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14 July 2004

Ms. Sybil Kolon
Michigan Department of Environmental Quality
Remediation and Redevelopment Division
301 East Louis Glick Highway
Jackson, MI 49201

RE: Review of Feasibility Study
Gelman Sciences Site, Ann Arbor, Michigan
Site ID No. 81000018

W.O. No. 20083.054.001

Dear Ms. Kolon:

As described in our Scope of Work dated 11 June 2004, Weston Solutions of Michigan, Inc. (WESTON) has reviewed the *Feasibility Study and Proposed Interim Response Plan for the Unit E Plume* for the Gelman Sciences Site in Ann Arbor, Washtenaw County, Michigan. This document was prepared by Pall Life Science (PLS) and received on 2 June 2004 by the Michigan Department of Environmental Quality (MDEQ). WESTON conducted this work under State of Michigan Level of Effort (LOE) Contract No. 2002.

This letter report summarizes the results of WESTON's general evaluation of the remedial alternatives and Interim Response (IR) options presented in the Feasibility Study (FS) and of the reasonableness of the cost estimates for those activities. WESTON did not conduct a detailed, technical and cost evaluation because of the short timeframe for completion of this project.

In addition, this letter report provides a cost estimate for the MDEQ-proposed remedial alternative for the site. MDEQ proposes to combine alternatives that were detailed separately in the FS to address both the core of the plume of contaminated groundwater and the leading edge of that plume. WESTON based the cost for this combined remedial alternative on the costs in the PLS FS and those generated by WESTON.

SUMMARY OF MAJOR COMMENTS ON THE FS

WESTON provides the following summary of our major comments:

- The FS did not provide sufficient information about the potential future migration of the plume of contaminated groundwater to allow WESTON to concur with the conclusion





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that all the remedial alternatives are equally protective of human health and the environment.

- WESTON concurs with the recommendation of the FS that further investigation and modeling are required to reliably predict the migration of the plume or the success of natural attenuation on the concentrations of 1,4-dioxane that currently exceed the cleanup criteria. WESTON recommends that the proposed additional investigation be a component of all the alternatives. The results of the proposed investigation may change the relative costs of the final alternatives.
- As the Final Response Plan, the FS proposes a combination of remedial approaches. IR actions would be initiated to remove some contaminant mass near the portions of the plume with the highest concentrations of 1,4-dioxane, while PLS would monitor the migration of the plume towards the Huron River. PLS proposes to implement Alternative 6 (Groundwater Pumping with Active Remediation and Treatment Proximate to the Huron River) if the proposed monitoring demonstrated that potential receptors were threatened.
- Alternative 6 includes investigating the fate of the plume and, if necessary, interception, capture, treatment, and disposal at a location to be selected near the Huron River. The FS calls this alternative by different names in different chapters, some of which include IR in the title. However, WESTON was unable to confirm that the costs for the IR were included in the costs for Alternative 6. Therefore, WESTON has numbered the Final Response Plan as Alternative 6a on Table 1, which compares relative costs for the various alternatives.
- WESTON concurs that the IR would be a positive step and would make any long-term solution easier to implement. However, WESTON notes that the IR appears to be designed to reduce the mass of contaminant while producing a manageable volume of water to treat and dispose, rather than achieving the remedial objectives.
- The IR proposes to reinject the treated water back into the Unit E plume near the location of the Maple Road extraction well. The FS does not provide information on the potential effects of such reinjection on the existing plume. This disposal method would require additional investigation and modeling of the effects before WESTON could consider it a viable option.



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- WESTON notes that if further investigation supports the assumptions in Alternative 6, the proposed contingent remedial system near the Huron River would not be necessary. Under that scenario, Alternative 6 would be implemented much like monitored natural attenuation (Alternative 2), but without the institutional controls proposed for that alternative.
- The FS states Alternative 6 is the most expensive option. WESTON notes that this statement is true only if the contingent extraction and treatment system is constructed near the Huron River. That cost would be driven by the extra number of years that the Huron River system might be required to operate, because WESTON presumes that the plume will double in length by the time it reaches the river and will expand laterally by dispersion and diffusion as it migrates. The presumed expansion of the plume will be affected downgradient of the current leading edge by the complex hydrogeology, which cannot be predicted based on the limited information provided in the FS.

WESTON has the following comments about the contingent remedial system discussed in Alternative 6:

- Because of the lack of the additional hydrogeological information that would be generated during implementation of this alternative, the FS does not propose locations for the contingent extraction and treatment system. Therefore, WESTON cannot evaluate the degree to which this alternative would reduce or minimize disruptions, delays, and/or costs versus other alternatives, as stated in the FS.
- Because potential locations for the treatment system/extraction wells are not provided, WESTON cannot evaluate whether the land use near the river would be more compatible with the alternative than land use at locations proposed for other alternatives.
- Because the route of a pipeline to the river is not provided, the uncertainty of construction cannot be compared to the other pipeline routes, except that the route will be significantly shorter.
- WESTON cannot evaluate the reasonableness of the cost assumptions for the contingent extraction and treatment system. The length of the pipeline and the size of a treatment system cannot be estimated because the volume of groundwater that would require treatment is unknown.



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- There is uncertainty on the number of years the Huron River system will operate. It is assumed from the FS that the Huron River system will be installed after 20 years of monitoring and will operate for 30 years.

The FS rejects alternatives that address the leading edge of the plume because they would increase disruption of the community, because they involve long pipelines and associated infrastructure, and because the amount of time to implement them would increase the uncertainty for the locations of extraction wells. WESTON provides the following comments to that rationale:

- WESTON does not agree that technical feasibility problems would prevent attempts to contain the leading edge of the plume, although political or legal problems could delay implementation as described in the FS.
- WESTON did not find documentation in the FS to support the selected paths for the pipelines and believes that alternate, shorter, less disruptive, and more cost-effective routes may be possible.
- WESTON recommends that the timing of the installation of extraction wells follow the completion of infrastructure rather than precede it. In addition, the proposed investigation of the plume and the downgradient hydrogeology could be completed concurrently with the infrastructure project. The results of the proposed investigation could lead to even more efficient placement of extraction wells.

