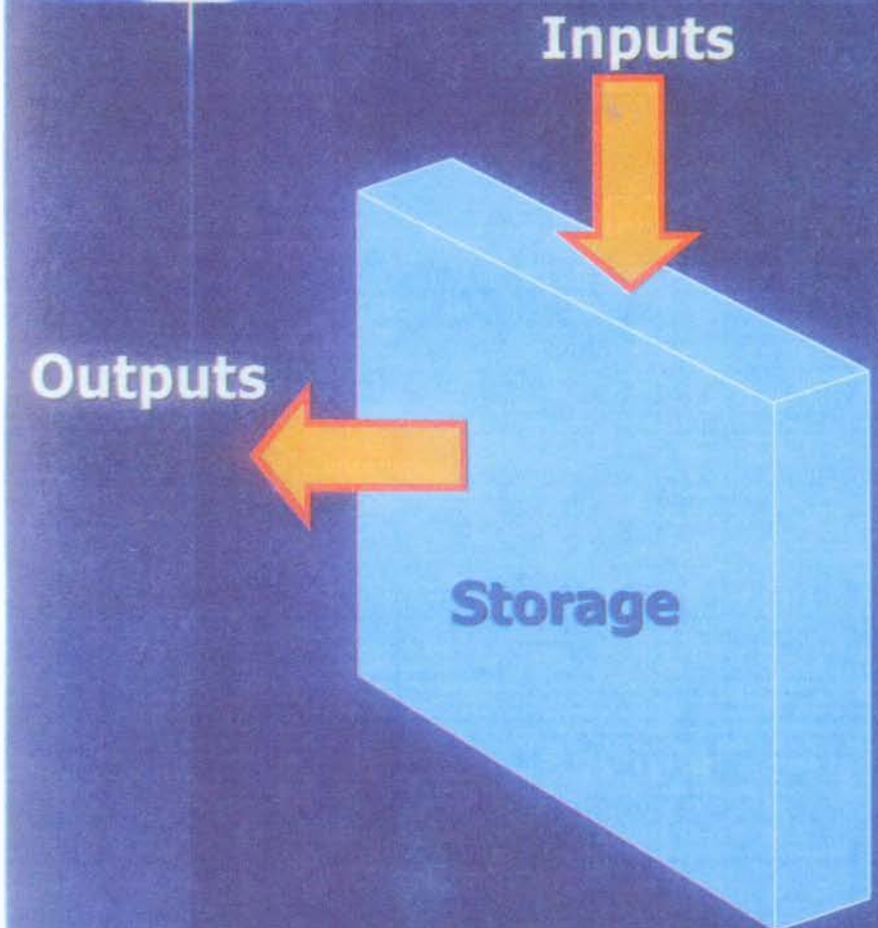
- Meet MTCA requirements
- Identify contaminant flow paths that may reach sensitive receptors (people, fish, etc.)
- Design a detection monitoring network
- Identify and evaluate appropriate cleanup actions
- Understand and evaluate risks, which will allow development of appropriate and effective contingency plans

How Did the PLPs Propose Defining Contaminant Flow Paths?

- By determining whether a "Black Box" approach was appropriate, then
- By determining "whether contaminants are migrating out of the 'black box' at concentrations that are unacceptable or pose a risk to the public and the environment"- RI Work Plan, GAI 1992

The City of Kent has continuously since 1993, raised serious issues and concerns and with this approach which have not been resolved.

What is a "Black Box"?



"The term "Black Box" is used to describe a undefined system where internal characterization is difficult"

– Phase I RI Work Plan, GAI, 1992

What Are the Necessary Consequences of Adopting the "Black Box" Approach?

- The nature and distribution of contaminants within the "box" are not characterized (despite MTCA requirements)
- Contaminant flow paths within the "box" are not characterized (despite MTCA requirements)

BUT-

- The risk of mobilizing contaminants within the "box" is avoided

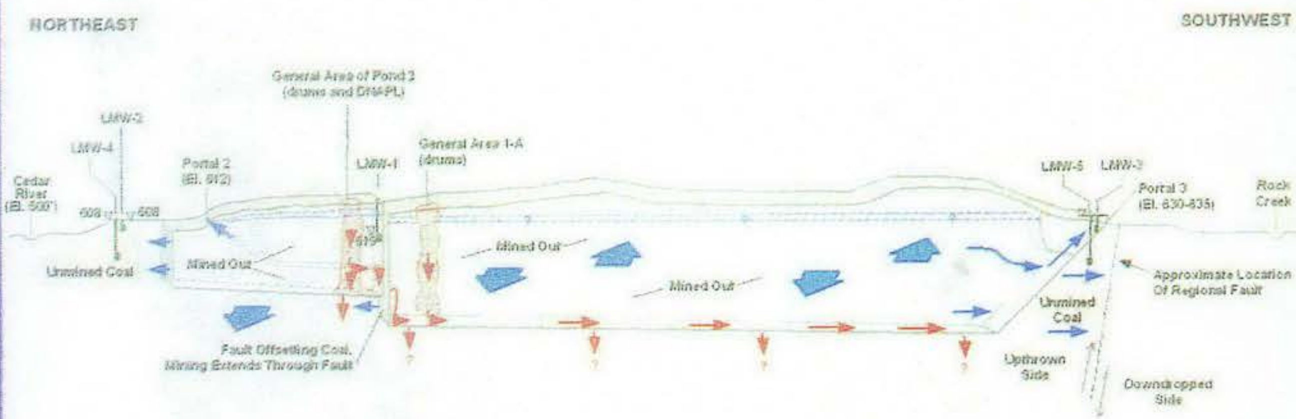
What Are the Minimal Necessary Requirements for Investigating a "Black Box"?

- The boundaries of the "box" must clearly defined
- Flow path investigations must assume that all known contaminants are distributed at maximum known concentrations throughout the "box"
- Groundwater and contaminant flow paths through all portions of the "box" must be defined
- Identification of all significant flow paths must be demonstrated using a mass (water) balance that incorporates real values for inputs to, outputs from, and potential changes in storage within the "box"

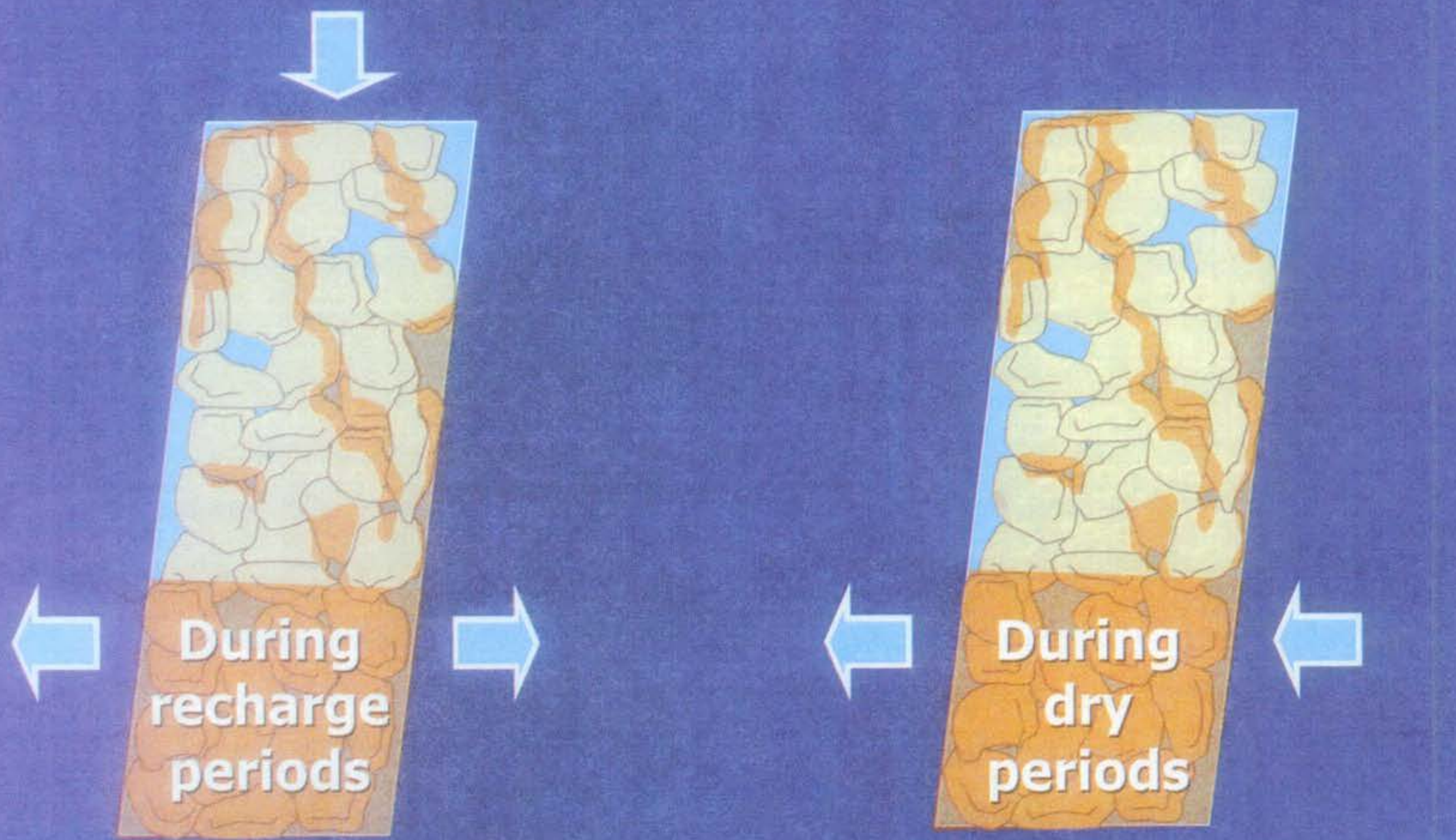
These requirements have not been met.


Conceptual Model of Waste within Mine Workings
After mining, before waste discharge
During waste discharge
After mine refilled

Conceptual Distribution of Waste within Mine Workings



Groundwater Flow Through Mine and Waste



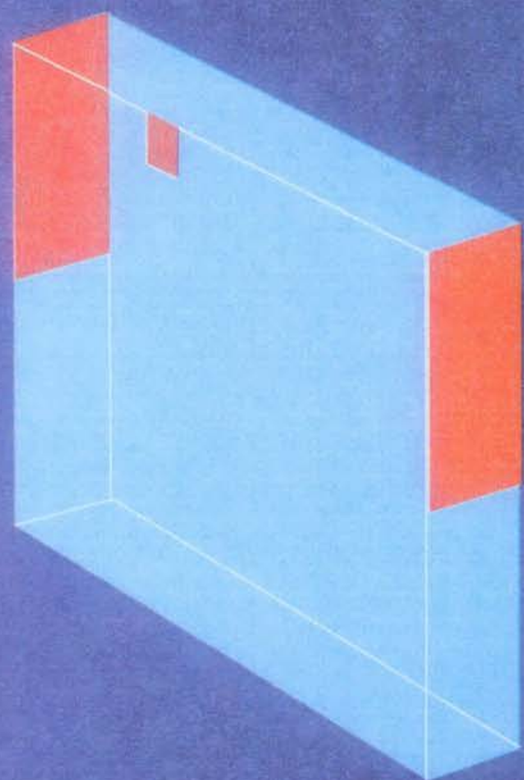
Radial Flow

Regional Gradient

What are the Boundaries of the "Black Box"?

- Mine "ends": Unmined coal seam, about 16 feet wide and more than 500 feet deep (0.3% of the saturated cross-sectional area)
- Mine bottom: Unmined coal seam, about 16 feet wide and 4,600 feet long, and slopes south to the south portal area
- Mine sidewalls: Unmined sandstone with shale interbeds, about 4,600 feet long and more than 500 feet deep, faulted and highly fractured (99.7% of the saturated cross-sectional area)
- Portals: tunnels excavated into coal and sedimentary rock, now partially collapsed (effective open area has not been estimated)

What Portions of the "Black Box" Were Evaluated?



Parts of the ends:

- The regional aquifer water table elevation is at about 620 feet near the mine
- The base of the mine workings is around 50 feet.
- The lowermost of the 4 wells in coal stops at 403 feet (upper 38% of saturated portion)
- The only well in sandstone is at 582 feet (upper 7%), and was unintentional

What Aspects of the "Black Box" Were Not Evaluated?

- The great majority of the "box" surface area
- Bedrock fractures and faults, and their potential influence on groundwater flow through bedrock
- Volumetric measurements of discharges from the "box" (water balance "outputs")
- Potential change in (water balance) storage within the "box"
- Any actual contaminant flow paths

Contaminant Flow Paths at Depth from the Mine to Receptors are Expected Because:

- Contaminants, including DNAPLs, are expected at depth in the mine
- Groundwater (in the regional aquifer and from localized recharge) flows through the mine and surrounding bedrock
- The sedimentary bedrock is porous, faulted, and fractured; groundwater can flow through the pores and along faults and fractures

Faults and Fractures?

Source: Davis, G.H. 1984, Structural Geology of Rocks and Regions

- Two major and numerous minor faults were identified in or near the mine
- Two major sets of fractures (at 3-foot spacings!) were identified in mine sidewalls
- Hydraulic testing results suggest fracture flow
- Nearby potable water supply wells are completed to draw groundwater from fractures in the sandstone bedrock

It Matters: Deep Contaminant Flow Paths Could Affect Ground Water Resources

- The purpose of investigations and cleanup is to protect human health and the environment
- Beneficial use of ground water for drinking water is the presumed under MTCA
- Numerous residents rely upon regional (bedrock) aquifer for their water supply
- The regional aquifer may discharge to alluvial deposits that provide the drinking water supply for numerous residents
- Clark Springs produces water from underlying bedrock in addition to the alluvial deposits
- Clark Springs is the primary drinking water supply for the City of Kent, and serves 57,000 people

It Matters: Deep Contaminant Flow Paths Could Affect Surface Water Resources

- Georgetown Creek is less than 1,000 feet from the Mine
- Rock Creek and Clark Springs are less than 4,500 feet from the Mine
- The Cedar River is less than 2,000 feet from the Mine
- All surface waters are hydraulically continuous with their alluvial river beds, and these alluvial deposits are hydraulically continuous with the bedrock
- Rock Creek and the Cedar River are important fisheries resources

What Happens Next?

- Either: a) The "Black Box" concept should be rejected and a more thorough approach to source characterization should be proposed and performed, or

  b) A comprehensive evaluation of all significant flow paths from all portions of the "Black Box" to all potential sensitive receptors must be performed:
  - A Supplemental Remedial Investigation is required
  - Groundwater and contaminant flow paths through all of the "box" boundaries must be defined and characterized
  - A mass (water) balance must be calculated to confirm that all significant flow paths have been identified

A Supplemental Remedial Investigation is required to address the remaining data gaps.

City of Kent Presentation Topic #2

Landsburg Mine Technical Meeting

September 29th, 9:00 AM Meeting
Between
Ecology/PLPs/Golder/
City of Kent/Interested Parties

Topic 2: Should Groundwater Flow and Contaminant Transport Transverse to Bedding Be Characterized and Monitored?

- Yes
- This will require a Supplemental Remedial Investigation

Groundwater Flow and Contaminant Transport Transverse to Bedding Must Be Characterized and Monitored to:

- Meet MTCA requirements
- Identify contaminant flow paths that may reach sensitive receptors
- Design a detection monitoring network
- Identify and evaluate appropriate cleanup actions
- Understand and evaluate risks, which will allow development of appropriate and effective contingency plans

What is Known About the Nature and Volume of Contaminants?

