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FINAL REPORT

DEMONSTRATION TEST AND EVALUATION OF ULTRAVIOLET/ULTRAVIOLET CATALYZED PEROXIDE OXIDATION FOR GROUNDWATER REMEDIATION AT OAK RIDGE K-25 SITE

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For

**U.S. DEPARTMENT OF ENERGY
OAK RIDGE OPERATION
Under Contract DE-AC05-93OR22000**

MASTER

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EXECUTIVE SUMMARY

In the Ultraviolet/Ultraviolet Catalyzed Groundwater Remediation program, W.J. Schafer Associates, Inc. (WJSA) demonstrated, tested and evaluated a new ultraviolet (UV) lamp integrated with an existing commercial technology employing UV catalyzed peroxide oxidation to destroy organics in groundwater at an Oak Ridge K-25 site. The existing commercial technology is the perox-pureTM process of Peroxidation Systems Incorporated (PSI) that employs standard UV lamp technology to catalyze H_2O_2 into OH radicals, which attack many organic molecules. In comparison to classical technologies for remediation of groundwater contaminated with organics, the perox-pureTM process not only is cost effective but also reduces contaminants to harmless by-products instead of transferring the contaminants from one medium to another (such as in activated carbon or air stripping). Although the perox-pureTM process is cost effective against many organics, it is not effective for some organic contaminants of interest to DOE such as TCA, which has the highest concentration of the organics at the K-25 test site. Contaminants such as TCA are treated more readily by direct photolysis using short wavelength UV light. WJSA has been developing a unique UV lamp which is very efficient in the short UV wavelength region. Consequently, combining this UV lamp with the perox-pureTM process results in a means for treating essentially all organic contaminants.

In the program reported here, the new UV lamp lifetime was improved and the lamp integrated into a PSI demonstration trailer. Even though this UV lamp operated at less than optimum power and UV efficiency, the destruction rate for the highest concentration organic (TCA) was more than double that of the commercial unit. An optimized UV lamp may double again the destruction rate; i.e., a factor of four greater than the commercial system. The demonstration at K-25 included tests with (1) the commercial PSI system, (2) the new UV lamp-based system and (3) the commercial PSI and new UV lamp systems in series. The evaluation of these tests indicates that:

1. The PSI system is cost-effective for treating water at the K-25 site. In comparison to the remediation approach implemented at K-25, the PSI system may save the Department of Energy additional cost.
2. The PSI system may have specific applicability at numerous DOE sites.

3. The new UV system (alone and in tandem with the PSI system) can provide additional cost-reduction of water treatment at many DOE sites for difficult organic contaminants like TCA.
4. Additional engineering development is necessary for full-scale operation with the new UV lamp.

Recommendations from the demonstration results include:

1. Use the perox-pureTM system results as a basis for considering further use at the SW-31 Spring as well as at other DOE sites requiring water remediation.
2. Support further development of SD UV lamp technology to reduce the cost of water remediation.

1.0 INTRODUCTION

This Ultraviolet/Ultraviolet Catalyzed Groundwater Remediation Demonstration Test and Evaluation program consisted of the integration of a special ultraviolet (UV) lamp with an existing commercial water treatment system to remediate groundwater contaminated with mixed organic compounds from the SW-31 Spring at the K-25 Plant in Oak Ridge, Tennessee. The commercially available perox-pureTM system of Peroxidation Systems Inc. (PSI) utilizes high intensity, medium pressure UV lamps along with hydrogen peroxide (H_2O_2) to destroy organic contamination in water via photochemical oxidation. The destruction of the organic compounds occurs by a combination of mechanisms. H_2O_2 is catalyzed by UV light at a specific wavelength to form hydroxyl radicals, powerful chemical oxidants that break down organic molecules. At the same time, some chemical bonds are broken by UV light, aiding in the destruction of the organics. In comparison to classical water remediation technologies, the perox-pureTM process not only is cost effective but also reduces contaminants to harmless end-products instead of transferring the contaminants from one medium to another [such as in granulated active carbon (GAC) or air stripping]. Although the perox-pureTM process is cost effective against many organics, it is not as effective for some organic contaminants of interest to DOE such as TCA, which has the highest of the organic concentrations at SW-31. Such contaminants are treated more readily by direct photolysis using short wavelength UV light. W.J. Schafer Associates, Inc. (WJSA) has been developing a unique surface discharge (SD) UV lamp which is very efficient in the short UV wavelength region. Consequently, combining the SD UV lamp with the perox-pureTM process results in a more effective means for treating a wide range of organics. Earlier results of bench-scale testing indicated that the SD UV lamp can yield more rapid destruction of saturated volatile organic compounds (VOCs) than the commercially available system. The on-site demonstration at K-25 tested this concept under field conditions.

In the program reported here, the SD UV lamp was upgraded and integrated into a PSI demonstration trailer. The general project objectives were to:

1. Maximize the rate and extent of destruction of all organic contaminants in the influent waste stream by the existing and new advanced UV catalyzed oxidation systems, both separately and in series.
2. Evaluate the process economics of the UV catalyzed oxidation systems.

The evaluation of the demonstration tests indicates that:

1. The PSI system is cost-effective for the K-25 site.
2. The PSI system has widespread applicability at DOE sites.
3. The SD UV system (alone and in series with the PSI system) can provide additional cost-reduction of water treatment at many DOE sites.
4. Additional development is necessary for practical water treatment with the SD UV lamp.

2.0 REMEDIATION OF ORGANICS IN WATER

2.1 DOE Need

2.1.1 Regulatory Requirements for Water Remediation

Groundwater contaminated with a broad range of organic compounds is a common problem at many DOE sites. The organic contamination levels at the SW-31 Spring DT&E site, summarized in Appendix I, are an example of the broad range of contaminants and concentrations which occur. Some of the DOE facilities at which groundwater contaminants have been identified are: the Feed Materials Production Center (Fernald, OH); the three Oak Ridge facilities (K-25, Y-12, and ORO); Mount Laboratory; the Kansas City Plant; and the Savannah River Plant.

The K-25 site, as well as other Oak Ridge sites, are on the National Priority List, and thus fall under the jurisdiction of both CERCLA and DOE/EPA Interagency Agreements. These regulations require consideration of alternatives for remediation. This demonstration project meets that requirement.

2.1.2 Standard Water Remediation Technologies

The Environmental Protection Agency (SPA) has accepted Packed Tower Aeration (PTA) "air stripping" and Granulated Activated Carbon (GAC) as the best demonstrated available technologies (BDAT). In air stripping, the most economical water treatment process, air is bubbled through the water, removes organic contaminants from the water and transfers them to the air. Stringent emission regulations have made this technique less acceptable. In GAC, organics are removed by absorption as water flows through the carbon medium. GAC is not effective for all organic contaminants, and results in contaminated carbon. The handling of a secondary contaminant is undesirable at many DOE sites. For both classical water remediation technologies, the contaminants are transferred from one medium to another resulting in a new contamination problem.

At the SW-31 Spring site, GAC is unacceptable due to the contaminated carbon by-product. Consequently, the plan is to transport the water to the Y-12 site, which has a permit for air stripping. Alternative technologies are desirable.

2.2 Application to DOE of UV/UV Catalyzed Peroxide Oxidation Technology

The use of Advanced Oxidation (AO) processes to destroy toxic and refractory organic compounds present in water has gained rapid acceptance since their emergence in the mid 1980's. Much of this acceptance is due to the ability of AO processes to reduce most organic contaminants in water to CO₂, H₂O and, if present, inorganic halides. The perox-pure™ process incorporates a UV lamp, hydrogen peroxide (H₂O₂) and a patented reactor to provide total on-site destruction of the organics without by-products, solid wastes to dispose of, or gas emissions. This process has been demonstrated to be cost-effective for a wide variety of contaminated waters and wastewaters.

This technology, however, is not as cost-effective for some organics, which are better treated by direct UV photolysis. This group of organics includes 1,1,1 TCA, one of the major organic contaminants at the SW-31 Spring. Treating these organics cost-effectively requires the incorporation of a high intensity UV lamp with efficient light emission below 250 nm. The surface discharge (SD) UV lamp has the desired UV light output. Thus, the combination of the UV peroxide process with UV photolysis allows remediation of essentially all organic water contamination at DOE sites.

2.3 Site Description

The K-25 site is located in Roane County between Oak Ridge and Kingston, Tennessee. The site was home to one of three U.S.-based uranium enrichment plants to support the nuclear fuel cycle. The plant, which is no longer in operation, is currently managed by Martin Marietta Energy Systems, Inc. (MMES) for DOE.

The SW-31 Spring influent to the UV system is located adjacent to the east side of Avenue D, about 110 feet south of the center of the intersection with 9th Street, on the eastern portion of the K-25 facility (Figure 2.1). The SW-31 Spring flows from a PVC pipe imbedded at the foot of a 6-foot high slope, and at the time of the test drained through an open concrete channel along the road into a storm drain (SD-180-04) approximately 80 feet north of the SW-31 Spring. The SW-31 Spring is located approximately 200 feet west of the boundary of the K-1070-C/D Classified Burial Ground.

OAK RIDGE K-25 FACILITY

The base SW-31 Spring flow appears to be relatively constant at a few gal/min. Flow increases during and immediately following storms, and reportedly has stopped completely during extended dry periods.

Chemical characteristics of the SW-31 Spring have been determined and are summarized in Appendix I. This water, once it entered the storm drains, continued on to local streams.

Due to recently enacted treatment criteria for the spring water, an effort is currently underway to collect the 2 to 3 gpm effluent. Two 12,500-gallon tanks have been placed at the Western base of the burial ground hill where the spring flows from the PVC pipe. Each day, the water in the collection tanks is hauled via tanker truck to the Groundwater Treatment Plant at the nearby Y-12 facility.

2.4 Demonstration Objectives

As stated in the Statement of Work (SOW), the objective of this DT&E was "to demonstrate an integrated groundwater treatment system that oxidizes a wide variety of organic compounds." The specific "success criteria" from the SOW are listed in Table 2.1.

TABLE 2.1 SOW SUCCESS CRITERIA

1.	All seep water target organic compounds must be reduced in the effluent to levels that meet Drinking Waste Standards.
2.	Operational costs should be comparable to or less than existing groundwater remediation technologies.
3.	Operational conditions should be optimized when the UV light source is integrated with the perox-pure TM system.
4.	Secondary waster generation must be held to a minimum.
5.	Environmental, safety and health documentation will be prepared and maintained.
6.	Reporting of the demonstration activities, including observations, conclusions and recommendations, will be made to DOE for review and comment prior to finalization.

The first is to reduce all organic compounds to concentration levels that meet drinking water standards while at the same time demonstrating that the water discharge requirements at SW-31 Spring are met. A comparison of the maximum contaminant levels allowed for drinking water (see Appendix II) with the effluent levels demonstrated (see Appendices IV and V) shows that the first success criteria was met. The DOE water discharge requirement at the SW-31 Spring, namely that the total toxic organics be below 2.13 milligrams per liter (see Appendix V, Table 2), is readily achievable and was met in many cases by the influent organic concentrations. The second primary objective is to demonstrate that the costs for the UV demonstration technologies are comparable or less than existing ground water remediation technologies. While precise cost comparisons are difficult in mixed waste waters such that exist at the SW-31 Spring unless demonstrations are carried out in parallel, the results of this program (see Section 5.2) demonstrate that the costs for the existing UV commercial technology is less than the currently identified alternative and is more acceptable from a regulatory standpoint than other classical alternatives. Furthermore, the test demonstrated that using the new UV light source, the destruction rate of the rate limiting organic (TCA) contaminant is increased by more than a factor of two (see Section 4.6.4) and, consequently, that once the new UV light source is commercialized, water remediation costs would be reduced. Also, the third objective was achieved since the fastest destruction rates occurred with the system in which the UV light source was integrated with the perox-pureTM system. The test also corroborated the fact that secondary waste is minimal with this UV-based water treatment system. Environmental Safety and Health documentation was successfully maintained, and with the completion of this report, all required reporting activities under this effort are also complete. Consequently, all program objectives have been met.

3.0 DESCRIPTION OF UV/UV CATALYZED PEROXIDE OXIDATION WATER REMEDIATION

3.1 Introduction

UV/UV catalyzed peroxide oxidation water remediation relies on two processes. In the first, UV light is absorbed by peroxide and produces $\text{OH}\cdot$ radicals which are very strong oxidizers of organics. In the second (photolysis), organic molecules absorb UV light directly which breaks bonds and/or produces excited states which are chemically reactive. The commercial perox-pureTM process relies primarily on the former, UV catalyzed peroxide oxidation, which is effective on many, but not all, organic contaminants. The UV light from the commercial lamp is weak in the short wavelength UV needed for the second process (photolysis). The surface discharge (SD) UV lamp is a strong source of short wavelength UV light and hence is suited for UV photolysis. Consequently, combining the SD UV lamp with the perox-pureTM process is an effective means for treating all organics.

Starting in 1989, WJSA and PSI collaborated in proof-of-concept experiments which lead to the successful demonstration of an SD UV lamp in an experimental PSI test chamber. Laboratory tests with synthetic water showed the advantages of the SD UV lamp over available commercial UV lamps. This proof-of-principle experiment led to the DT&E program reported here.

Preparation for the field test in this program included engineering the SD UV lamp for improved reliability and integrating the improved SD lamp with a PSI field demonstration trailer. The following sections describe the technology, the improvements accomplished in this program and the integration with the demonstration trailer.

3.2 Perox-PureTM Process

UV light catalyzes the chemical oxidation of organic contaminants in water by its combined effect upon the organic contaminant and its reaction with H_2O_2 . Many organic contaminants absorb UV light and may be directly oxidized or form intermediates that are more reactive to chemical oxidants. More importantly, UV light at less than 400 nm wavelength reacts with H_2O_2 molecules to form hydroxyl radicals ($\text{OH}\cdot$). This process is described by:

The OH· chemical oxidant then reacts with the organic contaminants in the water. Given sufficient H₂O₂ and UV dose the compounds are completely destroyed. The H₂O₂ concentration is not stoichiometric as other inorganic ions can consume hydroxyl radicals. Also, the UV light converts H₂O₂ to hydroxyl radicals regardless of the organic content. Rather, the required H₂O₂ dosage is dependent upon a number of parameters including contaminant type, water quality, oxidation time, and UV intensity.

Hydroxyl radicals are the strongest practical oxidant to use for water remediation. For example, oxidation rates for OH· are 10⁶ to 10¹⁰ times faster than for ozone (see Table 3.1). Although many organic contaminants, such as TCE and benzene, are rapidly destroyed by hydroxyl radical attack, some compounds are not readily attacked by OH· (see Table 3.2). Oxidation for these organics, such as chloroform, 1,1,1-TCA and carbon tetrachloride, depends on photolysis, i.e., direct reaction with UV light. Most of these organic compounds are absorptive only in the short UV region below 240 nm where standard UV lamps are inefficient.

TABLE 3.1 OXIDATION RATES OF OZONE AND HYDROXYL RADICALS

Compound	O ₃ *	OH·*
Olefins	10 ³ -10 ⁵	10 ⁹ -10 ¹⁰
Phenols	10 ³	10 ⁹
Aromatics	10 ⁰ -10 ²	10 ⁸ -10 ¹⁰
Aldehydes	10	10 ⁹
Ketones	1	10 ⁹ -10 ¹⁰
Alkanes	10 ⁻²	10 ⁶ -10 ⁹
*K, in L mole ⁻¹ S ⁻¹		

TABLE 3.2 HYDROXYL RADICAL RATE CONSTANTS

Compound	Rate Constant ($K \times 10^{-9} \text{ M}^{-1} \text{ S}^{-1}$)
Benzene	7.8
Vinyl Chloride	7.1
TCE	4.0
Dichloromethane	0.058
Chloroform	0.005
TCA	Very slow
Carbon Tetrachloride	Non-reactive

Since 1985, a number of improvements and advances have been made in the perox-pure™ technology to increase the oxidation rate of difficult to oxidize organic compounds. Many of these compounds are low molecular weight chlorinated alkanes such as chloroform (CHCl_3), carbon tetrachloride (CCl_4), 1,1,1-trichloroethane (1,1,1-TCA), methylene chloride (MeCl), and 1,1-dichloroethane (1,1-DCA). Overall improvements in oxidation rates range from 200 to 400%, depending on the compound.

Much of this advancement is due to UV lamp efficiency. The most recent innovation incorporates a novel UV lamp technology. Briefly this new lamp generates two to three times the UV energy with the same electrical input as conventional high intensity UV lamps. In addition, much of this UV light is generated below 250 nm wavelength where it has enough energy to oxidize chlorinated alkanes directly. Therefore, the combination of standard perox-pure™ technology with the novel UV lamp results in an AO process that is effective for the destruction of a wide variety of organic compounds found in contaminated groundwater.

3.3 Surface Discharge (SD) UV Lamp

The SD is a pulsed plasma discharge along a dielectric surface between two electrodes. High UV efficiency is achieved by electrically driving the SD lamp at high intensity and producing UV light from the dielectric material that is generated in the plasma.

An SD occurs when the electrical potential between the two electrodes is large enough to cause a gas breakdown. A schematic of a rectangular SD is shown in Figure 3.1. Capacitive coupling through the dielectric substrate with the conductor below the dielectric aids in generating the plasma along the surface. The breakdown occurs preferentially along the surface, resulting in a ribbon-like plasma which emits intense incoherent light. The light properties (i.e., peak intensity, spectrum, and pulselength) depend on several parameters including the electrical circuit components, gas composition and pressure, geometrical arrangement of the electrode/substrate combination and the composition of the substrate material. For typical well designed systems, over 90% of the stored electrical energy is deposited in the plasma. Generally, over 70% of the energy deposited in the SD plasma is converted to light. Consequently, the SD is a very efficient source of light.

The radiant emission from the SD can be enhanced in a specific spectral region by choosing a substrate material with constituents that have emission lines in the desired spectral region. A summary of research and development of the SD light source conducted at the WJSA Laboratory is given in Table 3.3.

FIGURE 3.1 SURFACE DISCHARGE SCHEMATIC

TABLE 3.3 SURFACE DISCHARGE TECHNOLOGY DEVELOPMENT⁽¹⁻¹²⁾

High intensity radiant output (W/cm ²)	4 x 10 ⁶
Large area emission (cm ²)	750
Uniform radiant output	Yes
Geometrical shaping	Linear, rectangular, cylindrical, annular
Spectral enhancement	Factor of 2 in 0.2 - 0.3 μ m band
Repetitive pulse rate (Hz)	5000
Temporal pulsewidth (s)	7 x 10 ⁻⁸ - 10
Lifetime (shots), fused silica substrate	>10 ⁶

The SD geometrical configuration is flexible. That is, the dielectric can be arranged in many different shapes, including rectangular (shown in Figure 3.1), annular, linear and cylindrical. We use a cylindrical SD lamp for in-water remediation applications, shown in Figure 3.2. In this configuration, the electrical discharge generates a plasma along a cylindrical rod between cylindrical electrodes. An outer envelope retains the rare gas used for the plasma discharge. Figure 3.2 also shows an open shutter photograph of the pulsed plasma discharge. Many streamers are generated along the circumference of the cathode, which together form a cylindrical light emitting plasma.

A comparison of the most efficient SD UV spectrum with a standard medium pressure mercury lamp (see Figure 3.3) shows the efficiency advantage of the SD lamp. In the wavelength region below 240 nm needed for photolysis, the SD UV efficiency shown is about five times that of the commercial lamp. This results in much faster organic destruction rates with the SD lamp.

Prior to this DT&E program, WJSA and PSI collaborated in an internal research and development program using the SD cylindrical lamp to demonstrate the advantages of the short UV light. In order to achieve sufficient reliability for processing tests, the SD lamp was operated at: (1) one-fourth of the UV efficiency shown in Figure 3.3 and (2) at low power (200 W). In those tests, the destruction rates of organic compounds 1,1,1-TCA and CCL₄ (which are treated by UV photolysis with the SD lamp) were 1.5 times that with the standard lamp. This result established the advantage of the SD lamp and led to the DT&E program reported here.

