



TOSC Outreach Plan

Pall Life Sciences; Ann Arbor, MI

A publication of the Hazardous Substance Research Centers' Technical Outreach Services for Communities (TOSC) Program

Hazardous Substance Research Centers

The five regional Hazardous Substance Research Centers were established in 1989 and funded by the U.S. Environmental Protection Agency (U.S. EPA). The Centers' mission is to support and conduct innovative research and technology development in hazardous substance control, cleanup and management. The Centers have an interdisciplinary group of knowledgeable scientists and engineers who can offer technical advice, review sites, and help increase understanding of hazardous contamination.

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Summary of Outreach Plan

Officials of the City of Ann Arbor and Scio Township Residents for Safe Water (SRSW) have requested Technical Outreach Services Communities (TOSC) Program assistance concerning a groundwater contamination problem in Ann Arbor and Scio Township, Michigan. The contamination is related to the Pall/Gelman manufacturing facility, which released 1,4-dioxane into the environment, in Scio Township. TOSC is a university-based technical assistance program that is funded under a grant from the U.S. Environmental Protection Agency (U.S. EPA). TOSC promotes effective public involvement in the decision-making about the investigation and cleanup of hazardous waste sites. The Michigan State University TOSC office (MSU-TOSC) and the Midwest Hazardous Substance Research Center, headquartered at Purdue University will provide the services described in this document. Following meetings with interested citizens and local officials, MSU- TOSC has



The Midwest Hazardous Substance Research Center is a consortium of Michigan State University, Purdue University, and Kansas State University

prepared this Outreach Plan, which provides an overview of the concerns of community members, the PLS 1,4-dioxane contamination problem, current work to “clean up” the contamination, and services that MSU-TOSC will provide to address those concerns.

Gelman Sciences Inc. (GSI), now Pall Life Sciences (PLS), used 1,4-dioxane in the manufacture of medical filters during the years 1966-1986. Waste disposal practices led to the release of the chemical into the environment during this period. PLS is currently working on the issue, under an agreement with the Michigan Department of Environmental Quality (MDEQ), to remedy the problem. The current work plan includes cleanup goals that were established under court order and that PLS must meet by the year 2005. Those goals are described further below.

During meetings, city officials and members of the public expressed specific concerns and questions on the past, current, and future strategies used by PLS to remediate the contamination. Meeting participants particularly inquired if PLS could formulate and implement remediation (cleanup) strategies when the plume had not been completely delineated. PLS currently pumps and treats contaminated groundwater using an ex-situ¹ (above ground) system. PLS is seeking to implement new remedial measures, and on October 17, 2003, PLS submitted a feasibility work plan for the implementation of a *pilot-scale* in-situ (below ground) oxidation² system for the treatment of 1,4-dioxane. Subsequently, on December 22, 2003 PLS submitted an additional feasibility work plan for the implementation of a *pilot-scale* in-situ oxidation system for the treatment of 1,4-dioxane. These in-situ oxidation systems are targeting the contamination located in the Unit E aquifer (see Appendix A for more on the contaminated aquifers and their locations). The community has expressed a concern over the effectiveness of these newly proposed treatment systems. MSU-TOSC has been asked review the suitability of the treatment systems and other future treatment remedies presented by PLS. Specific concerns about the pilot-scale studies include:

1. What drives the need for a new treatment technology? Is the current technology not working? What is the current technology’s status?
2. Is the proposed treatment technology applicable for this site? Is the treatment technology applicable for the contaminant, 1,4-dioxane?
3. What are the design details of the new system? How much water will be treated by the system? Is the system designed to remove 99.9% of contaminant from the groundwater?

¹ Ex-situ – Ex-situ is used to describe remediation technologies that, in the case of groundwater contamination, occur following the pumping of the groundwater from the ground through a well and treating it at the surface.