- An estimated 4,500 drums and additional 200,000 gallons of liquid waste were discharged to the regional aquifer; less than 0.2% were recovered
- Contaminants include VOCs, metals, and PCBs.
- Several of the VOCs are dense, non-aqueous phase liquids (DNAPLs)
- Site data show that at least 2,600 gallons of chlorinated VOCs, including TCE and 1,1,1-TCA, remain present as DNAPLs in surface soils- it is reasonable to expect that significant additional volumes also penetrated to depth
- DNAPLs would penetrate to the base of the mine even if groundwater were present

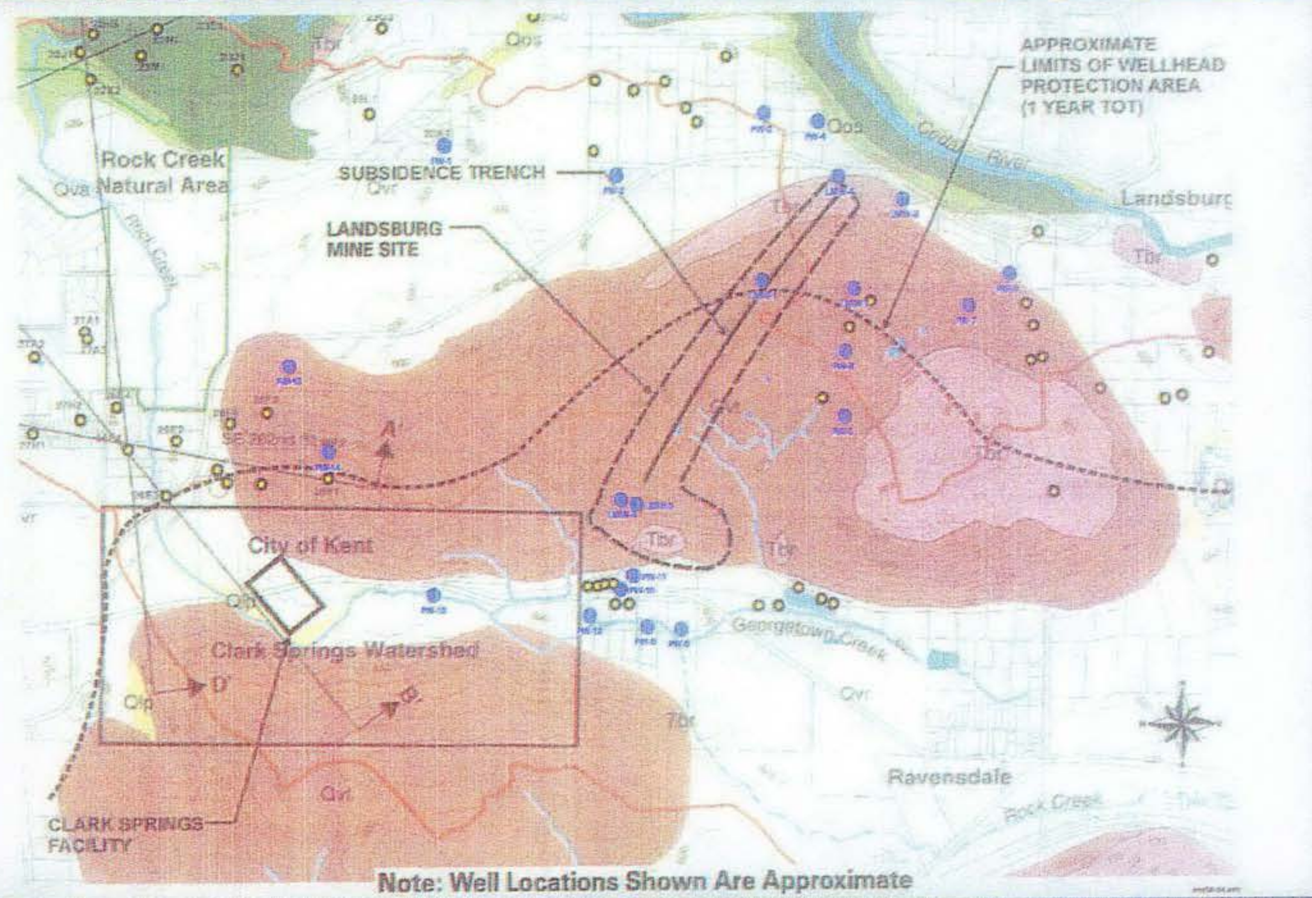
DNAPLs Have Unique Properties and Require Special Consideration

- More dense than water
- Less viscous than water
- Free product phase flows in response to the DNAPL potential and not hydraulic potential
- Compounds often have low solubility but can be carcinogenic at those low concentrations and can degrade into even more toxic compounds:

TCE → Vinyl Chloride

(5 µg/L MCL) (0.2 µg/L MCL)

Site and Nearby Water Supply Well Locations



Most of the Rock Exposed in the Mine is Sandstone

- The mine sidewalls are about 4,600 feet long and more than 500 feet deep (97.7% of the exposed unmined rock)
- The mine "ends" are about 16 feet wide and more than 500 feet deep (0.3% of the exposed unmined rock)
- The mine bottom is about 16 feet wide and 4,600 feet long (2.0% of the exposed unmined rock)
- The Rogers Seam was a coal mine, so mining efforts focused on removing the coal and much of the rubble within the mine is sedimentary bedrock

Groundwater Flows Through Sandstone!

- Liquid contaminants and contaminated groundwater can and do flow through sandstones, and will do so here- even if they must flow across bedding planes to do so!
- Nearby supply wells are installed in sandstone; the regional sandstone aquifer yields water economically to these wells
- Contaminated groundwater can flow through the sandstone itself (porous flow) and also through preferential pathways (fracture flow)
- Flow velocities through fractures can be high, with contaminant concentrations remaining similar to the source area

Evidence that Flow Through Fractured Bedrock Occurs at This Site:

- Numerous faults and two or more joints sets are documented; fault displacements range up to 75 feet with most reportedly being 2- to 16-feet
- Nearby water supply wells are completed in fractured zones that appear water-bearing
- Responses of wells to stresses suggest fracture flow
- Mining required near-continuous pumping at estimated rates of up to 80 gpm

Procedures for Evaluating Contaminant Distribution and Groundwater Flow in Sandstone are Well-Established

- There are numerous sites where DNAPLs have discharged to sandstone aquifers all over the world
- Standard characterization techniques to define groundwater flow and contaminant distribution at such sites exist; those routinely implemented include:
  - Fracture trace analysis and surface geophysics to define fracture spacing and orientation
  - Analytical and numerical modeling to predict fractures
  - Borehole geophysics to define fracture position, orientation, and flow within a given borehole
  - Systematically locating and screening wells to intercept fractures

Standard fractured bedrock characterization techniques have not been implemented during investigation of this site.

Summary

- The mine was excavated into the regional aquifer
- Contaminants, including DNAPLs, were discharged into the dewatered mine and therefore into the regional aquifer
- Groundwater and contaminant flow through the fractured sandstone bedrock is expected
- Site data strongly suggest flow across bedding, as porous or fracture flow
- If significant groundwater flow across bedding occurs, then significant contaminant flow paths to receptors have not been characterized; these flow paths may swiftly transport contaminants at high concentrations
- These issues are common to numerous other sites where DNAPLS were discharged to a fractured sandstone aquifer, but have not been addressed here
- Standard methods are available to resolve these issues; none have been implemented at this site

It Matters: Cross-Bedding Contaminant Flow May Reach Receptors

- The regional (bedrock) aquifer is the current source of drinking water for nearby properties
- The regional aquifer may discharge to Clark Springs or to surface water

What Happens Next?

- Groundwater and contaminant flow paths transverse to bedding must be evaluated
- Evaluations of flow paths transverse to bedding must apply standard methods typically applied to investigations of groundwater and contaminant (including DNAPL) flow through porous and fractured sandstone
- Contaminant flow paths from source areas to sensitive receptors should be defined and monitored

A Supplemental Remedial Investigation is required, as contaminant flow paths must be defined.

City of Kent Presentation Topic

Landsburg Mine Technical Meeting

September 29th, 9:00 AM Meeting
Between
Ecology/PLPs/Golder/
City of Kent/Interested Parties

Topic 3: Would Laboratory Measurements of the Contaminant Adsorption Properties of Rogers Seam Coal Be Meaningful?

- No

- The City of Kent rejects the hypothesis that Rogers Seam coal will geochemically immobilize all site contaminants.

Reasons Why Coal is Not Expected to Immobilize Significant Contaminant Mass

- Coal is to activated carbon as clay is to a porous ceramic: it is a feedstock. Activated carbon is a processed material that differs significantly from coal in grain size, grain size distribution, surface area, capillary porosity, etc.
- Groundwater flow through residual coal in the Rogers Mine bears no relationship to groundwater treatment using an engineered activated carbon treatment system. An engineered system is carefully designed, tested, and monitored; flow rates through the activated carbon are carefully controlled, and the activated carbon is regularly regenerated as it loses capacity.

Why Would One Measure the Contaminant Adsorption Properties of Rogers Seam Coal?

- Why is this being discussed?
  - The Work Plan proposed testing the hypothesis that coal may geochemically immobilize contaminants by collecting and testing actual site samples
  - The coal samples were collected, but the tests were not performed or the test results were not reported

Why Try to Define the Contaminant Adsorption Properties of Rogers Seam Coal Now?

- The PLP Group has stated "We are in agreement that wastes remain within the mine." - (GAI, July 6, 2004). However, no contaminants were detected in any of the wells installed during the RI. As a result, several hypotheses were postulated in the RI Report to explain how the wells could be interpreted as intercepting primary contaminant flow paths without detecting any contaminants. One of these hypotheses was "the residual coal remaining in the mine, with its high sorbtive capacity, has immobilized the wastes in-place."
- The alternative explanation, proposed by the City of Kent, is that the RI wells were not installed in contaminant flow paths. This demonstrates that no groundwater contaminant flow paths from the source areas have yet been defined for this site, and the fate and transport of the 450,000 gallons of waste are completely unknown.

City of Kent Position Regarding the Geochemical Role of Coal

Unless it can be conclusively demonstrated that coal at this site actually does geochemically immobilize all contaminants of concern, this hypothesis cannot be proposed as an explanation for the PLP's inability to define contaminant flow paths. Instead, it will be assumed that the existing detection monitoring wells are not installed in contaminant flow paths.

What Happens Next?

- The hypothesis that coal serves to immobilize significant volumes of contaminants at this site should either be:
    a) tested and proven, or
    b) rejected and not raised again.

- The City of Kent rejects the hypothesis and prefers to not expend further resources on this discussion

A Supplemental Remedial Investigation is required, as contaminant flow paths must be defined.

City of Kent Presentation Topic # V

Landsburg Mine Technical Meeting

September 29th, 9:00 AM Meeting
Between
Ecology/PLPs/Golder/
City of Kent/Interested Parties

Topic 4: Are Groundwater Monitoring Frequencies Proposed in the Draft Corrective Action Plan Appropriate?

- No. There is no benefit gained from discussing monitoring frequencies of these sampling points when:
  - Source characterization is incomplete
  - Flow paths through more than 90% of the boundaries of the "Black Box" (particularly, the sandstone sidewalls, the base of the coal mine ends, and the portals) have not been defined
  - The relationship between the local flow system created by surface water discharge to the mine, and the regional aquifer has not been defined or considered in the site conceptual model
  - No contaminant flow paths have been defined

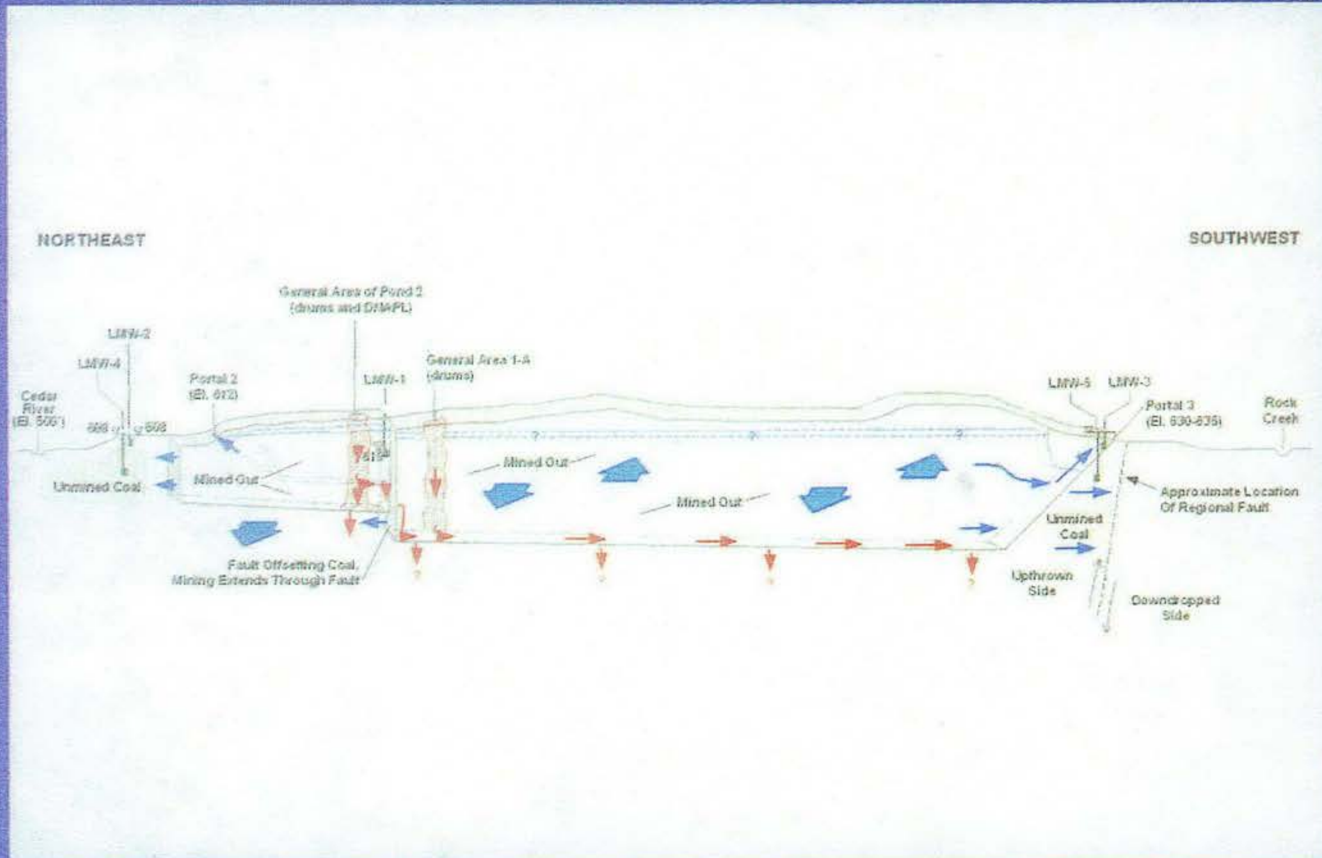
Source Area Characterization is Incomplete

- Source characterization, and subsequent selection of contaminants of concern, is based entirely on soils data
- Soils data are limited:
  - 14 samples collected during the SHA
  - 1 composite of 4 samples of pond sludge collected during expedited response action
- No groundwater data have been collected from the source area
- Source characterization was explicitly omitted from the RI as a direct consequence of adopting the "Black Box" approach: no soils or groundwater samples were collected from within the source area during the RI

Flow Paths Through Most of the "Black Box" Have Not Been Defined

- Investigations focused almost exclusively on flow paths through the unmined coal at the ends of the mine
- Only one well (LMW-1) was sited in a sandstone sidewall, and it was not sited to investigate possible fracture flow
- The possibility of significant flow through sandstone, either as porous flow or through preferential pathways, has been consistently rejected without having ever been tested
- At other sites where DNAPL has been discharged to sandstone, the primary contaminant flow paths have been at depth; where the sandstone is fractured, fracture flow is critical

Conceptual Distribution of Waste within Mine Workings



When Contaminant Flow Paths Have Been Identified, What Methodology is Appropriate for Establishing Contaminant Flow Rates (Travel Times)?

- The selected method(s) will depend upon site characteristics and measurements of groundwater flow and contaminant distribution, but may include:
  - Evaluation of fracture flow pathways using physical or chemical methods (hydraulic testing of specific fractures, tracer tests, etc.)
  - Graphic comparisons, such as isoconcentration maps or mixing curves
  - Comparison of measured contaminant concentrations with saturation concentrations
  - Numerical modeling
- Travel times along critical contaminant flow paths, such as those extending to Clark Springs or other potable water supplies, should be physically tested

Are the Flow Paths Being Monitored Contaminant Flow Paths?

- Apparently not. The flow paths proposed for monitoring have not been documented to be contaminant flow paths:
  - No contaminants have been detected in samples collected from any of the wells installed during the RI.
  - Contaminants were detected in surface water discharging from the South Portal; however, follow-up sampling was not performed and no surface water monitoring is proposed in the Draft Corrective Action Plan

Have Contaminant Flow Paths from Source Areas to Sensitive Receptors Been Effectively Defined?

- No.
- Not one contaminant flow path from the "Black Box" through groundwater has been defined.
- Significant potential groundwater flow paths between the source areas and sensitive receptors have been categorically excluded from evaluation.
- The fate and transport of more than 450,000 gallons of waste, including DNAPLS, is entirely unknown

Why Estimate Travel Times Using BIOSCREEN?

- MTCA requires justification of sampling frequency, and a travel time estimate is needed to justify the (infrequent) sampling intervals proposed in the Draft CAP. However:
  - Travel times can't be calculated using site data- no contaminant flow paths have been defined
  - Travel times can't be measured using physical testing, such as tracer tests, as no contaminant flow paths have been defined
  - Travel times estimated for simple advective flow using "idealized" site parameters yield fast travel times and frequent sample intervals

Why are Models Used?