(a) Tare Shot of SD Lamp

(b) Open Shutter Photo of SD Plasma

FIGURE 3.2 SURFACE DISCHARGE CYLINDRICAL LAMP

FIGURE 3.3 SD UV LAMP COMPARISON WITH COMMERCIAL UV LAMP

The primary limitation in SD lamp operation in the laboratory tests was due to the accumulation of substrate species on the envelope, reducing UV transmission. In the laboratory tests, the SD lamp had to be disassembled and cleaned after approximately 15 minutes of operation. Consequently, the first step in this DT&E program was to upgrade the lamp to operate at the higher power and longer operating times needed for a field test. This upgrade is described in the next section.

3.4 SD UV Lamp System Upgrade

3.4.1 Summary

At the start of this program, an upgraded SD lamp system, referred to as SD-2, was designed to improve performance for field tests and for integrating with the PSI demonstration system. Initial retrofit and upgrade design of SD-2 was followed by laboratory testing to establish the lifetime capabilities for the field test.

Both the laboratory and upgrade system designs have the same subcomponents shown in Figure 3.4. The SD lamp, which interfaces with a PSI test chamber, mounts against end flanges which orient the lamp axially in the center of a cylindrical processing chamber. Contaminated water flows in one end, is irradiated by the SD lamp (destroying the organic contaminants) and exits the other end of the chamber.

A gas recirculation system removes the gas from the discharge area, filters, cools and returns it to the lamp. The electrical driver stores and then discharges electrical energy into the lamp. A liquid cooling recirculation system cools the electrodes and substrate.

In the earlier laboratory prototype system, a powder from the SD substrate accumulated on the lamp envelope over time, which reduced the UV transmission. In that system, when operated at an average power of 200 watts, the UV transmission degraded after about fifteen minutes of operation. Insufficient electrode cooling and gas flow in the recirculation system were the key factors in that degradation.

SD-2 can operate as high as 1,500 watts, about a factor of 7 increase from the laboratory system. The liquid cooling flow rate is approximately a factor of 30 greater than the laboratory system. Also, the gas recirculation flow rate is larger, by over a factor of 100, than the laboratory system and the gas filter system is greatly improved.

FIGURE 3.4 SURFACE DISCHARGE LAMP SYSTEM BLOCK DIAGRAM

FIGURE 3.5 SURFACE DISCHARGE LAMP LAYOUT

3.4.2 Water and Gas Recirculation Systems

The layout drawing for the new SD UV lamp in Figure 3.5 shows specific details for the gas flow, water ports, and electrodes. The number of cooling ports to the electrodes is larger by a factor of 3, and the flow rate by approximately a factor of 30. The electrodes are approximately twice as massive, thereby providing better heat sinking.

The water circulation flow system cools the electrodes and the substrate of the SD lamp. The flow loop is arranged in series, with water flowing through the cathode first, then through the center of the lamp to the anode and back to a chiller that maintains the water at a selected temperature.

A system layout for the gas recirculation and filtering system is shown in Figure 3.6. The flow rate for this system removes the gas from the SD UV lamp between each shot for the maximum expected rep rate of five times per second. Expansion tanks allow the pressure from the discharge in the lamp to be relieved external to the lamp.

3.4.3 Preliminary Integration with PSI Test Chamber

The first step in integrating SD-2 with the PSI system was to integrate the lamp with the test chamber itself. Since the SD UV lamp has a different diameter than the standard lamp system used by PSI, custom end flanges were designed, fabricated and installed to mount the SD lamp to the test chamber.

3.4.4 Laboratory Testing of UV Lamp System

The fabrication of SD-2 led to laboratory testing. The SD UV lamp was assembled and the gas recirculation and liquid cooling systems checked out. Separately, the electrical driver was tested with a resistive load to verify design specifications. Next, the electrical driver was connected to the SD lamp mounted external to the test chamber. After observation of the plasma discharge visually for proper operation, the UV output was measured using an optical multichannel analyzer calibrated to an NBS traceable standard.

Next, the SD UV lamp was mounted in the test chamber and operated in a repetition rate mode. To simulate the field test, water was circulated through the laboratory reactor during SD operation. An optical fiber through the wall of the reactor served as a monitor of UV output from the lamp reaching the wall of the test chamber. The temperature of the gas and liquid flow

FIGURE 3.6 GAS RECIRCULATION SYSTEM LAYOUT

was monitored at different locations and as a function of time. Initial tests were at low repetition rates and the repetition rate gradually increased to observe changes in thermal response and/or UV transmission. In the final laboratory test series, the SD lamp operated for three hours at an average power of 1,000 watts without degradation in UV output. Since the previous laboratory lamp operated at 200 watts for 15 minutes, the SD-2 lamp operated at five times higher power for twelve times longer, or an increase of a factor of sixty in total UV emitted. At the end of these tests, SD-2 was crated and transported to PSI for further integration and process testing.

3.5 Integration and Process Testing at PSI

SD-2 was integrated with a bench-scale perox-pureTM unit in PSI's trailer field test demonstration unit. The closed-loop bench-scale unit consisted of a reactor, circulation pump, heat exchanger, recycle reservoir and H₂O₂ feed pump. The integration included installing the lamp and electrical driver pallets in the PSI demonstration trailer. Figure 3.7 shows the trailer, the electrical driver and lamp system pallets (located on the left-hand side of the trailer) as well as the perox-pureTM system (located on the right-hand side of the trailer). The perox-pureTM system in the trailer consisted of a perox-pureTM Model SSB-30R chemical oxidation unit and a Model PM-000X H₂O₂ Feed Module. Ancillary equipment used during the demonstration included a 300-gallon HDPE tank, a dual canister cartridge filter and a 50-gpm magnetic drive feed pump. Interconnecting piping and wiring was provided by PSI.

The perox-pureTM Model SSB-30R is a skid-mounted unit consisting of an oxidation chamber, a control panel, and an electrical enclosure. The oxidation chamber is made up of six horizontally-mounted sections. Each section consists of a cylindrical sub-chamber with a quartz tube mounted axially in the sub-chamber. One 5 kilowatt PSI UV lamp is positioned inside each quartz tube. Water to be treated enters the first subsection bottom of the oxidation chamber. The water is contained between the chamber wall and the quartz tube and does not contact the UV lamp. The water flows up through the chamber in a turbulent manner ensuring uniform mixing and contact with the UV light. The water exits the final subsection at the top of the oxidation chamber. The oxidation chamber is completely flooded during operation.

The control panel of the SSB-30R featured the process monitoring equipment, system control switches and alarms. The process monitoring equipment consisted of a flow meter, a flow accumulator, an hour meter, and ammeters for each UV lamp. The control switches

included system startup, H₂O₂ feed pump startup, and individual UV lamp startup. A system power cutoff button was provided for emergency use. Alarm annunciators were provided in the control panel to inform the user of the cause of system shutdown, if one occurred.

Plumbing lines were hooked up and installed to prepare for batch recycle testing at DOE. Initial process testing at PSI showed that the system integration was complete. The trailer was then shipped to Oak Ridge, Tennessee.

(a) View of SD System From Center of Trailer

(b) View of SD System From End of Trailer

(c) Demonstration Trailer

(d) View of Perox-Pure™ System From Center of Trailer

FIGURE 3.7 SD LAMP SYSTEM INTEGRATED WITH PSI DEMONSTRATION TRAILER

4.0 DEMONSTRATION TESTING

4.1 Summary

The demonstration testing has three stages: setup, testing and data analysis. Martin Marietta Energy Systems (MMES) was responsible for the on-site setup which included permitting and other regulatory requirements, arranging for a pump system to transfer the water to the demonstration trailer site, arranging for electric power to be brought in and for handling the treated water. WJSA and PSI set up the test plan with the objective of demonstrating (1) the viability of the perox-pureTM water treatment system and (2) improvements in water remediation from using the SD UV lamp. The test plan includes variations in lamp operating conditions, H₂O₂ dosage, pH level, water pretreatment and catalyst dose. Phase I testing was with the perox-pureTM system alone whereas Phase II testing employed SD-2 alone and with the perox-pureTM system. The data analysis shows that the perox-pureTM system successfully treated the water from the SW-31 Spring and that for the major organic constituent, TCA, SD-2 had greater destruction rate.

4.2 Test Objectives

The general test objective was to evaluate the performance of UV/UV catalyzed peroxide water treatment remediation methods. Specifically, the objectives were to compare and contrast the existing commercial perox-pureTM system with SD-2. The test had two phases. The first was to optimize the operation of the perox-pureTM system by varying the peroxide concentration, pH level, catalyst dose and the pretreatment conditions. The second phase was to measure the water treatment capabilities of SD-2 over the range of lamp operating parameters available for these tests. This data both establishes the water remediation capabilities of SD-2 and provides a basis to extrapolate to water remediation capabilities with SD lamps after further engineering to increase lifetime and UV efficiency.

4.3 Test Description

4.3.1 Test Setup and Site Description

The test site is on the eastern side of K-25. The SW-31 Spring is adjacent to the east side of Avenue D, approximately 200 feet west of the K-1070 classified burial ground. The SW-31 Spring flows from a PVC pipe which is embedded in the hillside below the classified burial ground. Flow rates vary depending on the weather, ranging from very little flow in dry weather up to six gallons per minute.

The location of the Spring is enclosed in an area requiring clearances and/or escorts. In order to facilitate our testing, the actual treatment site was located outside the fence. This allowed the workday to begin early and end late. The water from the Spring was pumped up the hillside approximately one block away to a holding tank at the demonstration site. Martin Marietta Energy Systems (MMES), in support of DOE, handled the site preparation as well as test support. MMES also arranged for power lines to be brought to the trailer site location to run the equipment. Almost all of the necessary equipment for running the demonstration was contained in the PSI demonstration trailer shown. In addition, tanker trucks were on-site to receive the treated water for transport over to the water treatment facility at the K-25 site for final discharge.

4.3.2 Testing Procedures

Testing with both the perox-pureTM and SD-2 systems was conducted with water collected from the SW-31 Spring. The SW-31 Spring emptied into a small sump. As needed, water spilling into the sump was pumped to the demonstration area approximately 100 yards away. The water was collected in a 330-gallon HDPE tote tank mounted inside a steel cage. The discharge from the water supply line was positioned inside the tank near the bottom to minimize volatilization losses of the VOCs. The tank was provided with a level control float to discontinue the water supply when 300 gallons had been collected. The water supply could also be manually controlled. In this way, water was collected in a sufficient volume on an as needed basis to insure that the untreated water was as fresh as possible for each day's testing.

The SW-31 Spring water contained 10 to 20 mg/l of ferrous iron in solution. Upon delivery to the demonstration collection tank, the iron began to oxidize due to contact with the atmosphere. The initially clear water turned turbid orange within a few hours of collection.

Since iron removal was desired in most tests, the water was allowed to set for at least four hours before being used.

After oxidation of the iron was complete, water was pumped to the batch tank inside the PSI trailer as needed. When iron removal was desired, the water was circulated through the cartridge filter canister loaded with 3 μ cartridges. In most instances, the iron concentration was reduced to less than 2 mg/l by running the water through the filters.

When desired, acid addition for pH adjustment was performed in the batch tank. Concentrated sulfuric acid was added to the batch in sufficient volume to produce the desired pH reduction. The water was circulated in the batch tank to facilitate mixing. Influent pH level controls the carbonate chemistry. Carbonate and bicarbonate ions scavenge hydroxyl radicals. Acid addition lowers the pH which shifts the carbonate equilibrium to carbonic acid, which reduces the completion for $\text{OH}\cdot$ radical.

After completion of the desired pretreatment, the water was used in the perox-pure™ or SD-2 system tests. At the conclusion of the testing, the treated water was pumped to a 5,000-gallon tanker truck for removal to a suitable location. Any untreated water was treated with the perox-pure™ system for a time sufficient to significantly reduce the VOC concentrations before discharge to the tanker.

4.3.2.1 Perox-Pure™ System

The pretreated water was treated in batch mode with the perox-pure™ system to provide longer contact times than would be available in a flow-through mode of operation. The water was pumped at a rate of 40 gpm from the batch tank into the oxidation chamber of the perox-pure™ unit. H_2O_2 was added at a given rate into the water between the feed pump and the oxidation chamber. The effluent from the oxidation chamber was directed back into the batch tank, with a volume of about 75 gallons.

During each test, the UV lamps were warmed up for a period of 2 minutes to reach peak intensity. H_2O_2 addition was initiated immediately after the lamp warmup period. Water samples were collected from a sample valve downstream of the feed pump. The first sample, designated as 0 minutes of oxidation, was collected just before H_2O_2 addition was initiated. Subsequent samples were collected from the same point at specific time intervals. In certain tests, samples were collected at points across the oxidation chamber to provide a comparison of flow-through

and batch mode VOC destruction rates. Throughout each test, the H_2O_2 addition rate was controlled to maintain the H_2O_2 concentration (see Section 3.2) at the influent of the oxidation chamber.

4.3.2.2 SD-2 System

Approximately 12 liters of pretreated water was transferred to the recycle reservoir of the SD-2 system before each test. The circulation pump was then turned on to fill the reactor and other components of the system. After presetting the SD-2 power supply to the desired set-points, WJSA personnel initiated the discharge and slowly increased the discharge frequency. When the SD-2 UV source had been brought up to full power and frequency, a sample was collected from a valve upstream of the recycle reservoir. This sample was designated as 0 minutes of oxidation. Immediately, the desired dosage of H_2O_2 was added to the recycle reservoir, and the H_2O_2 feed pump was set at a rate to maintain the test H_2O_2 concentration at the influent to the reactor.

At predetermined time intervals, treated samples were collected via the sample valve. At the conclusion of each test, the UV source frequency was slowly decreased to "cool down" the system and prevent potential damage.

4.3.3 Quality Assurance and Quality Control Test Methods

During the demonstration period, samples of untreated and treated groundwater were analyzed for volatile organic contaminants (VOC's) by EPA Method 601 and EPA Method 602. These analyses provide data to determine the efficiency of the perox-pureTM and SD-based processes and their cost effectiveness. Additional samples were analyzed for non-volatile organics using EPA Method 625/8250 (Extractable Organics). The combination of EPA Methods 601, 602 and 625 provide an accurate assessment of the success of the technology.

Peroxidation Systems, Inc. (PSI) regularly analyzes 300 to 500 samples per month for EPA Methods 601/602. Their laboratory in Tucson, Arizona has two complete gas chromatograph (GC) purge and trap systems using Hewlett-Packard 5890 chromatographs with O.I. analytical detectors and computerized data analysis. Also, some runs at the SW-31 Spring had a split sampling system for DOE analysis by a direct sampling ion trap mass spectrometer.

4.4 Test Conditions

4.4.1 Phase I Tests with Perox-Pure™ System

Sixteen (16) Phase I tests were performed on the SW-31 Spring water with the perox-pure™ system. The test conditions are shown in Table 4.1. H₂O₂ concentration, influent pH,

**TABLE 4.1 PHASE I CONDITIONS FOR PEROX-PURE™
TESTING ON SW-31 SPRING WATER**

Test	H ₂ O ₂ ¹ Maintained (mg/l)	Influent pH	Catalyst (mg/l)	Water ² Pretreated
1	20-100 ³	7	0	Yes
2	20	7	0	Yes
3	40	7	0	Yes
4	100-400 ³	7	0	Yes
5	50	6	0	Yes
6	50	5	0	Yes
7	50	3.5	0	Yes
8	70	6.5	0	Yes
9	200-600 ³	4	20	Yes
10	50	3.5	20	Yes
11	50	4	50	Yes
12	50	4	100	Yes
13	50	5	0	No
14	50	6.5	0	No
15	50	4.8	0	Yes
16	50	3.2	20	Yes
¹ H ₂ O ₂ Concentration maintained during test via continuous addition of 50% solution H ₂ O ₂ . ² Pretreatment for iron removal via filtration. ³ H ₂ O ₂ Concentration not effectively controlled.				

catalyst (proprietary to PSI) dosage, and water pretreatment (via filtration for iron removal) were the process variables evaluated during the study. In Test 1, 4 and 9, the H_2O_2 concentration was not properly controlled. Hence, the conditions of these tests were repeated with the correct H_2O_2 concentrations in Tests 2, 8 and 10, respectively. Also, Tests 15 and 16 were performed to repeat the conditions of tests 6 and 10, respectively, in order to check the accuracy of the earlier tests across the oxidation chamber to provide flow-through treatment results.

4.4.2 Phase II Tests with SD-2 System

Nineteen (19) Phase II tests were performed on the SW-31 Spring water with the SD-2 system. The test conditions are shown in Table 4.2. H_2O_2 concentration, influent pH, catalyst dosage and water pretreatment were varied as in Phase I. Most of the tests were conducted with no H_2O_2 at a pH of 3 to 4 since these conditions were expected to be the most favorable. In addition, SD-2 lamp parameter variations included gas-type, charging voltage (V_c), pulse repetition frequency (PRF), lamp envelope and substrate materials.

The tests included variations of all planned lamp system and water treatment parameters. However, technical problems caused some of the values of parameters to be changed. For instance, instead of an average power between 1,000 and 1,500 watts, the tests were between 500 and 1,000 watts due to glass envelope failure. The plan was to use Suprasil envelopes for most of the tests, but due to manufacturing flaws, Suprasil was used only for the first two tests. GE-214 was used for the rest of the tests.

The failure of the high quality UV transmissive (Suprasil) lamp envelopes was unexpected. Minimum orders for Suprasil were expensive and had long delivery times, but since the manufacturer (Hareus-Amersil) located a small batch of Suprasil with acceptable dimensions, it was decided that, based on previous experience, ten Suprasil envelopes available should be more than sufficient. However, the purchased Suprasil material had greater variability in thickness and diameter than previous lots. Custom end caps were machined for each end of each envelope. Nevertheless, the variability in diameter and thickness resulted in breakage not expected at the beginning of the program. Consequently, once the available Suprasil material was consumed, the tests continued with standard quality UV lamp envelopes (GE-214). As discussed below, this reduced the organic destruction rate due to the increase in UV absorption in the standard quality envelope material. Thus, the analysis of the destruction rates in this program includes

**TABLE 4.2 PHASE II CONDITIONS FOR SD UV LAMP
TESTING ON SW-31 SPRING WATER**

Test	H ₂ O ₂ mg/l	pH	Pre- treatment [◊]	Catalyst mg/l	Power (W)	Gas	V _c (KV)	PRF (Hz)
1A [□]	0	3.8	Yes	0	1000	Kr	18.4	2.6
2A [□]	0	3.3	Yes	0	1500	Kr	18.4	3.8
3A	0	3.3	Yes	0	500	Argon	17.3	1.5
4A	0	3.3	Yes	0	500	Kr	17.3	1.5
5A	70	3.3	Yes	0	500	Kr	17.3	1.5
6A	50	3.3	Yes	0	500	Kr	17.3	1.5
7A	25	3.3	Yes	0	500	Kr	17.3	1.5
8A	0	6.7	Yes	0	500	Kr	17.3	1.5
9A	0	4.0	Yes	20	500	Kr	17.3	1.5
10A	0	4.0	Yes	50	500	Kr	17.3	1.5
11A*	5	3.6	No	0	500	Kr	17.3	1.5
12A ^Δ	0	3.0	Yes	0	1000	Kr	17.3	3.0
13A ^Δ	0	3.0	Yes	0	500	Kr	17.3	1.5
14A	0	6.3	No	0	500	Kr	17.3	1.5
15A	0	3.0	Yes	0	500	Kr	17.3	1.5
16A	0	3.0	Yes	0	500	Xe	17.3	1.5
17A	0	3.0	Yes	0	1000	Xe	17.3	3.0
18A	0	3.0	Yes	0	600	Xe	18.9	1.5
19A	0	3.0	Yes	0	700	Xe	20.5	1.5

[□]Suprasil envelope

^ΔGE214 substrate (replaces Suprasil substrate)

*In series, with PSI unit first

[◊]Filter iron before treatment

extrapolations based on comparison of tests with and without Suprasil to estimate the destruction rates of a system with Suprasil.

The UV emission efficiency increases with atomic weight of the gas. That is, the UV output from xenon is greater than krypton is greater than argon. Thus, the organic destruction rate is expected to be greatest with xenon, less with krypton and least with argon.

4.5 Test Results

The analytical reports for all tests are compiled in Appendix VII for completeness. Summary tables for review and analysis are in Appendices IV and V, and are discussed below. Discussion of an apparent anomaly in the vinyl chloride data is discussed in Appendix VII.