²In-situ oxidation - Technology that oxidizes contaminants dissolved in ground water without removing the groundwater from the subsurface. For additional information on oxidation as cleanup method for contaminated groundwater, see the fact sheet at <http://www.envirotools.org/factsheets/chemicaloxidation.shtml>.

4. What kind of pilot testing will be done? Where will the treated water go? What conditions has the Department of Environmental Quality set to assure the efficiency of the system? Are there penalties for exceeding allowable discharge levels of 1,4-dioxane?

Community members and governmental representatives also raised more general concerns and questions about the effects of the Gelman contamination, including:

1. The current status of the delineation of the plumes, including boundaries of plumes, direction of contamination movement and rate of contaminant migration.
2. Questions were raised about gaps in the understanding of the aquifer system as a whole and whether the gaps are important in carrying out the proposed cleanup work.
3. The effects that the contamination has had on the City of Ann Arbor drinking water wells (if any).
4. A general lack of both community awareness about the contamination and adequate access to pertinent information is a problem in the Community.
5. Which wells in Ann Arbor and Scio Township have been affected?
6. How has the Scio Township water quality been affected by the PLS 1,4-dioxane contamination?
7. Is the water in the city and the township safe to drink?

While some data exist about the contamination, there are many gaps in the PLS and MDEQ understanding of the boundaries of the plume. The parties question where, for example, to place a treatment system that “captures” the plume. A technical working group, consisting of geologists, hydrogeologists and engineers, has been established to aid MDEQ due to the complexities of the contamination problem and its cleanup. MSU-TOSC was invited to join the technical working group in September 2003. It is hoped that additional work being done by PLS, MDEQ and the technical working group will address current project uncertainties and evaluate proposed remedies for the contamination. PLS is expected to submit a final feasibility study (FS) in April 2004 that identifies and assesses the remedies. An interim feasibility study was submitted in January and is posted to the TOSC website at (see http://www.egr.msu.edu/tosc/gelman/Interim_Feas_Study.pdf)

To address the concerns of community members, the MSU-TOSC program will carry out the following activities (these activities are described in detail in the full Outreach Plan, below):

1. Provide review and comment services on the suitability of treatment systems that PLS proposes to address the contaminated aquifers and the contaminant of concern, 1,4-dioxane.
2. Model the complex reactions that occur during the oxidation of 1,4-dioxane with ozone, using the simulation software *Aquasim*.
3. Review and comment on treatment system designs submitted by Pall before their full-scale implementation.
4. Evaluate hydrogeologic models proposed by Pall.
5. Address community questions over whether the 1,4-dioxane has affected drinking water quality in Scio Township and in Ann Arbor.
6. Hold workshops to educate the community about the PLS groundwater contamination, status of prior remedial activities by PLS and to assist residents in interpreting results of technical reviews conducted by MSU-TOSC.

The full TOSC Outreach Plan is presented below. Appendix B follows the Plan document and describes the history of the PLS/Gelman issue and current state of the investigation and activities toward cleaning up the contamination. For additional information on TOSC's work on the PLS/Gelman issue, see www.tosc.msu.edu/gelman.

TOSC Outreach Plan—Pall Life Sciences, Ann Arbor, MI

Introduction

Gelman Sciences Inc. (Gelman) is located at 600 S. Wagner Rd., just west of Ann Arbor, MI, in Scio Township. The Pall Corporation acquired Gelman in February 1997 and changed its name to Pall Life Sciences. Gelman used the solvent 1,4-dioxane in the manufacture of medical filters during the years 1966-1986. The chemical solvent is believed to have made its way into groundwater through unlined lagoons, where dioxane-containing wastewater was stored, and through spray irrigation of the wastewater over lawns at Pall's Wagner Road facility. In the mid-1980s, dioxane turned up in area lakes and wells.