- Data gap definition or data gap analysis: Models can be used to help define critical site parameters. For example, models commonly require significant user input regarding site characteristics, and can be used to define critical parameters by testing model sensitivity.
- Predictive modeling: Models can be used to predict future conditions at a site. However, predictive models can only be developed for well-characterized sites.

What Are the Limitations of Using BIOSCREEN?

- BIOSCREEN was developed to simulate remediation through natural attenuation of dissolved petroleum hydrocarbons at petroleum fuel release sites. Travel times are calculated to permit evaluation of whether the plume will reach sensitive receptors before it degrades sufficiently.
- BIOSCREEN assumes:
  - Simple groundwater flow conditions
  - The contaminants of concern are benzene, toluene, ethylbenzene, and xylenes and other petroleum-related constituents
  - Numerous user-entered values regarding site hydrogeology and contaminant distribution

What Was Missing From the BIOSCREEN Modeling Report?

- A discussion of why BIOSCREEN would be considered appropriate for this site, including:
  - A review of the modeling assumptions
  - A review of the model's limitations
- A clear statement of all model inputs
- A sensitivity analysis to evaluate how the model output may be affected by:
  - The complex mixture of contaminants actually present at this site, including discussion of whether their behavior is consistent with a BTEX mixture
  - The assumption of exponential decay within the source area
  - Gross underestimation of the actual source volume (and likely also source area)
  - The estimated carbon content of soils along the flow path

What Did The BIOSCREEN Model for This Site Assume?

- All contaminant flow extends from the mine to the Cedar River, and passes only through coal
- Exponential decay in the source area, with an initial source of one 55-gallon drum
- Coal behaves geochemically as would more typical forms of organic carbon in soils: *soils along the entire flow path are defined as 70% organic carbon*
- Many other constraints… none of which were defined.

Should Sampling Frequencies Be Based on the Travel Times Estimated Using BIOSCREEN?

- No.
- Actual contaminant flow paths should be defined
- Travel times for each significant actual contaminant flow path should be carefully evaluated using appropriate methods
- Appropriate methods will be defined after flow paths have been defined, and may include physical testing of individual critical flow paths (such as any paths that could swiftly contaminants to Clark Springs or other potable water supplies)

Also: Is Monitoring for Volatile and Semi-volatile Organic Compounds During Construction Unnecessary?

- No.
- At numerous sites, construction causes rapid contaminant mobilization
- Causes of mobilization can include changes in flow paths due to construction, creation of Pickering emulsions, etc.
- Contaminants of concern should be carefully monitored during all project phases

What Happens Next?

- Contaminant flow paths should be defined and tested
- After contaminant flow paths are defined and appropriately tested, appropriate monitoring parameters and frequencies can be discussed
- Sampling frequencies for critical contaminant flow paths must be based on physical testing

A Supplemental Remedial Investigation is required to address the remaining data gaps.

Landsburg Mine Technical Meeting Topic 5: Contingency Planning

September 29th, 9:00 AM Meeting
Between
Ecology/PLPs/Golder/
City of Kent/Interested Parties

Topic 5: Contingency Planning

- Why is this being discussed today?
  - Contingency Planning has been started BUT:
    - It is premature to complete at this time based on current site deficiencies. Existing data and analysis are inadequate to allow complete and effective contingency planning at this time
    - Contingency planning so far is inadequate as it stands – only addresses one contingent action

KENT
WASHINGTON

PUBLIC WORKS
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Director of Public Works

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220 Fourth Ave. S.
Kent, WA 98032-5895

October 6, 2004

SENT VIA FAX
10/06/04

Dr. Ching-Pi Wang, PhD
Department of Ecology
Toxic Clean-up Program
3190 160th Ave SE
Bellevue, WA 98008-5942

RE: City of Kent Request of a Supplemental Remedial Investigation for the Landsburg Mine Cleanup Site

Dear Mr. Wang,

In follow up to the technical discussion on the Landsburg Mine site which took place on September 29th, 2004 in your offices with the PLPs and other important interested groups, the City of Kent is making this formal request for a determination by WDOE that a Supplemental Remedial Investigation for the Landsburg Site is necessary, appropriate, and should be completed as soon as possible.

As the administrative record reflects, the City of Kent has identified and repeatedly raised major significant technically and scientifically based deficiencies with the current site understanding. Our recent technical discussions highlighted these deficiencies and we understand that WDOE is in the process of making a decision on what the next steps should be.

The City of Kent encourages in the strongest terms possible that the WDOE make a formal decision to require an SRI as soon as possible. An SRI work scope should be developed to address the data gaps remaining since the Phase I RI. Significant additional investigation of contaminant flow paths through the mine portals and within the regional aquifer is required. The City of Kent is available to discuss the details of the necessary SRI scope of work at your convenience but at a minimum these program elements should include:

1. Performing a thorough evaluation of the influence of fractures and faults on ground water flow within the regional aquifer using standard investigation methods (i.e., fracture trace analysis, borehole geophysics, and installation and testing of wells screened to intercept significant fractures), combined with a detailed presentation and review of mine plans.

2. Evaluate the mass balance of the mined-out workings within the regional hydrologic system to determine whether all significant flow paths from the mine workings have been identified by:
    a. Calculating the topographic area that contributes run-off to the mined-out workings (required to calculate inputs)
    b. Instrumenting the trench itself such that groundwater levels within the trench can be continuously monitored (required to calculate change in storage; also useful in evaluating discharge rates through pathways).
    c. Calculating the (lateral) input and output from the regional aquifer through mine sidewalls and ends (this may require additional

instrumentation), is required to calculate system inputs and outputs, and will likely display significant seasonal variability.

d. Instrumenting the portals so that the water level and discharge rate of each portal can be accurately measured (required to calculate outputs; also required to permit evaluation of output through other flowpaths).

e. Evaluating the response of portal discharge and groundwater levels within the mine workings, the unmined coal at the mine ends, and mine sidewalls to precipitation (if this evaluation does not sufficiently constrain discharge rates, additional investigations of gradient and hydraulic conductivity of the unmined coal may also be required).

3. Defining all significant flow paths from the mine workings to sensitive receptors, including flow paths at depth and flow paths transverse to sedimentary bedding.

4. Installing groundwater monitoring wells in areas potentially affected by contaminant flow deep in the mine. Wells should either be located within the mine workings (which would require fewer installations placed at the mid- and lowest levels of the mine workings near the original contaminant source areas and at the ends of the mine workings near the portals), or within bedrock on all sides of the mine workings in the middle and at the ends of the mine seam (which would require more installations). Data from these wells would be used to assess the presence or absence of contaminant flow paths from source areas. Well locations and screen positions should be based both on fracture analyses and on actual borehole conditions.

5. Confirming the depths of adjacent mines (the Frazier and Landsburg Seams) that could affect flow from the Rogers Seam towards potential receptors.

6. Physically characterizing the area reported to have previously been the location of dumping near the southern end of the site adjacent to the South Portal using standard testing protocol.

7. Characterizing whether DNAPLs are present in surface soils within the trench or in the trench as residual free product or as dissolved constituents. If DNAPL is present in surface soil, removing accessible soils where dumping occurred (MTCA requires that every reasonable effort to remove free product be made).

We are hopeful that you will complete your determination very quickly, within three weeks as you indicated in the meeting.

Finally, let me reiterate our appreciation for the continued opportunity to discuss our concerns with you and advise you that the City of Kent staff is available to discuss any further questions you may have regarding our position on these issues. Please contact Mr. Bill Wolinski at any time to coordinate any such discussions.

Sincerely,

Don E Wickstrom, P.E.
Public Works Director

c: Mr. William S. Wolinski, P.E., Environmental Engineering Manager
Mr. Kelly Peterson, Environmental Engineer
Dr. Jerome Cruz, PhD, Department of Ecology
File

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November 8, 2004

Mr. Ching-Pi Wang, P.E.
Senior Environmental Engineer, Toxics Cleanup Program
Department of Ecology, Northwest Regional Office
3190 160th Avenue Southeast
Bellevue, WA 98008-5452

Re: Evaluation of Chlorinated Solvents Occurring as DNAPL and Recommendations for Supplemental Remedial Investigations to Address the Landsburg Mine Site

Dear Mr. Wang:

The City of Kent appreciates Ecology's hosting the September 29, 2004, meeting to discuss unresolved technical issues for the Landsburg Mine Site. At that meeting, the City of Kent committed to provide Ecology with a detailed review of DNAPL concerns and the current status of remedial investigations at this site, along with recommendations for supplemental remedial investigations to address unresolved critical data gaps. The City of Kent is committed to protecting the Clark Springs water supply for the benefit of our citizens. Since 1995, the City has coordinated with Ecology regarding potential threats posed by the Landsburg Mine Site to Clark Springs and raised numerous technical questions that remain unresolved. The following letters are provided to assist Ecology in defining specific needs for an effective supplemental remedial investigation of the Landsburg Mine Site within the context of the requirements of MTCA and additional analysis regarding the presence of DNAPL, which also needs to be addressed under MTCA.

- Udaloy Environmental Services (UES), November 5, 2004. Evaluation of the Potential for Chlorinated Solvents to Occur as DNAPL at the Landsburg Mine Site. Letter to Mr. Bill Wolinski, City of Kent.
- UES, November 8, 2004. Recommendations for Supplemental Remedial Investigations to Address the Landsburg Mine Site. Letter to Mr. Bill Wolinski, City of Kent.

The City of Kent recognizes that techniques for defining the potential for contaminants to be present as dense non-aqueous phase liquid (DNAPL) in site soils and groundwater were under development at the time that Ecology approved the *Landsburg Phase I Remedial Investigation/Feasibility Study (RI/FS) Work Plan* (Golder Associates [Golder], November 18, 1992). Although appropriate technical guidance was published by the U.S. Environmental Protection Agency (EPA) shortly thereafter (*DNAPL Site Evaluation* [USEPA 600/R-93/022, February 1993]), the remedial investigations performed during the period of October 1993 to January 1995 did not investigate the potential for DNAPL to be present at this site. Specifically, the *Remedial Investigation and Feasibility Study for the Landsburg Mine Site, Ravensdale, Washington* (RI/FS Report) (Golder, February 1996) did not address the possibility that chlorinated solvents occur as DNAPL (in fact, the phrase "dense non-aqueous phase liquids" apparently does not occur anywhere in the report). The City of Kent also recognizes that the RI/FS Report did not use the EPA-recommended methods developed for DNAPL site evaluations to analyze the few existing source characterization data to determine whether contaminants could be present as DNAPL, and that investigations using EPA-recommended methods to define the presence and extent of chlorinated solvents as DNAPL have not yet been performed at the Landsburg Mine Site.

During the September 29th meeting, it became apparent that a technical evaluation of the potential presence of chlorinated solvents as DNAPL at the Landsburg Mine Site would be necessary. The attached letter (UES, November 5, 2004) presents a technical analysis of existing data using EPA-recommended methods; it concludes that chlorinated solvents were reported at percent concentrations in site soils and that these data indicate that significant volumes of contaminants remain in place as residual DNAPL within the Rogers Seam.

Ecology also has asked that the City of Kent identify additional remedial investigations that would be appropriate for the Landsburg Mine site. To provide a framework for subsequent discussions, the attached letter (UES, November 8, 2004) reviews the goals of the original remedial investigation, evaluates existing data, defines data gaps, and identifies specific tasks that would address critical data gaps and subsequently allow for the definition and evaluation of appropriate cleanup actions. The City of Kent recognizes the complexity of these issues and the decision-making process. For example, the specific tasks required during a supplemental remedial investigation are necessarily interdependent, and details of certain tasks may be refined based on data developed during earlier tasks.

As you know, the City of Kent continues to commit significant resources to the analysis of these issues and providing constructive input to the MTCA process; it is our intention to maintain this commitment and to continue to work with Ecology until final cleanup at the site is completed and the concerns regarding water supply and water resource issues are satisfactorily resolved. To that end, consistent with your commitment to the City of Kent at the September 29th meeting, we are ready to meet with you at your earliest convenience for further discussion of these issues prior to any final decisions being made by Ecology. We also note that we have not yet received Ecology's response to our letter of May 27, 2004, which reviewed several of these issues. We look forward to discussing these issues further with you. Please let us know as soon as possible when your schedule will allow our meeting. Thank you again for your continued attention to this very important matter and the City of Kent's concerns.

If you have any questions, please feel free to contact Mr. William Wolinski, P.E., of my staff at (253) 856-5548.

Sincerely,

Don E. Wickstrom, P.E.
Public Works Director

November 5, 2004

Mr. Bill Wolinski, P.E.
Environmental Engineering Manager
City of Kent
220 Fourth Avenue South
Kent, Washington 98032-5895

Re: Evaluation of Chlorinated Solvents and DNAPL at the Landsburg Mine Site

Dear Mr. Wolinski:

The Landsburg Site is a former underground coal mine located less than 1 mile northeast of the Clark Springs, the primary water supply source for the City of Kent (population 84,210, with municipal water service to approximately 57,000). Numerous household and private water supply systems are located within 1 mile of the site. The mine site is also located within 1/2 mile of critical surface water resources (the Cedar River and Rock Creek). Cleanup of the Landsburg Mine site is regulated under the Model Toxics Control Act (MTCA) (Washington Administrative Code [WAC] Chapter 173-340).

Existing site data suggest that chlorinated solvents and other contaminants were discharged to the Rogers Seam as liquids and that some contaminants remain as residual dense non-aqueous phase liquid (DNAPL). MTCA requires "a permanent cleanup action shall be used to achieve cleanup levels for ground water . . . where a permanent cleanup action is practicable or determined by the department to be in the public interest" (WAC 173-340-360 [2][c][i]). If a non-permanent groundwater cleanup action is approved, then MTCA requires that "Treatment or removal of the sources of the release shall be conducted for liquid wastes, areas contaminated with high concentrations of hazardous substances, highly mobile hazardous substances, or hazardous substances that cannot be reliably contained." MTCA states further that "This requires removal of free product . . . " and that "Source containment may be appropriate when the free product consists of a dense non-aqueous phase liquid that cannot be recovered after reasonable efforts have been made" (WAC 173-340-360 [2][c][ii][A]).

The purpose of this letter is to review the existing site data to determine whether chlorinated solvents may be present as DNAPL at this site. In the course of this review, critical inadequacies in existing site characterization (data gaps) are discussed. Selected issues related to implementation of the proposed corrective action (Golder Associates, 2002) also are discussed.

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Background

The disposal of large volumes of contaminants directly into mine workings that penetrate the regional aquifer has been documented at this site: the *Remedial Investigation/Feasibility Study (RI/FS) for the Landsburg Mine Site, Ravensdale, Washington* (Golder Associates, 1996), hereafter referred to as the RI/FS Report, states that "an estimated 4,500 drums and about 200,000 gallons of oily waste water and sludges were disposed into the trench . . . some of the drums contained wastes that included paint wastes, solvents, metal sludges and oily water and sludge" (RI/FS Report, Pages 6-4 and 6-5). The *Report on the Landsburg Mine Drum Removal Project, August 20 to October 30, 1991* (Burlington Environmental, 1991), hereafter referred to as the Drum Removal Report, indicates that 11 drums partially filled with liquid waste were removed from the site and that the liquid contents of all additional drums removed from the site were decanted into four drums (the drums of decanted liquid waste also were removed from the site). These data indicate that out of the 450,000 or more gallons of liquid waste disposed at the site, less than 1,000 gallons have been removed. These wastes were discharged during a period when the mine was actively dewatered. Therefore, it is reasonable to expect that wastes flowed to the base of the dewatered mine workings. In addition, DNAPLs simply flow through standing water into the mine.

Currently, a remedial investigation (RI) has been performed for the site (RI/FS Report [Golder Associates, 1996]). The City of Kent has repeatedly identified deficiencies in work proposed for the RI and in the RI Report (City of Kent, 1993; City of Kent, 1996; City of Kent, 1997a; City of Kent, 1997b; City of Kent, 1997c; City of Kent, 1997d; City of Kent, 2003a; City of Kent, 2003b; City of Kent, 2003c; City of Kent, 2004).

A fundamental premise of the RI was to consider the Rogers Seam to be a "black box." The RI intentionally avoided investigating any aspect of the internal workings of the "black box," and therefore did not characterize contaminants in source areas. Instead, the RI relied upon the limited data collected during the initial *Landsburg Mine Site Hazard Assessment* (Ecology and Environment, 1991) and an emergency cleanup action to define contaminants of concern. The RI did not evaluate the potential for contaminants to be present as DNAPL within the "black box" but instead investigated only shallow groundwater flow paths out of the unmined coal ends of the Rogers Seam.