4.5.1 Water Characterization

On October 12, 1993, during the initiation of the testing with the SD-2 system, 2 liters of SW-31 Spring water were obtained from the collection tank and shipped to the PSI Testing Laboratory in Tucson, Arizona. The water was characterized for a variety of water quality parameters of interest to the perox-pureTM and SD-2 processes. The characterization results are shown in Table 4.3. The iron and TSS settled rapidly leaving a clear, colorless solution with a residual iron (i.e., after oxidized iron settled) of 0.2 mg/l.

4.5.2 Phase I Tests with Perox-PureTM System

The perox-pureTM testing results are shown in Appendix IV. Chloroethane, 1,1-dichloroethane and 1,1,1-trichloroethane were the primary contaminants detected. In some tests, trichlorofluoromethane was also detected at a significant concentration. Low µg/l levels of several other halogenated and aromatic VOCs were also detected.

The variation in influent VOC concentration (0 minutes of oxidation) is attributed to the different holding times for each batch of spring water in the collection tank and the change in ambient temperature from day to day. Initial batches yielded a total VOC concentration of approximately 1 mg/l. In one test, the total VOC concentration was more than 5 mg/l. Typically, the total influent VOC concentration was between 1 and 2 mg/l.

TABLE 4.3 CHARACTERIZATION RESULTS FOR SW-31 SPRING WATER

Parameter	Value
Visual Appearance	Turbid Orange
pH	6.9
TDS (mg/l)	350
Turbidity (FTU)	2 ¹
Total Iron (mg/l)	16
Chloride (mg/l)	58
COD (mg/l)	13 ¹
TOC (mg/l)	5
Alkalinity (mg/l)	250
TSS (mg/l)	50
NO ₃ as N (mg/l)	<0.1
Hardness (mg/l)	300
¹ Valve obtained after solids allowed to settle	

During Tests 3, 5 and 13, additional samples were collected for analysis of base neutral/acid semivolatile organic compounds and none was detected (see Appendices IV and VII). No semivolatile compounds were detected, either in the influent or treated samples.

4.5.3 Phase II Tests With SD-2 System

The treatment results obtained with the SD-2 system are shown in Appendix V. As was the case with the perox-pure™ system, 1,1-dichloroethane and 1,1,1-trichloroethane were two of the primary compounds detected. However, chloroethane was only detected in Test 1 and 2. Subsequent tests, conducted several weeks after Tests 1 and 2, contained methylene chloride instead. Low µg/l levels of numerous other halogenated and aromatic VOCs were also detected.

The influent VOC concentration typically varied between 0.5 and 1 mg/l. This is somewhat lower than the concentration range detected during the perox-pure™ testing. This may

be attributed to the additional handling of the water in which water was transferred by bucket from the perox-pureTM feed to the SD batch tank required for the SD-2 tests.

4.6 Data Analysis

A performance analysis was conducted to correlate the organic destruction rates (see Appendix III for definition) with the test variables. As evident in the test results, TCA and DCA were the two organic contaminants with (by far) the highest initial concentrations. This was fortunate since it allows a comparative evaluation of the perox-pureTM and SD-2 systems. As discussed above, the perox-pureTM system is optimized for organic destruction via OH[·] oxidation (in terms of power, spectrum, processing chamber and H₂O₂ addition). Since DCA is responsive to OH[·], its destruction rate is a valid benchmark for perox-pureTM processing. The SD-2 system, on the other hand, due to its short wavelength UV spectrum, should be advantageous for destroying organics which are more receptive to direct UV photolysis. TCA is relatively unresponsive to OH[·] treatment, and is most responsive to UV photolysis. Thus, destruction rates of TCA should be sensitive to changes in SD-2 UV output and be processed relatively slowly with the perox-pureTM system. The ability of SD-2 to destroy TCA more quickly than the perox-pureTM system, then, is the primary measure in these tests of the improvement afforded by SD-2. The summary conclusions for the perox-pureTM system, SD-2 system and a comparison are in Tables 4.4 and 4.5.

The results for the perox-pureTM system are straightforward and generally as expected. The VOC destruction rate increased with increasing peroxide concentration, with about 50 milligrams per liter being the nominal best value since further additions of peroxide to 70 milligrams per liter increased the destruction rate only slightly. A careful examination showed that the DCA destruction rate was strongly affected by the peroxide whereas the TCA destruction rate increased very slightly with increased peroxide concentration. This is to be expected since, as explained above, DCA is responsive to OH[·] oxidation whereas TCA is not. The pH value had very little affect on the VOC destruction rates in general. A careful look at the data showed that the secondary constituents, such as Benzene and Xylene, did benefit greatly from reduced pH. The pretreatment to filter out the iron significantly increased the VOC destruction rate by greater than a factor of 2. The catalyst (proprietary to PSI) provided no overall advantage.

TABLE 4.4 SUMMARY CONCLUSIONS FOR PEROX-PURE™ TESTING

Variable	Conclusion
H ₂ O ₂ Concentration	Increasing H ₂ O ₂ concentration increased VOC destruction rate, with 50 mg/l, the nominal "best" value
pH	A reduction in pH from 6 to 3 slightly increased VOC destruction rates
Pretreatment	Iron filtration significantly increases VOC destruction rates
Catalyst	The catalyst provided no overall advantage

TABLE 4.5 SUMMARY CONCLUSIONS FOR SD LAMP TESTING

Variable	Conclusion
H ₂ O ₂ Concentration	The TCA destruction rate increased slightly with a small dose of H ₂ O ₂
pH	Lowering the pH from greater than 6 to about 3 increased the VOC destruction rate by greater than a factor of 2
Pretreatment	Iron filtration generally did not increase VOC destruction rates
Catalyst	The catalyst provided no benefit
Envelope Material	With Suprasil, TCA destruction rate was 2.7 times greater than with GE-214
Xenon Versus Krypton	The destruction rate of TCA was about 1.6 times greater with Xenon than with Krypton
Average Power	The destruction rate of VOCs scales linearly with power within experimental error

For SD-2 the increase in destruction rate with increase in H_2O_2 concentration was small with SD-2 since its spectrum is more attuned to photolysis. The TCA destruction rate did increase slightly (i.e., by about a factor of 1.17) with a small dose of H_2O_2 . The effect on DCA, as expected, was much greater, with an increased destruction rate of 3.3 with the addition of 25 milligrams per liter of H_2O_2 . Lowering the pH from greater than 6 to about 3 increased destruction rates by greater than a factor of 2 for both DCA and TCA in the SD-2 test. Unlike the perox-pureTM system, iron filtration did not increase the organic destruction rates. Also, the catalyst provided no benefit.

The most interesting SD-2 results were with the envelope material, the average power and the use of Xenon versus Krypton as a discharge gas. Although it was unfortunate that breakage of the Suprasil resulted in most of the tests being conducted with a GE-214 envelope, the contrast between the two does corroborate the supposition that the SD-2 system operates primarily by photolysis. The difference between Suprasil and GE-214 is that Suprasil transmits UV light down to 180 nm whereas GE-214 begins to cut off at 240 nm. The photolysis of TCA (and other similar organics) requires UV light below 240 nm. Consequently, the destruction rate of TCA should be sensitive to whether Suprasil or GE-214 is used whereas DCA, which is not based primarily on UV photolysis, should be relatively insensitive to the envelope material. This is seen in the data where the change from GE-214 to Suprasil envelope increases the TCA destruction rate by a factor of 2.7 and the DCA destruction rate increases by only 1.09. Also, within experimental error, the destruction rates of TCA and DCA are proportional to the SD-2 operating power. Finally, as expected, the replacement of Krypton with Xenon increased the destruction rate of both TCA and DCA by similar factors (1.6 for TCA and 1.9 for DCA).

A summary comparison of the two systems is as follows: As expected, the SD-2 system operated best with little or no peroxide whereas the perox-pureTM system optimized at about 50 milligrams per liter of H_2O_2 . The reduction in pH benefitted SD destruction rates strongly (i.e., by in the order of a factor of 2) whereas the perox-pureTM system benefitted only slightly (except for secondary organic compounds). The catalyst had no net effect for either system. Pretreatment benefitted the perox-pureTM system, but not the SD-2 system. Perhaps the most important conclusion is in the comparison of the TCA destruction rates for the two systems. Due to the breakage problem with the Suprasil, the destruction rate for the combination of Suprasil and xenon, which would be best, had to be inferred from a combination of tests. This is

explained in detail below. Based on this inference, the SD-2 destruction rate for TCA was more than double the rate for the perox-pure™ system. The actual best measured SD-2 destruction rate occurred in the first test with Suprasil in which the SD destruction rate was 1.35 times greater than the best perox-pure™ destruction rate. This test was run without the benefit of increased destruction rate from xenon and without the benefit of increased destruction rate of a small quantity of peroxide. In any case, the primary objective of the demonstration to demonstrate the improved destruction rate from the SD-2 system by means of photolysis was corroborated experimentally. Also since, as discussed above, the best UV efficiency demonstrated in the lab is about three times that of SD-2, further engineering improvements have the potential to increase organic destruction rates.

Finally, by operating the perox-pure™ and then SD-2 systems in series (in tests without pretreatment) both the TCA and DCA destruction rates benefitted with TCA destruction rate increasing by a 1.4 factor and the DCA destruction rate increasing by a 3.8 factor. This result indicates that a UV-based water treatment system optimized for a broad range of organics is likely to include test conditions which favor OH· oxidation in one portion of the treatment and photolytic oxidation at another point in the processing. Details of the test results are discussed further in the next paragraphs.

4.6.1 Perox-Pure™ System Data Analysis

The effects of variation in H₂O₂ dosage were demonstrated in Tests 2, 3 and 8. The H₂O₂ concentration maintained in solution was varied from 20 to 70 mg/l. All of these tests were conducted at a neutral pH, without catalyst, using water that had been pretreated for iron removal. Increasing the H₂O₂ concentration from 20 mg/l (Test 2) to 40 mg/l (Test 3) resulted in substantial improvement in the rate of total VOC destruction. Only a moderate rate increase was achieved by increasing the H₂O₂ concentration to 70 mg/l (Test 8). The unsaturated and aromatic VOCs were all destroyed to near or below the analytical detection limit in the first treated sample.

The effects of influent pH were evaluated in Tests 3, 5, 6 and 7. The influent pH was varied between 3.5 and 7 in these tests. All of these tests were conducted with a H₂O₂ concentration of 40 to 50 mg/l, without catalyst, using pretreated water. The treatment results were comparable in Tests 3 (pH 7), 6 (pH 5) and 7 (pH 3.5) indicating that pH reduction via acid

addition does not significantly benefit the VOC destruction rates. While the results for Test 5 (pH 6) appear to be significantly better than the other tests, we believe this is an artifact of the higher influent VOC concentrations, particularly the unsaturated and aromatic VOCs, which are rapidly destroyed to below the detection limit at any pH.

The benefits of catalyst addition were evaluated in Tests 7, 11, 12 and 16. The catalyst dosage was varied from 0 to 100 mg/l. During each test, the H_2O_2 concentration was maintained at 50 mg/l with an influent pH of 3.5 to 4 using pretreated water. The addition of catalyst did not increase the total VOC destruction rate. At the higher dosages, catalyst addition negatively impacted the rate of VOC destruction.

The effects of pretreatment at high and low pH were demonstrated in Tests 3, 6, 13 and 14. These tests were conducted with a H_2O_2 concentration of 40 to 50 mg/l and no catalyst addition. Pretreatment of the groundwater significantly increased the rate of VOC destruction at either pH. This is expected because the entrained iron interferes with UV penetration through the water. Lowering of the initial pH in Test 13 improved the total VOC destruction rate when the iron was not removed.

4.6.2 SD-2 System Data Analysis

Table 4.6 shows the destruction rates (see Appendix III for definition) for TCA and DCA in the SD-2 (Phase II) test series. These rates are "normalized" according to the power per unit volume in order to make a one-to-one comparison with perox-pureTM rates. This procedure is valid over the parameter range tested here based on PSI proprietary data showing that organic destruction rates are approximately proportional to the ratio of electrical power to processing chamber volume. The effects of H_2O_2 concentration on destruction rates were demonstrated in Tests 4A through 7A. H_2O_2 concentration was varied from 0 to 70 mg/l while all other parameters were held constant. The TCA and DCA destruction rates were increased by factors of 1.2 and 3.3, respectively, with the addition of 25 mg/l of H_2O_2 (Test 7A). Additional H_2O_2 did not provide further improvement, and in fact, decreased the TCA destruction rate. Note that the increase in DCA destruction rate ($\times 3.3$) with the addition of H_2O_2 is much greater than for TCA ($\times 1.2$), supporting our earlier assertion that DCA is much more receptive to $\text{OH}\cdot$ oxidation than TCA.

**TABLE 4.6 DESTRUCTION RATES FOR SD-2 TESTING
ON SW-31 SPRING WATER**

Test	H ₂ O ₂ mg/l	pH	Pre- treatment [◇]	Catalyst mg/l	Power (W)	Gas	DCA Rate (min ⁻¹)	TCA Rate (min ⁻¹)
1A [□]	0	3.8	Yes	0	1000	Kr	0.76	2.0
2A [□]	0	3.3	Yes	0	1500	Kr	0.54	1.8
3A	0	3.3	Yes	0	500	Argon	0.59	0.77
4A	0	3.3	Yes	0	500	Kr	0.70	0.75
5A	70	3.3	Yes	0	500	Kr	2.4	0.76
6A	50	3.3	Yes	0	500	Kr	2.3	0.78
7A	25	3.3	Yes	0	500	Kr	2.3	0.89
8A	0	6.7	Yes	0	500	Kr	0.16	0.25
9A	0	4.0	Yes	20	500	Kr	0.34	0.45
10A	0	4.0	Yes	50	500	Kr	0.39	0.47
11A*	5	3.6	No	0	500	Kr	0.98	0.50
12A ^Δ	0	3.0	Yes	0	1000	Kr	0.38	0.31
13A ^Δ	0	3.0	Yes	0	500	Kr	0.54	0.40
14A	0	6.3	No	0	500	Kr	0.26	0.36
15A	0	3.0	Yes	0	500	Kr	0.60	0.52
16A	0	3.0	Yes	0	500	Xe	1.12	0.83
17A	0	3.0	Yes	0	1000	Xe	0.66	0.62
18A	0	3.0	Yes	0	600	Xe	0.81	0.65
19A	0	3.0	Yes	0	700	Xe	0.71	0.58

[□]Suprasil envelope

^ΔGE214 substrate (replaces Suprasil substrate)

*In series, with PSI unit first

[◇]Filter iron before treatment

The effects of pH adjustment were evaluated in Tests 4A and 8A. The VOC destruction rates were significantly slower at neutral pH (Test 8A) than at a lower pH (Test 4A). Lowering the pH from 6.7 to 3.3 increased the TCA destruction rate by 3 and the DCA by greater than 4.

Catalyst addition in Tests 9A and 10A, 20 and 50 mg/l, respectively, resulted in slower VOC destruction than treatment without catalyst (Test 4A).

The VOC destruction rate results were slightly better for Test 8A, conducted with iron removal, than for Test 14A, conducted without iron removal. Pretreatment increased TCA and DCA destruction rates by 1.5 and 1.4, respectively.

The use of a Suprasil rather than a GE-214 envelope (tube) produced substantial improvement in the rate of VOC destruction because of the higher short UV transparency in Suprasil. The increase in TCA rate (2.7 factor) was much greater than for DCA (1.1) due to the sensitivity of TCA to UV light below 240 nm, where GE-214 transmission decreases.

The variation of VOC destruction rates with power is complicated. As seen in the next section, SD-2 produced intermediates, and net (effective) destruction rates varied with time during a given test. This effect is expected to vary with the type and concentration of organic contaminants. Further testing would be needed to quantify these effects for the SW-31. For this data analysis, we use the average destruction rate over the entire run. With this assumption, the VOC destruction rates vary approximately linearly with SD-2 power.

4.6.3 Continuous Water Monitoring Results

For several of the individual tests, personnel from Oak Ridge National Laboratories (ORNL) incorporated a continuous water monitoring system. This is a direct sample ion trap mass spectrometer (DSITMS) in which the concentration levels of organic constituents are monitored in real time and continuously during the test. The data package provided by ORNL is included in Appendix VI. A data example of the organic concentration levels (in terms of ion abundance) versus time is given in Figure 4.1. The initial delay of over a minute in concentration decrease corresponds approximately to the recirculation time of the water in the treatment system. As expected, the destruction rate of 1,1,1-TCA is the slowest with most of the other organics, i.e., xylene, benzene and toluene, falling off very rapidly. Notice that the falloff in 1,1-DCA concentration doesn't begin until after 200 sec. The exact reason for this is uncertain -- one possibility is that photolysis of 1,1,1-TCA produces 1,1-DCA. The production of MEK

**FIGURE 4.1 RUN 17A DSITMS CONTINUOUS WATER MONITORING
OF TREATMENT OF K-25 SEEP**

as an intermediate early on in the process is evident as its concentration increases from about the 100-second to the 350-second mark. It also appears that the TCA destruction rate decreases, as the DCA destruction commences and the MEK concentration increases. This is a good example of a mixed organic contaminant problem in which the assumption of linear destruction rates for all organic contaminants is unfounded. Also, since the production of intermediates and their subsequent destruction can depend nonlinearly of the ultraviolet input power, extrapolations of the destruction rates as a function of system power must be made with caution. Destruction rate testing to determine actual requirements is necessary for accurate cost estimates.

An important motivation for including the DSITMS analysis was for a comparison of the concentration levels measured versus standard analytical techniques. Tables 4.7 and 4.8 exhibit two comparisons. Table 4.7 is for Run No. 12 with the perox-pure™ system and Table 4.8 is for Run No. 17A with SD-2. For 1,1-DCA, 1,1,1-TCA and benzene the agreement is generally within about a factor of two at the high end of measured concentration. At lower concentration, and for benzene, toluene and xylene, the quantitative agreement is less good.

It would have significantly enhanced the field tests if the DSITMS diagnostic had been used for all the tests. Real-time feedback would have been valuable in examining trends and revising the test plan during the test series. Consequently, we recommend that in future tests this diagnostic be included for the entire test series.

TABLE 4.7 DSITMS ANALYSIS OF WATER FOR RUN NO. 12

Compound	Concentration at Test Start (ng/mL)		Concentration at 2 Min. (ng/mL)		Concentration at 3 Min. (ng/mL)	
	ORNL*	PSI	ORNL*	PSI	ORNL*	PSI
1,1-DCA	191	409	58	57	2	16
1,1,1-TCA	202	277	139	69	20	36
Benzene	9	18	0	0	0	0
Toluene	4	33	0	0	0	0
Xylene	14	44	1	0	1	0
*ORNL numbers are semi-quantitative field estimates.						

TABLE 4.8 DSITMS ANALYSIS OF WATER FOR RUN NO. 17A

Compound	Concentration at Test Start (ng/mL)		Concentration at Test Start (ng/mL)	
	ORNL*	PSI	ORNL*	PSI
1,1-DCA	624	407	36	67
1,1,1-TCA	552	366	81	67
Benzene	46	18	2	<1
Toluene	48	15	3	<1
Xylene	218	11	3	<1
*ORNL numbers are semi-quantitative field estimates.				

4.6.4 Comparison of Treatment Systems

The summary comparison of SD-2 with perox-pureTM in Table 4.9 emphasizes the TCA rate, which is representative of the photolysis-based oxidation rate (increase). The best perox-pureTM treatment results were achieved in Test 3 which was conducted with a H₂O₂ concentration of 40 mg/l, neutral pH, no catalyst, using pretreated water. These conditions are expected to be the optimum for perox-pureTM treatment of the SW-31 Spring water. At these conditions, the destruction rate constant for TCA was 1.5 min⁻¹ (see Appendix III).

For comparison with SD-2, several different rates are examined since, due to Suprasil breakage problems, not all intended combinations of lamp variables should be tested. The first SD-2 treatment test (1A), performed on pretreated water without H₂O₂ or catalyst addition, at a pH of 3.8 and a discharge power equivalent to 1,000 watts, is the baseline for the analysis. The quartz tube was Suprasil and Kr gas was used. At these conditions, the first-order destruction rates for 1,1,1-trichloroethane was 2.0 min⁻¹. This is a factor of 1.33 faster than the best perox-pureTM rate and was accomplished without the use of H₂O₂.

