STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
JACKSON DISTRICT OFFICE

JENNIFER M. GRANHOLM
GOVERNOR

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April 23, 2004

VIA ELECTRONIC & US MAIL

Mr. Farsad Fotouhi
Environmental Manager
Pall Life Sciences, Inc.
600 S. Wagner Road
Ann Arbor, MI 48103-9019

Mr. Alan D. Wasserman
Williams Acosta, PLLC
2430 First National Bank Building
Detroit, MI 48226-3535

Mr. Michael L. Caldwell
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31700 Middlebelt Road,
Suite 150
Farmington Hills, MI 48334

Dear Sirs:

SUBJECT: Gelman Sciences, Inc. Remedial Action
Work Plan for Testing of *In-Situ* Oxidation dated February 17, 2004

This letter is intended to modify our conditional approval, dated March 2, 2004, of the *In Situ* field testing that is now scheduled to begin on April 26, 2004. As you know, a public meeting was held on March 24, 2004, at which Dr. Susan Masten raised some concerns regarding the proposed testing. Mr. Michael Caldwell, attorney for Pall Life Sciences (PLS), also attended the meeting, and expressed a willingness to take reasonable steps to address Dr. Masten's concerns.

On April 2, 2004, the Department of Environmental Quality (DEQ) received Dr. Masten's written comments on the February 17, 2004 Work Plan for the Testing of In-Situ Oxidation. We have consulted with other DEQ staff with expertise in these matters and have been in contact with Mr. Fotouhi by telephone and electronic mail to exchange information in order to resolve these concerns.

Dr. Masten recommended that bench scale and column experiments be performed prior to implementation of the field test. We have considered this recommendation and have determined that such laboratory experiments are not a prerequisite for field testing; however, we do agree that these experiments could provide useful information. It is likely that the DEQ would require some laboratory experiments prior to full-scale implementation of *in situ* oxidation, if the testing indicates this method is feasible.

There are two key issues raised by Dr. Masten that we re-considered and discussed with PLS staff after receiving her comments: 1) the theoretical explosive potential due to the production of gases; and 2) formation of potentially harmful by-products.

Regarding the theoretical explosive potential due to production of gases, we agree that this is a concern, and have suggested that two additional wells be installed at the top of the aquifer, near the injection location, to allow venting of gases. PLS has not agreed to our suggestion for two primary reasons: 1) you assert that there is a very low risk of gases being released to the surface at a volume or concentration that would be a threat to public health; and 2) you assert that installation of additional wells would unnecessarily delay the performance of the test and prevent completion of the Feasibility Study by the due date of June 1, 2004. While we do recognize that much of the gas produced, mainly oxygen, may have a tendency to dissolve in the groundwater before reaching the surface, the DEQ still believes these venting wells would be a reasonable and prudent precaution to avoid unintended consequences. However, we do

not believe the theoretical safety risk of proceeding without these wells to be high enough to warrant taking court action to halt the test, as PLS has indicated would be necessary.

Regarding the 13 by-products that are expected to be formed, only two have cleanup criteria established by the DEQ. Formaldehyde has a generic residential drinking water cleanup criterion for groundwater (GRCCG) of 1,300 parts per billion (ppb) and a groundwater-surface water interface criterion (GSI) of 120 ppb. Formic acid has a GRCCG of 18,000 ppb, and has no established GSI criterion. Four of these 13 compounds have very short half-lives and are expected to degrade further into the other by-products. We have very little information regarding the toxicity of the remaining compounds, many of which may also continue to degrade on contact with the aquifer materials. Due to the short-term nature of this test, combined with the relatively small area of influence of the test relative to the large existing groundwater plume, we will not require testing of the four short-lived compounds. However, it is prudent to verify the presence of the other nine compounds to the degree practical, to better understand the entire reaction and identify potential problems that could occur if this technology were to be implemented on a long-term basis.

We realize that most laboratories are not set up to do these analyses to a low method detection limit (MDL). More information on the stability, toxicity and mobility of these compounds would need to be provided or developed if this technology were to be implemented on a large scale. Lower MDLs would likely be needed in that case for some or all of these compounds.

Oxalic acid must be analyzed using a MDL of 150 parts per billion (ppb). Formaldehyde must be analyzed using a MDL of 10 ppb. The following compounds, which are expected to be present for a greater period of time during and after the reaction, must be quantified using a MDL of 1 part per million (ppm):

- 1,2-ethanediol monoformate ester
- 1,2-ethanediol diformate ester
- methoxyacetic acid
- glycolic acid
- glyoxal
- glyoxylic acid
- formic acid

The monitoring wells that will require sampling for the nine by-products listed above will be based on the determination that a monitoring well shows a significant decrease in 1,4-dioxane. Due to normal fluctuations in the dioxane concentration, a 25% decrease in the concentration of 1,4-dioxane from the initial sampling of the well, compared to samples taken after initiation of the test, should be considered significant. For purposes of each sampling event, these will be designated as trigger wells. Generally, the trigger wells and the monitoring wells adjacent to the trigger wells will also need to be sampled. The adjacent monitoring wells requiring sampling will include those wells screened above and below the trigger well in the same well cluster and wells screened at the same elevation as the trigger well in adjacent well clusters. This is intended to be a guideline. PLS has agreed to provide the 1,4-dioxane results to the DEQ within 24 hours of collection of the samples, at which time PLS and the DEQ will confer to determine exactly which wells need to be sampled for by-products.

PLS should be aware of the potential of the *in situ* chemical oxidation to form compounds at a mass and concentration that may cause adverse effects, such as exceeding Part 201 cleanup criteria or other applicable standards. The objectives of this pilot test should include collecting data to evaluate this potential, to minimize the likelihood of having to perform additional field testing prior to being able to definitively evaluate the feasibility of use of this technology at this site in the long-term. Any such adverse effects will be the responsibility of PLS to address.

PLS proposes using 1,000 ppm of potassium bromide as a tracer for the hydrogen peroxide solution. PLS has addressed the concern about the possible formation of bromate by performing a laboratory test using potassium bromide and hydrogen peroxide. That test did not result in the production of detectable amounts of bromate (using a MDL of 10 ppb). Therefore, the DEQ approves the use of potassium bromide at 1,000 ppm as a tracer. The tracer should be analyzed for in all monitoring wells on the third day of the test and during all other sampling events.

PLS has agreed to monitor the temperature of the injection well using a probe that will remain in the well during the addition of the hydrogen peroxide. The amount and/or concentration of hydrogen peroxide solution will be adjusted to prevent excessive heat buildup.

Please contact me if you have questions or would like to discuss these matters in more detail.

Sincerely,

Sybil Kolon
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Gelman Sciences Project Coordinator
Remediation and Redevelopment Division
517-780-7937

SK/KJ

cc: Ms. Mary Ann Bartlett, PLS Corp.
Mr. Robert Reichel, Department of Attorney General
Mr. Andrew W. Hogarth, DEQ
Mr. Mitchell Adelman, DEQ/Gelman File
Mr. Leonard Lipinski, DEQ