



STATE OF WASHINGTON  
DEPARTMENT OF ECOLOGY

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December 30, 2004

Dr. Douglas Morell  
Golder Associates Inc.  
18300 NE Union Hill Road Suite 200  
Redmond, WA 98052-3333

Dear Dr. Morell:

Re: The Department of Ecology Decision on Further Investigations at the Landsburg Mine site, Ravensdale

After thorough evaluation of technical issues raised on the Landsburg Mine site cleanup, the Department of Ecology (Ecology) is presenting its decision for work needed to progress further with the cleanup process at this site.

Ecology directs the installation of one and possibly more deep wells in the lowest level of the former mine. The decision for an additional deep well may be based on a phased approach with the results of one well, including water quality testing, helping to determine the need for an additional well. The purpose for these wells is to determine the nature of water chemistry at the deep levels in the mine and characterize residual mine water contamination - if it exists - within the mine workings following disposal of hazardous wastes in the subsidence trench in the late sixties to late seventies. These wells are designed to more fully assess the level of risk posed by the former mine, and to address continuing concerns by various stakeholders on the nature of any potential threat to groundwater resources in this area that may relate to the materials disposed in the trench or in the mine workings.

Ecology believes drilling these deep wells is the major step to be taken in addressing lingering technical concerns. If sampling shows the water is not contaminated, it should remove other concerns relating to potential deep seated contamination and its relevant deep contamination pathway from the former mine. If sampling shows water is contaminated, then the types and concentrations of contaminants can be used to assess what further investigations may be warranted or how the remedial and compliance monitoring design can proceed.



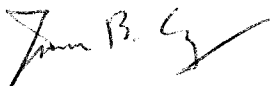
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Please note that in a meeting with City of Kent, Mayor Jim White, last November 10, 2004, his representatives spoke of a commitment by the City to pay for deep wells at this site. Although Ecology had not made any decision at the time on what additional work was to be recommended for this site, it is suggested that we explore this commitment and further map out a plan of action for cleanup at this site following Ecology's decision. We will be scheduling a meeting between the PLP Group and City of Kent representatives to have technical discussion and planning for the design and placement of these deep wells. Based upon our meeting with you and other representatives of the PLP Group last December 10, 2004, we understand that this technical planning session will be implemented to work out the design details of the wells.

Thank you for your constructive contributions to this cleanup. Ecology will work with you in implementing the appropriate regulatory and legal mechanisms for the suggested task. We are confident that after the above work is carried out, we will arrive at a cleanup plan that can be implemented smoothly. Attached is a detailed narrative with recommendations and justifications for these wells.

Please don't hesitate to contact me if you have any questions or comments.

Sincerely,



Jerome B. Cruz, Ph.D., L.G., L.H.G.  
Toxics Cleanup Program

JC:ll  
Attachments

cc: William Kombol, Palmer Coking Coal Co.  
Barbara Smith, Harris & Smith  
William S. Wolinski, City of Kent Public Works  
Don E. Wickstrom, Director of Public Works, City of Kent  
Elliot Furst, Assistant Attorney General, Ecology Division  
Ching-Pi Wang, WA State Department of Ecology  
Richard Bonewits, Greater Maple Valley Council  
Nathan Brown, Cedar River Council

## **Attachment A:**

### **Summary and Recommendations on Issues of Additional Investigation at the Landsburg Mine site in Ravensdale**

Please find below our narrative summary and recommendations on recent technical concerns by various stakeholders on the Model Toxics Control Act (MTCA) guided cleanup of the Landsburg Mine site at Ravensdale. As you know, the Department of Ecology (Ecology) held an internal meeting with technical review staff to discuss outstanding issues with regard to the conceptual site model and monitoring design at this site.

Prior to Ecology's internal meeting, the City of Kent provided technical comments on the Landsburg Mine cleanup in a letter dated May 27, 2004. The Landsburg PLP Group provided an item-by-item response to the points raised by the City in a communication dated July 6, 2004. In response to these two letters, Ecology organized a meeting on September 29, 2004 with the City of Kent Public Works, the Landsburg Mine PLP Group, and other stakeholders to address issues the City raised in their letter and in previous discussions. Only the technical issues that Ecology believed to be of merit were the topics of the September 29 meeting.