TABLE 4.9 SUMMARY COMPARISON OF PEROX-PURE™ WITH SD-2 TEST RESULTS

Variable	Conclusion
H ₂ O ₂ Concentration	SD-2 was best with little (~25 mg/l) or no H ₂ O ₂ perox-pure™ with larger (~50 mg/l) H ₂ O ₂ concentration
pH	SD-2 benefitted strongly but perox-pure™ benefitted only slightly
Catalyst	No effect
Pretreatment	Pretreatment benefitted the perox-pure™, but not the SD-2 systems
TCA Destruction Rate	The best inferred SD-2 destruction rate was 2.5 times greater than perox-pure™ rate
Use of Both Systems	The TCA destruction rates benefitted from operating perox-pure™ and SD-2 in series

To provide the best estimate possible with the available SD-2 test data, it is necessary to extrapolate the results of Test 1A to account for the effects of using Xe gas rather than Kr. In an internal research and development program, we (WJSA and PSI) showed that multiplication of different rates to give the net rate is a good approximation so long as each rate relates to UV efficiency, as in this case. By comparison of the results from Test 15A (Kr gas) and 16A (Xe gas), the destruction rate increases by $\times 1.6$ for 1,1,1-trichloroethane. Applying this factor to the data from Test 1A, the projected destruction rates with the SD-2 system is 3.2 min^{-1} for 1,1,1-trichloroethane or 2.1 times faster than the best perox-pure™ rate.

Furthermore, the addition of a small quantity of H₂O₂, as shown in comparing Tests 7A and 4A, increases the TCA destruction rate by about a factor of 1.2. Thus, an estimate of the results that might be expected with the SD-2 lamp system, including Xe and H₂O₂, is a TCA destruction rate of 3.8 min^{-1} , or a factor of 2.5 times faster than the best rate with the perox-pure™ system. Further development of SD lamp systems should include an experimental demonstration of these extrapolated destruction rates.

5.0 TECHNOLOGY EVALUATION

5.1 Progress and Status of SD Lamp Development

5.1.1 Background

Prior to this program, the SD UV lamp was a laboratory system which had not been operated in the field. In single pulse measurements of UV efficiency, SD UV emission was up to five times greater efficiency (between 200 and 240 nm) than the commercial high intensity UV lamps currently used. In that first SD system, inadequate gas flow resulted in the envelope UV transmission degradation in about 1,000 pulses when the lamp was operated at maximum efficiency. Consequently, to improve lifetime for the laboratory processing tests, the single pulse efficiency in the 200-240 nm region was approximately one-fourth of the best demonstrated in single pulse tests (i.e., about 25% higher than the medium pressure mercury lamp). At this single pulse efficiency, the average power was limited to 200-300 watts as compared to 2,000 watts for the commercial lamp. These SD UV lamp operating capabilities were inadequate for a field test. As described above, the SD-2 system designed and built in this program resulted in a power increase to 1,500 watts (from 300 watts) and demonstrated operating time of three hours (from 15 minutes).

5.1.2 Performance Improvements

For practical use the SD UV lamp requires performance improvements in the total energy delivery without degradation in UV transmission. Additional improvements are necessary to achieve commercially acceptable maintenance-free operating times. For instance, for eight weeks of maintenance-free operation for twenty-four hours a day, the degradation-free operating time must be increased by about a factor of 500 over the three hours demonstrated to date. We believe this goal is readily achievable with straightforward engineering. Commercial flashlamps, a similar technology to the SD lamp, have a demonstrated lifetime over 2,000 times greater than the three hours demonstrated with the SD lamp to date.

Also, the operational single pulse efficiency should be increased toward the maximum demonstrated single pulse efficiency. The single pulse efficiency of SD-2 was variable, but for the field tests was operated at close to the same efficiency as the laboratory unit (i.e., one-fourth

the maximum demonstrated). Operating the lamp at increased UV efficiency will increase the organic destruction rate, which is highly desirable.

5.1.3 Unique Characteristics of UV/UV Catalyzed Technology

In comparing UV/UV catalyzed technology with classic water remediation technologies, such as air stripping and GAC, the biggest difference is that UV/UV catalyzed technology has no by-products requiring additional treatment. That is, the organic contaminants are destroyed by UV/UV catalyzed technology, whereas the contaminants are transferred to another medium with the classical technologies. Air stripping is used only where special permits have been granted, allowing air emission of organic contaminants at some maximum rate. This approach is not a long-term solution. The use of GAC on DOE sites is particularly difficult due to the production of a new contaminated waste that must be handled. The possibility of radio-active components in this contamination exacerbates the regulatory and permitting efforts that would be necessary if GAC were chosen for water remediation.

The use of a SD UV lamp in a UV-based water remediation system has the additional advantage of increasing the processing rate and reducing the water remediation cost for many mixed organic waste water remediation problems (see Section 5.2). The data from this field test (see Section 4.6) indicate that some combination of UV processing with and without peroxide will be optimum. Depending on the organics requiring destruction, in some cases, very little or no peroxide may be required using the SD UV lamp. This can reduce handling and materials cost.

5.2 Cost Savings and Benefits

5.2.1 Cost Comparison

Both general (DOE-wide) and specific (the SW-31 Spring) comparisons of the perox-pure™ and SD UV-based water treatment systems with the classical air stripping and GAC techniques is difficult because of a combination of regulatory aspects and the variability in effectiveness of each technique with different organics. With a mixture of organics such as in the SW-31 Spring, the comparison is even more difficult. For the perox-pure™ process, as discussed above, hydroxyl destruction rate constants vary strongly with organic compound. Case studies have shown, for instance, that for TCE the perox-pure™ process cost ranges from 10 to

30 cents per 1,000 gallons for 99.9% destruction. For a compound such as benzene the cost increases to 60 to 80 cents per 1,000 gallons and for compounds such as 1,1,1-TCA the cost increases further to about \$1 to \$2 per 1,000 gallons.

Air stripping is the least costly water treatment process, and in most cases would be the remediation process of choice if processing costs were the deciding factor. However, air emission regulations may exclude the use of air stripping. In addition, in many water treatment problems, additional pretreatment requirements (such as the requirement to remove iron from the water in the SW-31 Spring) are the dominant costs. Also, shown below, if the air stripper is not on location and transportation is required, then the cost can become relatively expensive.

For GAC, the cost quoted above for the perox-pureTM system to treat chemicals such as TCE and benzene the perox-pureTM process is competitive. For 1,1,1-TCA, however, GAC does not work well. Consequently, the perox-pureTM process is likely to be chosen over GAC. At many DOE sites, the use of GAC may be unacceptable because its removal from the site for further treatment would be a significant extra expense.

A cost estimate for using the perox-pureTM at the SW-31 Spring is summarized in Table 5.1 for two scenarios, the first without iron pretreatment and the second with iron pretreatment. The perox-pureTM capital cost is the price for engineering, equipment and instrumentation as a package and is not broken out. Testing and start-up services are extra and site/water specific. Operating labor is negligible since the systems operate automatically. Maintenance labor is typically estimated at 2% of the capital investment. Permitting and site preparation, if any, are site/water specific. The projected costs are compared to hauling to Y-12 because the perox-pureTM system was proposed as an interim treatment measure until CNF at K-25 is completed. As shown in data above, iron pretreatment significantly increases the destruction rate; consequently, the cost for processing without iron pretreatment is approximately doubled. However, due to site disposal issues with the pretreatment filters, it may be preferable to operate the perox-pureTM system without iron pretreatment. In either case a 30 kilowatt full scale perox-pureTM unit is sufficient for the SW-31 Spring.

TABLE 5.1 COST ESTIMATE OF PEROX-PURE™ AT SW-31 SPRING

WITHOUT IRON PRETREATMENT

CAN TREAT AT 30 GPM FOR 3.5 HR/DAY USING A 30 KW
FULL-SCALE PEROX-PURE™ SYSTEM

CAPITAL: APPROXIMATELY \$100,000 (COMPLETE SYSTEM)

MAINTENANCE: APPROXIMATELY \$10,000 (ONE YEAR)

CONSUMPTION: 17.3 Kwh/1000 GAL
1.2 LB H₂O₂/1000 GAL

OPERATING COSTS:	<u>\$/1000 GAL</u>
ELECTRICAL ENERGY (@\$0.06/KWH)	1.04
50% H ₂ O ₂ (@\$0.65/LB)	<u>0.78</u>
TOTAL	1.82

WITH IRON PRETREATMENT

CAN TREAT AT 80 GPM FOR 1 HR/DAY USING A 30 KW
FULL-SCALE PEROX-PURE™ SYSTEM

CAPITAL: APPROXIMATELY \$100,000 (COMPLETE SYSTEM)

MAINTENANCE: APPROXIMATELY \$10,000 (ONE YEAR)

CONSUMPTION: 7.0 Kwh/1000 GAL
0.7 LB H₂O₂/1000 GAL

OPERATING COSTS:	<u>\$/1000 GAL</u>
ELECTRICAL ENERGY (@\$0.06/KWH)	0.42
50% H ₂ O ₂ (@\$0.65/LB)	<u>0.45</u>
TOTAL	0.89

Since the SD UV lamp is not yet a commercial device, cost estimates are preliminary. Based on the field test conducted in this program, combined with laboratory demonstrations of UV efficiency with the SD lamp, we project that a commercial SD lamp system will increase the destruction rate by a factor of 3 of the most difficult organic, namely 1,1,1-TCA, at the SW-31 Spring. The capital cost per unit power of a SD UV lamp system is greater than a perox-pure™ system. We estimate that the capital cost for a SD UV lamp system-based water remediation system will be one-half of a perox-pure™ system (i.e., although the SD UV lamp is three times as efficient, it will cost half as much due to the higher capital cost per unit power). Also, the quantity of peroxide necessary would be reduced by approximately one half. The cost estimate for an SD UV lamp-based system, shown in Table 5.2, is based on these assumptions and indicates a processing cost reduction of greater than a factor of 2. Furthermore, the test results indicate that the SD-2 system proceeds by a different destruction mechanism from the perox-pure™ since the more highly chlorinated molecule was destroyed faster. It may be inferred from this result that the SD-2 cost efficiency should increase, compared to the perox-pure™ system, for more highly chlorinated VOCs. Thus, the cost savings with the SD-2 system should be much greater for contaminants like chloroform or carbon tetrachloride. This result was anticipated based upon the previous bench-scale testing with the SD-2 system. Thus, at DOE sites with highly chlorinated VOCs, the advantage of using an SD-2 system is greatest.

5.2.2 Annual Savings Estimate

The annual savings estimate provided here is specifically for the SW-31 Spring. The currently planned alternative is to haul the water to the DOE Y-12 water stripper system. The hauling cost alone is approximately \$360K per year according to MMES personnel. For the first year, the total cost of a perox-pure™ system is approximately \$110K (i.e., the capital equipment cost plus the maintenance cost). This does not include the cost of on-site personnel which is outside our cost estimate basis. Consequently, the savings in the first year is approximately \$150K. Since the expected life of the perox-pure™ system is five years, for the additional four years, this cost savings per year would be approximately \$250K per year, for a total cost savings over a five-year period of \$1.15M.

**TABLE 5.2 COST ESTIMATE OF PEROX-PURE™ SD UV LAMP-BASED
SYSTEM AT SW-31 SPRING**

WITHOUT IRON PRETREATMENT

CAN TREAT AT 30 GPM FOR 3.5 HR/DAY USING A 10 KW
FULL-SCALE PEROX-PURE™ SYSTEM

CAPITAL: APPROXIMATELY \$50,000 (COMPLETE SYSTEM)

MAINTENANCE: APPROXIMATELY \$10,000 (ONE YEAR)

CONSUMPTION: 5.8 Kwh/1000 GAL
0.6 LB H₂O₂/1000 GAL

OPERATING COSTS:	<u>\$/1000 GAL</u>
ELECTRICAL ENERGY (@\$0.06/KWH)	0.35
50% H ₂ O ₂ (@\$0.65/LB)	<u>0.39</u>
TOTAL	0.79

WITH IRON PRETREATMENT

CAN TREAT AT 80 GPM FOR 1 HR/DAY USING A 10 KW
FULL SCALE PEROX-PURE™ SYSTEM

CAPITAL: APPROXIMATELY \$50,000 (COMPLETE SYSTEM)

MAINTENANCE: APPROXIMATELY \$10,000 (ONE YEAR)

CONSUMPTION: 2.5 Kwh/1000 GAL
0.35 LB H₂O₂/1000 GAL

OPERATING COSTS:	<u>\$/1000 GAL</u>
ELECTRICAL ENERGY (@\$0.06/KWH)	0.15
50% H ₂ O ₂ (@\$0.65/LB)	<u>0.23</u>
TOTAL	0.38

5.2.3 Return on Investment

This DT&E program costs approximately \$350K. If the perox-pureTM system were purchased and used for a period of five years, as discussed in the previous section, the total savings would be \$800K, with a total return of investment of over 200% or yearly return of approximately 18% (compounded). If, as we hope, the perox-pureTM system will receive increased use at DOE sites with similar cost savings then the cost return on investment would increase greatly.

A calculation with a return on investment for a SD UV-based lamp system is inappropriate since further development is required for a full-scale system. Consequently, we provide here an example return on investment. Assume ten gallons per minute are treated for a period of five years (the expected lifetime of a commercial SD UV-based lamp system). If the processing cost with an SD system is cut in half from \$1 to 50 cents per 1,000 gallons, and if this scenario occurred at five DOE sites, then the total cost savings would be \$6.5M. We estimate the additional cost for the development of a full-scale commercial system to be about \$1M. The return on investment of this example warrants development of a SD UV-based water treatment technology.

5.3 Other Benefits

5.3.1 Regulatory Advantages

The primary regulatory advantage, mentioned above, is that the UV/UV catalyzed technology has no contaminated by-products. The most widely used water remediation technologies, air stripping and GAC require special permitting and/or special handling. GAC, once used, must either be incinerated or re-activated in a process which produces contaminants requiring disposal.

5.3.2 Potential Acceptance Issues

The existing perox-pureTM commercial system has received acceptance both at government facilities as well as in industry. The perceived issue (of some parties) of peroxide handling and storage has been resolved by having safe and proper equipment and handling techniques. Other potential acceptance issues with the SD UV lamp could be concerns with high intensity UV light and/or high voltage electrical equipment.

5.3.3 Risk Assessment

The potential acceptance issues with the SD UV lamp system are similar to issues with other commercial hardware such as other UV lamps, lasers, and other systems with high voltage. The UV light is enclosed in the water processing reactor which can be designed to eliminate UV emission. Similarly, commercial high voltage systems routinely provide safe turn-key operation. Equipment would be labeled with cautions, interlocks and automatic turn-off switches incorporated into the system in case of unexpected failure.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The demonstration test and evaluation reported here successfully showed that ultraviolet/ultraviolet catalyzed peroxide oxidation groundwater remediation is practical for the SW-31 Spring tested here as well as at other DOE water remediation sites. Both the existing commercial perox-pureTM system and the new system incorporating an SD UV lamp were shown to be cost effective and to meet regulatory requirements intrinsically better than the current standard techniques.

For the SW-31 Spring, the perox-pureTM system would pay for itself in four months, and over a five-year period save more than \$1M when compared to the alternative now planned at DOE. Also, based on tests conducted to date, a water remediation system based on the SD UV lamp would increase organic destruction rates of highly chlorinated VOCs by a factor of 3 or more and decrease processing costs by about a factor of 2. Neither the perox-pureTM nor the SD UV lamp-based systems produce by-products requiring additional handling and/or treatment. This advantage is difficult to quantify in comparison to the current standard water remediation techniques.

Recommendations from the demonstration results include:

1. Use the perox-pureTM system results as a basis for considering further use at the SW-31 Spring as well as at other DOE sites requiring water remediation.
2. Support further development of SD UV lamp technology to reduce the cost of water remediation.

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**APPENDIX I. WATER QUALITY DATA, SW-31 SPRING
K-1070-C/D BURIAL GROUND, K-25 SITE
Data as of August 1993
(minimums and maximums collected from 1987 to 1993)**

Compound	Minimum	Maximum	6/25/93
Volatiles (µg/L)			
Benzene	190	1300	150
Chloroethane	<10	160	<100
Chloroform	<5	5	<50
Ethylbenzene	190	430	90
1,1-Dichloroethane	460	3800	920
1,1-Dichloroethane	250	920	200
1,2-Dichloroethane	<5	950	<50
Methylene Chloride	160	8000	<50
Tetrachloroethane	<5	110	<50
Toluene	440	3100	240
Trans-1,2-Dichloroethane	670	950	Not Detected
1,1,1-Trichloroethane	4000	6800	1300
1,1,2-Trichloroethane	<5	170	<50
Trichloroethane	140	430	39 J
Vinyl Chloride	<10	330	<100
Xylene (total)	1400	1900	770
1,2-Dichloroethane (total)	No Data	No Data	160

**APPENDIX II. MAXMUM CONTAMINATION LEVELS ALLOWED
FOR ORGANICS IN SW-31 SPRING WATER(*)**

Compound	MCL (µg/l)
Bromodichloromethane	100
Bromoform	100
Chloroethane	No Standard
1,1-Dichloroethane	No Standard
1,2-Dichloroethane	5
1,1-Dichloroethane	7
1,1,1-Trichloroethane	200
Trichlorofluoromethane	No Standard
Vinyl Chloride	2
Benzene	5
Toluene	1,000
Ethylbenzene	700
Total Xylene	10,000
1,3-Dichlorobenzene	600
1,4-Dichlorobenzene	75

*Drinking Water Regulations and Health Advisories, United States EPA, May (1993).

APPENDIX III. TERMINOLOGY AND DEFINITIONS

Reaction Rate (Oxidation or Destruction Rate)

Reaction rate and oxidation rate are synonymous. The nomenclature used in the literature is pseudo-first order reaction rate constant, symbolized by K with units of inverse time. The reaction rate constant is calculated from the equation:

$$K = (1/t) \ln (C_i/C_e)$$

where t is the oxidation time in minutes, C_i is the influent contaminant concentration, and C_e is the effluent contaminant concentration after t minutes of oxidation.

Batch and Flow-Through Testing

During flow-through testing, the water is pumped through the reactor only once. During batch testing, a fixed volume of water is recirculated through the reactor and back into the batch tank. Batch testing provides the opportunity to evaluate longer times while preserving a high flow rate to simulate full-scale operation.

Oxidation Time

The oxidation time for flow-through testing is calculated as follows:

$$t = V/Q$$

where t is the oxidation time in minutes, V is the reactor volume in gallons and Q is the flow rate in gallons per minute. The total contact volume in the S-30 is 15 gallons. More than one oxidation time can be obtained in each test by sampling at intermediate points (contact volumes) in the reactor.

For batch testing, the oxidation time is calculated as follows:

$$t = t' (V_R/V_T)$$

where t is the oxidation time in minutes, t' is the elapsed clock time in minutes, V_R is the reactor volume in gallons and V_T is the total batch volume. Batch volumes of 75 gallons are typically used during the perox-pureTM testing.

**APPENDIX IV. RESULTS OF PEROX-PURE™ TESTING ON
SW-31 SPRING WATER AT DOE K-25 SITE**

Table 1

**Conditions for Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test	H₂O₂¹ Maintained (mg/l)	Influent pH	Catalyst (mg/l)	Water ² Pretreated
1	20-100 ³	7	0	Yes
2	20	7	0	Yes
3	40	7	0	Yes
4	100-400 ³	7	0	Yes
5	50	6	0	Yes
6	50	5	0	Yes
7	50	3.5	0	Yes
8	70	6.5	0	Yes
9	200-600 ³	4	20	Yes
10	50	3.5	20	Yes
11	50	4	50	Yes
12	50	4	100	Yes
13	50	5	0	No
14	50	6.5	0	No
15	50	4.8	0	Yes
16	50	3.2	20	Yes

¹ H₂O₂ concentration maintained during test via continuous addition of 50% H₂O₂ solution.

² Pretreatment for iron removal via filtration.

³ H₂O₂ concentration not effectively controlled. Conditions repeated in subsequent tests.