Michigan Department of Environmental Quality is overseeing the remediation project that PLS is performing. The current work plan is designed to meet the cleanup goal of 85 parts per billion (ppb) for groundwater and 1,700 ppb for soils met in the year 2005. The cleanup criterion was calculated by MDEQ using the U.S. Environmental Protection Agency methodology for calculating risk-based cleanup criteria.³

The TOSC Program at Michigan State University has been asked to provide assistance to the citizens of Scio Township and the City of Ann Arbor on the Gelman contamination problem. In this Outreach Plan, MSU-TOSC describes a variety of activities to address public concerns over the environmental contamination in the groundwater in Ann Arbor with the goal of promoting citizen involvement in the decision making process. As initial activities, TOSC has reviewed the files that are maintained by the MDEQ on the PLS issue and examined the status of PLS's and MDEQ's understanding of the extent of contamination (particularly the vertical and horizontal boundaries of the plume and the associated hydrogeology). MSU-TOSC has also received documents from Scio Residents for Safe Water (SRSW) as background on the issue.

What is TOSC?

The Technical Outreach Services for Communities (TOSC) program promotes community involvement in environmental decision-making through educational and technical assistance services, and is funded under a grant from the U.S. Environmental Protection Agency. TOSC is housed in the Midwest Hazardous Substance Research Center. Participating universities include: Purdue University, Michigan State University, Kansas State University, and the Virginia Polytechnic Institute and State University.

TOSC program services seek to build community understanding of site contamination problems and empower citizens and local government to participate more effectively in the decision making process. TOSC faculty, working collaboratively with citizens, design educational workshops that address key questions and concerns. Additionally, TOSC reviews documents and provides professional guidance on site cleanup work. TOSC faculty members generally teach and conduct research in environmental engineering and sciences, hydrogeology, and toxicology.

³ For additional information on Michigan risk-based cleanup standards, see <http://www.envirotools.org/factsheets/riskstandards.shtml>. For U.S. EPA guidance, visit <http://www.epa.gov/superfund/programs/risk/ragsa/index.htm>.

At present, monitoring wells delineating the subsurface geology and providing data on 1,4-dioxane concentrations are widely spaced. Consequently, uncertainty exists in the delineation of the plume extent of groundwater contamination⁴. PLS is under a court order to submit a final Feasibility Study to MDEQ by June 1, 2004; MDEQ has been ordered to respond to Pall's submission by September 1. Over the past six months, Pall has been exploring innovative methods for treatment of the dioxane. To that end, on October 17, 2003, PLS submitted a feasibility work plan for the implementation of a *pilot-scale* in-situ oxidation system for the treatment of 1,4-dioxane. This work plan examined the ability of three oxidants, ozone (O₃), hydrogen peroxide (H₂O₂), and a combination of both (O₃/H₂O₂) to oxidize the contaminant and thereby degrade it (and reduce its levels in the groundwater). The objectives of the in-situ oxidation system test were to examine 1,4-dioxane reduction rates, hydraulic and geochemical changes in the injection zone, and reaction byproducts. Subsequently, on December 22, 2003 PLS submitted an additional feasibility work plan for the implementation of a *pilot-scale* in-situ oxidation system for the treatment of 1,4-dioxane. This work plan examined the ability of hydrogen peroxide or hydrogen peroxide in the presence of an iron catalyst (Fenton's reagent) to oxidize the contaminant. The primary objectives of the in-situ oxidation system test were to examine 1,4-dioxane reduction rates and hydraulic and geochemical changes in the injection zone. The in-situ oxidation system is being proposed to remediate the contamination located in the Unit E aquifer (see diagram at Appendix A, on p. 13).

Citizen Concerns

From June 2003 to present, MSU-TOSC staff members, including Dr. Thomas Voice, Associate Director of the Midwest Hazardous Substance Research Center, and Kirk Riley, TOSC Program Manager, have met with citizens and City of Ann Arbor officials, Washtenaw County staff members and representatives of Scio Residents for Safe Water to

What is 1,4-dioxane?