WESTON agrees with the FS that constructing a transmission pipeline back to the Wagner Road facility under interstate highway I-94 would be a significant physical obstacle. This situation provides justification for construction of a treatment unit at Maple Road, described under Alternative 4. In addition, construction of a treatment system at Maple Road would reduce the distance contaminated water would be piped before treatment.

REVIEW OF FEASIBILITY STUDY

For ease of reference, WESTON presents the results of our evaluation in the same order as the chapters of the FS.



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Comments on Executive Summary

WESTON does not concur with the statement in the Executive Summary (ES) that the plume of contaminated groundwater does not present an imminent, current threat to public health and safety, or to the environment, because the City of Ann Arbor (City) relies on both surface water and water supply wells for their water source. Well PW-1 of the City's Montgomery Well Field has been found to contain 1,4-dioxane and the well field has been taken out of service. The ES indicates that all the alternatives that were evaluated are equally protective of the environment and human health. However, WESTON did not find supporting documentation in the FS that indicates that the downgradient hydrogeology is well understood, or that the flow path of the plume can be reliably predicted. Several chapters of the FS propose additional investigations to address these data gaps. Therefore, WESTON has not been provided with sufficient information about the potential future migration of the plume of contaminated groundwater to concur with the conclusion that all alternatives are equally protective.

The ES indicates that alternatives that address the leading edge of the plume are not practical because of the lengthy construction horizons for these alternatives and continued migration of the plume during design and construction of the infrastructure. The ES indicates that the goal of capturing the leading edge of the plume would be compromised because recovery wells would have to be placed far enough downgradient to ensure that capture could be achieved at the time the pipeline infrastructure became available. WESTON did not find documentation in the FS to support the selected routes for the pipelines and believes that alternate, shorter, and more cost-effective routes may be possible. Therefore, construction could proceed more quickly and more easily at less expense than the FS assumed.

The FS also did not provide information about the rate of migration of the plume, or an estimate of how far the plume might travel during construction of the pipelines. Therefore, WESTON could not evaluate potential locations for additional extraction wells. The FS appears to assume that the wells would be installed before the pipelines were completed, which does not seem to be a pragmatic approach. If a treatment system is planned near Maple Road, then a pipeline could be constructed from that system to the river before wells are installed. The proposed monitoring and evaluation of the migration of the plume in the interim period during construction would allow extraction wells to be optimally located to capture the leading edge even more efficiently at the time the pipelines were near completion. Although political or legal problems could delay implementation as described in the FS, WESTON does not agree that technical feasibility problems would prevent attempts to contain the leading edge of the plume.

WESTON concurs that an IR that aggressively removes mass from the plume and addresses the most highly contaminated areas would be a positive step and would make any long-term solution



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easier to implement. WESTON believes that investigating the fate of the plume should be a component of all the alternatives, not just Alternative 2 (Monitored Natural Attenuation) and preferred Alternative 6 (Groundwater Pumping with Active Remediation and Treatment Proximate to the Huron River).

The ES indicates that an adequate IR will result in reduction of the concentrations of 1,4-dioxane sufficient to reduce or eliminate the likelihood of the need to intercept the plume before it reaches the Huron River. As indicated earlier, the FS does not provide documentation to support this assumption. If further investigation, monitoring, and modeling of the groundwater plume support this assumption, then the contingency for extraction of contaminated groundwater near the Huron River proposed in Alternative 6 would not be necessary. In that event, Alternative 6 would not be any more costly than Alternative 2. In effect, Alternative 6 would be implemented like Alternative 2, but without the institutional controls that alternative includes.

Comments on Chapter 1 – Introduction

Section 1.3 (page 5), does not provide documentation to demonstrate that the physical characteristics and geochemical environment of the Unit E aquifer are well understood, particularly at the downgradient, leading edge. Later chapters describe additional investigations that are proposed to address the hydrogeological data gaps. This information should be collected and evaluated to ensure that any remedial alternative is protective of human health and the environment.

The discussion of Potential Receptors (Section 1.4.2, pages 6 and 7) states that the available information on the natural flow path of the aquifer supports the assumption that the plume would not migrate directly towards the City's Montgomery Well Field, but rather would migrate east-northeast towards the Huron River. This conclusion appears to be based on Figure 4E in Appendix A, which is a map that was produced in 2002 during the delineation of the wellhead protection area for this well field. The notes on Figure 4E indicate that the potentiometric surface that is depicted is based on depth to water measurements from 36 wells. Because the map covers an area larger than 5 square miles, the 36-well database does not allow for a high degree of accuracy over the area impacted by the plume.

In addition, the detection of low levels of 1,4-dioxane in the City's well indicates that some component of groundwater flow has been in that direction, whether naturally or induced by prior pumping. Appendix B of the FS, contains a much smaller scale potentiometric surface map. This map is based on groundwater elevation data from site wells in September 2003 and shows a potential for a more southeasterly component of groundwater flow. If additional monitoring events confirm these data, then the City's well field could be considered a potential receptor. A



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more southeasterly flow direction could also allow the plume to impact the three water supply wells operated by the University of Michigan, which the FS indicates are not used for drinking water.

The FS indicates on Page 8 that the Huron River is the likely receiving water body for the plume, and that the plume is unlikely to underflow the river because of the river's size. No documentation is provided to support these assumptions, and WESTON recommends further investigation of the relationship between groundwater flow in Unit E and the Huron River. If underflow occurs at the river, then additional wells on the downgradient side could be considered potential receptors.

The Groundwater Flux Calculations (Section 1.4.4, pages 8 and 9 and presented in Appendix B) indicate that a purge system to capture the plume near Maple Road would need to be designed to extract approximately 500 gallons per minute (gpm), and a system near the leading edge of the plume would be designed for approximately 650 gpm. Due to the time constraints, WESTON did not independently evaluate these calculations and used these flow rates in evaluating the cost of treatment and piping.

Comments on Chapter 2 – Remedial Action Objectives

WESTON concurs with the methodology and evaluation of the Remedial Action Objectives, with the following comments.