The viewpoints expressed below constitutes an Ecology consensus decision only on issues that merit further consideration after the numerous discussions and correspondences we have had with the City of Kent, stakeholder groups and the PLP Group. This also constitutes Ecology's response to a recent letter to Mr. Ching-Pi Wang from Mr. Don Wickstrom of the City of Kent Public Works dated November 8, 2004. The recommendations in that letter are duly noted and Ecology will proceed with the technically relevant issues of characterization and cleanup that incorporate the appropriate administrative and regulatory sequence or steps and only to technical discussions that add value to the conceptual design needed for compliance monitoring and site remedy.

#### **Introduction**

The Landsburg Mine site is a former underground coal mine located at Ravensdale, Washington. Mining at the Landsburg Mine was done on three coal seams: the Landsburg Seam, the Rogers Seam, and the Frasier Seam. These seams are part of the geologic formation called the Puget Group, a sequence of Tertiary age sandstone, siltstone, shale, and coal.

The Rogers Coal seam is a steeply dipping layer of coal that runs through the center of the site along a northeast-southwest line between the Cedar River to the north and Rock Creek to the south. Due to the coal mining that occurred at this seam, a long subsidence trench formed above the areas where coal was extracted. Topographically, the mine workings and overlying trench are in a bedrock knob or hill that is mantled by glacial deposits at its lower elevations. This trench is 20 to 60 feet deep, 60 to 100 feet wide, and roughly 3/4s of a mile long. It is underlain by up to 800 feet of caved mine workings. During the late 1960s and late 1970s, the northern part of the trench was used as a disposal site for a variety of industrial and solid wastes. Coal mining at Rogers seam ended in 1975.

Based on previous investigations of this site, various contaminants of concern have been identified within the northern part of this subsidence trench. Based on an emergency response action in the subsidence trench in 1991, these include: chromium, lead, PCBs (polychlorinated biphenyls), bis(2-ethylhexyl)phthalate, methylene chloride, TCE (trichloroethene), and total petroleum hydrocarbons. Due to the isolated physical location of these wastes, the primary potential threat is to groundwater quality at this site caused by a possible release or leaching of the trench wastes into the mine water at the interior of the former mine. A potential threat to surface water exists since this mine water discharges into the shallow aquifers composed of glacial and alluvial deposits that mantle the area and consequently enters Cedar River and Rock Creek as a small part of water contributions into the watersheds of these respective surface water bodies.

Although no ground water contamination attributed to Landsburg Mine has been detected so far, the potential remains for a release to occur from the trench wastes. Various stakeholders such as the City of Kent Public Works remain vested in the MTCA cleanup of this site due to the presence of the Clark Springs Water Supply which taps into the Rock Creek watershed south of this site. Furthermore, the pristine condition of Cedar River to the north remains as an ongoing concern for residents and local organizations in the area.

### **Chronology of Activities at Landsburg Mine**

Attachment B provides a chronology of events at this site. It is important to be aware that following the dumping in the early 70s, preliminary study of this site was done in 1990 by the Department of Health in its sampling of water quality in private wells near Landsburg mine. In 1991, an Emergency Remedial Action (ERA) was carried out by the Department of Ecology, whereby 100 (out of an estimated 4,500) metal drums were removed from the trench. Chemical analyses of soil, drum material, and pond sludge at the northern part of the trench provided enough information to determine the range of contaminants at this source.

Landsburg mine was listed under the Model Toxics Control Act in 1991. In 1996, the Report of Investigation/Feasibility was completed and went to public comment under an Agreed Order. Starting in 1999, a Draft Cleanup Action plan was submitted for review by Ecology and is still undergoing revision. Interim quarterly groundwater monitoring was carried out in 2000, and was resumed in 2003 up to the present.

### **Water Quality and Contamination Risk**

An initial, major consideration for cleanup is the lack of detection of contamination in groundwater at the site which could be attributed to the wastes disposed in the Landsburg Mine site trench from 1969 to late 1970s. To date, no groundwater contamination due to waste disposal in the Rogers Seam has been found. Since the reported disposals in the 70s, there has been no detected contamination or significant deterioration of water quality that can be attributed to the site (incorporating background levels). The Clark Springs water supply, located in the Rock Springs watershed south of the site and operated by the City of Kent Public Works, has not had any detected deterioration in their water supply. In fact, the water quality has not suffered as much as the water supply in the watershed, wherein there has been

recent concerns by local residents and community groups about over withdrawal by the City of Kent and the threat to the salmonid habitat at this watershed. The shallow glacial outwash aquifer that mantles the area is the main aquifer source for the area. The majority of groundwater use taps this glacial outwash aquifer. There is also local use of the bedrock aquifer (Puget Group) where the Rogers coal seam is found.