1,4-dioxane (also called dioxane) is a flammable liquid. It may form explosive chemicals, especially when anhydrous (very dry). It is produced in large amounts (between 10 million and 18 million pounds in 1990) by three companies in the United States. Information of future U.S. demand for dioxane is not available. Companies use dioxane as a solvent for paper, cotton, and textile processing and for various organic products. It is also used in automotive coolant liquid, and in shampoos and other cosmetics.

What happens when dioxane enters the environment?

1,4-dioxane can evaporate when exposed to air. It mixes easily with water. Most references of dioxane to the U.S. environment are to air and surface water. Once in air, it breaks down to other chemicals. Dioxane can evaporate from dry soil exposed to air. It is not likely to evaporate as readily from water or moist soil. Because it is a liquid that does not bind well to soil, dioxane that makes its way into the ground can move through the ground and enter groundwater. Plants and animals are not likely to store 1,4-dioxane. For additional background on dioxane, see the fact sheet at <http://www.envirotools.org/factsheets/dioxane.shtml>

⁴ See the fact sheet "Understanding Groundwater" at <http://www.envirotools.org/factsheets/groundwater.shtml>.

discuss TOSC’s mission and services and community interest in working with TOSC. During these discussions, residents and officials expressed a variety of concerns about the Gelman contamination. The concerns focused on promoting community understanding of the site investigation, the risks posed by the site to public health and the environment, and options for developing and carrying out remedies for the contamination. TOSC representatives also met with Michigan DEQ staff members about the PLS issue and, later, joined the DEQ-established technical work group. The following questions/concerns were expressed, and provide a basis for developing educational and technical assistance services that MSU-TOSC may provide.

1. What is the need for a new treatment technology? Is the current technology not working? What is the current technology’s status?
2. Is the treatment technology appropriate for this site? Is the treatment technology effective for the contaminant, 1,4-dioxane?
3. What are the design details of the new system? How much water will be treated by the system? Is the system designed to remove 99.9% of contaminant from the groundwater?
4. What kind of pilot testing will be done? Where will the treated water go? What conditions has the Department of Environmental Quality set to assure the efficiency of the system? Are there penalties for exceeding discharge limits?
5. Has the drinking water quality in Scio Township and Ann Arbor been adversely affected by the contamination? If so, how has it been affected? Have drinking water wells been affected by the plume?
6. Why have treatment options been proposed when the plume has not been completely delineated and when there are gaps in Pall and DEQ’s understanding of the aquifer system?
 - What are the greatest gaps in the current understanding of the aquifer system?
 - Are these gaps important?
 - Do they pose a significant risk to the protection of human health and the environment?
 - Do they contribute a significant risk of failure to proposed remediation plans?
 - Can these gaps be reduced through:
 - a) The collection of additional data, and/or
 - b) The analysis of existing data in a new way?
 - If so,
 - a) What types of additional data are needed most?
 - b) At what locations is additional data needed most?

- c) What types of analyses are needed?
- d) How confident is TOSC that the new information will help?
- Is it feasible to collect such data or conduct such analyses?
 - a) How much will it cost?
 - b) How long will it take?
 - c) Will the new data and/or analyses influence the remediation decision-making process?

TOSC Services

MSU-TOSC will provide the following services to address the concerns of area citizens and the City of Ann Arbor. Area citizens, as well as the City of Ann Arbor, assisted MSU-TOSC in developing the list of services. Dr. Susan Masten, Professor of Environmental Engineering at Michigan State University will serve as technical project manager for TOSC, and will evaluate treatment process applicability. Dr. Larry Lemke, Senior Lecturer at Wayne State University will evaluate the hydrogeological aspects of the project. Other staff members include Kirk Riley, MSU-TOSC Program Manager, and Scott Siple, Project Specialist.