The evaluation of the MDEQ Groundwater Surface Water Interface (GSI) criterion (Section 2.1.2, page 11) indicates that if contaminated groundwater ultimately flows to the river, which is currently approximately 8,000 feet from the leading edge of the plume, then the maximum concentration of 1,4-dioxane that has been detected beyond the PLS property (3,788 parts per billion[ppb]) would have to be reduced by approximately 25 percent (%) in order to meet the 2,800 ppb GSI criteria. Higher concentrations of 1,4-dioxane have been detected on the PLS property, and the FS does not provide information to document that these higher concentrations could not migrate away from the source containment system. The constituent of concern is very conservative and undergoes little adsorption and degradation in groundwater. The amount of dilution and dispersion along the flow path, and the flow path itself, are not well understood. Therefore, the potential mechanisms for natural attenuation cannot be predicted at this time. WESTON agrees with the FS that further investigation will be necessary before the applicability of the GSI criterion can be determined.

Section 2.2 (page 13) indicates that the MDEQ has agreed to change the drinking water criterion for 1,4-dioxane from the 77 ppb specified in the Consent Judgment to the 85 ppb currently



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specified in the MDEQ rules. WESTON does not have any information that this change will occur, and assumes that the court-directed criterion will continue to apply. However, due to the time constraints for the FS review, WESTON was not able to re-evaluate the FS using the court-mandated criterion. It is not known if application of the more conservative criterion will substantively change the results of the FS.

Section 2.3 (pages 13 and 14) discusses a waiver to the MDEQ rules and the Consent Judgment that require containment of the downgradient leading edge of the plume in excess of the cleanup criterion. The discussion states: "The FS does not assume that a waiver could or would be granted by MDEQ for the purposes of establishing the remediation goals for the Feasibility Study." However, WESTON notes that the preferred Alternative 6 would in fact allow the leading edge of the plume to migrate to the Huron River, an additional 8,000 feet, and that Chapter 7 provides a request for the waiver. WESTON is not in a position to reconcile these two positions.

Comments on Chapter 3 – Identification and Screening of Remedial Technologies (Process Options)

In general, WESTON concurs with the methodology and the process used to identify and screen remedial technologies, with the following comments and exceptions.

Section 3.3.6 (page 20) indicates that six options for in-situ groundwater treatment were considered, and that five were screened out. On page 21, the FS indicates that the only in-situ treatment option that was retained was injection of hydrogen peroxide, pending the results of further field studies that were to be conducted in February and March of 2004. On page 22, the FS notes that these field studies did not indicate that hydrogen peroxide would effectively destroy 1,4-dioxane in-situ, effectively eliminating this alternative. The FS does not indicate the manner in which these data were provided to MDEQ, or whether the results have been reviewed and approved. WESTON notes that because all six in-situ options have been screened out, the language on pages 20 and 21 should be revised.

The discussion of Alternative 2 (Section 3.5.2, page 24) states: "Outside and more specifically downgradient of this area [the current boundaries of the plume], there are limited hydrogeological data regarding aquifer conditions. Investigations will be required to determine aquifer characteristics...to more reliably predict the migration pathway of the plume." WESTON agrees with this statement and believes that it also applies to all the alternatives.

The discussion of Alternative 2 also states that: "It is not possible to restrict property not owned by PLS." WESTON disagrees with that statement because restricting the use of off-site property



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is routinely done. However, these restrictions do require the consent of individual landowners. Therefore, WESTON concurs with the statement at the top of page 25: "Given the large numbers of landowners from whom restrictive covenants would need to be obtained, it does not appear that this option is practical." Furthermore, WESTON agrees that a city or county ordinance could accomplish the same purpose.

In the discussion of the various options under Alternative 3, Groundwater Pumping and Pipeline to PLS Wagner Road Facility (Section 3.5.3, page 26), WESTON agrees that constructing a transmission pipeline back to the Wagner Road facility under I-94 would be a significant physical obstacle. WESTON notes that despite this evaluation, the FS had designed the discharge pipelines from both the Wagner Road and Maple Road treatment systems to travel under the highway. This issue provides justification for construction of a treatment unit at Maple Road, described under Alternative 4, where I-94 would not be an obstacle, and the evaluation of alternate routes for the discharge of water to the river that would avoid crossing the Interstate or state highway M-14.

This chapter of the FS discusses the obstacles to obtaining access to public and private property to construct pipelines. Given the magnitude of the project, our experience indicates that access to private property should not be necessary. Access to public property for projects that benefit the community would be easier and less time-consuming to obtain.

WESTON understands that community opposition to construction of pipeline infrastructure could delay the project and provide uncertainty in timing. However, WESTON disagrees that the uncertainty would make it difficult to determine where the leading edge of the plume would be when such infrastructure is ready, and could require repositioning of recovery wells. Installing recovery wells in advance of the transmission lines is not practical. As indicated previously, the leading edge of the plume should be monitored and the necessary additional hydrogeological investigation completed while the infrastructure is designed and constructed. This implementation schedule would allow PLS to more accurately locate the leading edge of the plume. When the transmission pipeline is near completion, the final locations of the recovery wells and their associated pipelines could be determined even more accurately. Repositioning the extraction wells should not be an issue.

Therefore, WESTON disagrees with the following statement from Section 3.5.5 on page 26: "the practical feasibility of any of the remedial alternatives that involve construction of lengthy pipelines across property not owned by PLS is uncertain." Rather, WESTON concludes that constructing a pipeline to transmit contaminated groundwater back to the Wagner Road facility is less practical than constructing a similar pipeline along public rights-of-way to a treatment unit near Maple Road, as discussed in Alternative 4.



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Alternative 4 (Section 3.5.4, page 28), discusses the challenges associated with locating one or more chemical oxidation treatment units in congested commercial properties or in Veterans Park. The FS indicates that transportation, handling, storage, and use of the chemical oxidants in these areas may present unacceptable risks to human health and safety. Further, this section indicates that fences would have to be erected and maintained to protect the public from direct contact risk with contaminated media and remedial equipment. WESTON notes that these same concerns would be associated with the IR options that are proposed in Chapter 4 (page 34). These challenges appear manageable for the IR and should be equally manageable for Alternative 4.