In the 1992 summary report entitled "An Evaluation of Drinking Water Quality in the Vicinity of the Landsburg Mine Ravensdale, Washington" by the Department of Health, drinking wells sampled did not detect any compounds above primary Maximum Contaminant Levels for drinking water. Ten drinking water wells in the vicinity of the mine were sampled for volatile and semi volatile organic compounds, polynuclear aromatic hydrocarbons, organochlorine pesticides and polychlorinated biphenyls, EPA Target Compound List total metals, and cyanide. No organic compounds were detected except for bis(2-ethylhexyl) phthalate ranging from 2 to 21 parts per billion. The phthalates detections were attributed to laboratory or sampling contamination, or from piping materials used in the well.

During the Report of Investigation and Feasibility Study in 1996, sampling at the mine site wells and private wells detected a few organic contaminants at low levels; the detections were not repeated in more than a single round of sampling. In the monitoring wells, one organic compound, 1,2-dibromo-3chloropropane (DBCP) was detected, however, the two detected values (both at 0.025 µg/L) did not exceed the minimum potential regulatory criteria of 0.0312 µg/L and were only detected during the first quarterly sampling period. DBCP was not considered further because it was not detected in three subsequent sampling periods from these or any other monitoring wells. Bis(2-ethylhexyl)phthalate was detected only twice in 49 samples in private wells. Of these detections of bis(2-ethylhexyl)phthalate, a common laboratory contaminant, one occurred slightly above MTCA Method B standards in a private well (6.7 µg/L measured vs. the MTCA Method B level of 6.25 µg/L), but was not detected in either of two subsequent sampling rounds.

Interim ground water monitoring included analyses of groundwater for volatile organic compounds (EPA Method 8260), priority pollutant metals, and petroleum hydrocarbon identification scan. Analyses for Semivolatile Organic Compounds (EPA Method 8270) and pesticides/PCBs (EPA Method 8081) were also carried out for all sampling events (except May and August 2004 based on the interim monitoring plan made by the PLP). The results are as follows:

**May 2000:** Wells sampled were LMW-2, LMW-4, LMW-3, LMW-5, and Rogers Portal #3 seep water (see Figure 1 map). Results showed no significant change from 1996 Report of Investigation. Total dissolved solids, iron and manganese were the only compounds detected in excess of screening levels which are secondary maximum contaminant levels (SCMLs). SCMLs are not health based standards, but are based on aesthetic qualities of water. The high iron and manganese concentrations appear to be typical of coal mining regions.

**October 2003:** Wells sampled were LMW-2, LMW-4, LMW-3, LMW-5, and Rogers Portal #3 seep water. Analytical results showed no significant departures from 1996 RI. No volatile organic compounds, pesticides, PCBs, or petroleum hydrocarbons found. The Portal No. 3 seep sample detected 2-methylnaphthalene at 0.13 parts per billion (ppb) with a reporting level of 0.9 ppb. This did not exceed the federal MCL or MTCA Method A or B Cleanup levels.

**May 2004:** Wells sampled were LMW-2, LMW-4, LMW-3, LMW-5, LMW-6, LMW-7, LMW-8, LMW-9, and LMW-10. Results showed no significant departures from 1996 RI. LMW-9 detected diethyl phthalate at 26 ppb or 0.2 % of the MTCA groundwater cleanup standard set at 12,800 ppb. LMW-10 showed detectable benzene and toluene at 0.39 ppb and 0.68 ppb, respectively. The MTCA Method B cleanup level for benzene is 5 ppb and for toluene, 1000 ppb. This is 7.8% of the MTCA Method B value for benzene, and 0.07% for toluene. The trace benzene and toluene may be due to well drilling effects.

**August 2004:** Wells sampled were LMW-2, LMW-4, LMW-3, LMW-5, LMW-6, LMW-7, LMW-8, LMW-9, and LMW-10. Results showed no significant departures from 1996 RI. LMW-10 had detectable benzene and toluene at 0.29 ppb and 0.44 ppb, respectively. Benzene was therefore measured at 5.8% of the Method A Cleanup standard, while toluene was 0.04% of the standard.