As described below, TOSC services will focus on two crucial questions: 1) What is the status of Pall and DEQ's understanding of the aquifers and hydrogeology in the contaminated areas? And 2) Will the remedies that are proposed by PLS work to reduce concentrations of 1,4-dioxane to "acceptable" levels. (TOSC will also address the question of what level is acceptable, based on the risks to public health of dioxane.) In particular, TOSC seeks to address the community's request for a *site-specific* examination of conditions from the PLS dioxane problem and proposals for its resolution (see Item 6 under "Citizen Concerns.")

TOSC services will include the following:

1. **Provide information on the suitability of proposed treatment systems for remediating 1,4-dioxane in the aquifer systems where the contaminant is present (i.e., a site-specific review).**

MSU-TOSC's review of proposed treatment systems will address the suitability of the system. In addition to addressing the system applicability MSU-TOSC will comment on the design of the system including key design parameters such as by-product formation from the parent compound, applied reactant dose sufficient to reach the cleanup goal and suggest meaningful benchmarks to assess the success of the treatment. The suitability of proposed treatment activities will also be examined from a hydraulic standpoint, that is, with respect to natural and engineered groundwater flow through the aquifer system. The expected flow of groundwater, and therefore the movement of 1,4-dioxane, in response to remediation plans involving the withdrawal

of contaminated water or the injection of treated water and/or oxidizing agents will be assessed to the extent that available data and numerical simulations allow.

2. Attempt to model the complex reactions that occur during the oxidation of 1,4-dioxane with ozone using the simulation software *Aquasim*.

Dr. Susan Masten will use the computer-modeling program *Aquasim* to model the series of complex reactions that take place during the oxidation⁵ process. *Aquasim* will aid in the understanding of the processes occurring in the aquifer and provide a means to predict water quality conditions in the aquifer and oxidant concentrations present. The software will be a theoretical approach to what may be occurring in the field. A major problem with using ozone as an oxidant is the production of bromate. U.S. EPA has set the maximum contaminant level⁶ (MCL) for bromate at 10 parts per billion (ppb). According to The U. S. EPA consuming water contaminated with bromate above the MCL for many years can lead to an increased cause of cancer⁷.

3. Review and comment on treatment system designs submitted by Pall before their full-scale implementation.

Dr. Susan Masten will perform a technical review of the design and feasibility of treatment systems proposed by PLS to remediate the contaminated groundwater. Dr. Masten has performed a review of the work plan submitted by Pall for the testing of in-situ oxidation for the treatment of 1,4-dioxane⁸. Subsequent treatment system designs concerning 1,4-dioxane submitted to MDEQ may be reviewed by Dr. Susan Masten, as requested by MSU-TOSC clients.

4. Evaluate hydrogeologic and contaminant distribution interpretations proposed by Pall.

Dr. Larry Lemke will assess hydrogeologic models proposed by Pall, both conceptual and numerical, if available. The evaluation will focus on important uncertainties such as the subsurface arrangement of aquifer/aquitard materials, the three-dimensional distribution of 1,4-dioxane, and the identification of hydraulic gradients that drive flow through the aquifer system. Dr. Lemke will also evaluate the suitability of proposed treatment activities from a hydraulic standpoint, that is, with respect to natural and engineered groundwater flow through the aquifer system. The expected flow of groundwater, and therefore the movement of 1,4-dioxane, in response to remediation plans in-

⁵ **Oxidation** - Oxidation is the combination of a substance with oxygen. Oxidation can also describe a type of reaction in which the atoms in an element lose electrons and the valence is correspondingly increased.

The term is used here to describe the breakdown of dioxane through chemical means, namely by oxidation.

⁶ **MCL** - Maximum Contaminant Level is the highest level of a contaminant that is allowed in drinking water

⁷ Disinfection Byproduct Health Effects U.S. Environmental protection Agency

http://www.epa.gov/enviro/html/icr/dbp_health.html

⁸ Masten, Susan. Work Plan Testing of In-situ Oxidation for the Treatment of 1,4-Dioxane at the Pall Life Sciences Facility. 2003. (See http://www.egr.msu.edu/tosc/gelman/TOSC_20review_in-situ_pilot_study.pdf.)

volving the withdrawal of contaminated water or the injection of treated water and/or oxidizing agents will be assessed to the extent that available data and numerical simulations allow.