These limited investigations of groundwater and surface water flow evaluated discharge out of a small fraction (less than 5 percent) of the "black box" boundaries, and no contaminant flow paths were defined in this limited zone of investigation. The RI did not address any groundwater or contaminant flow at depth and included only one well to address more than 4.5 million square feet of mine sidewall (even this well was not intended to evaluate groundwater or contaminant flow through the porous and fractured mine sidewalls, inasmuch as it was originally targeted for a tunnel within the mine workings).

Data Review

The geochemical data available for evaluation are presented in the Drum Removal Report (Burlington Environmental, 1991). This report was recently provided to the City of Kent electronically and without appendices; therefore, only data presented in the report body were reviewed for this evaluation. The geochemical data presented in the report demonstrate that residual waste in excavated drums tested positive for chlorinated compounds and other contaminants. In addition, the report describes four samples (core samples collected using a hand auger) that were collected from the Pond 2 area at depths ranging from 1 to 4 feet below ground surface using a hand auger. Sampling documentation was not presented in the reviewed documents, and it is unclear whether the sample was primarily solid or contained a mixture of solids and liquids. These four discrete samples were mixed to create a single composite sample; this composite sample was tested for volatile organic compounds (VOCs). The Drum Removal Report (Burlington Environmental, 1991) states that this composite sample contained:

- 1,690 parts per million (ppm) methylene chloride (a potential DNAPL)
- 299 ppm trichlorofluoromethane (freon 11, a potential DNAPL)
- 216 ppm 1,1,2-trichlorotrifluoroethane (freon 13, a potential DNAPL)
- 317 ppm 1,1,1-trichloroethane (1,1,1-TCA, a potential DNAPL)
- 1,530 ppm trichloroethene (TCE, a potential DNAPL)
- 141 ppm toluene (a component of gasoline and a potential light non-aqueous phase liquid [LNAPL])
- 270 ppm ethylbenzene (a component of gasoline and a potential LNAPL)
- 1,320 ppm total xylenes (a component of gasoline and a potential LNAPL)
- 67,000 ppm total petroleum hydrocarbons (TPH, a potential LNAPL)
- 4.9 ppm polychlorinated biphenyls (PCBs), as Aroclor 1254 (a potential DNAPL)

Concentrations of VOCs in samples collected from drums were not presented in the report. Therefore, it is not possible to compare analytes detected in the composite soil sample with analytes detected in the drums.

This composite sample necessarily underestimates the actual concentrations of VOCs in Pond 2 soils, both because the sample is composited (therefore, any individual sample may contain as much as four times the concentration of the composite sample) and because compositing inherently reduces the concentration of VOCs in the tested sample due to volatilization.

The previously reported data for the composited sample are evaluated in this discussion to determine whether chlorinated solvents could be present as DNAPL using the standard method defined in *DNAPL Site Evaluation* (Cohen and Mercer, 1993). This method requires calculating the effective solubility of chlorinated compounds within the mixture using mole fraction ratios, calculating the theoretical pore water concentration for each constituent assuming that DNAPL is absent, and comparing these values. When the theoretical pore water concentration exceeds the calculated effective solubility of a constituent, that constituent is likely present as DNAPL.

The calculated effective solubilities of chlorinated constituents reported in the composite sample are presented in Table 1 (attached to this letter). The theoretical pore water concentrations for each constituent are compared with the calculated effective solubility for each constituent in Table 2 (attached). Constituents with theoretical pore water concentrations (assuming that DNAPL is absent) that exceed the calculated effective solubility are interpreted as potentially occurring as free product (DNAPL). These calculations indicate that concentrations of freon 11, freon 13, 1,1,1-TCA, and TCE are consistent with those expected if they were present as DNAPL. These data demonstrate that chlorinated solvents were likely discharged in liquid form (as DNAPL) to the Rogers Seam mine workings. These data are consistent with the simple additive concentration of chlorinated solvents, which indicates that chlorinated solvents compose 0.4 percent of the Pond 2 composite sample, or as much as 1.6 percent in one of the four discrete samples (see Table 1).

The area of affected soils was estimated in the Drum Removal Report (Burlington Environmental, 1991) as "about 24 feet in diameter," and the estimated depth was "about 4 feet" (consistent with the maximum depth of hand auger exploration), yielding a minimum of about 1,800 cubic feet (51 cubic meters) of affected soils. These observations are limited by the field sampling methods used (in this case hand augering). The actual depth of impacts beneath Pond 2 has not been evaluated but can be expected to go far beyond the maximum 4-foot depth sampled. It is reasonable to expect that if DNAPLs were discharged to the ground surface, they would flow down into subsurface soils until a barrier to flow was encountered. Inasmuch as the collapsed mine workings beneath Pond 2 consist primarily of rubble, it is also reasonable to expect that any DNAPL would have drained to the base of the mine (at an elevation of about 50 feet), then either drained along or penetrated into the mine floor. If DNAPL drained along the mine floor, the residual could extend far south of the Pond 2 area. It also is possible that some component of flow was diverted along the major fault located near Pond 2 or through faults or fractures elsewhere within the mine and surrounding bedrock.

For example, consider a single 55-gallon (7.35-cubic-foot) drum of solvents that ruptures and discharges its contents through a hole to a 1-foot-diameter area of soil, and assume:

- 5 percent residual saturation
- 25 percent average porosity within the rubble zone and overlying soils

Then:

$$\text{Residual volume} = \frac{7.35 \text{ cubic feet}}{(0.25 * 0.05)} = 588 \text{ cubic feet of soils will be affected}$$

Given the 0.79-square-foot area affected, this spill could extend about 745 feet into the mine, to and beyond the base of the mine workings. As noted previously, the RI/FS Report states that "an estimated 4,500 drums and about 200,000 gallons of oily waste water and sludges were disposed into the trench . . . some of the drums contained wastes that included paint wastes, solvents, metal sludges and oily water and sludge" (Golder Associates, 1996 [Pages 6-4 and 6-5]). Therefore, it is reasonable to assume that at least one drum of chlorinated solvents disposed into the trench has ruptured and that the released chlorinated solvents penetrated to the base of the mine workings.

Assuming a density of 1.8 grams per cubic centimeter (a conservative value), there are at least 91,800 kilograms (kg) of soil within the uppermost 4 feet beneath the Pond 2 area and at least 13,770,000 kg of soils between Pond 2 and the base of the mine workings. Assuming that the concentrations of chlorinated solvents detected in the composite sample are representative, the uppermost 4 feet of Pond 2 soils contain at least 140 kg (25 gallons) of TCE, and the area extending from Pond 2 to the base of the mine may contain 21,000 kg (3,800 gallons) of TCE (see Table 3 [attached]). In general, based on the limited available data, the soils in the area between Pond 2 and the base of the mine would be expected to contain 10,500 gallons of solvents and freons (see Table 3). It is likely that Pond 2 is only a portion of the area where chlorinated solvents and other contaminants were discharged as DNAPL. Assuming conservatively that the Pond 2 area represents only about 10 percent of the affected site soils, more than 100,000 gallons of residual DNAPL could be present within the Rogers Seam.

Given the calculated effective solubility of each constituent, dilution of these constituents to the maximum contaminant levels (MCLs) required under MTCA (WAC 173-340) would require at least 1.2 billion gallons of groundwater flowing through the residual DNAPL beneath Pond 2 alone (see Table 4 [attached]). This suggests that, conservatively, at least 12 billion gallons of groundwater would be required to dilute residual DNAPL within the Rogers Seam to the MCLs; however, annual recharge to the entire Rogers Seam (and not only to areas with residual DNAPL) is apparently about 2 to 3 million gallons per year. It is therefore reasonable to expect that significant volumes of DNAPL residual are present within the Rogers Seam and that concentrations of chlorinated solvents in groundwater within the Rogers Seam exceed MCLs.

This interpretation is supported by the Pond 2 area sampling observation that "when the sludgey soil was disturbed, a 1- to 2-second spike of 500 to 700 ppm was recorded on the organic vapor analysis (OVA) meter" (Burlington Environmental, 1991). This observation suggests that in 1991, residuals in shallow soils were capable of rapid volatilization even though the RI/FS Report (Golder Associates, 1996) reports that no hazardous wastes had been discharged to the site subsequent to 1978 (13 years previously).

Summary

MTCA requires that "the areal and vertical distribution and concentrations of hazardous substances" be defined for the site (WAC 173-340-350 [7][b][iii]). In proposing a "black box" conceptual model, the principally liable parties (PLPs) proposed instead to determine "whether contaminants were migrating out of the 'black box' at concentrations that are unacceptable or pose a risk to the public and the environment" (Golder Associates, 1992). The boundaries of the "black box" are the edges (ends, sides, top, and base) of the mined-out Rogers Seam. Although adopting this approach did not absolve the PLPs of the responsibility of defining the *nature* of contaminants within the "box," no additional soil or groundwater samples were collected within the "box" during the RI. As a result, there are remarkably few source characterization data for the Landsburg Mine site. In addition, the RI/FS Report (Golder Associates, 1996) did not address the possibility that chlorinated solvents occur as DNAPLs (in fact, the phrase "dense non-aqueous phase liquids" apparently does not occur anywhere in the report).

Existing source characterization data indicate that chlorinated solvents are present at percent concentrations in site soils and that significant volumes of contaminants (including freon 11, freon 13, 1,1,1-TCA, and TCE), remain in place as residual DNAPL within the Rogers Seam. Volumes of residual DNAPL calculated using site data are large (as much as 100,000 gallons). Consequently, it can be expected that groundwater within the Rogers Seam will be continuously impacted by dissolution of these residual contaminants and that concentrations of methylene chloride, 1,1,1-TCA, and TCE exceed the MCLs permitted under MTCA in groundwater within the Rogers Seam near Pond 2. Given their physical properties, these contaminants would be expected to persist indefinitely within the mine.

In the absence of data demonstrating otherwise, it must be assumed that all contaminants identified anywhere within the site are distributed throughout the "black box" at the maximum concentrations defined anywhere within the site. Therefore, it must be assumed that chlorinated solvents and freons are present as DNAPL and at saturation concentrations in groundwater throughout the Rogers Seam.

Site investigations performed during the RI did not address DNAPL. Instead, RI groundwater evaluations focused exclusively on shallow flow paths. Although more than 400,000 gallons of wastes were discharged to the mine, and although these wastes are known to contain significant volumes of persistent contaminants (including chlorinated solvents, PCBs, and metals), wells installed during the RI to monitor shallow flow paths did not detect a single contaminant. Contaminants have been detected subsequently in wells installed to monitor deeper flow paths (Golder Associates, 2004a and 2004b). Given the risks associated with these persistent contaminants, it is essential that deep flow paths from the mine to the surrounding regional aquifer and to sensitive receptors be defined and monitored. Additional site investigations are necessary to characterize the site and define contaminant flow paths.

Also, when DNAPL is identified at a site, MTCA requires that reasonable efforts be made to remove the free product (WAC 173-340-360 [2]). For example, source containment may be considered "when the free product consists of a dense non-aqueous phase liquid that cannot be recovered *after reasonable efforts have been made*" (WAC 173-340-360 [2][c][ii][A], emphasis added). No efforts have been made to remove DNAPL from Rogers Seam soils. Data available prior to the RI demonstrated that residual DNAPL was present on site. Response actions completed during 1991 required staging and operating a crane adjacent to Pond 2, and using this heavy equipment for drum removal. Nevertheless, no effort was made to remove the nominal 17 cubic yards of impacted soils identified in the Pond 2 area.

These impacted soils in the Pond 2 area remain accessible today. However, the draft cleanup action plan (Golder Associates, 2002) proposes installing more than 30 feet of fill over these impacted soils without:

- Completing characterization of the Pond 2 contaminant source area
- Completing characterization of the other contaminant source areas within the portion of the Rogers Seam proposed for capping
- Removing, or making any effort to remove, the residual DNAPL

Once 30 or more feet of fill soil are placed over the contaminant source areas, it will not be practicable to characterize these contaminant source areas or remove the residual DNAPL. Therefore, implementation of the proposed corrective cleanup action plan would impede source characterization and the removal of existing DNAPL.

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Please call should you have questions or if I can be of further assistance.

Sincerely,

Anne Udaloy, L.H.G.

Cc: Mr. Kelly Peterson, City of Kent
Mr. John Littler, P.E., LEC, Inc.

Table 1

Calculation of Effective Solubility of Chlorinated Solvents in Landsburg Site Pond 2 Composite Sample[a]

Sampling Location: Area 2 ("Pond 2").
Sample Type: Composite of four discrete samples of solids collected using a hand auger.

Constituent	Molecular Weight (g/mole)	Detected Concentration in Pond 2 Solids (mg/kg)	Detected Concentration in Pond 2 Solids (mole/kg)	Detected Concentration in Pond Solids (mole fraction)	Reported Pure Phase Solubility (mg/L)	Calculated Effective Solubility (mg/L)	Detected Concentration as Percent of Effective Solubility
Methylene chloride	84.93	1690	1.99E-02	0.53	13,000	6,945	24%
Trichlorofluoromethane	137.37	299	2.18E-03	0.06	1,100	64	465%
1,1,2-trichlorotrifluoroethane	187.38	216	1.15E-03	0.03	136	4	5132%
1,1,1-trichloroethane	133.40	317	2.38E-03	0.06	1,250	80	398%
Trichloroethene	131.39	1530	1.16E-02	0.31	1,400	438	350%
Mass of chlorinated solvents in sample		0.41%					

[a] Results were calculated using the method described in *DNAPL Site Evaluation* (Cohen and Mercer, 1993). If the sample were primarily liquid, then detection of a constituent at concentrations exceeding 100% of its effective solubility would indicate that the constituent is probably present as free product.

Solubilities of pure constituent phases in water are reported for the following temperatures (Montgomery, 1996):

Methylene chloride solubility at 25° Celsius
Trichlorofluoromethane solubility at 20° Celsius
1,1,2-trichlorotrifluoroethane solubility at 10° Celsius
1,1,1-trichloroethane solubility at 23 to 24° Celsius
Trichloroethylene solubility at 23 to 24° Celsius

However, typical groundwater temperatures range from 8 to 15° Celsius. Where the value used for pure phase solubility in water corresponds to a water temperature higher than normal groundwater temperatures, the effective solubility of the compound is increased. Therefore, these calculations are conservative in that the actual effective solubilities for methylene chloride, trichlorofluoromethane, 1,1,1-trichloroethane, and trichloroethylene in site groundwater would be lower than those used here for comparison.

Table 2
Assessment of Potential Chlorinated Solvents as Non-Aqueous Phase Liquid in Landsburg Site Pond 2 Composite Sample, Assuming Sample is Primarily Soil or Solids[a]

Sampling Location: Area 2 ("Pond 2").
Sample Type: Composite of four discrete samples of solids collected using a hand auger.

Constituent	Measured Concentration in Pond 2 Sample (mg/kg)	Calculated Effective Solubility (mg/L)[b]	Organic Carbon - Water Partitioning Coefficient (Koc) (unitless)[c]	Fraction of Organic Carbon (foc) in Soil/Sludge (mg/mg)	Distribution Coefficient (Kd)[d]	Estimated Bulk Density (mg/kg)	Effective Porosity of Soil/Sludge (vol/vol)	Theoretical Pore Water Concentration (Cw) Assuming DNAPL is Absent (mg/L)
Methylene chloride	1,690	6945	10	0.03	0.3	1.8	0.25	5432
Trichlorofluoromethane	299	64	158	0.03	4.74	1.8	0.25	**91**
1,1,2-trichloro-trifluoroethane	216	4	389	0.03	11.67	1.8	0.25	**27**
1,1,1-trichloroethane	317	80	135	0.03	4.05	1.8	0.25	**113**
Trichloroethene	1,530	438	94	0.03	2.82	1.8	0.25	**768**

[a] Results were calculated using the method described in *DNAPL Site Evaluation* (Cohen and Mercer, 1993). If the calculated theoretical pore water concentration exceeds the calculated effective solubility of the contaminant, DNAPL (free product) may be present. Constituents where calculations suggest the presence of DNAPL (free product) are in bold.
[b] Effective solubilities were calculated using the mole fraction defined in Table 1.
[c] Organic carbon-water partitioning coefficients are from CLARC Version 3.1 at a pH of 6.8 for methylene chloride, 1,1,1-trichloroethane, and trichloroethene. Organic carbon-water partitioning coefficients are from Montgomery (1996) for trichlorofluoromethane and 1,1,2-trichlorotrifluoroethane.
[d] Kd = Koc * foc.