### **Present Status and Progress of Regulatory Cleanup**

The Report of Investigation, Phase I Feasibility Study and public comment period was completed in 1996 under the terms of an Agreed Order pursuant to Ecology's authority under the Model Toxics Control Act, RCW 70.105D.050(1). Under the terms of the Agreed Order entered in 1993, the RI/FS was to be conducted under a phased approach wherein the scope of work for the first phase was outlined in a work plan, approved by Ecology, and incorporated by reference into the work plan.

The scope of work for a Phase II RI/FS was to be negotiated if required. However, additional RI phases to adequately characterize site conditions were no longer considered warranted by the PLP Group and approval was received from Ecology to finalize the FS without a Phase II RI. An amendment to the Agreed Order was issued in 1997 that stated that based on information from the Phase I RI, a Phase II RI was not necessary and that a detailed remedial evaluation in the form of a Phase II FS can be completed as an additional task of the Phase I RI/FS.

A public comment period on the RI/FS was held from March 13, 1996 to April 12, 1996. An amendment to the Agreed Order which stated that no Phase II RI/FS was necessary was also commented upon at that time. After the end of the public comment period, Ecology issued a responsiveness summary. The responsiveness summary is available at Ecology's Northwest Regional Office Central Files under Landsburg/SIT7.14.

After 1996, interim groundwater monitoring was conducted in 2000, 2003, and 2004. This monitoring is being done voluntarily by the PLP Group. The PLP Group also conducted a voluntary hydrogeologic investigation at the Rogers No. 3 portal (south portal). This

investigation was carried out last March to April 2004 in order to determine whether southward groundwater flow and discharge occurs towards the Rogers No. 3 portal of the former mine. The investigation included the installation of a deep north well (LMW-10), a south hill slope well (LMW-9), and shallow south portal wells (LMW-8 and P-2). The results of the investigation have shown that groundwater within the mine flows both to the north and the south towards Rogers No. 2 and No. 3, respectively. There are upward hydraulic gradients beneath both portals.

The first draft of the cleanup action plan was first circulated to Ecology in 1999 and is still under review. The Draft Cleanup Action, a Compliance Monitoring Plan, Operation and Maintenance Plan, and Contingency Groundwater Extraction and Treatment Plan are included as exhibits in a Draft Consent Decree document first reviewed by Ecology in November 2002. Ecology has not proceeded with the completion of the DCAP in order to evaluate technical concerns that the City of Kent has recently raised with regard to the subsurface hydrogeologic characterization of the site and the preferred remedial alternative.

### **Historical Narrative of Technical Concerns on Site Characterization and Feasibility Study**

There have been numerous comments by the City of Kent on Landsburg Mine, both technical and management related. At the end of the 1996 RI/FS, a public comment period was held that addressed the public's questions and concerns on the investigation and the proposed preferred remedial alternative, which consisted of capping portions of the trench and continuing groundwater monitoring.

From past correspondences, the City of Kent had highlighted its technical concerns over the extent of subsurface hydrogeologic knowledge at this site following the 1996 RI/FS until 2000. At that time, the City had acknowledged that many of the issues they raised may be addressed in the final remedy selection and cleanup action plan process (see letter dated 4/25/1996). There was agreement in principle with the "black box" approach with qualifications based on further requests for safeguards such as contingency plans and suitable compliance monitoring design. One of the major conclusions in the 1996 RI/FS was the impracticability of working further within the subsidence trench for further site characterization or excavation for remedial purposes. Based on the administrative and public comment records, there appears to have been a general acceptance of the inherent difficulty in this sort of activity, including acceptance by the City of Kent.

In 2003, renewed activity occurred at this site when the PLP Group, through Golder Associates, requested review of a work plan for the hydrogeologic investigation at Portal #3 (the South Portal). The City of Kent was promptly contacted and further discussions and critique ensued.

The City's comments have dealt with site characterization, hydrogeology and hydrology; they recently culminated in a call for a supplemental RI (see letters to Ecology dated 7/22/93, 1/15/97, 5/27/04, and 9/29/04). These comments continued a previous trend that did the following: called for further invasive investigation of the wastes in the trench, commented on

the various hypothesis proposed in the 1996 RI/FS over what may have happened to the wastes disposed of in the trench and observed lack of widespread contamination, called for detailed study of water balance, and called for a contingency plan.

After evaluation of these issues, Ecology has determined that the more invasive characterization of the disposed wastes in the trench is unwarranted. This is because the primary mode of potential chemical migration from the mine consists of the groundwater pathway and the remedy at the site will conservatively assume that waste remains in the trench and/or mine workings. Furthermore, there are health and safety dangers from unstable ground and sidewalls in the trench, and the possibility of triggering release of contaminants during such an activity. Adequate characterization was completed in the 1991 Emergency Response Action to determine contaminants of concern within the trench.