Additional Activities

MSU-TOSC welcomes suggestions and ideas for additional work and will work with interested citizens to focus on the issues of greatest concern. TOSC will hold quarterly meetings with citizens, and at other times as necessary, to update the community and present findings of reviews. TOSC will provide written summaries of meetings where needed and other written materials that address key technical issues (e.g., fact sheets on various topics).

Consistent with the mission of MSU-TOSC and the availability of program resources, additional technical services may be provided, if requested. For example, MSU-TOSC may speak to area high school science classes, or other local groups, about the Gelman site and site cleanup engineering and sciences. Final decision about additional services shall rest with the MSU-TOSC program. Any questions should be addressed to Kirk Riley at 1-800-490-3890 or Dr. Thomas C. Voice, Association Director of the Midwest Hazardous Substance Research Center, at 517-355-0228.

Appendix A

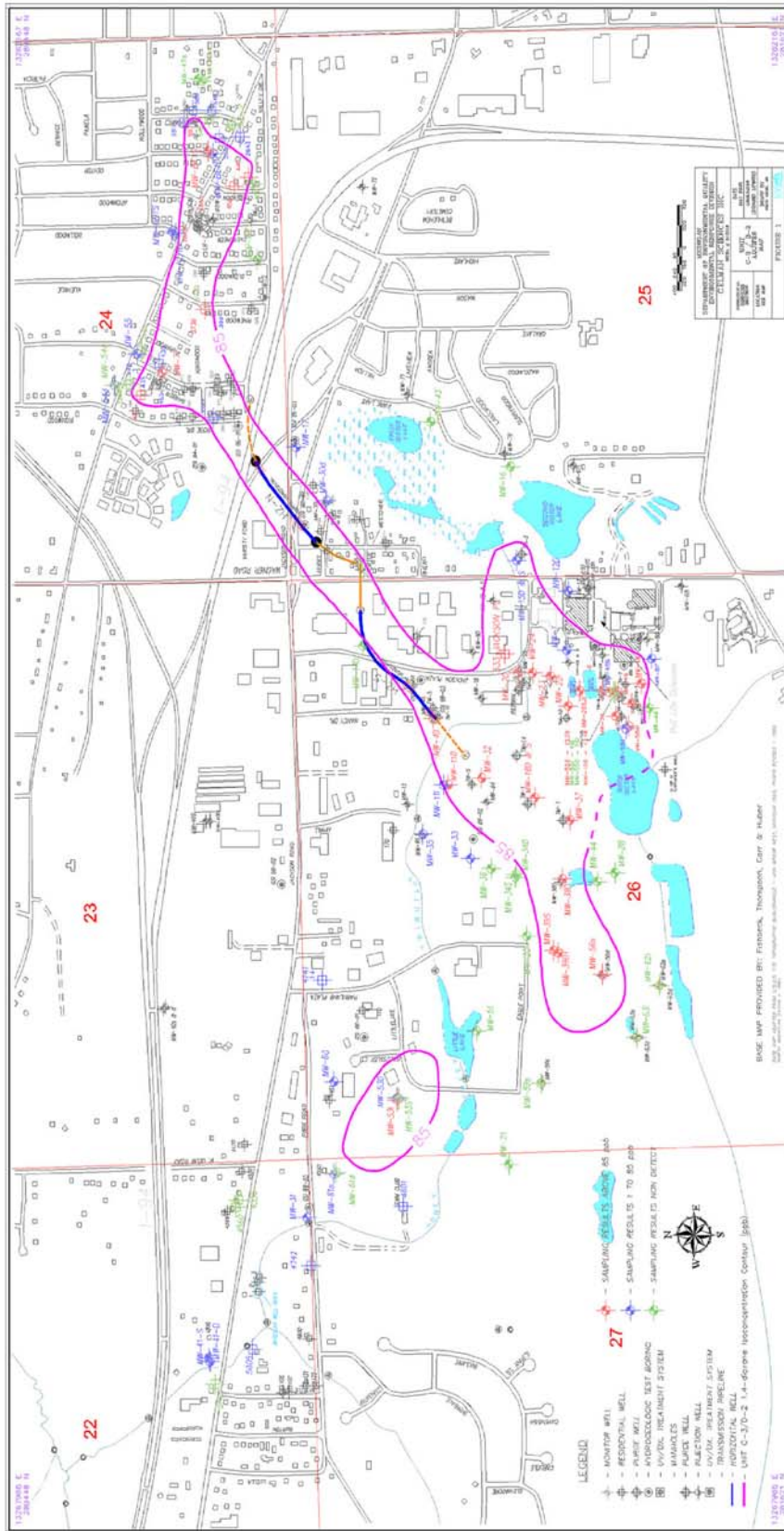


Figure 1. Unit C₃/D₂ aquifer map.
 (Source: MDEQ Environmental Response Division)

Appendix B

Background on Pall and the Contamination

Gelman Sciences, Inc. (GSI) is located at 600 S. Wagner Road, just west of Ann Arbor, MI in Scio Township (see Appendix A). The Pall Corporation acquired GSI in February 1997 and changed its name to Pall Life Sciences, Inc. (PLS). Starting in 1966 process wastewater containing 1,4-dioxane was discharged to unlined and lined lagoons located on the GSI property. A portion of the wastewater overflowed into an adjacent marsh. Spray irrigation was used to accelerate absorption of the wastewater into the soil for an eight-year period beginning in 1976. Some industrial wastes produced at GSI were disposed of and burned in a pit behind the plant. Permits were acquired from the Division of Natural Resources (DNR) for some of these activities.