Furthermore, Section 6.2.1 (page 56), indicates that operation of the remedial systems will not pose significantly different risks or impacts because automatic and manual control systems will be interlocked with critical function or parameter sensors that will reduce the probability and duration of system upsets to essentially equivalent probabilities among the active alternatives. Section 6.2.2.3 (page 65) indicates that periodic monitoring, inspection, and repair of the treatment building and equipment will control potential adverse impacts. Therefore, WESTON concludes from these statements the PLS' experience with the treatment system operation will minimize risks to human health and safety, regardless of the location of the treatment system.

WESTON agrees with the general discussion of Alternative 6 (Section 3.5.6, pages 30 and 31). This alternative would minimize the community disruption, potential construction delays, and uncertainties with installation of the longer pipelines from either Wagner Road or Maple Road; however, WESTON notes that because the location of this contingent system is not provided, uncertainties also exist about its potential for disruption, delays, and installation. Until the additional investigation that is proposed in this chapter is completed, WESTON does not agree that this alternative would be as protective of any potential receptors as the other alternatives. In WESTON's opinion, the proposed investigation to determine the fate of the Unit E plume and the potential receptors should be conducted regardless of the selected alternative, so that the fate and transport of 1,4-dioxane can be better defined and protection of human health and the environment assured. As noted in the following section of this letter, the results of this investigation of the leading edge should be combined with the results of the investigation in the vicinity of the PLS property, proposed as part of the IR Action, in order to maximize the effectiveness of the overall remedy.

If the results of the investigation substantiate the assumptions in Alternative 6, then extraction and treatment proximate to the Huron River would not be necessary. In that event, Alternative 6 would become essentially the same as the monitored natural attenuation discussed in Alternative 2, but without any institutional controls in place while the plume migrated beneath the properties.



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Comments on Chapter 4 – Identification and Screening of IR Process Options

WESTON agrees with the statement in Section 4.1 (page 32) that groundwater extraction is the only viable IR action and that the proposed locations for the IR wells will help reduce the mass of 1,4-dioxane in the plume of contaminated groundwater. WESTON concurs that the proposed investigation of groundwater quality in the vicinity of the PLS property will help to understand the effectiveness of the proposed IR. In light of the statement in Section 4.1.2 (page 33) that the aquifer thins out and becomes more complex to the east of Maple Road, WESTON recommends that this investigation be conducted in conjunction with the additional investigation proposed for the downgradient leading edge of the plume under Alternative 6, in order to maximize the effectiveness of the overall remedy.

Section 4.1.2 also recommends that the groundwater purged from the Maple Road area be treated at a location near the extraction well. WESTON notes that the FS recommended against this option under Alternative 4 (page 28) because transportation, handling, storage, and use of the chemical oxidants in this area may present unacceptable risks to human health and safety. However, WESTON agrees that groundwater treatment in this area appears feasible for both the IR and the final remedy because the difference between the two options is a matter of size and volume and not the treatment process.

The IR proposes to reinject the treated water back into the Unit E plume. The FS does not provide information on the potential effects of such reinjection on the existing plume. Reinjection at this location has the potential to create new conditions in the aquifer: the reinjection could split the plume, push contaminated groundwater farther downgradient faster, or slow the migration of the more contaminated portions of the plume and extend the duration of the remedial activities. Therefore, this disposal method would require additional investigation and modeling of the effects before WESTON could consider it a viable option.

Section 4.2.1 (page 34) indicates that none of the potential receptors will be threatened by contaminant concentrations above applicable criteria, even if no active remediation is undertaken. This section also indicates that the concentrations of 1,4-dioxane will be well below the GSI when the plume arrives at the Huron River. The FS indicates (page 35) that implementation of the proposed IR actions provide little benefit if the plume migrates along the flow pathway suggested by the water level data collected as part of the wellhead protection program. As noted previously, WESTON finds considerable uncertainty in that predicted flow pathway at the scale of the plume of contaminated groundwater. In the absence of additional information about the hydrogeological complexity of the aquifer downgradient of Maple Road and about the higher concentrations west of Maple Road, WESTON does not concur with these assumptions.



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Section 4.2.3 (page 36) appears to support WESTON's position. It concludes that although the proposed interim measures are not needed to protect human health and the environment, they are cost effective because of the conservatism they would provide against the uncertainties regarding downgradient aquifer conditions. On the other hand, this section also indicates that the interim measures would not be cost effective in combination with other remedial measures that result in capturing the plume. WESTON notes the internal inconsistency of this statement because the final proposed remedy combines the Interim Measures with Alternative 6, which includes the potential to capture the plume proximate to the Huron River. WESTON believes that removing mass from the plume and capturing the leading edge could be equally cost effective because of the reduction in time to reach remedial objectives that could be achieved by this combination. However, the FS did not provide an evaluation of the period of time that would be required to operate the IR system.

In summarizing the IR Actions, Section 4.4 (pages 35 and 36) indicates that these measures will remove more mass in the near term than a potential leading edge alternative, that they are practical, and that they can be implemented much sooner than any leading edge option. While WESTON concurs with this evaluation, it should be noted that the plume will continue to migrate unimpeded while this response action is implemented.

The IR at Maple Road relies on reinjection at locations close to the treatment system, rather than pipelines. The conclusion in this chapter that reinjection of the treated water will not distort the plume near Maple Road is not supported by any information in the FS. In fact, the evaluation of Alternative 3b in Section 5.3.3 (page 43) eliminates reinjection as an alternative because of the potential to distort the plume, dilute the contamination, and increase the project duration. Although the reinjected volumes are substantially larger for Alternative 3b than the interim measures, the same logic should apply in the absence of additional information about the characteristics of the aquifer and the plume.

WESTON notes that the driving logic appears to be that the interim measures will produce a more manageable volume of water for treatment and disposal than a final remedy that captures the leading edge of the plume. Therefore, this alternative is limited to removal of some of the mass of the plume of contaminated groundwater, rather than more comprehensive alternatives that would minimize the continued migration of the plume itself.