On September 29, 2004, Ecology held a meeting with the City of Kent, PLP Group consultants and stakeholder representatives to discuss the points raised by the City, specifically in the letter by City of Kent consultant Anne Udaloy (Udaloy Environmental Services or UES) dated May 27, 2004. The PLP Group provided a response to this letter on July 6, 2004, noting that the content of the letter appears similar to comments received from the City back in 1996 on the draft RI/FS and addressed in the Responsiveness Summary. After evaluating the merit of the many technical issues raised in these past correspondences, Ecology believes five of the issues warranted additional consideration:

- 1) Whether to characterize and/or monitor possible contaminant release from deep groundwater paths;
- 2) Whether to characterize and/or monitor transverse bedding flow and contaminant transport;
- 3) Whether or not laboratory measurements of contaminant adsorption properties of Landsburg Mine coal are warranted;
- 4) What should be the frequency of groundwater compliance monitoring; and
- 5) What contingency plans are necessary for addressing the potential release of contaminated water from the former mine.

During the Sept. 29 meeting, the City indicated that, upon further thought, the City did not believe laboratory measurements of the sorption properties of the coal were warranted. The City also indicated that discussion of ground water monitoring frequency and contingency plans was premature. The City did request additional work, including fracture trace analysis and fracture flow testing, water balance, and invasive characterization of trench wastes. This presentation included a position paper with the requests for a supplemental RI.

**Attachment C** summarizes the City's requirements and Ecology's preliminary response to these requested activities.

### **Continuing Technical Considerations for Site Characterization and Remediation**

After careful consideration of the technical issues that the City of Kent has raised these past months, we have concluded that they can be narrowed down to concerns that relate to groundwater contamination that may potentially exist at the deepest levels of the mine and



along deep flow paths that primarily occur to the strike of bedding planes at the site as deeper parallel "underflow" beneath the portal areas. It centers mainly on the question of what is the nature of flowing contaminated water or liquids at the deep portions of the mine, if it exists. The primary preferred pathway of groundwater, including potential contaminated groundwater, is along the strike of the Rogers coal seam and out of the former mine portals north and south of the seam (Rogers No. 2 and 3, respectively). The monitoring wells located at the portals are in a position to effectively detect any potential release from the trench wastes, including leachates, due to the permeability contrast between the mine workings and the silty sandstones of the Puget Group bedrock that form the hanging walls and footwalls of the former mine. The abandoned mine workings where coal was extracted is a highly permeable unit with major discharges at Rogers No. 2 and 3. The monitoring network at these portals remains as the most likely early alert monitoring system for the scenario of release of contaminated water deriving from the hazardous wastes disposed in the overlying trench.

However, there is the possibility of contaminated water moving along flowpaths deeper in the mine. This is because the records of disposal and mine closure show a time window of approximately 5 years between the dumping of wastes and the blasting of the mine portals closing off the mine. If any contaminants are present, then the monitoring design objectives, established in 1996, continue to be to detect a breakout of contamination from the former mine.

To date, there have been no impacts to water supplies and to groundwater quality in the area. However, the site lacks data on the potential presence of a deeper contaminated plume that may have migrated at the deeper subsurface starting in the 5 year time window. Deep plume(s) may exist deeper at the vicinity of the north and south end of the subsidence trench, possibly underflow beneath the mine portal areas that discharges to shallower levels. Such an underflow may be subject to attenuation processes such as dilution and solute adsorption.

### **Suggested Actions and Justifications**

Given the uncertainty above and the need to identify potential future risk, Ecology is directing the drilling of one or more deep wells to sample groundwater at the lowest level of the mine workings. The number, screen location and design of these wells will be determined by technical representatives from the PLP Group and the City of Kent Public Works with Ecology concurrence. The well should be of sufficient diameter to install a pump for the purpose of groundwater extraction as a contingency. Upon the proper completion of the deep well, groundwater will be sampled and analyzed with the full suite of contaminants used at this site for the purpose of assessing groundwater quality or degree of contamination of water within the deep mine. The results from the deep well will help determine the need for an additional well.