Table 2

**Conditions for WJSA SD Lamp Testing
on SW-31 Spring Water at DOE K-25 Site**

Test	H₂O₂¹ (mg/l)	Influent pH	Catalyst (mg/l)	Water² Pretreated	SD³ Conditions	Other Notes
1A	0	3.8	0	Yes	A	
2A	0	3.3	0	Yes	B	
3A	0	3.3	0	Yes	C	
4A	0	3.3	0	Yes	D	
5A	70	3.3	0	Yes	D	
6A	50	3.3	0	Yes	D	
7A	25	3.3	0	Yes	D	
8A	0	6.7	0	Yes	D	
9A	0	4.0	20	Yes	D	
10A	0	4.0	50	Yes	D	
11A	5	3.6	0	No	D	4
12A	0	3.0	0	Yes	E	
13A	0	3.0	0	Yes	F	
14A	0	6.3	0	No	D	
15A	0	3.0	0	Yes	D	
16A	0	3.0	0	Yes	G	
17A	0	3.0	0	Yes	H	
18A	0	3.0	0	Yes	I	
19A	0	3.0	0	Yes	J	

¹ H₂O₂ concentration maintained in solution during test via continuous addition of H₂O₂ solution.

² Pretreatment for iron removal via filtration.

³ SD conditions as follows:

A - 1000 W power, Kr gas, 65 mm tube, suprasil tube and substrate.

B - 1500 W power, Kr gas, 65 mm tube, suprasil tube and substrate.

C - 500 W power, Ar gas, 1.5 Hz, 65 mm tube, GE 214 tube, suprasil substrate.

D - 500 W power, Kr gas, 1.5 Hz, 65 mm tube, GE 214 tube, suprasil substrate.

E - 1000 W power, Kr gas, 3 Hz, 65 mm tube, GE 214 tube and substrate.

F - 500 W power, Kr gas, 1.5 Hz, 65 mm tube, GE 214 tube and substrate.

G - 500 W power, Xe gas, 1.5 Hz, 65 mm tube, GE 614 tube, suprasil substrate.

H - 1000 W power, Xe gas, 3 Hz, 65 mm tube, GE 214 tube, suprasil substrate.

I - 600 W power, (Higher Voltage), Xe gas, 1.5 Hz, 65 mm tube, GE 214 tube, suprasil substrate.

J - 700 W power (Highest Voltage), Xe gas, 1.5 Hz, 65 mm tube, GE 214, suprasil substrate.

⁴ Water treated in perox-pure™ System before treatment with WJSA SD lamp.

Table 3
Characterization Results for SW-31 Spring Water

Parameter	Value
Visual Appearance	Turbid Orange
pH	6.9
TDS (mg/l)	350
Turbidity (FTU)	2 ¹
Total Iron (mg/l)	16
Chloride (mg/l)	58
COD (mg/l)	13 ¹
TOC (mg/l)	5
Alkalinity (mg/l)	250
TSS (mg/l)	50
NO ₃ as N (mg/l)	<0.1
Hardness (mg/l)	300

¹ Value obtained after solids allowed to settle.

Table 4

Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site

Test 1

Oxidation Time ¹ (min)					
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	170	241	217	89	NA
1,1-Dichloroethane	175	35	NA ²	3	NA
1,2-Dichloroethane	<5				
1,1-Dichloroethene	<5				
1,1,1-Trichloroethane	150	121	72	28	NA
Trichlorofluoromethane	265	101	58	49	NA
Vinyl Chloride	11	18	NA	7	NA
Benzene	<5				
Toluene	<5				
Ethylbenzene	<5				
m,p-Xylene	<5				
o-Xylene	<5				

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

² Result not available.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 2

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	286	NA ³	230	SSB ²	143
1,1-Dichloroethane	236	182	30		5
1,2-Dichloroethane	<5	<1			
1,1-Dichloroethene	22	3	<1		
1,1,1-Trichloroethane	191	177	85		19
Trichlorofluoromethane	313	122	76		71
Vinyl Chloride	15	23	17		11
Benzene	8	<1			
Toluene	16	3	1		<1
Ethylbenzene	9	<1			
m,p-Xylene	8	<1			
o-Xylene	10	2	<1		

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

² Sample bottle broken in transit.

³ Result not available.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 3

Compound (µg/l)	Oxidation Time ¹ (min)				
	0	0.5	1	2	3
Chloroethane	297	276	256	181	126
1,1-Dichloroethane	NA ³	NA	NA	NA	NA
1,2-Dichloroethane	<5				
1,1-Dichloroethene	14	2	<1		
1,1,1-Trichloroethane	237	133	79	30	13
Trichlorofluoromethane	158	108	124	50	29
Vinyl Chloride	20	21	19	14	9
Benzene	5.8	<1			
Toluene	10	1	<1		
Ethylbenzene	<5				
m,p-Xylene	<5				
o-Xylene	6.6	<1			

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

² Result not available.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 4

Compound (µg/l)	Oxidation Time ¹ (min)				
	0	0.5	1	2	3
Chloroethane	NA ²	300	288	171	114
1,1-Dichloroethane	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA				
1,1-Dichloroethene	NA				
1,1,1-Trichloroethane	NA	212	199	115	49
Trichlorofluoromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	23	22	13	9
Benzene	NA				
Toluene	NA				
Ethylbenzene	NA				
m,p-Xylene	NA				
o-Xylene	NA				

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

² Result not available.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 5

Compound (µg/l)	Oxidation Time ¹ (min)				
	0	0.5	1	2	3
Chloroethane	412	NA ²	361	NA	NA
1,1-Dichloroethane	298	NA	44	6	NA
1,2-Dichloroethane	<5				
1,1-Dichloroethene	57	<1			
1,1,1-Trichloroethane	298	NA	139	45	NA
Trichlorofluoromethane	206	NA	174	27	NA
Vinyl Chloride	<5				
Benzene	<5				
Toluene	53	<1			
Ethylbenzene	9	1.3	<1		
m,p-Xylene	14	1.4	<1		
o-Xylene	34	<1			

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

² Result not available.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 6

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	316	281	236	149	88
1,1-Dichloroethane	501	139	29	5	3
1,2-Dichloroethane	<5				
1,1-Dichloroethene	54	2	1	<1	
1,1,1-Trichloroethane	316	140	69	21	11
Trichlorofluoromethane	NA ²	NA	NA	NA	NA
Vinyl Chloride	30	21	18	10	6
Benzene	29	<1			
Toluene	62	2	<1		
Ethylbenzene	38	1	<1		
m,p-Xylene	39	1	<1		
o-Xylene	45	2	<1		

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

² Result not available.

Table 4 (cont.)**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site****Test 7**

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	267	264	228	146	85
1,1-Dichloroethane	309	72	12	3	2
1,2-Dichloroethane	<5				
1,1-Dichloroethene	<5				
1,1,1-Trichloroethane	251	117	52	16	9
Trichlorofluoromethane	300	140	115	72	61
Vinyl Chloride	17	20	16	9	5
Benzene	<5				
Toluene	<5				
Ethylbenzene	<5				
m,p-Xylene	<5				
o-Xylene	<5				

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 8

Compound (µg/l)	Oxidation Time ¹ (min)				
	0	0.5	1	2	3
Chloroethane	448	351	321	232	163
1,1-Dichloroethane	555	124	31	4	2
1,2-Dichloroethane	6	2	<1		
1,1-Dichloroethene	71	3	<1		
1,1,1-Trichloroethane	395	184	127	45	20
Trichlorofluoromethane	215	173	148	67	30
Vinyl Chloride	38	26	24	16	10
Benzene	56	2	<1		
Toluene	59	2	<1		
Ethylbenzene	28	1	<1		
m,p-Xylene	55	2	<1		
o-Xylene	47	2	<1		

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 9

Compound (µg/l)	Oxidation Time ¹ (min)				
	0	0.5	1	2	3
Chloroethane	274	217	172	116	79
1,1-Dichloroethane	418	183	105	33	9
1,2-Dichloroethane	5	3	2	<1	
1,1-Dichloroethene	15	<1			
1,1,1-Trichloroethane	263	187	156	102	60
Trichlorofluoromethane	134	52	32	18	16
Vinyl Chloride	17	16	13	9	6
Benzene	10	<1			
Toluene	9	<1			
Ethylbenzene	<5				
m,p-Xylene	8	<1			
o-Xylene	13	<1			

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 10

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane			306	221	
1,1-Dichloroethane			18	3	
1,2-Dichloroethane					
1,1-Dichloroethene					
1,1,1-Trichloroethane			83	19	
Trichlorofluoromethane			151	98	
Vinyl Chloride					
Benzene					
Toluene					
Ethylbenzene					
m,p-Xylene					
o-Xylene					

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site****Test 11: Batch**

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	535	385	352	286	197
1,1-Dichloroethane	640	231	126	10	3
1,2-Dichloroethane	<5				
1,1-Dichloroethene	48	<1			
1,1,1-Trichloroethane	460	190	130	51	16
Trichlorofluoromethane	473	191	167	140	100
Vinyl Chloride	36	130	168	49	13
Benzene	12	2	<1		
Toluene	16	<1			
Ethylbenzene	6	<1			
m,p-Xylene	8	<1			
o-Xylene	12	<1			

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 11: Flow-Through

Compound (µg/l)	Oxidation Time ¹ (min)	
	0 (Influent)	0.4 (Lamp 6)
Chloroethane	352	258
1,1-Dichloroethane	126	28
1,2-Dichloroethane		
1,1-Dichloroethene		
1,1,1-Trichloroethane	130	66
Trichlorofluoromethane	NA ²	127
Vinyl Chloride		
Benzene		
Toluene		
Ethylbenzene		
m,p-Xylene		
o-Xylene		

¹ Flow - through oxidation time.

² Result no available.

Table 4 (cont.)**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site****Test 12**

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	308	279	266	227	184
1,1-Dichloroethane	409	233	73	57	16
1,2-Dichloroethane	<5	3	3	1	<1
1,1-Dichloroethene	34	<1			
1,1,1-Trichloroethane	277	154	119	69	36
Trichlorofluoromethane	175	113	103	78	57
Vinyl Chloride	33	<1			
Benzene	18	6	3	<1	
Toluene	33	<1			
Ethylbenzene	15	<1			
m,p-Xylene	18	<1			
o-Xylene	26	<1			

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site****Test 13**

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	396	356	324	245	197
1,1-Dichloroethane	483	264	183	61	18
1,2-Dichloroethane	<5	4	2	<1	
1,1-Dichloroethene	<5				
1,1,1-Trichloroethane	354	215	189	120	71
Trichlorofluoromethane	244	187	167	105	80
Vinyl Chloride	49	47	40	27	19
Benzene	7	2	<1		
Toluene	<5				
Ethylbenzene	<5				
m,p-Xylene	<5				
o-Xylene	<5				

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site****Test 14**

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	368	345	323	306	270
1,1-Dichloroethane	410	236	224	106	65
1,2-Dichloroethane	<5	3	3	1	<1
1,1-Dichloroethene	<5				
1,1,1-Trichloroethane	334	217	206	176	134
Trichlorofluoromethane	221	200	178	149	119
Vinyl Chloride	<5				
Benzene	<5				
Toluene	<5				
Ethylbenzene	<5				
m,p-Xylene	<5				
o-Xylene	<5				

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)

Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site

Test 15: Batch

Oxidation Time ¹ (min)					
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	<1				
1,1-Dichloroethane	343	99		5	4
1,2-Dichloroethane	<1				
1,1-Dichloroethene	14	14		14	14
1,1,1-Trichloroethane	339	171		28	16
Trichlorofluoromethane	<1				
Vinyl Chloride	<1				
Benzene	10	2		2	2
Toluene	5	2		2	2
Ethylbenzene	<1				
m,p-Xylene	7	4		4	4
o-Xylene	5	2		2	2

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

² Sample not collected.

Table 4 (cont.)**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site****Test 15: Flow-Through**

Compound (µg/l)	Oxidation Time ¹ (min)		
	0 (Influent)	0.2 (Lamp 3)	0.4 (Lamp 6)
Chloroethane			
1,1-Dichloroethane	13	<1	<1
1,2-Dichloroethane			
1,1-Dichloroethene			
1,1,1-Trichloroethane	97	50	53
Trichlorofluoromethane			
Vinyl Chloride			
Benzene	2	<1	
Toluene	2	<1	
Ethylbenzene			
m,p-Xylene	4	<1	
o-Xylene	2	<1	

¹ Flow - through oxidation time.

Table 4 (cont.)**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site****Test 16: Batch**

	Oxidation Time ¹ (min)				
Compound (µg/l)	0	0.5	1	2	3
Chloroethane	<1		N		
1,1-Dichloroethane	343	99		5	4
1,2-Dichloroethane	<1				
1,1-Dichloroethene	14	<1			
1,1,1-Trichloroethane	340	171		28	16
Trichlorofluoromethane	439	355		229	161
Vinyl Chloride	30	22		12	7
Benzene	109	2		2	<1
Toluene	6	2		2	<1
Ethylbenzene	<1	2		2	<1
m,p-Xylene	8	2		2	5
o-Xylene	5	2		2	<1

¹ Oxidation Time calculated from ratio of UV contact volume to batch volume multiplied by the actual elapsed time.

Table 4 (cont.)

**Results of Perox-Pure™ Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 16: Flow-Through

Compound (µg/l)	Oxidation Time ¹ (min)		
	0 (Influent)	0.2 (Lamps)	0.4 (Lamp 6)
Chloroethane	<1		
1,1-Dichloroethane	13	<1	
1,2-Dichloroethane	<1		
1,1-Dichloroethene	<1		
1,1,1-Trichloroethane	97	50	53
Trichlorofluoromethane	339	273	317
Vinyl Chloride	20	15	18
Benzene	2	<1	
Toluene	2	<1	
Ethylbenzene	2	<1	
m,p-Xylene	4	<1	
o-Xylene	2	<1	

¹ Flow - through oxidation time.

**APPENDIX V. RESULTS OF SD-2 TESTING ON
SW-31 SPRING WATER AT DOE K-25 SITE**

Table 1

**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 1A

Compound (µg/l)	Oxidation Time¹ (min)			
	0	2	4	6
Chloroethane	290	176	161	145
Chloroform	<5	<1		
1,1-Dichloroethane	322	152	113	82
1,2-Dichloroethane	<5	<1		
1,2-Dichloroethene	<5	<1		
Methylene Chloride	<5	<1		
Tetrachloroethene	<5	<1		
1,1,1-Trichloroethane	186	57	20	5
1,1,2-Trichloroethane	<5	<1		
Trichloroethene	<5	<1		
Benzene	6	<1		
Toluene	7	<1		
Ethylbenzene	<5	<1		
m,p-Xylene	<5	<1		
o-Xylene	<5	<1		
1,2-Dichlorobenzene	<5	<1		
1,3-Dichlorobenzene	<5	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 2A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	2	4	6
Chloroethane	243	215	203	163
Chloroform	<5	<1		
1,1-Dichloroethane	258	161	109	59
1,2-Dichloroethane	<5	3	3	3
1,1-Dichloroethene	7	<1		
Methylene Chloride	<5	<1		
Tetrachloroethene	<5	<1		
1,1,1-Trichloroethane	131	34	5	1
1,1,2-Trichloroethane	<5	2	2	1
Trichloroethene	<5	<1		
Benzene	<5	<1		
Toluene	6	<1		
Ethylbenzene	<5	<1		
m,p-Xylene	<5	<1		
o-Xylene	<5	<1		
Trichlorofluoromethane	115	69	46	26
Vinyl Chloride	17	63	<1	

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 3A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	11	7	3	<1
Chloroform	1	<1		
1,1-Dichloroethane	239	195	145	107
1,2-Dichloroethane	2	2	1	<1
1,1-Dichloroethene	<1	<1		
Methylene Chloride	78	72	60	54
Tetrachloroethene	<1			
1,1,1-Trichloroethane	199	148	103	70
1,1,2-Trichloroethane	3	2	2	2
Trichloroethene	<1			
Trichlorofluoromethane	139	132	117	105
Benzene	2	<1		
Toluene	<1			
Ethylbenzene	<1			
m,p-Xylene	<1			
o-Xylene	<1			

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 4A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	17	4	4	<1
Chloroform	<1			
1,1-Dichloroethane	274	215	149	106
1,2-Dichloroethane	2	2	1	<1
1,1-Dichloroethene	<1			
Methylene Chloride	101	81	66	56
Tetrachloroethene	<1			
1,1,1-Trichloroethane	232	175	117	85
1,1,2-Trichloroethane	3	2	2	2
Trichloroethene	<1			
Trichlorofluoromethane	195	142	147	107
Benzene	3	<1		
Toluene	2	<1		
Ethylbenzene	<1			
m,p-Xylene	<1			
o-Xylene	<1			

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 5A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	13	1	<1	
Chloroform	<1			
1,1-Dichloroethane	265	139	42	10
1,2-Dichloroethane	2	<1		
1,1-Dichloroethene	<1			
Methylene Chloride	101	91	72	56
Tetrachloroethene	<1			
1,1,1-Trichloroethane	242	196	132	86
1,1,2-Trichloroethane	3	2	<1	
Trichloroethene	<1			
Benzene	4	<1		
Toluene	2	<1		
Ethylbenzene	<1			
m,p-Xylene	<1			
o-Xylene	<1			

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 6A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	15	2	<1	
Chloroform	<1			
1,1-Dichloroethane	277	139	40	12
1,2-Dichloroethane	2	<1		
1,2-Dichloroethene	<1			
Methylene Chloride	107	89	68	59
Tetrachloroethene	<1			
1,1,1-Trichloroethane	242	180	123	84
1,1,2-Trichloroethane	<1			
Trichloroethene	<1			
Trichlorofluoromethane	187	160	128	115
Benzene	2	<1		
Toluene	<1			
Ethylbenzene	<1			
m,p-Xylene	<1			
o-Xylene	<1			

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 7A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	18	2	<1	
Chloroform	<1			
1,1-Dichloroethane	240	119	32	10
1,2-Dichloroethane	2	<1		
1,1-Dichloroethene	<1	<1		
Methylene Chloride	111	89	61	63
Tetrachloroethene	<1			
1,1,1-Trichloroethane	232	173	102	69
1,1,2-Trichloroethane	3	1	<1	
Trichloroethene	<1			
Trichlorofluoromethane	264	226	112	163
Benzene	2	<1		
Toluene	<1			
Ethylbenzene	<1			
m,p-Xylene	<1			
o-Xylene	<1			

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)

**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 8A

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	35	33	27	25
Chloroform	3	1	<1	
1,1-Dichloroethane	400	323	331	321
1,2-Dichloroethane	3	3	3	3
1,2-Dichloroethene	2	5	4	3
Methylene Chloride	169	149	128	117
Tetrachloroethene	4	<1		
1,1,1-Trichloroethane	326	298	257	232
1,1,2-Trichloroethane	4	4	3	3
Trichloroethene	8	4	<1	
Trichlorofluoromethane	354	337	275	263
Benzene	54	38	26	17
Toluene	52	32	18	11
Ethylbenzene	23	16	9	6
m,p-Xylene	80	44	18	10
o-Xylene	39	22	10	6

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 9A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	18	NA ²	11	13
Chloroform	2	<1		
1,1-Dichloroethane	291	238	218	183
1,2-Dichloroethane	3	3	2	2
1,2-Dichloroethene	1	<1		
Methylene Chloride	89	79	70	57
Tetrachloroethene	1	<1		
1,1,1-Trichloroethane	214	194	155	119
1,1,2-Trichloroethane	4	4	4	5
Trichloroethene	3	<1		
Trichlorofluoromethane	190	172	145	130
Carbon Tetrachloride	<1	2	4	4
Benzene	20	<1		
Toluene	17	<1		
Ethylbenzene	8	<1		
m,p-Xylene	22	<1		
o-Xylene	11	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

² Result not available.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 10A**

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	27	22	19	19
Chloroform	1	3	3	2
1,1-Dichloroethane	394	339	278	231
1,2-Dichloroethane	3	3	2	2
1,2-Dichloroethene	3	1	<1	
Methylene Chloride	133	118	105	86
Tetrachloroethene	2	<1		
1,1,1-Trichloroethane	313	263	206	164
1,1,2-Trichloroethane	4	4	5	6
Trichloroethene	6	<1		
Trichlorofluoromethane	276	260	220	188
Carbon Tetrachloride	6	6	5	6
Benzene	39	4	1	1
Toluene	34	2	<1	
Ethylbenzene	16	2	<1	
m,p-Xylene	46	2	<1	
o-Xylene	24	2	<1	

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)
Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site

Test 11A

Compound (µg/l)	Oxidation Time ¹ (min)		
	0 ²	3	6
Chloroethane	<1		
Chloroform	<1		
1,1-Dichloroethane	83	55	34
1,2-Dichloroethane	<1		
1,2-Dichloroethene	<1		
Methylene Chloride	107	90	73
Tetrachloroethene	<1		
1,1,1-Trichloroethane	178	144	113
1,1,2-Trichloroethane	1	<1	
Trichloroethene	<1		
Trichlorofluoromethane	242	205	173
Benzene	<1		
Toluene	<1		
Ethylbenzene	<1		
m,p-Xylene	<1		
o-Xylene	<1	5	<1

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

² After perox-pure™ treatment for 0.5 minutes.