In the evaluation of the cost for the IR Action, WESTON notes that only one year of operation and maintenance costs have been included for the additional extraction well at the source area and for extraction and reinjection wells on Maple Road. Assuming that the IR action will be

operated for 20 years or more, WESTON believes that the costs for this alternative are underestimated.

Comments on Chapter 5 - Screening of Remedial Alternatives

In general, WESTON concurs with the criteria, methodology, and the process used to screen the remedial alternatives. We concur with the elimination of several alternatives based on that process and provide the following comments.

The discussion of Alternative 2 (Section 5.3.2, page 40), indicates that this alternative must ensure that no adverse impact occurs as a result of contaminant migration and that enforceable land use restrictions prevent unacceptable risk from exposure. This section concludes that this alternative would be reliable because deed restrictions and enforceable city ordinances would be easily maintained and essentially self-enforcing. Although an evaluation of institutional controls is beyond WESTON's technical scope of work, it should be noted that the previous discussion in Section 3.5.2 (page 25) focused on the impracticability of obtaining property restrictions from such a large number of landowners. Although IR is included for the first time in the title of this Alternative, WESTON did not find the IR included in the description or the costs for this alternative.

The discussion in Section 5.3.3 of Alternatives 3a through e (beginning on page 40), indicates that the transmission line would have to pass under I-94, which is significant physical obstacle, and that constructing the pipeline would be difficult and lengthy process. The discussion on page 42 indicates that construction of a second transmission pipeline to the Huron River would make Alternative 3a the most expensive alternative in this group. The FS provides no information concerning the evaluation of pipeline routes to either the Wagner Road facility or to the Huron River. In WESTON's opinion, consideration of other pipeline routes might provide shorter distances and fewer obstacles and thus, make this alternative more cost effective.

As mentioned previously, the discussion of Alternative 3b (page 43) eliminates reinjection as an alternative because of the potential to distort the plume, dilute the contamination, and increase the project duration. Although the reinjected volumes are substantially larger for Alternative 3b than for the interim measures, WESTON notes the internal inconsistency between the evaluation of this alternative and the evaluation of the IR actions.

The discussion in Section 5.3.4 (page 47) of Alternative 4a, indicates that the discharge pipeline would pass under I-94. The cost of this pipeline makes this alternative the most expensive of those in this group of alternatives. As discussed previously, WESTON did not observe documentation in the FS to support the selected path for the pipeline and believes that alternate,

shorter routes may be possible from Maple Road to the Huron River; therefore, construction could proceed more quickly and be more cost effective than the FS assumed.

Section 5.3.6 (page 51) discusses Alternative 6, Groundwater Pumping with IR and Active Remediation and Treatment Proximate to the Huron River. This title includes the IR for the first time, but WESTON did not find reference to the IR in the description or the cost for this alternative.

Comments on Chapter 6 – Detailed Analysis of Remedial Action Alternatives

Section 6.0 (starting on page 53) summarizes the assessment of the remedial action alternatives. WESTON concurs with the methodology and criteria that were used for this assessment. This section again indicates the assertion that all the remedial alternatives are equally protective of the environment because contaminant levels will be acceptable before reaching potential receptors. As indicated previously, until the results of all the proposed additional investigations are available, WESTON does not have sufficient information to concur with this assumption.

This section indicates that the preferred alternative is Alternative 6, which includes investigating the fate of the plume and, if necessary, interception, capture, treatment, and disposal at a location to be selected near the Huron River. The FS indicates that this alternative is preferred because it would involve less disruption of neighborhoods, minimize use of transmission pipelines and infrastructure, reduce traffic interruptions, and minimize construction-related safety risks to residents. The discussion rejects alternatives that address the leading edge of the plume because they would increase disruption and because extraction wells would have to be placed downgradient of the current leading edge of the plume to ensure capture could still be achieved when the pipeline infrastructure was completed.

As noted previously, WESTON does not concur with this evaluation because the downgradient hydrogeology and migration of the plume are not well understood, because alternate pipeline routes could be evaluated that could be less disruptive for shorter time frames, and because the timing of installation of extraction wells should follow the completion of infrastructure rather than precede it. In addition, the proposed investigation of the plume and the downgradient hydrogeology could be completed concurrently with the infrastructure project. The results of the proposed investigation could lead to even more efficient placement of extraction wells.

This section indicates that Alternative 2, is the least expensive alternative, but does not adequately address political and societal concerns. The FS indicates that based on current dollars, Alternative 6 is the most expensive option. WESTON notes that Alternative 6 is the most expensive option only if the extraction, treatment, and discharge system is constructed near



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the Huron River. That cost would be driven by the extra number of years that the system might have to operate, because the plume would have been allowed to double in length and expand laterally by dispersion and diffusion as it migrated. The expansion of the plume does not account for the potential effects of the complex hydrogeology, which cannot be predicted based on the information provided in the FS. If that system is not constructed, then Alternative 6 is comparable to Alternative 2, but lacks the institutional controls associated with Alternative 2.

Section 6.2.1 (page 55), indicates that Alternative 2 would not, by design, contain the plume at all, and that Alternative 6 would contain the plume as necessary prior to any potential impact on downgradient receptors. Under the assumptions described for Alternative 6, WESTON has previously noted that the net effect of these two alternatives would be the same. The major difference would be that that institutional controls would not be placed on any properties above the plume under Alternative 6.

This section also indicates that by design, the leading edge alternatives would not capture all of the 1,4-dioxane, but only prevent expansion of the areas of contamination above the drinking water criterion. As a result, the FS indicates that over time roughly the same area of Unit E would contain detectable levels of 1,4-dioxane, regardless of the alternative that is selected. Because no one would be consuming the contaminated groundwater, the FS indicates that all the alternatives would be protective of human health and the environment. The FS does not quantify the difference in area that would be impacted between the alternatives because of the significant uncertainty in timeliness to implement the leading edge alternatives. WESTON has previously noted that significant uncertainty exists concerning the downgradient migration of the plume, regardless of the alternative selected, until the results of the proposed investigations are known. Therefore, the assumptions that roughly the same area would be contaminated and the same level of protectiveness achieved are not supported by data at this time. If institutional controls are not provided for the area of the plume, then the remedy does not ensure that no one will consume the contaminated groundwater.