The recommended approach would be to situate a deep well south of the groundwater divide within the mine, north of the location of the 4<sup>th</sup> level sump. The presence of the interior groundwater divide within the former mine may conceivably provide a hydraulic barrier between groundwater flow toward the north Rogers No. 2 portal and groundwater flow toward the south Rogers No. 3 portal. However, if trench waste or leachate had infiltrated

down and southward, it may be possible that the contaminated zone may exist deep in the mine toward the south portal. Given the distance from the waste areas in the subsidence trench, this is a less likely scenario and its chemical imprint should be detectable if the mine water is well mixed and the contaminant loading was high enough. The fault at the "rock bridge", where LMW-1 is situated, is a right lateral strike slip fault with a displacement of approximately 75 feet. Due to the offset, this fault may be serving to mostly confine the mine workings except where horizontal tunnels connect the offset coal seam/mine workings. It is not known how effective the horizontal tunnels are in establishing hydraulic communication between the mine workings north of the rock bridge to the rest of the former mine's southern portion.

A phased, conditional approach to the proposed drilling may be adopted. For example, if the deep well beneath the more southerly portion of the mine shows contamination attributable to the trench wastes, an additional well at the northern half could be drilled to determine the characteristics and extent of potential deep mine water contaminant migration.

If the groundwater samples from the southern deep well drilling yield no contamination, this is sufficient justification to proceed with the capping alternative as originally planned in order to physically contain the contaminant source and prevent further leaching of trench wastes. Further speculations over contaminants migrating towards the south portal from deep sources should no longer be of concern, although compliance monitoring and contingency monitoring at the south portal wells should continue especially in light of a possible release of contaminants from trench wastes due to a catastrophic event such as an earthquake. Detected contaminants must be of the type and magnitude indicative of the hazardous substances disposed of in the trench, and not area background.

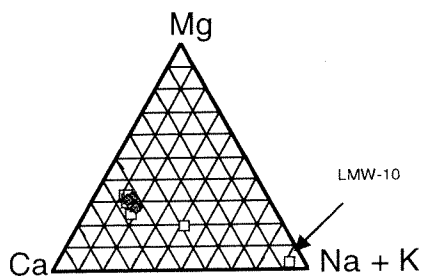
If deep seated contamination is found, the Department of Ecology and the PLP Group will evaluate its risks and the extent of protective measures to be taken if warranted. Ecology and the PLP Group will further consider what additional activities may be necessary or if the remedy, compliance monitoring, and contingency plans in the Draft Cleanup Action Plan will address technical and regulatory concerns.

The installation of the well or wells will provide a better understanding of risk from a potential contaminant source or reservoir, as applied to both human health and environment. Justifications for the deep well or wells include the following:

- 1) Determination of water quality deep within the south end in the mine interior will define the level of risk that may exist from the site to the City of Kent water supply. The drums that contained hazardous wastes themselves are physically isolated within the trench, thus, there are no immediate risks from direct contact and the main risk is from potentially contaminated mine water. Conversely, "clean" mine water will alleviate public and City of Kent concerns about the contamination potential of the mine. Water samples taken within the deep end of the mine will evaluate the potential deep groundwater pathway to the south from the mine, in contrast to the portal wells

which may be mixed with younger water from the glacial outwash aquifer. This will determine what contamination is actually present at the south end of the mine, if any, and will either confirm or weaken the case for how representative the Portal #3 water samples are for characterizing water quality of discharges from the mine.

- 2) The well or wells may serve as early warning or sentinel well(s) in the possible event of a release from the source area in the trench. For example, in the event of an earthquake, the buried drums may potentially shift and rupture. Therefore, the deep well(s) may be monitored for contaminants to track contaminant transport.
- 3) The well(s) may be used for remediation or to extract mine water, thus lowering the water table and providing inward hydraulic gradients that will prevent breakout of potentially contaminated mine water.
- 4) There is evidence that deeper groundwater at the site is geochemically different from shallow groundwater based on major cation compositions. For example, the deep northern well LMW-10 that is screened at an elevation of 338.5 feet above sea level is richer in the alkalis Na + K and lower in Ca and Mg compared to other waters:



Data for the above graph was taken from the May 2004 groundwater analytical results. LMW-10 was a recently installed deep well. At present, we cannot preclude the high Na and K to be artifacts of the well installation process (from bentonite seal or from material in Portland cement used to fill the borehole beneath the well screen). Coupled with an upward hydraulic gradient at the discharge (portal) areas, this points to a complex flow system with upward groundwater flow from deeper levels. If there is contaminated water at these deep levels, based on the results of LMW-10, it may be expected that deeper waters may reach the shallow levels that affect groundwater use and surface water quality. Therefore, there is a need to identify the water quality emanating from the deeper region of the former mine.