Table 3
Calculation of Residual Chlorinated Solvent Volume In Landsburg Site Pond 2 Soils[a]

Sampling Location: Area 2 ("Pond 2").
Sample Type: Composite of four discrete samples of solids collected using a hand auger.

Constituent	Measured Concentration in Pond 2 Sample (mg/kg)	Minimum Analyte Mass (grams)	Minimum Solvent Volume (cubic cm)	Minimum Solvent Volume, Upper 4 Feet of Pond 2 (gallons)	Minimum Solvent Volume Below Pond 2 (gallons)[b]
Methylene chloride	1,690	155,142	116,947	30.9	4,630
Trichlorofluoromethane	299	27,448	18,459	4.9	730
1,1,2-trichlorotrifluoroethane	216	19,829	12,682	3.4	500
1,1,1-trichloroethane	317	29,101	21,733	5.7	860
Trichloroethene	1,530	140,454	96,136	25.4	3,810
Residual solvent volume, in gallons				70.3	10,530

[a] The volume of affected soils used for calculations is 1,800 cubic feet (51 cubic meters), which is a minimum estimate (see text). The bulk density of the soils and sludge is estimated to be 1.8 grams per cubic centimeter (1,800 kilograms per cubic meter; see Table 2). This yields a calculated soil mass of 91,800 kilograms.
[b] The mine workings below Pond 2 are estimated to be 600 feet deep.
Densities of pure contaminant phases in water are reported for 4° Celsius (Montgomery, 1996):

Analyte	Density
Methylene chloride	1.33 grams/cubic centimeter
trichlorofluoromethane	1.49 grams/cubic centimeter
1,1,2-trichlorotrifluoroethane	1.56 grams/cubic centimeter
1,1,1-trichloroethane	1.34 grams/cubic centimeter
Trichloroethylene	1.46 grams/cubic centimeter

Table 4

Calculation of Minimum Volume of Groundwater Required to Dilute Residual Chlorinated Solvents in Landsburg Site Pond 2 Soils to MTCA MCLs

Sampling Location: Area 2 ("Pond 2").
Sample Type: Composite of four discrete samples of solids collected using a hand auger.

Constituent	Minimum Analyte Mass in Pond 2 Soils (grams)	Minimum Analyte Mass Below Pond 2 (grams)	MTCA MCL for Groundwater (mg/L)	Calculated Effective Solubility (mg/L)[a]	Volume of Groundwater Required for Dilution to MCL (gallons)[b]
Methylene chloride	155,142	23,271,300	0.005	6,945	1,201,100,000
1,1,1-trichloroethane	29,101	4,365,090	0.2	80	5,600,000
Trichloroethene	140,454	21,068,100	0.005	438	1,087,400,000

MTCA = Model Toxics Control Act (WAC 173-340).
MCL = Maximum contaminant level.
mg/L = milligrams per liter (parts per million).
[a] Calculated effective solubilities are presented in Table 1.
[b] This value is the calculated minimum volume of groundwater required to dilute the calculated volume of analytes below Pond 2, rounded to the nearest 100,000 gallons.

November 8, 2004

Mr. Bill Wolinski, P.E.
Environmental Engineering Manager
City of Kent
220 Fourth Avenue South
Kent, Washington 98032-5895

Re: Recommendations for Supplemental Remedial Investigations to Address the Landsburg Mine Site

Dear Mr. Wolinski,

The Landsburg Site is a former underground coal mine located less than one mile northeast of the Clark Springs, the primary water supply source for the City of Kent (population 84,210, with municipal water service to approximately 57,000). Numerous household and private water supply systems are located within one mile of the site. The mine site is also located within one-half mile of critical surface water resources (the Cedar River and Rock Creek). The cleanup of the Landsburg Mine site is regulated under the Model Toxics Control Act (MTCA; Washington Administrative [WAC] Code Chapter 173-340). The disposal of large volumes of contaminants directly into mine workings that penetrate the regional aquifer has been documented at this site. The potential risk to human health and the environment posed by waste discharged into the Rogers Seam is significant.

The City of Kent and its consultant team have, since the early 1990s, reviewed and commented on activities related to the investigation and remediation of the Landsburg Mine Site. The City of Kent and its consultant team have repeatedly raised many concerns to the Washington State Department of Ecology (Ecology) and the Potentially Liable Parties (PLPs) regarding data gaps, the inadequacies of site characterization, the lack of appropriate responses to data developed during site characterization, and related questions.

The purpose of this letter is to identify the investigations and evaluations still needed to complete site characterization such that it is sufficient to support selection of a cleanup action (WAC 173-340-350 [6]). This summary is not intended to define every data gap that does or could exist, but is intended to provide a basis for identifying and prioritizing data acquisition and evaluations needed to permit definition and evaluation of appropriate cleanup actions.

Section 1 of this letter reviews the current site status with respect to primary site characterization goals, and identifies critical data gaps. Critical data gaps are defined as those that must be addressed to characterize contaminant flow paths from the Rogers Seam to sensitive receptors, and to comply with MTCA. Section 2 presents recommendations for supplemental remedial investigations that would address the critical data gaps identified in Section 1.

1 Evaluation of Current Remedial Investigations

The purpose of a remedial investigation is to "collect data necessary to adequately characterize the site for the purpose of developing and evaluating cleanup alternatives" (WAC Chapter 173-340-350 [7a]). When the site has been sufficiently characterized, it will be possible to accurately answer the following fundamental questions:

- Exactly where are the primary contaminant source areas?
- Do contaminants remain in place and, if so, what contaminants remain, what are the residual contaminant concentrations, and where are they?
- Has site groundwater been contaminated and, if so, what are the contaminants and where are they?
- If site groundwater has been contaminated, then have all primary contaminant flow paths between source areas and sensitive receptors been identified and are they being monitored?

Remedial investigation data acquisition requirements can be grouped under the following primary components of the site conceptual model:

1) Define the Nature of Rogers Seam Contaminants
2) Confirm the Distribution of Contaminants Within the Rogers Seam
3) Identify Contaminant Flow Paths to Sensitive Receptors

After contaminants are identified and contaminant flow paths are defined, then critical flow paths can be evaluated to define the nature (compounds and concentrations) of contaminants transported by those flow paths, the volume of flow for each critical flow path, and the transport rate (velocity) for each critical flow path. Subsequently, corrective actions addressing critical contaminant flow paths can be identified, performance monitoring for those actions can be defined, and detection monitoring network protecting sensitive receptors can be designed and installed.

A remedial investigation (RI) and Feasibility Study (FS) has been performed for the site (Golder, 1996). Three rounds of groundwater monitoring have been reported (Golder, 2000; Golder, 2004a; and Golder, 2004b). Supplemental remedial investigations have also been performed (Golder, 2004c). Prior to the RI, a preliminary hazard assessment of the Landsburg site was performed (Ecology and Environment, Inc. [E&E], 1984; E&E, 1991). In addition, readily-accessible drums were removed from the site (Burlington Environmental, Inc., 1991). Results of the E&E assessments and drum removal activities are summarized in the RI/FS Report (Golder, 1996). The recommendations presented in this letter were developed based on data presented in the RI/FS Report (Golder, 1996), the subsequent groundwater monitoring reports (Golder, 2000; Golder, 2004a; and Golder, 2004b), the supplemental remedial investigations (Golder, 2004c), and the body of the drum removal report (Burlington Environmental, Inc., 1991). UES did not review the original E&E reports or appendices for the drum removal report in developing these recommendations. Reviews of waste disposal at the Landsburg Mine site are apparently also presented in reports provided by the Landsburg

PLP Steering Committee (1991) and Golder (1992b). These reports were not reviewed in developing these recommendations.

This section reviews the rationale and data requirements for each of the three primary conceptual model components identified above, summarizes the data provided in the reviewed reports, and presents a summary of remaining data gaps. Critical data gaps, where present, are defined.

1.1 Define the Nature of Landsburg Site Contaminants

The nature of contaminants within the mine and the area near the south portal previously identified as a potential waste disposal area must be understood in order to:

- Define contaminants of concern and their physical properties
- Develop an appropriate conceptual model of contaminant fate and transport based on known contaminants and their properties
- Define appropriate sampling and analysis procedures
- Determine appropriate investigation protocol based on contaminants and their properties
- Define and select cleanup actions
- Select indicator hazardous substances
- Evaluate risk for exposure pathways
- Select cleanup standards, including cleanup levels
- Identify points of compliance
- Define performance and confirmational monitoring requirements
- Comply with the MTCA

Data requirements, and the current status of site investigations with respect to these data requirements, are identified in Table 1.

The disposal of large volumes of contaminants directly into mine workings that penetrate the regional aquifer has been documented at this site: the RI/FS Report states that "an estimated 4,500 drums and about 200,000 gallons of oily waste water and sludges were disposed into the trench... some of the drums contained wastes that included paint wastes, solvents, metal sludges and oily water and sludge" (Golder, 1996). Although an interim cleanup action was performed to remove drums from the site, it appears that less than 1,000 gallons of liquid waste have been removed from the site (Burlington Environmental, Inc., 1991).

As shown in Table 1, the characterization of the nature of organic compounds in 450,000 gallons of site contaminants effectively rests upon historical descriptions of wastes discharged to the site and the analytical results from a single composite sample of Pond 2 soils. The sampling data reported during drum removal (Burlington Environmental, Inc., 1991) demonstrate that, in addition to chlorinated solvents, residual waste in excavated drums tested positive for contaminants such as PCBs, petroleum hydrocarbons, phenolics, lead, chromium, and cadmium. An evaluation of the Pond 2 soil sample indicates that chlorinated solvents were present in site soils at part-per-hundred (percent) concentrations at the time of sampling, more than 13 years after the last reported disposal of hazardous waste at the site (UES, November 5, 2004). The Pond 2 soil sample data also indicate that significant volumes of contaminants (including Freon 11, Freon 13, 1,1,1-TCA, and TCE), remain in place as residual dense, non-aqueous phase liquid (DNAPL) within the Rogers Seam. Volumes of residual DNAPL calculated using site data are large (as much as 100,000 gallons). Given their physical properties, these contaminants would be expected to persist indefinitely within the mine. Consequently, it can be expected that groundwater within the Rogers Seam will be continuously impacted by dissolution of these residual contaminants, and that concentrations of methylene chloride, 1,1,1-TCA, and TCE exceed the maximum contaminant levels (MCLs) permitted under MTCA in groundwater within the Rogers Seam near Pond 2.

The limited characterization of contaminant sources at this site significantly affects the evaluation and selection of cleanup actions. For example, the draft Cleanup Action Plan does not identify contaminants of concern or their concentrations in site soils, surface water, or groundwater; instead, "source characteristics" are generally defined in a narrative indicating that undefined volumes of undefined wastes presumably remain in place (Golder, 2002). However, the description does not report the percent concentrations of chlorinated solvents in Pond 2 soils, or note that likelihood that chlorinated solvents as remain in place as DNAPL. As a result, the MTCA requirement to remove free product, (WAC 173-340-360 [2][c][ii][A]), was apparently not included as an applicable or relevant and appropriate requirement (ARAR).

Consequently, two remediation alternatives evaluated for the site that included a component of excavating "surficial affected soil" and disposing these soils off-site were rejected (Golder, 2002). One of these, Alternative 8, which included limited excavation and removal of affected soil was "eliminated during the screening evaluation", with no further explanation of the rationale for its elimination (Golder, 2002). The other, Alternative 9, required "complete removal of all waste and affected soil" and was rejected because it ranked lower than the other evaluated alternatives. However, the explanations for deriving its ranking were incomplete, and the fact that the remaining alternatives did not meet ARARs was not addressed.

Specifically, MTCA states that "Source containment may be appropriate when the free product consists of a dense non-aqueous phase liquid that cannot be recovered after reasonable efforts have been made." (WAC 173-340-360 [2][c][ii][A]). However, the remaining alternatives do not include *any* effort to recover site DNAPL. Instead, they address covering the residual sources with large volumes of soil- actions that would preclude efforts to remove residual DNAPL.

Similarly, remedial action objectives are described only in broad terms. No specific action levels, cleanup levels, or point(s) of compliance are defined.

The inadequate source characterization for this site is a significant data gap. Therefore, the draft Cleanup Action Plan (Golder, 2002) defines an extensive array of constituents (volatile and semi-volatile organic compounds, chlorinated pesticides and PCBs, metals, and selected water quality parameters) as contaminants of concern. However, the draft Cleanup Action Plan does not explicitly acknowledge the presence of residual DNAPL at the site, consider the implications of DNAPL presence on contaminant fate and transport, or address the MTCA requirements for DNAPL cleanup.

1.2 Confirm the Distribution of Site Contaminants

Contaminant distribution within the Rogers Seam itself has not yet been defined because the RI/FS process to date has considered the Rogers Seam as a "black box". The MTCA requires that field investigations be performed to "adequately characterize the areal and vertical distribution and concentration of hazardous substances" in soil and groundwater (173-340-350 (7) (c) (iii) WAC). The RI Work Plan instead proposed that "The RI/FS will collect information and data for identifying and quantifying operative exposure pathways and for detailed evaluation of source control and off-site migration control remedial measures" (Golder, 1992). To accomplish this stated goal of the RI Work Plan, contaminant distribution along all possible flow paths from the mine to sensitive receptors must be characterized. Therefore, all portions of the Rogers Seam must be considered the "source area" and potential contaminant flow paths from all portions of the Rogers Seam must be evaluated. Contaminant flow path evaluations must also assume that all contaminants detected anywhere within this source area are present everywhere, with contaminant concentrations equal to the maximum detected anywhere.

Adoption of the "black box" conceptual model does not imply that data must not or should not be collected from within the Rogers Seam. For example, it will not be possible to effectively define the nature of contaminants (per Section 1.1) without sampling within the Rogers Seam. (The RI Work Plan noted that "Source characterization... is not recommended for Phase I RI/FS because "chemical characterization of sources during exhumation, instead of during the RI, is expected to provide most cost effective and more relevant information" [Golder, 1992]). The absolute need to acquire data from within the Rogers Seam in order to complete site characterization is acknowledged by recent investigations that explicitly target the former mine workings (i.e., well MW-10 was intentionally installed within the mined-out workings, and contaminants were detected in the groundwater sample collected from this well; Golder, 2004c). Therefore, investigations to acquire necessary data from the Rogers Seam are identified as those required to define the nature of Landsburg Site contaminants (per Section 1.1), and those required to identify contaminant flow paths (per Section 1.3).

1.3 Identify Contaminant Flow Paths

Contaminant flow paths must be defined in order to:

- Define potential contaminant receptors, including sensitive receptors
- Define potential risks to sensitive receptors
- Define an appropriate detection monitoring system to protect sensitive receptors

- Identify appropriate corrective actions
- Define appropriate performance monitoring for corrective actions
- Identify appropriate contingency plans
- Comply with the MTCA

As noted in Section 1.2, the RI/FS process to date has considered the Rogers Seam as a "black box". Consequently, all portions of the Rogers Seam are considered source areas with all contaminants detected anywhere being present everywhere, and with contaminant concentrations equal to the maximum detected anywhere. In addition, contaminant distribution along all possible flow paths from the Rogers Seam to sensitive receptors must be characterized. This requires defining flow:

- Within the regional aquifer surrounding the Rogers Seam (including the alluvial deposits of Cedar River and Rock Creek drainages, and the sedimentary bedrock surrounding the Rogers Seam)
- Through the unmined coal bedrock north and south of the mined area
- Through fractured sedimentary bedrock east and west of the Rogers Seam (considering both faults and joints)
- Through intact bedrock east and west of the Rogers Seam

Data requirements to support an effective and complete flow path analysis, and the current status of site investigations with respect to these requirements, are identified in Table 2. As shown in Table 2, no contaminant flow paths have been identified for this site. In addition, flow paths discharging from the "black box" have not been comprehensively investigated because the RI focused on characterizing only shallow flow paths through mined and unmined coal at the ends of the Rogers Seam. As a result, the RI did not evaluate or define flow through more than 95% of the "black box". For example, the RI did not evaluate flow through the mine sidewalls or flow through the unmined ends of the Rogers Seam at depth. Instead, the RI treated that the regional (bedrock) aquifer surrounding the Rogers Seam as a "no-flow boundary". Only one well was (inadvertently) installed into bedrock adjacent to the mine, and no investigations were performed to evaluate flow through the bedrock sidewalls of the mine, and no investigations were performed to evaluate the potential for flow through fractures (such as the regional and local faults and joint systems identified within the Study Area). Consequently, existing site studies have not defined relationships between contaminated groundwater within the Rogers Seam and surface water or ground water within the Study Area.