Evaluation of Cost Information

This section provides a written comparison of the costs for the alternatives, while the detailed costs for each alternative are provided in Tables 4 through 14, and Appendix G of the FS provides the costs for the IR Actions (WESTON was not provided with Table 15 listed in the Table of Contents as summarizing the IR costs). WESTON later learned that Table 15 did not exist and the information was provided in Appendix G. The FS does not provide a table that summarizes the costs for all the alternatives so that they can be compared to each other more easily. Such a table is routinely provided as part of feasibility studies.



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To compensate for this deficiency in the FS, WESTON has compiled and summarized the information provided in FS Tables 4 through 14 and Appendix G into one table and has provided it as **Table 1**. **Table 1** allows for relatively efficient comparison of the capital, operations and maintenance, and post closure costs of each alternative.

Table 2 presents WESTON's evaluation of the individual unit cost items on FS Tables 1 through 14 and Appendix G, which make up the total costs of the alternatives. **Table 2** reflects our understanding of how the various alternatives would be implemented and compares the costs provided in the FS to our knowledge of common costs for similar activities, given the time constraints. The table identifies some of the costs in the FS that are overestimated and some that are underestimated. WESTON has also identified omissions from the costs of some alternatives that should have been included in the FS, such as groundwater investigation and modeling and monitoring wells.

A review of costs for Alternatives 2 and 6 and the IR identified omissions. These omissions consist of costs not being added into the total dollar amount or the contingency fee not being applied to all costs in a group. WESTON identifies and corrects for these omissions in **Table 1**.

Comments on Section 6.2.2.1 Alternative 2 – Monitored Natural Attenuation and Institutional Controls

The detailed evaluation of Alternative 2 (page 57) indicates that the components of this alternative include: (1) initial hydrogeological investigations to determine the fate of 1,4-dioxane in Unit E, (2) installation of a monitoring well network, (3) long-term monitoring of the contaminant in Unit E, and (4) implementation of institutional controls. WESTON points out again that the first three components of this alternative should be included in any selected alternative in order to ensure protection of human health and the environment. WESTON notes that the IR is no longer in the title as it was in Chapter 5.3.2.

The evaluation indicates that this alternative does not create potentially significant adverse impacts because the risks are controlled through institutional controls. However, the FS indicates that the most significant impediment to this alternative is obtaining restrictive covenants from each of the large number of property owners. The FS indicates that the City could adopt an ordinance to accomplish the same purpose, but concludes that political and societal consensus may be difficult to obtain, and that this alternative cannot be implemented without adequate public support. Therefore, the FS concludes that this alternative may not be implementable. WESTON is not in a position to evaluate the technical merits of this political assessment.



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Comments to Section 6.2.2.2 Alternatives 3a, 3c, and 3e – Groundwater Pumping - Pipeline to and Treatment at Wagner Road.

The detailed evaluation of the constructability of this option (page 59) indicates that the most significant concern is access to public and private property for the construction of transmission pipelines for untreated water to PLS and treated water to the Huron River. Until the pipelines are constructed, the plume cannot be captured and continues to move, making capture harder to achieve and perhaps rendering the design obsolete before construction begins. The FS estimates that this alternative involves over 33,000 linear feet of pipelines. The FS raises technical concerns over the time needed to obtain access and construct the pipelines of that length.

WESTON concurs with the evaluation of the challenges of constructing the pipelines as described. WESTON understands that community opposition to construction of pipeline infrastructure could delay the project and provide uncertainty in timing. WESTON did not find documentation in the FS to support the selected routes for the pipelines and believes that alternate, shorter routes may be possible, allowing construction to proceed more quickly and more easily at less expense than the FS assumed.

The FS did not provide information about the rate of migration of the plume, nor an estimate of how far the plume might travel during construction of the pipelines. Therefore, WESTON cannot evaluate where additional extraction wells might be located. However, the FS appears to assume that the wells would be installed before the pipelines were completed, which does not seem to be a pragmatic approach. As stated previously, the leading edge of the plume should be monitored and the necessary, additional hydrogeological investigation completed as proposed while the infrastructure is designed and constructed. When the transmission pipeline is near completion, the optimal locations of the recovery wells and their associated pipelines would be determined. Repositioning the extraction wells should not be an issue.

WESTON agrees that constructing a transmission pipeline back to the Wagner Road facility under I-94 would be a significant physical obstacle. This situation provides justification for construction of a treatment unit at Maple Road, described under Alternative 4, where the I-94 would not be an obstacle.

Alternatives 3c and 3e differ from 3a in that Alternative 3c would dispose of the treated water using multiple injections wells, while Alternative 3e would discharge the treated water to Honey Creek under an amendment to the exiting National Pollutant Discharge Elimination System (NPDES) permit. The challenges and obstacles to constructing a pipeline to the Wagner Road facility would exist, but the pipeline to the Huron River would be eliminated.



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As noted on page 61, locating a sufficient number of injection wells to accept the necessary volume of water under Alternative 3c would be difficult and would make capturing the plume more difficult. As WESTON noted previously, the FS does not provide information on the effects of reinjection on the plume of contaminated groundwater. In fact, Alternative 3b was eliminated in part because reinjection could potentially distort the plume, dilute the contamination, and increase the project duration.

While Alternative 3e would be technically feasible, the FS did not provide information to indicate whether the receiving stream could accept the increased discharge volume of treated water. The FS notes (page 63) that NPDES permit issues could create implementation problems. In the absence of information related to the capacity of the receiving stream, WESTON cannot evaluate this alternative further.

Comments on Section 6.2.2.3 Alternatives 4a and 4c – Groundwater Pumping – Treatment near Maple Road

The evaluation of the implementation and constructability of Alternative 4a (pages 64 and 65) includes the same issues and challenges for construction of the pipeline from Maple Road to the Huron River as discussed for Alternative 3a. As noted previously, WESTON did not observe documentation in the FS to support the selected path for the treated water pipeline and believes that alternate, shorter routes may be possible; therefore, construction could proceed more quickly and more easily at less expense than the FS assumed.