Section 3.6.3.4 in the 1996 RI/FS for Landsburg Mine distinguished high Na-HCO<sub>3</sub> groundwater from Ca dominant groundwater. The Ca dominant groundwater represented younger groundwater derived from recent recharge and short flowpaths. Private wells installed in the glacial outwash aquifer, the mine portal samples, and site wells (LMW-1 through LMW-6) exhibited this behavior. The second group of Na

dominant type groundwater was associated with relatively deep wells “in Puget Group materials located away from the mine.” This was characterized as older groundwater with longer flowpaths that experienced cation exchange of Ca and Mg with Na in siltstones, shales and/or coal beds in the Puget group.

If the groundwater sampled at deep well LMW-10 taps the flow path of older, Na dominant water that may exist at deeper levels in the mine, this implies that there is still little known about the nature of groundwater quality that emanates from the deeper portions of the mine. Although this deeper, older type of groundwater was not identified in the Landsburg mine in the 1996 RI/FS, the recent results from LMW-10 is the first indication that such older water exists. The deep well(s) will intercept these potential deep flow paths and monitor contaminants deriving from a deeper source in the former mine.



**Attachment B:  
Chronology of Major Events at Landsburg Mine**

- 1959-1975 Coal mining
- 1969 – late 1970s Industrial waste, disposed in subsidence trench, land clearing debris in 80s;
- 1988 Voters approve Model Toxics Control Act;
- 1990-1991 Private wells and south portal water studied. Department of Health;
- 1991 Site Hazard Assessment and listing under Model Toxics Control Act;
- 1991 Expedited Response Action (drum removal);
- 1993 Agreed Order for Remedial Investigation /Feasibility Study (RI/FS) started;
- 1994-1996 RI/FS conducted, went to public comment and was finalized. Sampling of private wells and monitoring wells;
- 1996 Amendment to the Agreed Order;
- 1999, 2002 Draft Cleanup Action Plan and subsequent revisions based submitted to Ecology;
- 2000 Interim groundwater monitoring (first round);
- 2001 Amendment to the Model Toxics Control Act;
- 2003 Interim groundwater monitoring (second round);
- 2003-2004 Workplan developed for South Portal hydrogeologic investigation by City of Kent, Landsburg Steering Committee, and Ecology; and
- 2004 Hydrogeologic investigation (March/April) of Rogers No. 3 Portal; continued technical discussion on Landsburg Mine conceptual site model and remedy with City of Kent, Landsburg Steering Committee, and other interested stakeholders.

## Attachment C:

### Summary of City of Kent requirements on Landsburg Mine Investigation with Ecology response (based on September 29, 2004 position paper)

- 1) "Thorough" evaluation of influence of fractures and faults on groundwater flow within the regional aquifer using "standard investigations methods (i.e., fracture trace analysis, borehole geophysics, and installation and testing of wells screened to intercept significant fractures)."

#### Response:

This focus on fractures is a shift in emphasis from the focus of technical comments made in comments last May 27, 2004.

The 1996 RI/FS addressed fractures and fracture flow based on mining records and mine maps. A major fault is recognized in the RI at the location of LMW-1A and LMW-1; a slug test was conducted in the sandstone in this fault zone, which forms the rock bridge in the subsidence trench area. Miners did not note any flow from fractures during mining activities and the RI concluded that faults and fractures are tight. Based on observation of geology at the site, there may be no added value to a "fracture trace analysis" because the area and aerial photos of the site have already been mapped and analyzed. Private wells in bedrock in the area which intercept fracture zones are very low yield wells and have not shown any deteriorated water quality traceable to Landsburg mine waste contamination. LMW-6 is located in the Frasier seam west of the Rogers seam. This well appears to be located on the west extension of the fault zone at the LMW-1 rock bridge. No contamination has been detected at the LMW-6 well.

Recently obtained LIDAR images of Landsburg mine has not revealed any extensive photo-lineaments indicative of a major fracture network. However, the offset associated with fault at the rock bridge at LMW-1, and a fault escarpment south of Rogers #3 (south portal) is apparent.

If results from the deep wells show deep groundwater contamination of sufficient magnitude to pose a threat to human health or the environment should a breakout from the former mine occur, then preferential pathways for contaminated water should be reconsidered. At present, there is no indication of major influence and no near-term practicality given the lithology and other observations at the site. In fact, based on the observed tightness of these structures, they may provide impermeable barriers to further groundwater flow.