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 12A**

Compound (µg/l)	Oxidation Time¹ (min)			
	0	3	6	9
Chloroethane	26	13	3	1
Chloroform	1	1	<1	
1,1-Dichloroethane	376	279	181	133
1,2-Dichloroethane	3	2	1	1
1,2-Dichloroethene	2	<1		
Methylene Chloride	146	120	94	86
Tetrachloroethene	<1			
1,1,1-Trichloroethane	322	248	180	137
1,1,2-Trichloroethane	4	3	3	3
Trichloroethene	7	<1		
Benzene	36	<1		
Toluene	37	<1		
Ethylbenzene	27	<1		
m,p-Xylene	59	<1		
o-Xylene	28	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

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2 of 3

Table 1 (cont.)**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site****Test 13A**

Compound (µg/l)	Oxidation Time¹ (min)			
	0	3	6	9
Chloroethane	27	18	9	5
Chloroform	1	1	<1	
1,1-Dichloroethane	368	300	232	177
1,2-Dichloroethane	3	2	2	1
1,2-Dichloroethene	<1	2	<1	
Methylene Chloride	144	124	105	91
Tetrachloroethene	3	<1		
1,1,1-Trichloroethane	322	257	221	186
1,1,2-Trichloroethane	4	3	3	2
Trichloroethene	5	<1		
Trichlorofluoromethane	279	252	220	191
Benzene	24	<1		
Toluene	24	<1		
Ethylbenzene	18	<1		
m,p-Xylene	39	<1		
o-Xylene	19	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)
Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site

Test 14A

Compound (µg/l)	Oxidation Time¹ (min)			
	0	3	6	9
Chloroethane	28	24	SBB ²	18
Chloroform	1	1		
1,1-Dichloroethane	385	315		271
1,2-Dichloroethane	3	3		2
1,2-Dichloroethene	3	5		3
Methylene Chloride	175	142		114
Tetrachloroethene	4	1		<1
1,1,1-Trichloroethane	348	278		214
1,1,2-Trichloroethane	4	3		3
Trichloroethene	7	3		<1
Trichlorofluoromethane	309	352		198
Carbon Tetrachloride	<1	<1		2
Benzene	54	40		19
Toluene	56	36		15
Ethylbenzene	38	27		12
m,p-Xylene	101	61		20
o-Xylene	45	31		9

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

² Sample bottle broken in transit.

Table 1 (cont.)

**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 15A

Compound (µg/l)	Oxidation Time¹ (min)			
	0	3	6	9
Chloroethane	27<1	17	9	2
Chloroform	1	1	<1	
1,1-Dichloroethane	374	298	229	165
1,2-Dichloroethane	3	2	2	1
1,2-Dichloroethene	2	<1		
Methylene Chloride	139	119	97	85
Tetrachloroethene	3	<1		
1,1,1-Trichloroethane	318	252	207	157
1,1,2-Trichloroethane	4	3	3	3
Trichloroethene	6	<1		
Trichlorofluoromethane	278	237	201	170
Benzene	37	<1		
Toluene	38	<1		
Ethylbenzene	26	<1		
m,p-Xylene	59	1	<1	
o-Xylene	29	1	<1	

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)
Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site

Test 16A

Compound (µg/l)	Oxidation Time¹ (min)			
	0	3	6	9
Chloroethane	35	18	2	<1
Chloroform	2	<1		
1,1-Dichloroethane	476	323	203	103
1,2-Dichloroethane	4	3	1	<1
1,2-Dichloroethene	2	<1		
Methylene Chloride	187	134	77	43
Tetrachloroethene	4	<1		
1,1,1-Trichloroethane	415	288	207	133
1,1,2-Trichloroethane	6	4	3	2
Trichloroethene	8	<1		
Trichlorofluoromethane	243	291	221	160
Benzene	30	<1		
Toluene	30	<1		
Ethylbenzene	21	<1		
m,p-Xylene	45	<1		
o-Xylene	20	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)

**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 17A

Compound (µg/l)	Oxidation Time ¹ (min)			
	0	3	6	9
Chloroethane	17	4	1	<1
Chloroform	3	<1		
1,1-Dichloroethane	407	237	135	67
1,2-Dichloroethane	<1			
1,2-Dichloroethene	5	<1		
Methylene Chloride	<1			
Tetrachloroethene	3	3	<1	
1,1,1-Trichloroethane	366	217	118	67
1,1,2-Trichloroethane	1	<1		
Trichloroethene	4	<1		
Trichlorofluoromethane	399	333	254	203
Carbon Tetrachloride	6	2	2	<1
Benzene	18	<1		
Toluene	15	<1		
Ethylbenzene	<1			
m,p-Xylene	23	<1		
o-Xylene	11	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)

Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site

Test 18A

Compound (µg/l)	Oxidation Time ¹ (min)			
	0	3	6	9
Chloroethane	19	8	2	<1
Chloroform	<1			
1,1-Dichloroethane	426	305	185	113
1,2-Dichloroethane	<1			
1,2-Dichloroethene	7	<1		
Methylene Chloride	<1			
Tetrachloroethene	4	<1		
1,1,1-Trichloroethane	371	276	186	128
1,1,2-Trichloroethane	<1			
Trichloroethene	7	<1		
Trichlorofluoromethane	423	364	283	228
Carbon Tetrachloride	5	3	1	<1
Benzene	24	<1		
Toluene	23	<1		
Ethylbenzene	<1			
m,p-Xylene	33	<1		
o-Xylene	16	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 1 (cont.)

**Results of SD-2 Testing
on SW-31 Spring Water at DOE K-25 Site**

Test 19A

	Oxidation Time¹ (min)			
Compound (µg/l)	0	3	6	9
Chloroethane	<1			
Chloroform	<1			
1,1-Dichloroethane	394	269	168	102
1,2-Dichloroethane	<1			
1,2-Dichloroethene	6	<1		
Methylene Chloride	<1			
Tetrachloroethene	4	<1		
1,1,1-Trichloroethane	354	255	170	116
1,1,2-Trichloroethane	<1			
Trichloroethene	4	<1		
Benzene	21	2		
Toluene	17	<1		
Ethylbenzene	<1			
m,p-Xylene	26	4	<1	
o-Xylene	13	<1		

¹ Oxidation time calculated from ratio of UV contact volume to batch volume multiplied by the elapsed time.

Table 2

**Primary Organic Treatment Criteria
for SW-31 Spring Water**

Contaminant	Influent (mg/l)	Effluent Objective (mg/l)
Benzene	0.15	
Chloroethane	<0.10	
Chloroform	<0.05	
Ethylbenzene	0.09	
1,1-Dichloroethane	0.92	
1,1-Dichloroethene	0.20	
1,2-Dichloroethane	<0.05	
Methylene Chloride	<0.05	
Tetrachloroethane	<0.05	
Toluene	0.24	
1,1,1-Trichloroethane	1.30	
1,1,2-Trichloroethane	<0.05	
Vinyl Chloride	<0.10	
Xylene (Total)	0.77	
1,2-Dichloroethene (Total)	0.16	
Total Toxic Organics	3.83-4.28	2.13

APPENDIX VI. FIELD TEST OF DIRECT SAMPLING ION TRAP MASS SPECTROMETER FOR GROUNDWATER CLEANUP PROCESS MONITORING*

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February 21, 1994

Introduction

A field-transportable Direct Sampling Ion Trap Mass Spectrometer (DSITMS) developed by ORNL for the Department of Energy Office of Technology Development (EM-50) was evaluated for its utility as a process monitoring aid. DSITMS allows the very rapid (3 minutes or less) quantification of volatile organic chemicals in water so it was thought the multiple samples could be taken, analyzed on-site, and results reported to the operators in more-nearly real-time.

Two field tests were carried out. The first test was designed to determine whether DSITMS was applicable to the analysis of the multiple contaminant water being processed. This involved field analyses of samples by DSITMS for comparison with results generated using standard EPA methods performed by the process support laboratory. The second test resulted from an observation by the ORNL field team that it might be possible to monitor the process in a truly continuous, on-line, real-time manner.

Both tests were very successful. Results suggest that it would be possible and worthwhile to develop a continuous monitoring version of the instrument. The current instrument is already applicable if manual operation and quantification are acceptable. Summaries of data and observations follow.

*Modified version of "DSITMS Real-Time Monitoring of VOC's in Peroxidation Systems Water Treatment System," Summary Report Draft, C. V. Thompson and M. B. Wise, 1/4/94. Modifications (by M. R. Guerin) remove brief descriptions of the process and of observations which are treated more completely by the main document.

First Field Test

In the first test, conducted on September 3, 1993, 40 mL grab samples of water from the treatment process, and water standards of the pertinent VOCs, were analyzed at the site by DSITMS. Results from these analyses were calculated the next work day. Qualitative analysis of the samples was possible in real-time by monitoring the spectral display of the analyses (Figure 3). Table 1 is a comparison of data from the DSITMS analysis with data generated by a standard GC/MS method.

Table 1. Analysis of Water Samples from Treatment of K-25 Seep

	Test Start		2 Min. Elapsed Time		3 Min. Elapsed Time	
	ng/mL		ng/mL		ng/mL	
Compound	ORNL ^a	Per-Ox ^b	ORNL ^a	Per-Ox ^b	ORNL ^a	Per-Ox ^b
1,1,-DCA	191	409	56	57	2	16
1,1,1-TCA	202	277	139	69	20	36
Benzene	9	18	0	0	0	0
Toluene	4	33	0	0	0	0
Xylenes	14	22	1	0	1	0

(^a DSITMS ^b GCMS)

The data generated by DSITMS are based on crude field standards and represent semi-quantitative results at best. The results for both methods show the same trends of decaying concentrations for each of the analytes. In addition to the analytes listed in Table 1, acetone and C₃- and C₄- benzenes were also present in the samples but were not quantitated due to a lack of appropriate standards. These three analytes were not mentioned in the GCMS analytical report and apparently were not looked for in the analysis.

Second Field Test

For the second field test which was conducted on October 18 and 19, 1993, a continuous water monitor developed here at the laboratory, was deployed to provide real-time analysis of VOCs in the water from the treatment process. The continuous water monitor employs a new Venturi-based technology which is presently under patent consideration. The delay time between processing of the sample in the continuous water monitor and display of the spectrum on screen was about 7 seconds.

The continuous water monitor was used in conjunction with five tests of the experimental water treatment system and with two tests of the commercial system. Figures 4-10 are graphs of the temporal responses for analytes of interest for each of these tests. The data for each analyte has been subjected to a running ten-point smoothing routine to reduce random noise. It should be noted that relative ion abundances for the analytes do not correlate to relative concentrations. Although xylenes and 1,1,1-TCA have comparable ion abundances, they differ in concentrations by a factor of 2 to 3. Test start times are marked on each of the graphs. Tables 2-7 contain starting and ending concentrations derived from standards run for the tests. In each of the tests, analytes expected to be in the seep water in significant concentrations included 1,1,1-trichloroethane, 1,1-dichloroethane, benzene, toluene, and xylenes. Another analyte, possibly methyl ethyl ketone (MEK), appears to have been an intermediate formed during the treatment process and eventually consumed by it. Its presence was unexpected and had not been reported prior to the use of the continuous water monitor with the treatment processes. Standards used with the continuous water monitor did not include MEK, so no quantitation of it is possible in the tests.

The first experimental test which was monitored had no corresponding standards for calibration; therefore, it has not been quantified. The fourth experimental test had no standards for calibration, but the standards from the third and fifth tests have been averaged and used to provide estimates of the analyte concentrations in this test. The second commercial test included the introduction of acetone into the water undergoing treatment at a concentration of 20 mg/L at an elapsed time of about 6.5 minutes from the start of the test. This addition appeared to accelerate the rate of degradation of the organics. However, it is also possible that the large concentration of acetone ions in the ion trap depressed the ions from other analytes through space charging. One other effect of the acetone addition was an immediate increase in the concentration of MEK.

One benefit of a system like the continuous water monitor is the ability to provide data in real time of the effects of treatment processes such as the ones used at K-25. When operating parameters for the treatment systems are changed, their effects on the rates of degradation of various compounds can be immediately observed, allowing for optimization of the process in a much shorter time than if standard analyses had to be performed using grab samples. With a temporal resolution of one data point per second for the continuous water monitor, rate constants for degradation of individual compounds by the treatment process can be easily determined from the generated data. This represents a significant benefit of the continuous water monitor over the relatively small number of grab samples which can be acquired during a test.

Analytical results are listed from laboratory analyses of grab samples from commercial tests 16 and 17 are listed in Tables 8 and 9, respectively. Concentrations as determined by the continuous water monitor are given for comparison. The results from the DSITMS analyses are significantly lower than the concentrations as determined by the continuous water monitor. Results from the standard GC/MS analysis of split

samples performed at ORNL are even lower. One possible reason for these differences is that the peroxide and catalysts added to the samples continued to degrade the organics in the samples, albeit at much slower rates, leading to the progressively lower numbers as the samples aged.

**Table 2. Continuous Water Monitor - Semi-quantitative Concentration Estimates
Second Field Test, 10/18/93, Run #12A Experimental Treatment System**

Compound	Test Start (ng/mL)	Test End (ng/mL)
1,1-DCA	605	115
1,1,1-TCA	662	299
Benzene	33	3
Toluene	26	5
Xylene	108	6

**Table 3. Continuous Water Monitor - Semi-quantitative Concentration Estimates
Second Field Test, 10/18/93, Run #14A Experimental Treatment System**

Compound	Test Start (ng/mL)	Test End (ng/mL)
1,1-DCA	1431	461
1,1,1-TCA	939	579
Benzene	51	22
Toluene	44	15
Xylene	209	49

Table 4. Continuous Water Monitor - Semi-quantitative Concentration Estimates*
Second Field Test, 10/18/93, Run #15A Experimental Treatment System

Compound	Test Start (ng/mL)	Test End (ng/mL)
1,1-DCA	373	131
1,1,1-TCA	368	273
Benzene	32	2
Toluene	32	3
Xylene	136	2

*These estimates were generated by averaging the standards for the runs preceding and following this one.

Table 5. Continuous Water Monitor - Semi-quantitative Concentration Estimates
Second Field Test, 10/18/93, Run #17A Experimental Treatment System

Compound	Test Start (ng/mL)	Test End (ng/mL)
1,1-DCA	624	36
1,1,1-TCA	552	81
Benzene	46	2
Toluene	48	3
Xylene	218	3

**Table 6. Continuous Water Monitor - Semi-quantitative Concentration Estimates
Second Field Test, 10/19/93, Run #16 Commercial Treatment System**

Compound	Test Start (ng/mL)	Test End (ng/mL)
1,1-DCA	259	8
1,1,1-TCA	460	10
Benzene	32	2
Toluene	24	3
Xylene	107	4

**Table 7. Continuous Water Monitor - Semi-quantitative Concentration Estimates
Second Field Test, 10/19/93, Run #17 Commercial Treatment System**

Compound	Test Start (ng/mL)	Test End (ng/mL)
1,1-DCA	114	10
1,1,1-TCA	338	14
Benzene	29	2
Toluene	27	3
Xylene	124	3

**Table 8. Analysis of Water Samples from Treatment of K-25 Seep
Second Field Test, 10/19/93, Run #16, Commercial Treatment**

	Test Start			Test End		
	ng/mL			ng/mL		
	Cont. Monitor	DSITMS	GC/MS	Cont. Monitor	DSITMS	GC/MS
Date Analyzed	10/19/93	10/20/93	10/29/93	10/19/93	10/20/93	10/29/93
Compound						
1,1,-DCA	259	129	7	8	8	2
1,1,1-TCA	460	294	60	10	20	9
Benzene	32	5	ND	2	2	ND
Toluene	24	5	ND	3	4	ND
Xylenes	107	32	ND	4	28	ND

**Table 9. Analysis of Water Samples from Treatment of K-25 Seep
Second Field Test, 10/19/93, Run #17, Commercial Treatment**

	Test Start			Test End		
	ng/mL			ng/mL		
	Cont. Monitor	DSITMS	GC/MS	Cont. Monitor	DSITMS	GC/MS
Date Analyzed	10/19/93	10/20/93	10/29/93	10/19/93	10/20/93	10/29/93
Compound						
1,1,-DCA	114	109	4	10	5	1
1,1,1-TCA	338	265	54	14	20	7
Benzene	29	3	ND	2	1	ND
Toluene	27	3	ND	3	2	ND
Xylenes	124	22	ND	3	16	ND

Perox-pure Commercial Treatment Process

Figure 1

WJSA Experimental Treatment Process

Figure 2

Chro Analysis File: E:\MAG\1018CT5 Date: Oct-18-1993 16:11:13
Comment: K-25 Seep Sample, with stds after, blank, low, high, h2oci, m1600
Scan No: 187 Retention Time: 3:07 RIC: 32899 Mass Range: 47 - 150
Plotted: 1 to 1273 Range: 1 to 1273 100% = 37818

Figure 3

DSITMS CONTINUOUS WATER MONITORING OF TREATMENT OF K-25 SEEP
Run 13A, 10/18/93, Experimental Treatment System

Figure 4

DSITMS CONTINUOUS WATER MONITORING OF TREATMENT OF K-25 SEEP
Run 12A, 10/18/93, Experimental Treatment System

Figure 5

DSITMS CONTINUOUS WATER MONITORING OF TREATMENT OF K-25 SEEP
Run 14A - Iron left in seep water, 10/18/93, Experimental Treatment System

Figure 3

DSITMS CONTINUOUS WATER MONITORING OF TREATMENT OF K-25 SEEP
Run 15A, 10/18/93, Experimental Treatment System

Figure 7

DSITMS CONTINUOUS WATER MONITORING OF TREATMENT OF K-25 SEEP
Run 17A, 10/18/93, Experimental Treatment System, Higher Energy UV

Figure 8

DSITMS CONTINUOUS WATER MONITORING OF TREATMENT OF K-25 SEEP
Run 16, 10/19/93, Commercial Treatment System

Figure 9

DSITMS CONTINUOUS WATER MONITORING OF TREATMENT OF K-25 SEEP
Run 17, 10/19/93, Commercial Treatment System

Figure 10

APPENDIX VII. ANALYTICAL REPORTS FOR PEROX-PURE™ AND SD-2 TESTS ON SW-31 SPRING

Comment on Vinyl Chloride Measurements

Based on the analytical analyses performed in this study, vinyl chloride was "detected" as being present in the SW-31 Spring water. However, the destruction rates for vinyl chloride demonstrated by the analytical results are significantly lower in magnitude than historically demonstrated destruction rates for the perox-pure™ process, and are less than expected for the SD-2 system based on the destruction rates achieved in this study for other chlorinated ethylene compounds such as TCE. Therefore, an anomaly exists between the vinyl chloride analytical results and the expected/demonstrated destruction rates. This anomaly is even further supported by the fact that the destruction rates for the other more difficult to treat VOC's in the SW-31 water (such as TCA and DCA) were close to expected results. Because the analytical methodology utilized in this study for VOC analysis (i.e., EPA Method 601/602) was not of a confirmatory nature [because it did not employ gas chromatograph/mass spectroscopy (GC/MS) per EPA Method 624]; and the level of vinyl chloride detected was very low, it is uncertain that the compound "detected" as vinyl chloride was actually vinyl chloride.

In future studies at the SW-31 Spring site, it is recommended that GC/MS analysis be performed for VOC's using EPA Method 624 or B240 to confirm the presence of vinyl chloride (or not) and its destruction rates.

CHAIN OF CUSTODY FORM

Arizona Certified Laboratory

Page 1 of 1

Aspen Environmental Laboratory

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COMPANY PSI

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PROJECT NAME DOE / WJSA PROJ. MGR. EMERY FROENICH / CHRIS GIGOR

PROJECT NUMBER 345 SAMPLES TAKEN FROM: OAK RIDGE, TN

☒ 24 HOUR RUSH (_____ % Surcharge) ☐ 48 HOUR RUSH (_____ % Surcharge)

ON
SOME

SAMPLER'S (SIGNATURE)

[Signature]

PHONE NO.
(MUST INCLUDE)

FAX NO.