In November of 1985, the Washtenaw County Health Board identified 1,4-dioxane contamination in 30 residential and commercial water-supply wells north of GSI. In 1986, GSI ceased using 1,4-dioxane and began conducting hydrogeologic studies to determine the extent of contamination. Impacted wells were identified in the Evergreen Subdivision northeast of GSI in 1989. To date over 70 former water supply wells have been affected.

Soil sampling performed in 1998 found that 1,4-dioxane contamination in soil was limited to a small area on PLS property at a high concentration (944,000 ug/kg). Levels of 1,4-dioxane as high as 210,000 ug/l have been recorded in groundwater (Feb. 1989). Concentrations have fallen in response to remediation efforts, however, and the highest concentration found in 2001 was 34,897 ug/L. A total of four aquifers have been affected by the contamination. These aquifers are designated as the C₃, D₂, D₀, and E.

Current Status of Project

Remedial actions are currently underway at four of the five areas of groundwater contamination. Investigation of the Core, Unit E, and Evergreen Areas are on going.

Core Area: A portion of the Core Area (C₃ aquifer) extends through the PLS property and connects to the other three contaminated aquifers. Remediation of contaminated groundwater began in May 1997 when a National Pollution Discharge Elimination System (NPDES) permit for discharge of treated water was issued. Problems with the treatment system caused the original three extraction wells to be operated at less than the proposed flow rates for the first year. Capture of the contamination in the Core Area has been demonstrated in all areas except the Southwest Area, where additional investigation and an interim response are underway. A total of eight extraction wells have been installed in the Core Area, three of which are low volume wells due to low hydraulic conductivity in the southwest portion of the plume.