In summary, although contaminant flow paths from the Rogers Seam to the surrounding regional aquifer necessarily exist, none have been defined or characterized. The relationships between contaminated groundwater in the Rogers Seam, surface water, and the regional aquifer are poorly understood. Groundwater flow paths within the regional aquifer have not been identified or characterized. Groundwater flow paths between the Rogers Seam and sensitive receptors have not been identified or characterized. These data gaps preclude characterizing contaminant fate and transport for this site. It is not possible to proceed with selection of a cleanup remedy using only existing data, and a supplemental RI will be required to complete necessary site characterization.

2 Recommendations

This section presents recommendations for supplemental remedial investigations and evaluations required to complete site characterization necessary (although possibly not sufficient) to support selection of a cleanup action (WAC 173-340-350 [6]).

The RI assumed that all of the mined-out Rogers Seam would be considered the contaminant source areas. The RI did not identify or provide effective rationale for defining Rogers Seam contaminants of concern, their physical properties, or the potential for contaminants to be present as DNAPL. The RI did not define or evaluate significant potential contaminant flow paths from the Rogers Seam to sensitive receptors, such as flow paths through the fractured bedrock mine sidewalls or at depth.

As a result, the RI did not define any contaminant flow paths. Instead, the RI identified a few areas where contaminant flow was not detected during the few periods tested. Currently, the PLP group is attempting to develop a corrective action plan (CAP) for the site even though no contaminant flow paths have yet been identified, no additional characterization of contaminant flow paths has been proposed, and site characterization is clearly insufficient to support selection of cleanup actions.

2.1 Supplemental Remedial Investigations

The Supplemental Remedial Investigation should include the following elements:

- Task 1: Characterize Landsburg Site Contaminants
  - Subtask 1.1: Compile and Review Existing Data
  - Subtask 1.2: Develop Sampling and Analysis Plan
  - Subtask 1.3: Develop and Implement Soil and Surface Water Sampling Plan
- Task 2: Update Study Area Boundaries and Critical Study Area Characteristics
- Task 3: Evaluate the Structural Geology of the Study Area
- Task 4: Update the Conceptual Model of Site Hydrology, Hydrogeology, and Geochemistry
  - Subtask 4.1: Evaluate Groundwater Flow Through Bedrock
  - Subtask 4.2: Evaluate System Geochemistry
  - Subtask 4.3: Evaluate Data and Revise Conceptual Model
  - Subtask 4.4: Evaluate Contaminant Flow Paths
- Task 5: Revise the Draft Cleanup Action Plan

Task 1: Characterize Landsburg Site Contaminants
The purpose of this task is to define contaminants of concern for the Rogers Seam site based on a records review and field investigations. In addition, field investigations will be

performed to define residual chlorinated solvents as DNAPL within shallow trench soils. Task deliverables will include a MTCA-compliant Sampling and Analysis Plan, and a summary of contaminant source characterization data. These evaluations and investigations will:

- Allow definition of contaminants of concern
- Support definition and selection of cleanup actions
- Support selection of indicator hazardous substances
- Support evaluations of risk for exposure pathways
- Support selection of cleanup standards, including cleanup standards and points of compliance

Subtask 1.1: Compile and Review Existing Data

1) Acquire and review all reports presenting data and data summaries from previous site investigations (these files are presumably available from Ecology and the PLP Group).
2) Review of the existing data and define potential contaminants of concern.
3) Prepare a summary of known contaminant characteristics (for example, summarize the information provided in waste manifests). Include a tabular summary for each sample matrix (e.g., soil, pond sludge, surface water, drum residue) defining:
   - Samples collected
   - Sampling methods (e.g., discrete sample or composited sample)
   - Analytic method and detection limits
   - The maximum detected concentration of tested analytes

Subtask 1.2: Develop Sampling and Analysis Plan

1) Develop a sampling and analysis plan consistent with the requirements of 173-340-820 WAC to characterize site contaminants identified under Subtask 1.1. The plan will define the requirements for ongoing monitoring of surface water and ground water. In addition, the plan will include provisions for source area characterization and testing for residual chlorinated solvents as DNAPL within shallow trench soils (i.e., collection of soil, surface water, and groundwater samples under Subtask 1.3).

Subtask 1.3: Develop and Implement Source Area Characterization Sampling Plan

1) Identify sampling locations, then collect and analyze samples from known or potential contaminant source areas. Source area contaminant characterization should include sampling and analysis of:
   a. Soils within the mine trench, particularly in areas where drums were removed
   b. Soils in the previously-identified area near the south portal that has not yet been evaluated.
   c. Surface water ponded near areas where drums were removed.

d. Groundwater directly beneath defined contaminant source areas, such as Pond 2
e. Groundwater at depth within the Rogers Seam near the South Portal
f. Groundwater at depth within the Rogers Seam near the North Portal

Task 2: Update Study Area Boundaries and Critical Study Area Characteristics
The purpose of this task is to define the study area using natural hydraulic boundaries to facilitate subsequent data collection and interpretation, and to confirm that all hydraulic features within the Study Area have been defined and located so that these features can be effectively integrated into the conceptual model of the site.

1) Define the Study Area as the area within the apparent hydrogeologic boundaries for the regional aquifer: the Cedar River, Rock Creek, Georgetown Creek, and the valley fill deposits with Section 30, Township 22 North, Range 7 East (east of the bedrock rise containing the Landsburg, Rogers, and Frazier coal seams). This is a minor extension of the existing Study Area that more nearly coincides with natural (hydraulic) boundaries.
2) Explicitly define the horizontal and vertical extents, including the basal elevations, of the Rogers, Landsburg, and Frazier Seam mines (these data apparently exist but have not yet been reported).
3) Define all surface water features (particularly springs) within and along the boundaries of the Study Area (this task is largely complete).
4) Define all public and private water supply wells and monitoring wells within the Study Area (this task is largely complete)
5) Survey the horizontal positions and elevations of all wells, portals, springs, and surface water features within or alongside the Study Area using State Plane Coordinates and National Geodetic Vertical Datum (NGVD) of 1929 (this task is largely complete)
6) Provide scaled base maps illustrating the Study Area topography and the positions of the three major mines, subsidence features, surface water features, wells, roads, and residences (base maps for this task exist and need minor updates based on new data).

Task 3: Evaluate the Influence of Geologic Structures on Groundwater Flow
The purpose of this task is to define structural features that may influence groundwater flow, and to identify appropriate locations for testing these features.

1) Identify, map, and describe significant geologic structural features within the Study Area. Geologic features will include regional folds and faults, faults mapped within the Rogers, Landsburg, and/or Frazier Seams, and secondary features (such as the two closely-spaced joint sets observed present within the Rogers Seam).
2) Prepare a report summarizing structural features, describing the nature, orientation, offset (if any), and spacing of these features. Discuss the relative timing of and relationships between structures (if any).

3) Perform appropriate analyses or modeling to define the effect of geologic structures on groundwater distribution within bedrock by:
    a. Identifying the geologic structures that could affect groundwater distribution within bedrock, and documenting the rationale for identifying structures as either potential conduits of or barriers to groundwater flow
    b. Defining the orientation and spacing of fractures that could act as potential preferential groundwater flow paths
    c. Defining the orientation and spacing of fractures that could act as potential barriers to groundwater flow
4) Define locations where the potential influence of significant geologic structures could be tested. This will include defining the known or anticipated structure, defining drilling approach and target depths, and defining procedures for evaluating borings to determine whether the site data support the conceptual model of structural influence on groundwater flow through bedrock.

Task 4: Update the Conceptual Model of Site Hydrology, Hydrogeology, and Geochemistry

The purpose of this task is to perform focused field investigations that will permit development of a conceptual model of site hydrogeology and geochemistry that:

- Define contaminant flow paths between the Rogers Seam and sensitive receptors
- Allow calculation of flow velocity for each critical flow path
- Demonstrate that all significant contaminant flow paths have been defined
- Support definition and selection of cleanup actions
- Support selection of indicator hazardous substances
- Support evaluations of risk for exposure pathways
- Support selection of cleanup standards, including cleanup standards and points of compliance
- Support definition of performance and confirmational monitoring requirements

Subtask 4.1: Evaluate Groundwater Flow Through Bedrock

1) For the drilling locations identified under Task 3:
    a. Install borings at positions predicted to intercept fractures acting as conduits, and of fractures interpreted as flow barriers (if any)
    b. Evaluate these boreholes using appropriate geophysical instruments and tests
    c. Install wells in each borehole screened to permit subsequent testing of either the fracture(s) or, if no transmissive fractures are defined, the competent bedrock
2) Install three or more piezometers within the Rogers Seam to define water table elevations within the mined-out portion of the Rogers Seam
3) Within the Study Area, measure synoptic water levels in all wells and discharge rates and stage at all points of surface water discharge (including portals and springs). Measurements will occur over a sufficient time frame and at sufficient frequency will

be sufficient (e.g., at 15-minute intervals over a 12-month period) to permit evaluation of static water levels and the dynamic response of the hydrogeologic system to precipitation during periods of recharge and seasonal low water elevations.

4) Perform single-well and multiple well tests to define fracture flow paths, determine the actual hydraulic influence of fractures acting as conduits (if any), determine the actual hydraulic influence of fractures interpreted as flow barriers (if any), and determine the transmissivity and hydraulic response of the bedrock. Wells should test all of the boundaries of the "black box", including the intact coal at the ends of the box, fractured bedrock sidewalls, and unfractured bedrock sidewalls of the "black box". Properly-constructed wells tested during previous investigations should be retested (wells constructed using pre-packed screens would not be tested).

Subtask 4.2: Evaluate System Geochemistry

1) Collect and analyze geochemical samples from wells and all points of surface water discharge (including portals and springs) within the Study Area. Samples will be collected at a frequency (quarterly for eight quarters, and periodically thereafter) to permit evaluation of the system's geochemical response to precipitation, and to permit evaluation of geochemical facies throughout the Study Area.

Subtask 4.3: Evaluate Data and Revise Conceptual Model

1) Define groundwater flow through bedrock in the Study Area by:
   a. Presenting existing records from former mine operations demonstrating that flow volumes were less than 100 gallons per minute, and that flow was through the porous rock matrix rather than discrete fractures
   b. Defining the relationship between the water table elevations in the Rogers Seam subsidence trench and groundwater levels in wells completed in bedrock (including water supply wells)
   c. Presenting evaluations of results for single well and multiple well testing
   d. Presenting an analysis of the response of wells completed in bedrock to hydraulic loading of the Rogers Seam, either during unique events (such as the August 1994 Baker Tank discharge) or due to seasonal recharge (using the synoptic water level measurements).
2) Define the hydrogeology and hydrology (e.g., therelationships between groundwater in the Rogers Seam, groundwater in bedrock, and surface water at portals and springs) of the Study Area by:
   a. Analyzing the synoptic water level data and defining:
      i. Local flow systems within the regional aquifer (e.g., the Landsburg Seam Mine, the Rogers Seam Mine, the Frazier Seam Mine, the till, and potentially other portions of the bedrock highlands)
      ii. Intermediate flow systems within the regional aquifer (e.g., groundwater in the outwash soils and alluvium of the Cedar River and Rock Creek and in bedrock at equivalent elevations)

iii. The regional flow system (if monitored)

b. Defining interactions between the "black box" and surface water, and the "black box" and local, intermediate, and/or regional groundwater flow systems using the synoptic water level data
c. Defining which flow systems may be affected by Rogers Seam contaminants using hydraulic criteria
d. Preparing a water balance for the Rogers Seam:
    i. Calculate system inputs based on measured precipitation and measured topographic area draining to the subsidence trench. Identify all data and data sources.
    ii. Explicitly define assumptions or present demonstrations regarding system storage.
    iii. Identify system outputs (i.e., flow through unmined coal at ends of mine, discharge to portal #2, discharge to portal #3, evapotranspiration, etc.). Calculate the mass of water lost to each system output. Identify all data (including specific measurements related to each identified output) and data sources.
    iv. Evaluate the relationship between defined system inputs, defined system outputs, and assumptions or demonstrations regarding system storage. Discuss potential sources and magnitudes of error.
d. Defining all potential flow paths from the "black box", including flow paths through the mine sidewalls, through the portals, through conduits discharging to portals, springs, or structures (such as faults) and at depth through the sidewalls and unmined coal at the mine ends

3) Revise the conceptual hydrogeologic model of the site by integrating additional site data and defining all flow paths passing through the Rogers Seam.

Subtask 4.4: Evaluate Contaminant Flow Paths

1) Provide a description and graphical representation of the three-dimensional groundwater flow from the Rogers Seam.
2) Identify the Rogers Seam contaminant flow paths that may discharge to sensitive receptors.
3) For contaminant flow paths that may discharge to sensitive receptors, calculate the range of probable flow velocities (where flow velocity may vary significantly along a flow path due to geologic or hydrogeologic conditions, calculate flow velocities for each unique condition)
4) Identify wells monitoring each flow path, and demonstrate which portion of each flow path is monitored by that well. Identify portions of flow paths that are not monitored. Demonstrate how each flow path or portion thereof is or will be monitored.
5) Install additional wells as needed to monitor all contaminant flow paths discharging from the Rogers Seam and confirm that sensitive receptors are not impacted by Rogers Seam contaminants.

2.2 Coordination with Interim Remedial Actions

Performance of these supplemental remedial investigation tasks will require development of one or more work plans, and preparation of one or more reports. The findings of these reports will be used to define and select appropriate cleanup actions for the site, which will be presented in a revised Draft Cleanup Action Plan. At this time, it is inappropriate to perform cleanup actions that would prevent or render impractical actions required under the MTCA. For example, if the northern portion of the subsidence trench were capped by placing more than 30 feet of soil over areas known to contain residual DNAPL, it would be impractical to subsequently remove residual DNAPL from areas buried by that fill. Therefore, it is imperative that Task 1 (and any consequent actions required to remove DNAPL), be completed before any interim actions, including capping of source areas, are performed.

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Please call should you have questions, or if I can be of further assistance.

Sincerely,

Anne Udaloy, L. H. G.

Cc: Mr. Kelly Peterson, City of Kent
Mr. John Littler, P.E., LEC, Inc.

Table 1
Summary of Characterization Requirements and Current Status for Definition of the Nature of Landsburg Site Contaminants

Requirement	Current Status
1) Identify contaminants present in soils	The limited data known to exist apparently consist of: • One composite of four pond sludge samples • 12 soil samples • 2 surface water samples • Characterization testing of drum residue for waste transport and disposal Based on these data, contaminants in soils are known to include metals, volatile organic compounds including chlorinated solvents, PCBs, carcinogenic PAHs, petroleum hydrocarbons (including benzene). Concentrations of some compounds, including chlorinated solvents (trichlorofluoromethane, 1,1,1-trichloroethane, and trichloroethene) and freons (1,1,2-trichlorotrifluoromethane, or Freon 113) apparently are present as free product; other chlorinated solvents, (such as methylene chbride), may also be present as free product. It is unclear whether waste manifests were reviewed and if so, what data were derived from those manifests. Discussions of site contaminants do not identify the presence of chlorinated solvents and residual DNAPL, even though the presence of residual DNAPL is implicit. Per the RI Work Plan (Golder, 1992), no contaminant source characterization data were collected during the RI.
2) Identify contaminants present in groundwater	Groundwater sampling parameters are based on soil characterization performed during drum removal (see above) All groundwater samples, with the exception of a few recent samples, have been collected from shallow flow paths. No contaminants were detected in the wells installed during the RIto monitor shallow groundwater; therefore, these wells did not monitor contaminant flow paths. Contaminants have been detected in groundwater samples from recently-installed wells that monitor deeper flow paths; however, samples collected during September 2004 were not tested for analytes detected during April/May 2004 (such as diethyl phthalate). Numerous potential (and probable) deep contaminant flow paths are not monitored.