SAMPLE ID.	DATE			TIME TAKEN	MATRIX	LAB ID.	NOTES
	MO.	DAY	YR.				
DOE1A-0,2,3,4	9	1	93	a.m. p.m.	H ₂ O	091593-16, 17, 18, 19	
DOE2A-0,2,3,4	9	1	93	a.m. p.m.	"	091593-20 21, 22, 23	
				a.m. p.m.			
				a.m. p.m.			
				a.m. p.m.			
				a.m. p.m.			
				a.m. p.m.			
				a.m. p.m.			
				a.m. p.m.			
				a.m. p.m.			

ANALYSIS REQUESTED (Circle Method, Place X in Box)															
Number of Containers	Halogenated Volatiles 601 / 8010	Aromatic Volatiles 602 / 8020	BTEX / TPHC 8020 / 8015	Phenols, Sub-Phenols 604 / 8040	Pesticides / PCB 608 / 8080	TCLP Organics and Metals	TCLP Metals	Petroleum Hydrocarbons 418.1 (BLS181)	Semi-Volatiles GC MS 625 / 8270	Volatiles GC MS 624 / 8260	SWDA Volatiles 502.2/524	Priority Pollutant Metals (13)	Oil & Grease Method No. 413.1	COD EPA 410.1	BOD EPA 405.1
	X	X													

PROJECT INFORMATION		SAMPLE RECEIPT		RELINQUISHED BY		RELINQUISHED BY	
PROJECT:	TOTAL NO. OF CONTAINERS	(Signature) <i>[Signature]</i>	(Time)	(Signature)	(Time)	(Signature)	(Time)
P.O. #:	REC'D GOOD CONDITION/COLD	(Printed Name) <i>CHRIS GIGOR</i>	(Date) <i>9/19/93</i>	(Printed Name)	(Date)	(Printed Name)	(Date)
PRESERVATIVES:	CUSTODY SEALS	(Company) <i>PSI</i>		(Company)		(Company)	
SPECIAL INSTRUCTIONS/COMMENTS: <i>RUSH SAMPLES ARE: DOE 2A-0, DOE 2A-4, DOE 1A-0, DOE 1A-4. PLEASE FAX RESULTS TO CHRIS GIGOR</i>				RECEIVED BY		RECEIVED BY (LABORATORY)	
				(Signature)	(Time)	(Signature) <i>Deborah Cartmell</i>	(Time)
				(Printed Name)	(Date)	(Printed Name) <i>Deborah Cartmell</i>	(Date) <i>9/15/93</i>

CHAIN OF CUSTODY FORM

Arizona Certified Laboratory

Page 1 of 1

Aspen Environmental Laboratory

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COMPANY PST
 ADDRESS Tucson Office
 CITY _____ STATE _____ ZIP _____
 PROJECT NAME WJSA/DOE PROJ. MGR. Chris Giger
 PROJECT NUMBER 395 SAMPLES TAKEN FROM: DOE K-25 SITE
☒ 24 HOUR RUSH (_____ % Surcharge) ☐ 48 HOUR RUSH (_____ % Surcharge)

SAMPLER'S (SIGNATURE)				PHONE NO. (MUST INCLUDE)		FAX NO.	
<i>Chris Giger</i>							
SAMPLE ID.	DATE			TIME TAKEN	MATRIX	LAB ID.	NOTES
	MO.	DAY	YR.				
DOE 3A-0,3, 6,9	10	15	93	a.m. p.m.	H ₂ O	102093-21 22 2324	
DOE 4A-0,3, 6,9		11		a.m. p.m.	"	102093-25 26 2728	
DOE 5A-0,3, 6,9		11		a.m. p.m.	"	-29,30,31 32	
DOE 6A-0,3, 6,9		11		a.m. p.m.	"	-33,34,35 36	
DOE 7A-0,3, 6,9		11		a.m. p.m.	"	-37,38,39 40	
FIELD BLANKS		11		a.m. p.m.	"	-41	
TRIP BLANKS				a.m. p.m.		-42	
				a.m. p.m.			
				a.m. p.m.			

ANALYSIS REQUESTED (Circle Method, Place X in Box)															
Number of Containers	Halogenated Volatiles 601/8010	Aromatic Volatiles 602/8020	BTEX/TPHC 8020/8015	Phenols, Sub-Phenols 604/8040	Pesticides/PCB 608/8080	TCLP Organics and Metals	TCLP Metals	Petroleum Hydrocarbons 418.1(BLS181)	Semi-Volatiles GC MS 625/8270	Volatiles GC MS 624/8260	SWDA Volatiles 502.2/524	Priority Pollutant Metals (13)	Oil & Grease Method No. 413.1	COD EPA 410.1	BOD EPA 405.1
	X	X													
	X	X													
	X	X													
	X	X													
	X	X													
	X	X													
	X	X													
	X	X													
	X	X													

PROJECT INFORMATION		SAMPLE RECEIPT		RELINQUISHED BY		RELINQUISHED BY	
PROJECT:		TOTAL NO. OF CONTAINERS		(Signature) <i>Chris Giger</i> (Time)		(Signature) (Time)	
P.O. #:		REC'D GOOD CONDITION/COLD		(Printed Name) <i>Chris Giger</i> (Date) <i>10/15/93</i>		(Printed Name) (Date)	
PRESERVATIVES:		CUSTODY SEALS		(Company) <i>PST</i>		(Company)	
SPECIAL INSTRUCTIONS/COMMENTS: RUSH ON DOE 4A-0, 4A-6, 5A-6, 6A-0, 6A-6, 7A-6. FAX ASAP MONDAY TO CHRIS GIGER				RECEIVED BY		RECEIVED BY (LABORATORY)	
				(Signature) (Time)		(Signature) (Time)	
				(Printed Name) (Date)		(Printed Name) (Date)	
				(Company)		(Company)	

Page 1 of 1

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CITY _____ STATE _____ ZIP _____

PROJECT NUMBER 345 SAMPLES TAKEN FROM: DOE K-25

☐ 24 HOUR RUSH (_____ % Surcharge) ☐ 48 HOUR RUSH (_____ % Surcharge)

SAMPLER'S SIGNATURE

PHONE NO.
(MUST INCLUDE)

FAX NO.

[illegible]

PROJECT INFORMATION		SAMPLE RECEIPT		RELINQUISHED BY		RELINQUISHED BY	
PROJECT:	TOTAL NO. OF CONTAINERS	28		(Signature)	(Time)	(Signature)	(Time)
P.O. #:	REC'D GOOD CONDITION/COLD	✓		(Printed Name)	(Date)	(Printed Name)	(Date)
PRESERVATIVES:	CUSTODY SEALS	No		(Company)	(Date)	(Company)	(Date)
SPECIAL INSTRUCTIONS/COMMENTS: STD. TURNAROUND				RECEIVED BY		RECEIVED BY (LABORATORY)	
				(Signature)	(Time)	(Signature)	(Time)
				(Printed Name)	(Date)	(Printed Name)	(Date)
				(Company)	(Date)	(Company)	(Date)

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ADDRESS Tucson Office

PROJECT NAME WJSA/DOE PROJ. MGR. EMERY/CITRIS

☐ 24 HOUR RUSH (_____ % Surcharge) ☐ 48 HOUR RUSH (_____ % Surcharge)

(MUST INCLUDE)

SAMPLE ID.	DATE	TIME	MATRIX	LAB ID.	NOTES
------------	------	------	--------	---------	-------

DOE 11A-0,3	1	2	3	4	5	a.m.	10/9/93-04,05
						p.m.	

USE 10A = 5,3, 6,9	11	a.m. p.m.	11	USE 10B = 5,3, 10, 11
-----------------------	----	--------------	----	--------------------------

6, 9	11	p.m.	14, 15
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6	9						p.m.		13		release
---	---	--	--	--	--	--	------	--	----	--	---------

[illegible]

						a.m.			
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FILED	APR 11	1993	AM	11	10/993-23
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TRIP BLANK	CH	a.m.	6	101993-24
		p.m.		

PROJECT INFORMATION	SAMPLE RECEIPT	RELINQUISHED BY
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P.O. #:	REC'D GOOD CONDITION/COLD	<i>Chen J. J.</i>
---------	---------------------------	-------------------

PRESERVATIVES:	CUSTODY SEALS	LMS 1167 (Germany)
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SPECIAL INSTRUCTIONS/COMMENTS:	RECEIVED BY
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	(Orig. 2/10/8)
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	(Continued)
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14. [Return to Table of Contents](#)

[illegible][illegible]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

RELINQUISHED BY _____

(Time)	(Signature)	(Time)
--------	-------------	--------

6/19/93

RECEIVED BY (LABORATORY)

(Time) (Signature) (Time)

(Date)	(Filing Name)	(Date)

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/14/93

Project Name: WJSA/DOE

Date Received: 9/15/93

Project Number: 345

Date Analyzed: 9/15/93

Sample ID: 091593-16, 18, 20, 22

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	1A-0*	1A-4	2A-0*	2A-4	
Bromodichloromethane	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Bromoform	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Bromomethane	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Carbon Tetrachloride	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Chlorobenzene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Chloroethane	1.0	290	161	243	203	
Chloroform	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Chloromethane	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
2-Chloroethyl vinyl ether	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Dibromochloromethane	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
1,2-Dichlorobenzene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
1,3-Dichlorobenzene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
1,4-Dichlorobenzene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
1,1-Dichloroethane	1.0	322	113	258	109	
1,2-Dichloroethane	1.0	< 5.0	1.7	< 5.0	3.4	
1,1-Dichloroethene	1.0	10	< 1.0	7.0	< 1.0	
Trans-1,2-Dichloroethene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
1,2-Dichloropropane	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Cis-1,3-Dichloropropene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Trans-1,3-Dichloropropene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Methylene Chloride	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
1,1,2,2-Tetrachloroethane	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Tetrachloroethene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
1,1,1-Trichloroethane	1.0	186	20	131	4.9	
1,1,2-Trichloroethane	1.0	< 5.0	1.5	< 5.0	1.9	
Trichloroethene	1.0	< 5.0	< 1.0	< 5.0	< 1.0	
Trichlorofluoromethane	1.0	134	48	115	46	
Vinyl Chloride	1.0	16	57	17	< 1.0	

Comments:

*5:1 Dilution made on this sample.

Reviewed By:

Tanella Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/14/93

Project Name: WJSA/DOE

Date Received: 9/15/93

Project Number: 345

Date Analyzed: 9/15/93

Sample ID: 091593-16, 18, 20, 22

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	1A-0*	1A-4	2A-0*	2A-4	
Benzene	1.0	6.0	<1.0	<5.0	<1.0	
Toluene	1.0	7.3	<1.0	5.6	<1.0	
Chlorobenzene	1.0	<5.0	<1.0	<5.0	<1.0	
Ethyl Benzene	1.0	<5.0	<1.0	<5.0	<1.0	
m,p-Xylene	1.0	<5.0	<1.0	<5.0	<1.0	
o-Xylene	1.0	<5.0	<1.0	<5.0	<1.0	
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<5.0	<1.0	
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<5.0	<1.0	
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<5.0	<1.0	

Comments: _____
*5:1 Dilution made on this sample.

Reviewed By: Tamara K. Keady Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/14/93

Project Name: WJSA/DOE

Date Received: 9/15/93

Project Number: 345

Date Analyzed: 9/15/93

Sample ID: 091593-17, 19, 21, 23

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	1A-2	1A-6	2A-2	2A-6
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	176	145	215	163
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	152	82	161	59
1,2-Dichloroethane	1.0	2.0	2.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	4	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	57	5	34	1
1,1,2-Trichloroethane	1.0	1.6	1.2	<1.0	<1.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	63	37	69	26
Vinyl Chloride	1.0	30	<1.0	63	<1.0

Comments: _____

Reviewed By: Tamille Kennedy

Date: 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client:	Peroxidation Systems, Inc. 5151 E. Broadway, Suite 600 Tucson, Arizona 85711	Sample Type:	Groundwater
Project Name:	WJSA/DOE	Date Sampled:	9/14/93
Project Number:	345	Date Received:	9/15/93
Sample ID:	091593-17, 19, 21, 23	Date Analyzed:	9/15/93
		Analyzed By:	Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	1A-2	1A-6	2A-2	2A-6	
Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
Toluene	1.0	<1.0	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	
o-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: James H. Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-21 - 24

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	3A-0	3A-3	3A-6	3A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	11	7	3	<1.0
Chloroform	1.0	1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	239	195	145	107
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	78	72	60	54
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	199	148	103	70
1,1,2-Trichloroethane	1.0	3.0	2.0	2.0	2.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	139	132	117	105
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Jaselle Kennedy Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater
Date Sampled: 10/15/93

Project Name: WJSA/DOE
Date Received: 10/18/93

Project Number: 345
Date Analyzed: 10/18/93

Sample ID: 102093-21 - 24
Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	3A-0	3A-3	3A-6	3A-9	
Benzene	1.0	1.7	<1.0	<1.0	<1.0	
Toluene	1.0	<1.0	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	
o-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Jamille Kennedy

Date 10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-25, 27, 31, 33, 35

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	4A-0	4A-6	5A-6	6A-0	6A-6
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	17	4.0	<1.0	15	<1.0
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	274	149	42	277	40
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	101	66	72	107	68
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	232	117	132	242	123
1,1,2-Trichloroethane	1.0	3.0	2.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	195	147	NA	187	128
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Comments: NA - Data not available, Pending QA/QC.

Reviewed By:

Tanette Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-25, 27, 31, 33, 35

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	4A-0	4A-6	5A-6	6A-0	6A-6
Benzene	1.0	3.3	<1.0	<1.0	2.0	<1.0
Toluene	1.0	1.8	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Timothy Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-26, 28, 29, 30, 32

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	4A-3	4A-9	5A-0	5A-3	5A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	7.0	<1.0	13	1.0	<1.0
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	215	106	265	139	10
1,2-Dichloroethane	1.0	2.0	<1.0	2.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	81	56	101	91	56
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	175	85	242	196	86
1,1,2-Trichloroethane	1.0	<1.0	<1.0	3.0	2.0	<1.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	142	107	NA	NA	NA
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Comments: NA - Data not available. Pending QA/QC.

Reviewed By:

Janele Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711
Sample Type: Groundwater
Date Sampled: 10/15/93
Project Name: WJSA/DOE
Date Received: 10/18/93
Project Number: 345
Date Analyzed: 10/18/93
Sample ID: 102093-26, 28, 29, 30, 32
Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	4A-3	4A-9	5A-0	5A-3	5A-9
Benzene	1.0	<1.0	<1.0	3.6	<1.0	<1.0
Toluene	1.0	<1.0	<1.0	2.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Tamela Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-34, 36, 39

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	6A-3	6A-9	7A-6		
Bromodichloromethane	1.0	<1.0	<1.0	<1.0		
Bromoform	1.0	<1.0	<1.0	<1.0		
Bromomethane	1.0	<1.0	<1.0	<1.0		
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Chloroethane	1.0	2.0	<1.0	<1.0		
Chloroform	1.0	<1.0	<1.0	<1.0		
Chloromethane	1.0	<1.0	<1.0	<1.0		
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0		
Dibromochloromethane	1.0	<1.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,1-Dichloroethane	1.0	139	12	32		
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0		
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0		
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0		
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0		
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Methylene Chloride	1.0	89	59	61		
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0		
Tetrachloroethene	1.0	<1.0	<1.0	<1.0		
1,1,1-Trichloroethane	1.0	180	84	102		
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0		
Trichloroethene	1.0	<1.0	<1.0	<1.0		
Trichlorofluoromethane	1.0	160	115	112		
Vinyl Chloride	1.0	<1.0	<1.0	<1.0		

Comments: _____

Reviewed By: Janele Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-34, 36, 39

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	6A-3	6A-9	7A-6		
Benzene	1.0	<1.0	<1.0	<1.0		
Toluene	1.0	<1.0	<1.0	<1.0		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Ethyl Benzene	1.0	<1.0	<1.0	<1.0		
m,p-Xylene	1.0	<1.0	<1.0	<1.0		
o-Xylene	1.0	<1.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		

Comments: _____

Reviewed By: Janelle Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-37, 38, 40

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	7A-0	7A-3	7A-9		
Bromodichloromethane	1.0	<1.0	<1.0	<1.0		
Bromoform	1.0	<1.0	<1.0	<1.0		
Bromomethane	1.0	<1.0	<1.0	<1.0		
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Chloroethane	1.0	18	2.0	<1.0		
Chloroform	1.0	<1.0	<1.0	<1.0		
Chloromethane	1.0	<1.0	<1.0	<1.0		
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0		
Dibromochloromethane	1.0	<1.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,1-Dichloroethane	1.0	240	119	10		
1,2-Dichloroethane	1.0	2	<1.0	<1.0		
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0		
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0		
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0		
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Methylene Chloride	1.0	111	89	63		
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0		
Tetrachloroethene	1.0	<1.0	<1.0	<1.0		
1,1,1-Trichloroethane	1.0	232	173	69		
1,1,2-Trichloroethane	1.0	3	1	<1.0		
Trichloroethene	1.0	<1.0	<1.0	<1.0		
Trichlorofluoromethane	1.0	264	226	163		
Vinyl Chloride	1.0	<1.0	<1.0	<1.0		

Comments: _____

Reviewed By: Janelle Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/15/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/18/93

Sample ID: 102093-37, 38, 40

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	7A-0	7A-3	7A-9		
Benzene	1.0	2	<1.0	<1.0		
Toluene	1.0	<1.0	<1.0	<1.0		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Ethyl Benzene	1.0	<1.0	<1.0	<1.0		
m,p-Xylene	1.0	<1.0	<1.0	<1.0		
o-Xylene	1.0	<1.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		

Comments: _____

Reviewed By: Tanilla Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/16/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101893-67 - 70

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	8A-0	8A-3	8A-6	8A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	35	33	27	25
Chloroform	1.0	3	1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	400	323	331	321
1,2-Dichloroethane	1.0	3	3	3	3
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	2	5	4	3
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	169	149	128	117
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	4.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	326	298	257	232
1,1,2-Trichloroethane	1.0	4.0	4.0	3.0	3.0
Trichloroethene	1.0	8	4.0	<1.0	<1.0
Trichlorofluoromethane	1.0	354	337	275	263
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Jarilla Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/16/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101893-67 - 70

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	8A-0	8A-3	8A-6	8A-9	
Benzene	1.0	54	38	26	17	
Toluene	1.0	52	32	18	11	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	23	16	9	6	
m,p-Xylene	1.0	80	44	18	10	
o-Xylene	1.0	39	22	10	6	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Jamille Kennedy

Date 12/15/93

PSI Environmental Laboratories

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ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/16/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101893-71 - 74

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	9A-0	9A-3	9A-6	9A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	2.0	4.0	4.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	18	NA	11	13
Chloroform	1.0	2.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	291	238	218	183
1,2-Dichloroethane	1.0	3	3	2	2
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	1	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	89	79	70	57
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	214	194	155	119
1,1,2-Trichloroethane	1.0	4	4	4	5
Trichloroethene	1.0	3	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	190	172	145	130
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: NA - Data not available. Pending QA/QC.