The evaluation of the implementation of these two alternatives indicates for the first time that the cost of liability insurance may be significant for chemical oxidation treatment in the area of Maple Road. This issue was not raised in Chapter 3 for the identification and screening of technologies, or in Chapter 4 for the IR actions (which also include treatment at Maple Road), or in Chapter 5 for the screening of the alternatives. The cost estimate for Alternative 4a combines legal fees, access, and insurance and provides a 50% contingency that appears to have been applied for these cost items. While this line item amounts to \$275,000, WESTON cannot determine how much of that cost is for insurance. Because the total cost of Alternative 4a exceeds \$25,000,000 and Alternative 4c exceeds \$30,000,000, WESTON does not consider the cost of insurance to be a significant impediment to implementation of this alternative.

The evaluation of protection of public welfare and public perspective (page 65) indicates that installation of the treatment system near Maple Road is not consistent with current land uses and may raise public objections and legal challenges. WESTON notes that this concern was not raised in the discussion of the IR action, which would also include a treatment system in the same location.

Alternative 4c differs from Alternative 4a in that the treated water would be disposed of through injection wells, rather than a pipeline to the river. As WESTON noted previously, the FS does not provide information on the effects of reinjection on the plume of contaminated groundwater. As a result, this alternative cannot be fully evaluated based on the existing information.

Comments on Section 6.2.2.4 Alternative 5 – Groundwater Pumping – Injection into Deep Formation

WESTON concurs with the evaluation of this alternative with one exception. In addition to further study to verify that adequate flow rates can be injected into the deep formation, further study will also be needed to verify that the treated water will be compatible with the receiving formation water.

Comments on Section 6.2.2.5 Alternative 6 - Groundwater Pumping with Active Remediation and Treatment Proximate to the Huron River

The FS indicates (page 68) that this alternative is different from the other active remediation alternatives in that groundwater extraction, if necessary, would occur closer to the Huron River. The FS indicates that this location would minimize community disruption, potential delays, and uncertainties with installation of pipelines, while still being protective of any potential receptors. The document also indicates that the institutional controls would not be necessary because the active system would be implemented if necessary. WESTON notes that the IR is no longer in the title as it was for Chapter 5.3.6.

WESTON notes again that the FS did not contain information to indicate that the hydrogeology is well understood downgradient of the current plume location, or that the flow path of the plume can be reliably predicted. Several chapters of the FS propose additional investigations to address these data gaps. Therefore, sufficient information was not available for WESTON to review regarding the potential future migration of the plume of contaminated groundwater, and therefore, WESTON cannot concur with the conclusion that this alternative is, or can be, equally protective of human health and the environment.

In the absence of the additional hydrogeological information, the FS does not propose locations for the contingent extraction and treatment system. Therefore, WESTON cannot evaluate the degree to which this alternative would reduce or minimize disruptions, delays, and/or costs. Because the location is not provided, WESTON cannot evaluate whether the land use near the river would be more compatible than at locations proposed for other alternatives. Because the



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route of a pipeline to the river is not provided, the uncertainty of construction cannot be compared to the other pipeline routes, except that the route will be significantly shorter.

Furthermore, the cost assumptions for the contingent extraction and treatment cannot be verified. The length of any pipeline or the size of a treatment system cannot be estimated because the volume of groundwater that would require treatment is unknown. The FS indicates that Alternative 6 is the most expensive option. WESTON notes that the cost would apparently be driven by the extra number of years that the system might have to operate, because the plume would have been allowed to double from its current length and would have expanded laterally by dispersion and diffusion as it migrated. The expansion of the plume does not account for the potential effects of the complex hydrogeology, which cannot be predicted based on the information provided in the FS.

If the proposed investigation, monitoring, and modeling of the groundwater plume support the assumption that the potential receptors will be protected, then the contingency for extraction of contaminated groundwater near the Huron River would not be necessary. In that event, Alternative 6 would be comparable to Alternative 2, but without the institutional controls. However, the plume of contaminated groundwater would still be migrating under those properties. In WESTON's opinion, some institutional controls would be prudent to ensure that the contaminated groundwater is not consumed.

Comments on Chapter 7 – Overall Response Plan and Waiver Request

As the Final Response Plan, the FS proposes to combine the IR Actions described in Chapter 4 with Alternative 6 to aggressively remove mass from near the most contaminated portions of the plume while it continues to migrate towards the river. PLS would implement Alternative 6 if the proposed monitoring demonstrated that potential receptors were threatened.

WESTON's previous comments about both the IR and Alternative 6 remain applicable to the combination of the two remedial actions and are not repeated here. In order to compare the costs for all the alternatives on Table 1, WESTON has labeled the Final Response Plan as Alternative 6a. WESTON assembled the costs for this alternative from three separate sources within the FS. WESTON notes that the costs provided in Appendix G of the FS for the IR portion of this alternative included operation of the additional extraction wells and the treatment/reinjection system at Maple Road for only one year. Other capital costs and costs for access that are intrinsic to the response action were not included in the Appendix. Therefore, the total cost for the final response plan appears to be lower than it should be because it would be expected that the IR action would continue for more than one year. If the IR was operated for 30 years, the



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cost would be significantly higher. On the other hand, this cost assumes an active remediation system near the Huron River for 30 years, which the FS has included only as a contingency.

The rest of Chapter 7 deals with PLS' request for a waiver from MDEQ Rules 299.5705(5) and (6). WESTON is not in a position to render an opinion about the legal arguments that are presented, but provides the following comments about the technical aspects of the waiver request.

Section 7.2.1 (page 73) indicates that the IR will reduce concentrations of 1,4-dioxane to levels below applicable criteria before it reaches human receptors through surface or groundwater. The waiver request indicates that the environment will be protected because the plume will naturally disperse to acceptable levels before environmental receptors are reached. Because of the uncertainties in the existing hydrogeological information and the future migration of the plume as presented in the FS, WESTON does not have enough information to concur with these assumptions.