- 2) Installing groundwater wells in areas "likely to be affected by contaminant flow at depth"

**Response:**

There is already a monitoring network installed at the site that will detect groundwater and contaminant flow at the most permeable, shorter pathways. Ecology agrees that potential contamination at depth is an issue of merit and therefore the deep well(s) will address contaminant flow at depth.

- 3) "Instrumenting the portals such that the water level and discharge rate of each portal can be accurately measured."

**Response:**

This request to further use the portals and a separate request to sample the south portal monthly is inconsistent with the City's previous position that the present monitoring network at the portals is not located in a position suitable to detect potential contamination discharge from the former mine. Despite this, there is still no detailed justification provided to Ecology for this level of work and sustained monitoring. The immediate objective of the monitoring network is not volumetric quantification of water discharges from the mine, nor has there been provided to Ecology adequate justification for a detailed water balance. The objective is the detection of groundwater contamination that issues from the former mine if it occurs. This is more related to water quality and flow direction rather than water quantity.

The issue of detailed water balance is related to the question of whether the former mine portals are the principal discharges of water entering the former mine. In such a water balance, "Water in" is achieved through precipitation into the trench and inflow from the subsurface. This should be balanced by "Water out," which is comprised of outflow that include the north and south mine portal discharges. By inference, if the portal discharges are less than the "Water in" amount, then there may be other discharges that, if contaminated, may pose risks to groundwater resources.

Conceptually, Ecology concurs that other subsurface outflows from the mine may be achieved both in the sidewalls and as underflow beneath the portals and parallel to coal seam strike. Due to apparent permeability contrasts, the magnitudes should be less than portal discharges. However, none has been quantified in any detail. There is no present justification for water balance and evaluation of risks from contaminated mine water until groundwater contamination issuing from the mine has been detected and measured. It should also be noted that the cleanup remedy may obviate the concern for these other potential pathways by natural partial hydraulic containment provided by the remedial action, followed up by compliance monitoring. Review of estimates of inflows and outflows by Golder Associates in previous communications and reports on this subject has not shown any order-of-magnitude discrepancies in water budget that would cause a concern for major groundwater paths being neglected.

- 4) Evaluating response of portal discharge and groundwater levels within the mine workings, unmined coal and bedrock sidewalls to precipitation.



**Response:**

The Baker tank discharge and well hydrograph curves are some of the studies done previously in 1996 that address the extent of hydraulic communication at the site. The City of Kent, on this issue, does not pose any regulatory or technical problem to solve with this request.

- 5) Define a water balance from mine workings “to determine whether all significant flow paths from the mine working have been identified.”

**Response:**

Ecology recognizes the importance of a detailed water balance, but only if there is any detected contamination issuing from the former mine and if there is a subsequent need to quantify the loading from this release. However, it is apparent that the major flow paths have been already been identified especially when considering the permeability contrasts at the site. If deep contamination is detected within the mine, Ecology can consider if further work will be needed to characterize, monitor and evaluate the risk of deep contaminant transport if it exists.

Further explanation on the difficulties in estimating water balance at the site and its limited usefulness may be found in a letter by Golder Associates dated August 18, 2003 in response to the City of Kent comments to the South Portal Hydrogeologic investigation Work Plan.

- 6) “Defining all significant flow paths from the mine workings to sensitive receptors, including flow paths at depth”

**Response:**

See answer to 5) above.

- 7) “Characterizing the area near the southern end of the site adjacent to the South Portal identified by PLP representatives as an area where they could not be certain whether or not dumping occurred. Either define the nature and extent of contamination at that location should be defined, or the area should be demonstrated to be uncontaminated.”

**Response:**

This appears to refer to an area at the site where there is a contention of unreported dumping. If this refers to possible dumping at the southern portion of the subsidence trench, please note that the 1996 RI/FS investigated the whole length of the trench to determine the extent of the disposed wastes. The geophysical survey detected magnetic anomalies mostly at the northern end of the trench where it was also documented that

most dumping occurred. Air monitoring surveys did not detect chemical vapor concentrations indicative of hazardous wastes at the south trench. Past flyovers, and site visits also did not note any such materials (based on review of past communications that apparently touch upon this subject). The RI/FS concluded that the wastes are located at the northern part of the trench.

If this refers to a separate event or discovery, Ecology can investigate this through a separate early discovery and initial investigation process under MTCA.