Evergreen Area: The Evergreen Area (D₂ aquifer) extends over a mile to the northeast from the PLS property. Remediation began in June 1993. Initially treated water was discharged to the Ann Arbor sanitary sewer. Reinjection of treated water into the deeper E aquifer began in December 1993. Plugging of the injection well caused frequent problems over the next year. Extraction ceased in December 1994 until September 1995, when the Waste Management Division agreed to an approved method of introducing chlorine to minimize

well plugging. In November 1996 it had been determined that contaminated groundwater had escaped the capture zone of the extraction well. Two additional extraction wells and a new injection well were installed and began operating in July 1998. Higher levels of contamination in the extraction wells resulted in PLS decreasing the extraction rate because of the inability of the treatment system to meet non-detect for groundwater reinjection. In 1999 PLS completed a pipeline to transfer contaminated water from the Evergreen Area back to the PLS property for treatment and discharge to surface water. In April 1999 the Surface Water Quality Division modified the NPDES permit, at the request of PLS, to allow the discharge flow rate to increase from 300 gallons per minute (gpm) to 800 gpm. In November 1999 PLS began transferring water from the Evergreen Area, treated to the limits of the NPDES permit, to the PLS property, for discharge to the Honey Creek Tributary. PLS began transferring untreated Evergreen System water to the PLS property for treatment and discharge in October 2000.

Western Area: The Western Area (D_0 aquifer) extends about 1-1/2 miles to the northwest of the PLS property. Groundwater monitoring in this area indicates that 1,4-dioxane concentrations are decreasing. PLS monitoring and investigation of the Western Area is continuing.

Unit E Aquifer: Investigations in June 2001 determined that the deeper E aquifer, just above the bedrock, is contaminated with 1,4-dioxane up to 1,670 ug/l. The area of contamination extends nearly a mile northeast of the PLS property. There is concern that detection of 2 ug/l of 1,4-dioxane in a municipal well may be related to the GSI site. PLS has obtained access from the City of Ann Arbor to install two additional monitoring wells to help define the extent of the contamination. A wellhead protection study is currently underway that should determine if this contamination is from the GSI site.

Marshy Area: The Marshy Area contains perched groundwater overlying the Core Area that is contaminated with 1,4-dioxane. Remediation of this area resumed with issuance of the NPDES permit in May 1997. Contaminated water from this area is treated and discharged along with water extracted from the Core Area. A final design submitted in May 2000 has been implemented, with additional seasonal purging to supplement the existing extraction well.

Soils System: Previous plans to place a deed restriction on the impacted area were determined to be unnecessary after additional sampling showed levels within generic industrial criteria. Groundwater that would be impacted is being remediated. Verification sampling will be required before the Core Area remediation is terminated.

NPDES Permit: The first permit was issued in May 1997. The initial permit had a monthly average for 1,4-dioxane of 10 ug/l with a daily maximum of 30 ug/l, and a volume limit of 300 gpm. In November 1997 PLS filed a contested case to increase the level of 1,4-dioxane in the discharge to 100 ug/l. Local citizens also filed a contested case to decrease the level to 3 ug/l. In April 1999 the volume of the discharge was increased to 800 gpm. An Administrative Law Judge (ALJ) heard the contested case in September 1999. In April 2000

the ALJ recommended that the discharge be reduced to a monthly average of 5 ug/l, with a 15 ug/l daily maximum. The final decision of the MDEQ Director in June 2000 allows a monthly average of 10 ug/l and a daily maximum of 60 ug/l. PLS has generally been operating within permit limits.

On October 17, 2003 PLS submitted a feasibility work plan for the implementation of a *pilot-scale* in-situ oxidation⁹ system for the treatment of 1,4-dioxane. Subsequently, on December 22, 2003 PLS submitted an additional feasibility work plan for the implementation of a *pilot-scale* in-situ oxidation system for the treatment of 1,4-dioxane. On behalf of the MSU-TOSC program, Dr. Susan Masten reviewed the feasibility work plan submitted on October 17, 2003 and submitted comments to MDEQ. (See: http://www.egr.msu.edu/tosc/gelman/TOSC_20review_in-situ_pilot_study.pdf)

⁹In-situ oxidation - Technology that oxidizes contaminants dissolved in ground water without removing the groundwater from the subsurface. (<http://www.egr.msu.edu/tosc>)