Table 1, continued
Summary of Characterization Requirements and Current Status for Definition of the Nature of Landsburg Site Contaminants

Requirement	Current Status
3) Identify contaminants present in surface water	Limited surface water samples were collected from ponded water within the Rogers Seam trench during preliminary site investigations, but the results were not summarized in the RI report. Four surface water samples have been collected from the north portal during the RI. Five surface water samples have been collected from the south portal: four were collected duringthe RI, and one was collected during May 2000 (note that the detection limits for critical analytes, such as diethyl phthalate, were an order of magnitude higher during this final sampling event than those used during the previous sampling rounds).
4) Identify contaminants present in air	Air monitoring was performed during preliminary characterization (AGI, 1990); reportedly, no organic vapors were detected in air within the trench. Air monitoring was also performed during the RI (November 1993, August 1994, and January 1996). Organic vapors were consistently detectedin air above ground surface near the "sludge pond"; concentrations increased significantly when surface soils were disturbed(this location is tentatively correlated with Pond 2; however, sampling stations are not presented in report figures).
5) Define the physical properties of known contaminants	Contaminants are known to include metals, volatile organic compounds including chlorinated solvents, PCBs, carcinogenic PAHs, petroleum hydrocarbons (including benzene). Contaminants are known to be present as solid and liquid waste. Liquid waste includes dense, nonaqueous phase liquids and may also include light, non-aqueous phase liquids. Solid waste reportedly includes drums, residue in drums, and layers of sludge. Contaminants are known to be present in air above source areas.
Summary of Critical Data Gaps	Contaminant characterization is incomplete. Specifically: • Contaminant characterization is currently based almost exclusively on the results from one composite of four pond sludge samples, and limited waste characterization testing of drum residue. • The physical properties of known contaminants have not been effectively defined, reviewed, or integrated into the conceptual hydrogeologic and hydrogeochemical model. • The area of potential contamination near the South Portal has not been characterized.

Table 2
Summary of Characterization Requirements and Current Status for Identification of Contaminant Flow Paths

Requirement	Current Status
1) Define the Study Area as the area potentially affected by the Rogers Seam, and a sufficient surrounding area to permit integration of the Rogers Seam with regional hydrogeologic conditions	The study area has been defined to generally permit evaluationof the area potentially affected by contaminants emanating from theRogers Seam. However, the Study Area boundaries are not hydrogeologic boundaries,; therefore the current Study Areais insufficient to permit evaluation of the Rogers Seam within a regional context.
2) Define the elevation of surface water features within the Study Area, including: • The Cedar River and its tributaries • Rock Creek and its tributaries • Springs (including the portal springs)	The elevation of the spring at the north portal (Portal #2) has been defined; however, the staff gage used to monitor water levels at this location has not been maintained.It is unclear whether the position of the staff gage was surveyed.No other surface water body elevations have been defined. The source(s) used to define the positions of the Cedar River, Rock Creek, and their tributaries is undefined.
3) Define the elevation of groundwater within the mined areas, including: • The Rogers Seam • The Landsburg Seam • The Frazier Seam	The elevation of groundwater is defined for one point in the Landsburg Seam has been defined (using LMW-7). Groundwater elevation in unmined coal likely equivalent with the Frazier Seam is defined using LMW-6. Well logs indicate that no wells are installed to measure the water table elevation within the Rogers Seam, and that although wells LMW-1A, LMW-1, and LMW-9 are installed in sedimentary bedrock near the Rogers Seam, water levels in these wells may not be equivalent withthose within mined-out portions of the Rogers Seam. Well logs also indicate that: • Well LMW-4 is installed in siltstone and unmined but fractured coal near the Rogers Seam, and water levels in this well may be equivalent with water levels within mined-out portions of the Rogers Seam. Well LMW-2 is installed in unmined Rogers Seam coal, and water levels in this well are equivalent with water levels within bedrock as measured at LMW-4. • Well LMW-10 may be installed in a mined-out portion of the Rogers Seam near Portal #2. However, well LMW-10 has not been surveyed or fitted with a pressure gauge; therefore, it is not possible to relate groundwater pressures in LMW-10 to Study Area water levels. • Well LMW-5 and piezometer P-2 are apparently installed in mined-out portions of the Rogers Seam near Portal #3. Well LMW-3 is installed in unmined Rogers Seam coal, and water levels in this well are equivalent with water levels within mined-out portions of the Rogers Seam as measured at LMW-5 and P-2. • Well LMW-8 is installed in silty gravels near Portal #3. Water levels in this well are likely related to those in the southern mined-out portion of the Rogers Seam monitored at LMW-5 and P-2.

Table 2, continued
Summary of Characterization Requirements and Current Status for Identification of Contaminant Flow Paths

Requirement	Current Status
4) Within the Study Area, evaluate the potential effect of geologic structures on groundwater distribution within bedrock by: • Defining the nature and position of significant structural features (such as regional faults, and faults mapped within the Rogers, Landsburg, and/or Frazier Seams) • Performing a fracture trace analysis of secondary structural features, including the two closely-spaced joint sets observed present within the Rogers Seam, and comparing these features with the orientations of the significant structural features • Defining the orientation and spacing of potential preferential flow paths	Geologic structures have not been scientifically evaluated for this site. There is no scientific evaluation of the potential influence of structures on groundwater flow. The position of one major regional fault has been reproduced on some figures, and the positions of some faults within the Rogers Seam have been reproduced on an illustration of a mine in cross-section. The relationships between structural features in the Landsburg and Frazier mines and structural features in the Rogers Seam have not been defined or evaluated. Borings into bedrock and coal have not been evaluated for structural features (for example, no geophysical testing, such as acoustical video or flow meter evaluations, have been performed for any borings).
5) Evaluate structural features of interest by: • Installing borings to test for the presence and influence of fractures • Evaluating boreholes using appropriate geophysical tests and instruments • Installing wells screened to permit testing of selected flow paths • Evaluating the geochemistry of potential contaminant flow paths	Structural features of interest have not been defined. Structural features have not been used to define preferential flow paths. Structural features have not been used to define well locations or screen positions. No wells have been installed to evaluate the influence of structural features on groundwater flow or contaminant transport.
6) Within the Study Area, define and evaluate water levels in wells screened in soils and bedrock, including: • Glacial soils overlying bedrock near the Rogers Seam • Alluvial soils adjacent to surface water (springs, the portals, Rock Creek, the Cedar River, and their tributaries) • Unmined coal at the ends of the Rogers Seam • Sedimentary bedrock east and west of the Rogers Seam (including discrete evaluation of fractured and intact sedimentary bedrock)	No systematic evaluation of water levels screened in different soil or rocktypes has been provided.

Table 2, continued
Summary of Characterization Requirements and Current Status for Identification of Contaminant Flow Paths

Requirement	Current Status
7) Define the physical extent of mined areas, including • The Rogers Seam • The Landsburg Seam • The Frazier Seam	The physical extent of these mines are incompletely reported in that the base of the Rogers Seam must be estimated based on cross-section; the basal elevations of the Landsburg and Frazier Seams are not reported. Although a tunnel through a major fault zone is reported within the Rogers Seam, the position and extent of this tunnel, and its relationship to the fault, is not reported.
8) Evaluate the relationship(s) among wells and between water levels in wells and surface water levels, including: • Evaluating head distribution throughout the mine workings, from the water table to the base of the workings • Evaluating the response of water levels throughout the mine workings, and discharge from portals and springs, to seasonal precipitation • Evaluating the response of water levels within the mine workings to stress (this may not be necessary if evaluations of seasonal responses indicates that head is swiftly distributed)	Relationships among wells and between water levels in wellsand surface water levels have not been systematically evaluated. The water table within the mined-out workings is undefined. Existing flow evaluations assume that vertical gradients are inconsequential, do not vary seasonally or in response to recharge, and do not affect data interpretations. Existing data demonstrating the response of groundwater levels near the mine to stress were incompletely evaluated. The response of groundwater levels and portal discharge to precipitation events have not been evaluated except in the most general terms; the response of spring discharge has not been evaluated.
9) Characterize the geochemistry of surface water discharging from springs, including the north and south portal	Existing surface water data include: • Four surface water samples collected from the north portal during the RI • Four collected from the south portal during the RI, plus one additional sample collected during May 2000 (note that the detection limits for critical analytes, such as diethyl phthalate, were an order of magnitude higher for the May 2000 sampling event than those used during the RI). No geochemical samples have been collected from any springs except those at the north and south portals of the Rogers Seam.
10) Characterize the geochemistry of groundwater within differing soil and bedrock types (i.e., sands and gravels, intact coal, mine voids, sandstone bedrock, and shale bedrock)	The RI data indicate that there may be distinct geochemical facies within area groundwater. For example, the geochemistry of groundwater in wells such as PW-14, screened in sandstone and coal in the western portion of the study area, well LMW-7, which monitors groundwater in the Landsburg Seam (a coal mine that did not receive waste), and the Rogers Seam portal discharges apparently reflect related simple mixing of end members. However, groundwater geochemistry among wells and within different soil and rock types has not been systematically evaluated.

Table 2, continued
Summary of Characterization Requirements and Current Status for Identification of Contaminant Flow Paths

Requirement	Current Status
11) Characterize contaminant flow through all potential flow paths from the "black box"	The absence of contaminant flow through shallow portions of the unmined coalseam was defined four times during a one-year period, once during 2000, and twice during 2004 (however, the analytes monitored varied significantly among sampling rounds). Recently installed wells will permit more effective evaluation of potential contaminant distribution within mined out areas, near the north and south portals, and of possible conduit flow towards the south portal. Potential contaminant flow through unmined coal at the ends of the mine is evaluated only for some shallow areas. The following potential contaminant flow paths have not been evaluated: • Potential contaminant flow through the mine sidewalls • Potential contaminant flow through conduits towards the north portal, or towards springs north and east of the north portal • Potential contaminant flow out the "bottom" of the "black box"
12) Characterize the hydraulic relationship(s) between groundwater in the Rogers Seam and surface water discharging from the north and south portal, including the relationship of Rogers Seam water levels on portal: • Water levels • Discharge rates • Geochemistry	Water table levels within the Rogers Seam have not been evaluated. The limited water level and water level time trend data collected during the RI have not been systematically evaluated. Geochemical relationships between Rogers Seam groundwater and portal discharge have not been evaluated.
13) Characterize flow paths of surface water discharging though the north and south portals after it leaves the portals (for example, defining whether surface water discharging from the south portal subsequently discharges to shallow groundwater within the Rock Creek drainage).	Flow paths for surface water discharging through the north and south portals have not been evaluated.
14) Calculate the water balance for the "black box", to determine whether inputs to the "box" are accounted for and thereby confirm that all significant flow paths through the box are defined.	There has been no scientific definition of the water balance, or of significant water balance components, for the "black box".

Table 2, continued
Summary of Characterization Requirements and Current Status for Identification of Contaminant Flow Paths

Requirement	Current Status
Summary of Critical Data Gaps	Additional survey data needed to define potential contaminant flow paths include: 1) LMW-10 position, and ground and measuring point elevations 2) Portal #3 discharge position and elevation 3) The shoreline position and elevation of the Cedar River, Rock Creek, and their tributaries within or along the boundary of the Study Area 4) The position and elevation of all springs within the Study Area 5) The position and elevation of all water supply wells within the Study Area 6) The extent and basal elevations of the Rogers, Landsburg, and Frazier Seam Mines Structural geologic data needed to define and evaluate potential contaminant flow paths include: 1) Define (map) the positions, orientations, and (where applicable) offsets of regional structural features, including faults and joint systems 2) Map the positions of known structural features within the Rogers Seam, evaluate the offsets of such features, and compare these features with those defined in the Landsburg and Frazier Seams 3) Evaluate which structural features may act as flow conduits and which may act as barriers to flow 4) Identify locations where hypotheses regarding the effects of structures on groundwater flow may be tested Additional groundwater level data needed to define potential contaminant flow paths include: 1) The water table within the Rogers Seam subsidence trench 2) Groundwater levels within bedrock fractures (faults, etc.) adjacent to the Rogers Seam Additional geochemical data needed to define potential contaminant flow paths include: 1) Definition of an appropriate list of analytes, analysis methods, and detection limits 2) Geochemical samples of discharge from springs and portals 3) Geochemical samples from all water supply wells in the Study Area, collected to best preserve groundwater chemistry

Table 2, continued
Summary of Characterization Requirements and Current Status for Identification of Contaminant Flow Paths

Requirement	Current Status
Summary of Critical Data Gaps, continued	Data evaluations needed to define and evaluate potential contaminant flow paths include: 1) Definition of the hydraulic boundaries of the area potentially affected by contaminants discharged from the Rogers Seam 2) Evaluation of structural geologic data, including the potential influence of geologic structures (including fractures such as faults joints) on groundwater flow 3) Evaluation of local, intermediate, and regional flow systems, including the relationships between surface water and groundwater within the Study Area 4) Evaluation of water levels screened in different soil or rock types considering variations in soil and rock transmissivity, the influence of structural features, and three-dimensional flow (specifically, regional gradients, recharge and discharge areas, and local horizontal and vertical gradients) 5) Definition of surface water and groundwater hydrogeochemical facies 6) Evaluation of flow paths, including potential contaminant flow paths, from all portions of the mined-out Rogers Seam, including the unmined ends, the sidewalls, the portals, conduits such as the shafts from the portals to lower portions of the mine, and any springs potentially receiving flow from the mine 7) Evaluation of portal discharge flow paths downstream from the portals, including paths through which surface water flow from portals to either groundwater or surface water 8) Evaluation of mass balance for the mined-out portion of the Rogers Seam for common conditions, including high-water levels (when the mine is being actively recharged by precipitation and water levels in the mine exceed water levels in the regional aquifer), and low-water levels (when water levels in the mine are consistent with the regional aquifer).

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June 21, 2006

Mr. Jerome Cruz
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RE: Landsburg Mine Draft Cleanup Action Plan
Ravensdale, Washington

Dear Mr. Cruz,

Thank you for the opportunity to comment on the Draft Cleanup Action Plan (Draft CAP) for the Landsburg Mine near Ravensdale, Washington. The City of Kent is hopeful that these comments will be incorporated into a revised draft clean-up action plan as additional data has been collected since the Draft CAP was developed in 2002.

The purpose of this letter is to identify deficiencies in the Draft CAP and propose document edits, performance monitoring requirements and specific activities to ensure protection of groundwater and surface water resources including water supply and critical habitat to salmonids in Rock Creek and the Cedar River.

Though the City of Kent has additional concerns regarding the Draft CAP, the City feels at a minimum the following should be required to ensure protection of the groundwater and surface water resources:

1) A second deep well should be installed just south of Pond Area 2 in the deepest part of the mine. If contamination is discovered, it will help characterize the waste disposed of in the mine.
2) The entire subsidence trench should have a physical cap installed, rather than a limited cap on the northern portion of the mine. The cap should be impervious to prevent water from entering the mine, and precipitation which falls in the Rock Creek Basin should remain in the basin. A limited cap will still allow water to enter the mine, while a full cap will provide a level of assurance that contamination is less likely to migrate out of the mine.
3) The Potentially Liable Parties (PLP) Group should be required to pump out the mine, treat the water appropriately and discharge the water to the

sewer. Assuming a cap is installed over the entire subsidence trench, the mine will eventually be dewatered, reducing the potential of the contamination from migrating.

4) Monitoring frequency as proposed in the Draft CAP is grossly inadequate given the close proximity of a major potable water source for a large municipal water purveyor and several residences in the area.
5) The time of travel from the southern portal is a significant issue. If contamination is discovered in a shallow well at the southern portion of the mine, the contamination could reach the City of Kent's Clark Springs facility prior to detection. The Responsiveness Summary for the Agreed Order Amendment regarding the Infrastructure for a Contingent Groundwater Treatment System stated that 2-3 months would be required to obtain and install a treatment system. With the monitoring frequencies proposed in the Draft CAP, contamination could easily reach Clark Springs prior to detection at the southern portal, even prior to the installation of treatment facilities or infrastructure to capture water seeping out of the southern portal into the outwash aquifer.

Background

The City of Kent has, since the early 1990s, reviewed and commented on activities related to the investigation and remediation of the Landsburg Mine Site. The site is within the 1-year zone of contribution to Clark Springs, which provides the primary drinking water supply for the City of Kent. Numerous other citizens rely upon the regional (bedrock) aquifer and groundwater in unconsolidated soils overlying bedrock for their primary drinking water supply. The City of Kent and its consultant team have repeatedly raised many concerns to Ecology and the Potentially Liable Parties (PLPs) regarding data gaps, the inadequacies of site characterization, incompatibilities between the proposed conceptual hydrogeologic model and actual data, the potential that alternate conceptual models better accommodate actual site data, and related issues.

Central to all of the concerns raised by the City of Kent was the PLP's proposal to deviate from standard site characterization methods and attempt site characterization using a "black box" approach. Under the Model Toxics Control Act (MTCA; Chapter 173-340 of the Washington Administrative Code), the fundamental purpose of the Remedial Investigation (RI) is to "collect data necessary to adequately characterize the site for the purpose of developing and evaluating cleanup action alternatives" (Chapter 173-340-350 WAC). The MTCA requires that RI field investigations provide:

- A description of and sufficient sampling to define the location, quantity, areal and vertical extent, concentration within and sources of release.
- The areal and vertical distribution and concentrations of hazardous substances in the soil.
- Properties of surface and subsurface soils that are likely to influence the type and rate of hazardous substance migration, or that are likely to affect the ability to implement alternative cleanup actions.
- The areal and vertical distribution and concentrations of hazardous substances in the groundwater.