Section 7.2.2 (pages 73 and 74) indicates that containment of the leading edge of the plume is technically impractical due to the following factors: (1) the volume of water that would have to be captured, which renders reliable reinjection impossible; (2) the distance to move water to a treatment site and/or disposal location and the difficulties in installing the infrastructure; (3) the difficulties in engineering an effective capture system given the uncertainties of installing the infrastructure; (4) the cost and level of effort required to meet the standards; and (5) the fact that the net environmental benefit from capture is not commensurate with items (1) through (4).

WESTON's responses to these technical impracticability arguments have been addressed previously. WESTON concurs that reinjection would not be reliable based upon the level of information provided in the FS. The criteria for selection of the proposed pipeline routes were not provided in the FS, and other routes should be evaluated because they may be more cost-effective and less disruptive than those proposed. The additional hydrogeological investigations that have been proposed should address the uncertainties in installing an effective capture system while the pipeline infrastructure is engineered and constructed. The FS is not clear as to what standards are referred to in (4) above, but the FS has indicated that all applicable environmental criteria will be achieved by all the alternatives. The concept of net environmental benefit is argued in detail in the sections of the FS that follow the list provided above.

The discussion of environmental benefits from a containment remedy on page 74 replicate those provided on pages 53 and 55. As WESTON previously noted, WESTON does not concur with this evaluation because the downgradient hydrogeology and migration of the plume are not well understood. Significant uncertainty exists concerning the downgradient migration of the plume



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until the results of the proposed hydrogeological investigations are known. Therefore, the assumptions that roughly the same area would be contaminated and the same level of protectiveness achieved are not supported by data at this time. If no institutional controls are provided for the area of the plume, then the remedy does not ensure that no one will consume the contaminated groundwater.

The discussion of detriments to the environment beginning on page 75 provides new information not previously discussed in the FS, including groundwater level and surface water level declines that could result from aggressively extracting groundwater from the Unit E plume. The FS does not provide any data or other information to support these statements. As a result, WESTON cannot provide technical evaluation of their validity.

Comments on Chapter 8 – Conclusions

This Chapter reiterates and summarizes the previous discussions and comparisons of the alternatives and the proposed final remedy. These discussions and WESTON's comments are not repeated here. The FS again recommends Alternative 6 in conjunction with the IR, because it actively remediates groundwater, provides an added level of safety and reduced risk to exposure of potential receptors, and reduces the mass of 1,4-dioxane migrating to the Huron River. WESTON notes that the proposed response plan does not stop migration of the plume at concentrations above 85 ppb, much less the court-mandated concentration of 77 ppb. If the contingent system is not installed near the river, then the final response plan is equivalent to monitored natural attenuation, with removal of an unquantifiable amount of mass from the extra extraction wells, and without institutional controls for the additional area that will be contaminated by the continued migration of the plume. In addition, the duration of the remedy will be prolonged by more than doubling the affected area.

ESTIMATED COST OF MDEQ-PROPOSED REMEDIAL ALTERNATIVE

The MDEQ-selected alternative combines portions of the alternatives PLS developed in the FS. This alternative will extract groundwater from the source, Maple Road, and the leading edge of the plume. Treatment will be at both Wagner Road (groundwater from the source areas) and Maple Road (groundwater from the Maple Road and the leading edge extraction wells). Treated water from Wagner Road will be discharged to Honey Creek, while water treated at Maple Road will be piped to the Huron River. A summary of the costs for the three extraction areas is summarized in **Table 3**.

During design work associated with the MDEQ-selected alternative, supplemental hydrogeologic studies will be conducted at the source area and the leading edge of the plume. This



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hydrogeologic work will include contaminant fate modeling. These studies will be conducted to alleviate gaps in the data and allow for a more efficient and cost effective design.

Wagner Road

Two new extraction wells will be installed in the vicinity of Wagner Road and connected to the existing system, which consists of two existing deep aquifer extraction wells and a trunk pipeline. It is assumed that flow from all wells feeding the existing treatment system will be modified so that the maximum total combined pumping rate does not exceed 1,300 gpm. Treated water will be discharged to Honey Creek under the current NPDES permit using existing discharge pipelines. Operation and Maintenance (O&M) costs for extraction, treatment, and discharge are not included in the cost estimate because they will be absorbed by the existing system costs. Costing for the Wagner Road system is provided in **Table 4**.

Maple Road

Two new extraction wells will be installed and used in conjunction with existing well TW-16 to extract water from the Maple Road area. Extracted groundwater will be transported using a new 8-inch high density polyethylene (HDPE) pipeline to a temporary treatment building located behind the K Mart building on Maple Road. The contaminated groundwater will be treated using ozone and hydrogen peroxide. Treated water would then be discharged to the Huron River using a newly constructed pipeline that for costing purposes follows the route proposed in Alternative 4a. For volume estimating purposes, it is assumed that the extraction wells will be pumped at a combined rate of 500 gpm. Costing for water treatment and transport to the discharge point is provided under the Leading Edge alternative (below). Costing for the Maple Road system is provided in **Table 5**.

Leading Edge

Three new extraction wells will be installed to extract water at the leading edge of the groundwater contaminant plume. Extracted groundwater will be transported using a new 8-inch HDPE pipeline to a temporary treatment building located behind the K Mart building. The contaminated groundwater will be treated using ozone and hydrogen peroxide. The treatment unit consists of a unit transported to the site in standard shipping containers. The system is approximately 40 feet long by 8 feet wide by 9 feet high. Treated water would then be discharged to the Huron River along with the treated water from Maple Road using a newly-constructed parallel system of 8 inch HDPE pipes. For costing purposes, it is assumed that the leading edge extraction wells will be pumped at a combined rate of 650 gpm. Costing for the Leading Edge is provided in **Table 6**.



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WESTON appreciates the opportunity to provide continued professional services to the MDEQ for the Gelman Sciences Site. Should you have any questions or require additional information regarding this submittal, please feel free to call me at 517-381-5955.

Very truly yours,

WESTON SOLUTIONS OF MICHIGAN, INC

A handwritten signature in black ink, appearing to read "Michael A. Pozniak".

Michael A. Pozniak, C.P.G
Project Manager

A handwritten signature in black ink, appearing to read "Robert C. Hunt".

Robert C. Hunt
Program Manager

Attachments