A typical field investigation for a MTCA-regulated site evaluates the contaminant source area (often a release area) to determine the nature of the impacts, then extends the investigations to define the areal and vertical distribution and concentrations of impacts. Contaminant flow paths and critical site characteristics that affect contaminant transport rates and flow paths are defined through the course of the investigations.

The Landsburg Mine Site PLPs proposed instead defining and characterizing potential contaminant flow paths emanating from a "black box" (i.e., the Rogers Seam) and characterizing the hydrogeology and geochemistry of selected areas outside of the "box" rather than fulfilling the fundamental MTCA requirements. This unusual approach bears the inherent risk that initial predictions of potential contaminant flow paths will be incorrect, and that repeated efforts to identify contaminant flow paths will therefore be required. Such an approach may increase the duration and costs of the RI to the frustration of all involved.

It is now apparent that the "black box" approach has not permitted sufficient site characterization to fulfill the purpose of the RI. Disposal of about 4,500 drums and 200,000 gallons of oily waste water and sludge into the trench has been documented. Soils collected from the Pond 2 area indicate that chlorinated solvents and other volatile and semi-volatile organic compounds (VOCs and SVOCs) were discharged to the Rogers Seam as liquids and that some contaminants remain as residual dense non-aqueous phase liquid (UES, 2004b). Attempts to define the nature and extent of contamination, and contaminant flow paths, by evaluating the periphery of the "box" have to date been entirely unsuccessful:

- Descriptions of the areal and vertical distribution and concentrations of hazardous substances in soil presented in the Draft CAP rely entirely on data collected before the RI; the pre-RI soil sampling data are themselves limited to a single composite of four discrete soil samples that was collected from the Pond 2 area.
- Data regarding the properties of soils that are likely to influence the type and rate of hazardous substance migration, or that are likely to affect the ability to implement alternative cleanup actions, are limited to a few tests of the hydraulic conductivity of coal and mine workings near the mine portals plus one slug test of a well completed in Puget Group bedrock.
- The areal and vertical distribution and concentrations of hazardous substances in the ground water is entirely unknown, as none of the VOCs or SVOCs discharged to the Rogers Seam have been consistently detected in monitoring wells.

However, significant progress has been made in defining unimpacted flow paths, and in identifying deficiencies in the original conceptual hydrogeologic model.

Ecology has indicated an intent to finalize a CAP for the Landsburg Site that will define cleanup actions and performance monitoring requirements based on existing data. The proposed cleanup actions include capping a portion of the Rogers Seam subsidence trench, diverting surface water flows from the subsidence trench, and installing infrastructure for a contingency groundwater extraction and treatment system. The purpose of the City's review is to identify and propose sufficiently robust compliance and performance monitoring requirements that CAP implementation will either define contaminant flow paths, or demonstrate that contaminants do not discharge from the Rogers Seam, or demonstrate conclusively that contaminants are not present in the Rogers Seam.

Draft CAP Deficiencies

Post 1996 Data Updates

Significant additional investigations have been performed at this site subsequent to Phase I of the RI and preparation of the draft CAP. For example, five additional monitoring wells have been installed after 2001 (LMW-8, LMW-9, LMW-10, LMW-11, and P-2), and several rounds of groundwater sampling have been performed.

There are also relevant changes to the surrounding area. For example, at least 13 additional wells have been installed within a 1-mile radius of the site since submittal of the RI Report. These include (but are not necessarily limited to:

- Four 6-inch diameter wells installed to depth of 40 to 180-feet by Palmer Coking Coal Company during October and November 2001 (Wells AEM 276, AEM 277, AEM 278, and AEM 280).
- At least nine additional potable water supply wells completed in bedrock within an apparent 1-mile radius of the site that have been installed after September 1996.

Additional relevant studies have also been performed. For example, the *Coal Mine Hazard Assessment* (SubTerra, 2005) has been completed, and the City of Kent has submitted reports that provide alternative interpretations of site data (UES, 2004a, UES, 2004b). The Puget Sound LIDAR (Light Detection and Ranging) Consortium provides LIDAR imagery of the Landsburg area. It is likely that additional relevant evaluations of site and area conditions are available.

Data Limitations and Consequent Conceptual Model Limitations

There are several critical data limitations that constrain definition of the conceptual hydrogeologic model for the site. The data permit alternative but contradictory conceptual models of groundwater flow directions and rates. Selection of an appropriate conceptual model is critical, as the conceptual model provides the basis for defining the selected cleanup action(s), and also for defining compliance and performance monitoring requirements. It is inappropriate to base conceptual model selection on conjecture when limited testing would readily demonstrate which alternative most effectively describes actual site conditions.

The Draft CAP presents only a single, sketchy conceptual model of site hydrogeology-alternative models permitted by the data are neither presented or reviewed, and the implications of having potentially selected an incorrect conceptual model are not evaluated. The conceptual model presented in the RI/FS report is inaccurate in that it does not incorporate findings from studies performed subsequent to the RI/FS Report and, more importantly, does not effectively predict the actual findings of subsequent work. For example, hydrogeologic predictions presented in the RI/FS Report and repeated in the Draft CAP (such as prediction of the presence of a groundwater divide within the southern portion of the mine workings) are contradicted by subsequent data. However, hydrogeologic predictions derived from alternative conceptual site models (such as the absence of a measurable gradient within the southern portion of the mine workings) are supported by subsequent data.

Discussions of the hydrogeologic conceptual model (and discussion that subsequently rely upon that model) must therefore be edited to indicate the remaining degree of uncertainty in the model. Critical components of the conceptual hydrogeologic model for this site that remain unresolved include:

1) Rate and Direction of Groundwater Flow
   a) Page 10: The Draft CAP discusses a "groundwater divide" postulated as occurring "within the southern portion of the mine". The section uses this postulate as the basis for then concluding, "The majority of groundwater flow from the mine is therefore to the north." And further that "All groundwater flow beneath the subsidence trenches that were utilized for waste disposal is towards the north". However, groundwater level data collected during February 2006 (apparently within about a one-hour time frame) indicate that water elevations in LMW-3, LMW-5, LMW-9, LMW-11, and P-2 (wells completed at widely varying depths in the mine workings and adjacent bedrock) a total distance of about 1,200 feet) were 645.25 ±0.06 feet (i.e., identical given the limits of precision of collecting water levels in deep wells). Although these data are consistent with the alternative conceptual model proposed by UES (UES, 2004a); they do not support a hypothetical groundwater divide "within the southern portion of the mine" or demonstrate that the majority of groundwater within the Rogers Seam, including all groundwater beneath defined contaminant source areas, flows to the north.
   b) Page 10: The Draft CAP states that "wells installed in Puget Group materials and located laterally away from the mine are hydraulically isolated from the mine workings. These include wells LMW-6 and -7...". An alternate explanation of existing data is that the transmissivities of the mined Frazier Seam (between LMW-6 and the Frazier Seam discharge area) and the mined Landsburg Seam (between LMW-7 and the Landsburg Seam discharge area), significantly exceed the transmissivity of the faulted bedrock between these mines and the Rogers Seam. As a result, water levels in the Frazier and Landsburg Seams equilibrate with the base levels of their respective discharge sumps more rapidly than they equilibrate across the separation between the three mines (UES, 2004a). The existing data support both hypotheses: the Frazier and Landsburg Seam may be either hydraulically isolated from, or hydraulically continuous with, the Rogers Seam. It is not possible to resolve this issue without additional testing. Performing such tests is critical because the Draft CAP proposes that "groundwater monitoring would focus on detecting potential releases... within the Frazier and Landsburg coal seams (i.e., LMW-6 and LMW-7, respectively)." (page 31). However, the Draft CAP

previously concluded that "wells installed in Puget Group materials and located laterally away from the mine are hydraulically isolated from the mine workings. These include wells LMW-6 and -7..." (page 10). It is inconsistent to propose wells thought to be "hydraulically isolated from the mine workings" as detection monitoring points. It is important to determine whether these seams are hydraulically continuous both to define groundwater flow directions and rates, and to determine whether LMW-6 and LMW-7 are appropriate detection monitoring points.

2) Hydraulic Influence of Faults
Numerous faults were defined within the Rogers Seam. Of these, the most extensive appears to be a fault located near LMW-1 that penetrated all four levels of mine workings and had more than 75 feet of right-lateral displacement. Well LMW-1 was intended to penetrate a tunnel connecting the northern and southern portions of the mine workings; however, the tunnel was not encountered and the exact position of the fault in relation to LMW-1 is unclear. This major fault has been postulated as extending through the Landsburg Seam and the Frazier Seam (SubTerra, 2005). The current hydrogeologic model assumes that faulted bedrock has the same hydrogeologic characteristics as unfaulted bedrock:
   a) Page 10: The Draft CAP states that "Faults through the coal seam are *probably* tight and do not act as significant conduits, based on the regional state of stress, mine reports, water level measurements, and geochemical analyses." (emphasis added). The potential for significant flow along this or other faults is of critical concern, as such flow could represent an unmonitored pathway between contaminant source areas and sensitive receptors (Pond 1 is located immediately to the north of, and Pond 2 is located almost directly above, the major fault). However:
      - Reports of observations during mining are largely irrelevant as increased flows would not be expected during mining- the mine was intentionally dewatered to the base of the zone being mined therefore, assuming the coal was relatively permeable, faults would have been dewatered to or below the level being mined before being encountered by miners; and
      - Existing water level measurements and geochemical results are consistent with either a tight or permeable fault hypothesis; and
      - Reliance upon "the regional state of stress" to constrain such a critical issue in an area as structurally complex as the Landsburg Site is inappropriate and unreasonable.

It is also unreasonable to rely upon the hope that the fault is indeed "*probably* tight" when simple testing of the structure could determine whether or not the fault is *actually* "tight". Both the tight and permeable fault hypotheses are equally supported by existing data, and neither can be rejected using existing data. Therefore, it is reasonable to require testing of the hydraulic characteristics of the major fault where it crosses the Rogers Seam. In the absence of test data demonstrating that the fault does not act as a contaminant flow path, it is protective to assume that the fault can and does act as a contaminant flow path.

3) Nature and Extent of Impacts and Definition of Contaminants of Concern (COC)
   a) Page 8: A section entitled "Source Characteristics" is typically expected to present a summary of contaminant source characteristics such as the identities, concentrations, and nature (DNAPL, LNAPL, miscible liquid, VOC, SVOC, metal, gas, etc.), of contaminants detected in various media (drum residue, soil, surface water, and groundwater). However, the "source characteristics" section is incomplete in that it does not review results for surface water, soil, or drum residue samples collected from the source areas, or present a description of the characteristics of specific contaminants in the source areas, or review the location and physical characteristics of known contaminant source areas.
   b) Page 13: The Draft CAP states "The only COCs identified in the RI are the seven (7) compounds detected indicated above for soils inside the trench." However, no groundwater samples have ever been collected from beneath contaminant source areas. Two surface water samples were collected from the trench area. Only one soil sample has ever been collected from a contaminant source area, and it consisted of four discrete samples that were composited before analysis. Given the paucity of data defining contaminants and their concentrations, it is protective to assume that any detected contaminant could occur at concentrations exceeding MTCA Level B standards.
   c) Page 13: Soils test results are described as "Within the trench, chromium, lead, PCBs, bis-(2-ethylhexyl)phthalate, methylene chloride, TCE and TPH exceed Method B standards in an area confined to the northern portion of the trench where waste disposal is thought to have occurred in the past." This discussion does not mention that there results are from only one soil sample, or that the single soil sample is a composite of four discrete soil samples (and may therefore underestimate specific contaminant concentrations). Detected analytes and concentrations are not tabulated (and were not tabulated in the RI/FS Report, either), and neither the Method B calculations nor the assumptions used for the calculations are provided. Therefore, the suggestion that only the seven listed analytes exceed MTCA Method B standards cannot be readily evaluated. Rather than limiting COCs to those detected at elevated concentration in the single composite soil sample, it is protective to adopt all hazardous substances detected in any soil surface water, or drum residue sample as a COC for soils, groundwater, and surface water.
   d) Page 5: Although the drum residue, trench soil sample, surface water sample results are mentioned in passing, the types and concentrations of analytes detected in the drum residue and surface water samples are not presented or reviewed in the Draft CAP. The discussion of surface water impacts on Page 12 is limited to evaluation of data from portal #2 and portal #3; therefore, the Draft CAP does not identify

Contaminants of Concern (COCs) for surface water. Rather than simply omitting surface water COCs, it is protective to adopt all COCs identified for soils and groundwater as COCs for surface water.

4) Selection of a Remedy
    a) It is unclear exactly what remedies and contingencies are being proposed in the Draft CAP. The Draft CAP includes appendices that are not referenced in the text or identified in the Table of Contents. Although monitoring programs are presented in the Body of the Draft CAP and the appendices, details of the monitoring differ slightly. Numerous pages in the appendices contain handwritten notes and deletions.
    b) Existing data limitations and conceptual model uncertainty for this site are sufficient that the only fully protective remedy would be groundwater extraction and treatment at rates sufficient to dewater the Rogers Seam mine workings. However, source removal through groundwater extraction and treatment (dewatering the Rogers Seam to the base of the former mine workings) was not identified as a remedial alternative. (Remedies involving groundwater extraction and treatment were rejected from the Feasibility Study on the grounds that "groundwater already meets remediation goals." [Golder, 1996, page 7-11]. This conclusion was inappropriate and unsupportable given that the investigation specifically avoided evaluating groundwater quality beneath identified waste disposal areas and instead sampled groundwater in areas found to not be contaminant flow paths.) The current site conceptual model, and the design of the contingent groundwater extraction and treatment system, assume that the maximum recharge rate to the mine workings is about 30 to 50 gallons per minute (gpm). This recharge rate is based on the dewatering flow rates reported by former mine workers. Given this remarkably low recharge rate, and given the costs associated within long-term compliance and performance monitoring, it is unclear why source removal through groundwater extraction and treatment was not even evaluated as a potential remedial alternative. In addition, the feasibility of this option is assured- the mine was successfully dewatered for years. This remedial alternative would also be highly effective in that all possible outcomes are protective of human health and the environment. For example, one possible outcome (consistent with the conceptual model of the site proposed in the RI and Draft CAP) is that groundwater extracted from the source area (the deepest Rogers Seam workings north and south of the major fault) would contain low or undetectable contaminant concentrations, demonstrating that whatever contaminants remain present in groundwater pose no risk to potential receptors. Another possible outcome is that contaminants will be detected in groundwater in which case the system will remove the contaminant source (in addition, the extraction system would permit both evaluation of water levels near the source area and the hydraulic role of the nearby fault, which would

allow more effective identification of potential contaminant flow paths from the source area to sensitive receptors).

c) If a primary goal of capping is to minimize recharge to the Rogers Seam workings, then the cap should be extended to the limits of the subsidence trench. No rationale for selecting the proposed limits of capping were provided.

d) Implementation of the proposed capping remedy will require characterization and monitoring of groundwater quality beneath known contaminant source areas to evaluate performance of the remedy by demonstrating that "residual substance concentrations no longer exceed cleanup or remediation levels under MTCA" and to determine whether the requirement for groundwater extraction and treatment should be triggered. However, implementation of groundwater monitoring beneath known source areas is not proposed.

e) A Contingency Groundwater Extraction and Treatment Plan is appended, but not referenced in the Draft CAP or mentioned in the discussion of the proposed remedy. Implementation of groundwater extraction and treatment would require additional performance monitoring. At a minimum, such monitoring would require measurement of groundwater levels within:

   - the Rogers Seam north and south of the major fault
   - the major fault east and west of the Rogers Seam, if the fault is permeable
   - bedrock adjacent to the Rogers Seam

   However, no performance monitoring is proposed in the appended plan.

f) The criteria for implementing the contingency groundwater extraction and treatment are unclear. The Draft CAP should be revised to present the proposal for contingency groundwater treatment in the body of the CAP, and clarify that the criteria for triggering the contingency will be exceedance of an action level in groundwater beneath a known contaminant source area. It would be inappropriate to limit definition of action level exceedances to locations that thus far do not appear to be contaminant flow paths.

5) Definition of Monitoring Requirements

The proposed monitoring requirements are based on the inadequate conceptual model presented in the RI/FS Report and recapitulated in the Draft CAP.

a) It is difficult to determine exactly what monitoring is being proposed in the Draft CAP. Monitoring proposed in the Draft CAP is unclear and, at times, incoherent (for example, on Page 31 the discussion of short-term monitoring includes the assertion that "Since the selected remedy involves containment, attainment of cleanup standards is not applicable to the selected remedy since it involves containment."). Short term monitoring should be discussed in case of the selection of a