Reviewed By:

Jessie Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/16/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101893-71 - 74

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	9A-0	9A-3	9A-6	9A-9	
Benzene	1.0	20	<1.0	<1.0	<1.0	
Toluene	1.0	17	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	8	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	22	<1.0	<1.0	<1.0	
o-Xylene	1.0	11	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Janette Kenedy

Date 12/15/93

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ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/16/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101893-75 - 78

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	10A-0	10A-3	10A-6	10A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	6	6	5	6
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	27	22	19	19
Chloroform	1.0	1	3	3	2
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	394	339	278	231
1,2-Dichloroethane	1.0	3	3	2	2
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	3	1	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	133	118	105	86
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	2	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	313	263	206	164
1,1,2-Trichloroethane	1.0	4	4	5	6
Trichloroethene	1.0	6	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	276	260	220	188
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Tanette Kennedy

Date: 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/16/93

Project Name: WJSA/DOE

Date Received: 10/18/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101893-75 - 78

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	10A-0	10A-3	10A-6	10A-9	
Benzene	1.0	39	4	1	1	
Toluene	1.0	34	2	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	16	2	<1.0	<1.0	
m,p-Xylene	1.0	46	2	<1.0	<1.0	
o-Xylene	1.0	24	2	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Terrell Kennedy

Date 10/15/93

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ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101993-4 - 7

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	11A-0	11A-.5	11A-3	11A-6	
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0	
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0	
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0	
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Chloroethane	1.0	12.0	<1.0	<1.0	<1.0	
Chloroform	1.0	2	<1.0	<1.0	<1.0	
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0	
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0	
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,1-Dichloroethane	1.0	516	83	55	34	
1,2-Dichloroethane	1.0	4	<1.0	<1.0	<1.0	
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	
Trans-1,2-Dichloroethene	1.0	1	<1.0	<1.0	<1.0	
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0	
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	
Methylene Chloride	1.0	247	107	90	73	
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0	
Tetrachloroethene	1.0	9	<1.0	<1.0	<1.0	
1,1,1-Trichloroethane	1.0	455	178	144	113	
1,1,2-Trichloroethane	1.0	5	1	<1.0	<1.0	
Trichloroethene	1.0	15	<1.0	<1.0	<1.0	
Trichlorofluoromethane	1.0	NA	242	205	173	
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: NA - Data not available, Pending QA/QC.

Reviewed By:

Jarulle Kennedy

Date *12/15/93*

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101993-4 - 7

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	11A-0	11A-.5	11A-3	11A-6	
Benzene	1.0	85	<1.0	<1.0	<1.0	
Toluene	1.0	90	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	66	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	164	<1.0	<1.0	<1.0	
o-Xylene	1.0	72	<1.0	5	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	1	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Jarvis Kennedy Date: 12/15/93

PSI Environmental Laboratories

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ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 101993-8 - 11

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	12A-0	12A-3	12A-6	12A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	26	13	3	<1.0
Chloroform	1.0	1	1	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	376	279	181	133
1,2-Dichloroethane	1.0	3	2	1	1
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	2	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	146	120	94	86
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	322	248	180	137
1,1,2-Trichloroethane	1.0	4	3	3	3
Trichloroethene	1.0	7	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	NA	NA	NA	NA
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: NA - Data not available, Pending QA/QC.

Reviewed By: Jamille Kennedy

Date: 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 101993-8 - 11

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	12A-0	12A-3	12A-6	12A-9	
Benzene	1.0	36	< 1.0	< 1.0	< 1.0	
Toluene	1.0	37	< 1.0	< 1.0	< 1.0	
Chlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Ethyl Benzene	1.0	27	< 1.0	< 1.0	< 1.0	
m,p-Xylene	1.0	59	< 1.0	< 1.0	< 1.0	
o-Xylene	1.0	28	< 1.0	< 1.0	< 1.0	
1,2-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	
1,3-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	
1,4-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	

Comments: _____

Reviewed By: Tamela Kennedy

Date 10/15/93

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ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101993-12 - 15

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	13A-0	13A-3	13A-6	13A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	27	18	9	5
Chloroform	1.0	1	1	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	368	300	232	177
1,2-Dichloroethane	1.0	3	2	2	1
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	144	124	105	91
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	3	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	322	257	221	186
1,1,2-Trichloroethane	1.0	4	3	3	2
Trichloroethene	1.0	5	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	279	252	220	191
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Jamie Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101993-12 - 15

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	13A-0	13A-3	13A-6	13A-9	
Benzene	1.0	24	<1.0	<1.0	<1.0	
Toluene	1.0	24	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	18	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	39	<1.0	<1.0	<1.0	
o-Xylene	1.0	19	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Tamela Kennedy Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 101993-16 - 18

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	14A-0	14A-3	14A-9		
Bromodichloromethane	1.0	<1.0	<1.0	<1.0		
Bromoform	1.0	<1.0	<1.0	<1.0		
Bromomethane	1.0	<1.0	<1.0	<1.0		
Carbon Tetrachloride	1.0	<1.0	<1.0	2		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Chloroethane	1.0	28	24	18		
Chloroform	1.0	1	1	<1.0		
Chloromethane	1.0	<1.0	<1.0	<1.0		
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0		
Dibromochloromethane	1.0	<1.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,1-Dichloroethane	1.0	385	315	271		
1,2-Dichloroethane	1.0	3	3	2		
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0		
Trans-1,2-Dichloroethene	1.0	3	5	3		
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0		
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Methylene Chloride	1.0	175	142	114		
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0		
Tetrachloroethene	1.0	4	1	<1.0		
1,1,1-Trichloroethane	1.0	348	278	214		
1,1,2-Trichloroethane	1.0	3.5	3.4	2.7		
Trichloroethene	1.0	7	3	<1.0		
Trichlorofluoromethane	1.0	309	252	198		
Vinyl Chloride	1.0	<1.0	<1.0	<1.0		

Comments: _____

Reviewed By: Jamille Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 101993-16 - 18

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	14A-0	14A-3	14-9		
Benzene	1.0	54	40	19		
Toluene	1.0	56	36	15		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Ethyl Benzene	1.0	38	27	12		
m,p-Xylene	1.0	101	61	20		
o-Xylene	1.0	45	31	9		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		

Comments: _____

Reviewed By: Tamela Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 101993-19 - 22

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	15A-0	15A-3	15A-6	15A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	27	17	9	2
Chloroform	1.0	1	1	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	2	1	1
1,1-Dichloroethane	1.0	374	298	229	165
1,2-Dichloroethane	1.0	3	2	2	1
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	2	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	139	119	97	85
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	3	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	318	252	207	157
1,1,2-Trichloroethane	1.0	4	3	3	3
Trichloroethene	1.0	6	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	278	237	201	170
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Tamela Kennedy Date: 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 101993-19 - 22

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	15A-0	15A-3	15A-6	15A-9
Benzene	1.0	37	<1.0	<1.0	<1.0
Toluene	1.0	38	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	26	<1.0	<1.0	<1.0
m,p-Xylene	1.0	59	<1.0	<1.0	<1.0
o-Xylene	1.0	29	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Tammi Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 101993-25 - 28

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in µg/L (ppb)

Compounds	Limit of Detection	16A-0	16A-3	16A-6	16A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	35	18	2	<1.0
Chloroform	1.0	2	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	476	323	203	103
1,2-Dichloroethane	1.0	4	3	1	<1.0
1,1-Dichloroethene	1.0	<1.0	1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	3	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	187	134	77	43
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	4	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	415	288	207	133
1,1,2-Trichloroethane	1.0	6	4	3	2
Trichloroethene	1.0	8	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	342	291	221	163
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Janele Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 101993-25 - 28

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	16A-0	16A-3	16A-6	16A-9	
Benzene	1.0	30	<1.0	<1.0	<1.0	
Toluene	1.0	30	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	21	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	45	<1.0	<1.0	<1.0	
o-Xylene	1.0	20	<1.0	<1.0	2	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Jennifer Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 101993-29 - 32

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	17A-0	17A-3	17A-6	17A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	6	2	2	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	17.3	4.2	1.2	<1.0
Chloroform	1.0	3	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	407	237	135	67
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	23	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	5	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	3	3	<1.0	<1.0
1,1,1-Trichloroethane	1.0	366	217	118	67
1,1,2-Trichloroethane	1.0	1	<1.0	<1.0	<1.0
Trichloroethene	1.0	4	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	399	333	254	203
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Trish K. Kandy

Date: 11/10/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 101993-29 - 32

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	17A-0	17A-3	17A-6	17A-9	
Benzene	1.0	18	<1.0	<1.0	<1.0	
Toluene	1.0	15	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	23	<1.0	<1.0	<1.0	
o-Xylene	1.0	11	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: _____

Date: _____

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 101993-33 - 36

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	18A-0	18A-3	18A-6	18A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	5	3	1	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	19	8	2	<1.0
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	426	305	185	113
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	28	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	7	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	4	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	371	276	186	128
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	7	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	423	364	263	228
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Janelle Kandy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 101993-33 - 36

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	18A-0	18A-3	18A-6	18A-9	
Benzene	1.0	24	<1.0	<1.0	<1.0	
Toluene	1.0	23	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	33	<1.0	<1.0	<1.0	
o-Xylene	1.0	16	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Janet Kennedy

Date 10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101993-37 - 40

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	19A-0	19A-3	19A-6	19A-9
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	NA	NA	NA	NA
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	394	269	168	102
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	24	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	6	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	4	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	354	255	170	116
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	4	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	NA	NA	NA	NA
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0

Comments: NA - Data not available, Pending QA/QC.

Reviewed By: Jamille Kennedy

Date: 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/18/93

Project Name: WJSA/DOE

Date Received: 10/19/93

Project Number: 345

Date Analyzed: 10/26/93

Sample ID: 101993-37 - 40

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	19A-0	19A-3	19A-6	19A-9	
Benzene	1.0	21	2	<1.0	<1.0	
Toluene	1.0	17	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	26	4	<1.0	<1.0	
o-Xylene	1.0	13	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Tamela Kennedy

Date 12/15/93

Arizona Certified Laboratory

Aspen Environmental Laboratory

1730 N Oracle Road, Suite 212 • Tucson, Arizona 85706 • (602) 897-1975 • FAX (602) 897-2352

COMPANY

TS

ADDRESS

CITY Tucson STATE At

PROJECT NAME	WJSA / DOE	PROJ. MGR.	EMORY FLORENCH
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PROJECT NUMBER	395	SAMPLES TAKEN FROM:	DOE SITE, TN
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☒ 24 HOUR RUSH (____ % Surcharge) ☐ 48 HOUR RUSH (____ % Surcharge)

SAMPLER'S (SIGNATURE)

IMPLER'S (SIGNATURE) *Cyrus Giger*

PHONE NO.**FAX NO.**

SAMPLE ID.	DATE			TIME TAKEN	MATRIX	LAB ID.	NOTES
	MO.	DAY	YR.				
DOE 1-1MFL, .5 1, 2, 3	8	3	1993	a.m. p.m.	H ₂ O		7 2-1 090193-8
DOE 2-4MFL, .5 1, 2, 3	8	3	1993	a.m. p.m.	H ₂ O		2-2 -9
DOE 1-1MFL				a.m. p.m.		090193-1	2-3 -10
1-0.5				a.m. p.m.		-2	
1-1				a.m. p.m.		-3	
1-2				a.m. p.m.		-4	
1-3				a.m. p.m.		-5	
DOE 2-1MFL				a.m. p.m.		-6	
1-2-.5				a.m. p.m.		-7	

PROJECT INFORMATION		SAMPLE RECEIPT		RELINQUISHED BY		RECEIVED BY (LABORATORY)	
PROJECT:		TOTAL NO. OF CONTAINERS		(Signature)		(Signature)	
P.O. #:		REC'D GOOD CONDITION/COLD		(Time)		(Time)	
PRESERVATIVES:		CUSTODY SEALS		(Printed Name)		(Printed Name)	
SPECIAL INSTRUCTIONS/COMMENTS: <div style="border: 1px solid black; padding: 5px; margin: 5px;"> <p>Do IRON & ALKALINITY ONLY ON INFLUENT SAMPLES FOR TEST MARKED.</p> </div>				(Date)		(Date)	
				(Company)		(Company)	
				(Signature)		(Signature)	
				(Time)		(Time)	

SPECIAL INSTRUCTIONS/COMMENTS:

~~DO~~ DO IRON + ALKALINITY ONLY ON
INFLUENT SAMPLES FOR TEST
MARKED:

CHAIN OF CUSTODY FORM

Arizona Certified Laboratory

Page 1 of 1

Aspen Environmental Laboratory

4730 N. Oracle Road, Suite 212 • Tucson, Arizona 85705 • (602) 887-1975 • FAX (602) 887-2352

COMPANY PSI
 ADDRESS 5151 E. BROADWAY, STE 600
 CITY TUCSON STATE AZ ZIP 85711
 PROJECT NAME WJSA PROJ. MGR. CHRIS GIGBY / JENNY FROELICH
 PROJECT NUMBER 0845 SAMPLES TAKEN FROM: _____
☐ 24 HOUR RUSH (_____ % Surcharge) ☐ 48 HOUR RUSH (_____ % Surcharge)

SAMPLER'S (SIGNATURE)

[Signature]

PHONE NO. (MUST INCLUDE) (602) 790-8883

FAX NO. (602) 790-8008

SAMPLE ID.	DATE			TIME TAKEN	MATRIX	LAB ID.	NOTES
	MO.	DAY	YR.				
<u>DOE8-9.5.1</u>	<u>09</u>	<u>02</u>	<u>83</u>	a.m. p.m.	<u>H₂O</u>		
<u>DOE8-9.5.1</u>	<u>09</u>	<u>02</u>	<u>83</u>	a.m. p.m.	<u>H₂O</u>		
<u>DOE8-0</u>				a.m. p.m.		<u>090393-14</u>	
<u>8-5</u>				a.m. p.m.		<u>-15</u>	
<u>8-1</u>				a.m. p.m.		<u>-16</u>	
<u>8-2</u>				a.m. p.m.		<u>-17</u>	
<u>8-3</u>				a.m. p.m.		<u>-18</u>	
				a.m. p.m.			

ANALYSIS REQUESTED (Circle Method, Place X in Box)

Number of Containers	Halogenated Volatiles 601 / 8010	Aromatic Volatiles 602 / 8020	BTEX / TPHC 8020 / 8015	Phenols, Sub-Phenols 604 / 8040	Pesticides / PCB 608 / 8080	TCLP Organics and Metals	TCLP Metals	Petroleum Hydrocarbons 418.1 (BLS181)	Semi-Volatiles GC MS 625 / 8270	Volatiles GC MS 624 / 8260	SWDA Volatiles 502.2 / 524	Priority Pollutant Metals (12)	Oil & Grease Method No. 413.1	COD EPA 410.1	BOD EPA 405.1	pH EPA 150.1
	X	X														

PROJECT INFORMATION

PROJECT: WJSA

P.O. #:

PRESERVATIVES:

SAMPLE RECEIPT

TOTAL NO. OF CONTAINERS

REC'D GOOD CONDITION/COLD

CUSTODY SEALS

RELINQUISHED BY

(Signature)

(Printed Name)

(Company)

RECEIVED BY

(Signature)

(Printed Name)

(Company)

RELINQUISHED BY

(Signature)

(Printed Name)

(Company)

RECEIVED BY (LABORATORY)

(Signature)

(Printed Name)

(Company)

SPECIAL INSTRUCTIONS/COMMENTS:

[Signature]
 9/03/93

CHAIN OF CUSTODY FORM

Arizona Certified Laboratory

Page ____ of ____

Aspen Environmental Laboratory

4730 N. Oracle Road, Suite 212 • Tucson, Arizona 85705 • (602) 887-1975 • FAX (602) 887-2352

COMPANY PSI
 ADDRESS _____
 CITY Tucson STATE AZ ZIP _____
 PROJECT NAME WSSA/DOE PROJ. MGR. EMERY FROELICH / CHRIS GIGGY
 PROJECT NUMBER 395 SAMPLES TAKEN FROM: DOE SITE, TN
☐ 24 HOUR RUSH (____ % Surcharge) ☐ 48 HOUR RUSH (____ % Surcharge)

SAMPLER'S (SIGNATURE)
Chris Giggy

PHONE NO.
(MUST INCLUDE)
 FAX NO.

SAMPLE ID.	DATE			TIME TAKEN	MATRIX	LAB ID.	NOTES	Number of Containers	Halogenated Volatiles 601 / 8010	Aromatic Volatiles 602 / 8020	BTX / TPHC 8020 / 8015	Phenols, Sub-Phenols 604 / 8040	Pesticides / PCB 608 / 8080	TCLP Organics and Metals	TCLP Metals	Petroleum Hydrocarbons 418.1 (BLS181)	Semi-Volatiles GC MS 625 / 8270	Volatiles GC MS 624 / 8260	SWDA Volatiles 502.2 / 524	Priority Pollutant Metals (13)	Oil & Grease Method No. 413.1	COD EPA 410.1 BOD EPA 405.1	pH EPA 150.1
	MO.	DAY	YR.																				
DOE 9-0, 5, 1, 2, 3	09	03	93	a.m. p.m.	H ₂ O	0907-01 → 05		X	X														
DOE 10-0, 5, 1, 2, 3		"		a.m. p.m.	"	0907-06 → 10		X	X														
DOE 11-0, 5, 1, 2, 3, 6		"		a.m. p.m.	"	0907-11 → 16		X	X							X							
DOE 12-0, 5, 1, 2, 3		"		a.m. p.m.	"	0907-17 → 21		X	X														
DOE 13-0, 5, 1, 2, 3		"		a.m. p.m.	"	0907-22 → 26		X	X							X							
DOE 14-0, 5, 1, 2, 3		"		a.m. p.m.	"	0907-27 → 31		X	X														
DOE 15-0, 0.75, 1.5		"		a.m. p.m.	"	0907-32 → 34		X	X														
				a.m. p.m.																			
				a.m. p.m.																			

PROJECT INFORMATION	SAMPLE RECEIPT	RELINQUISHED BY	RELINQUISHED BY
PROJECT:	TOTAL NO. OF CONTAINERS	(Signature) <u>Chris Giggy</u> (Time) <u>7 PM</u>	(Signature) _____ (Time) _____
P.O. #:	REC'D GOOD CONDITION/COLD	(Printed Name) <u>CHRIS GIGGY</u> (Date) <u>9/3/93</u>	(Printed Name) _____ (Date) _____
PRESERVATIVES:	CUSTODY SEALS	(Company) <u>PSI</u>	(Company) _____
SPECIAL INSTRUCTIONS/COMMENTS:		RECEIVED BY	RECEIVED BY (LABORATORY)
		(Signature) _____ (Time) _____	(Signature) <u>Deborah Cartmell</u> (Time) _____
		(Printed Name) _____ (Date) _____	(Printed Name) _____ (Date) _____
		(Company) _____	(Company) _____

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 8/31/93

Project Name: WJSA/DOE

Date Received: 9/1/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090193-01 - 05

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	1-Infl*	1-.5	1-1	1-2	1-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	16	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	170	241	217	89	NA
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	175	35	NA	3	NA
1,2-Dichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<5.0	<1.0	1.3	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	150	121	72	23	NA
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	265	101	58	49	NA
Vinyl Chloride	1.0	11	18	NA	7.0	NA

Comments: NA - Data not available, Pending QA/QC

*5:1 Dilution was made on 1-Infl

Reviewed By: Janelle Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 8/31/93

Project Name: WJSA/DOE

Date Received: 9/1/93

Project Number: 345

Date Analyzed: 9/2/93

Sample ID: 090193-01 - 05

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	1-Infl*	1-.5	1-1	1-2	1-3
Benzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Toluene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0

Comments:

*5:1 Dilution was made on this sample.

Reviewed By:

Tamika Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 8/31/93

Project Name: WJSA/DOE

Date Received: 9/1/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090193-06 - 10

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	2-Infl*	2-.5	2-1	2-2**	2-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0		<1.0
Bromoform	1.0	<5.0	<1.0	<1.0		<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0		<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0		<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0
Chloroethane	1.0	193	299	230		143
Chloroform	1.0	<5.0	<1.0	<1.0		<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0		<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0		<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0		<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0
1,1-Dichloroethane	1.0	286	NA	30		5
1,2-Dichloroethane	1.0	<5.0	<1.0	<1.0		<1.0
1,1-Dichloroethene	1.0	22	3	<1.0		<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0		<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0		<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0		<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0		<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0		<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0		<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0		<1.0
1,1,1-Trichloroethane	1.0	191	177	85		19
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0		<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0		<1.0
Trichlorofluoromethane	1.0	313	122	76		71
Vinyl Chloride	1.0	15	23	17		11

Comments: NA - Data not available, Pending QA/QC

*5:1 Dilution was made on 2-Infl

**Sample bottle broken

Reviewed By:

Turquoise Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater
Date Sampled: 8/31/93

Project Name: WJSA/DOE
Date Received: 9/1/93

Project Number: 345
Date Analyzed: 9/13/93

Sample ID: 090193-06 - 10
Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	2-Infl*	2-.5	2-1	2-2**	2-3
Benzene	1.0	8	<1.0	<1.0		<1.0
Toluene	1.0	16	3.0	1.0		<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0
Ethyl Benzene	1.0	9	<1.0	<1.0		<1.0
m,p-Xylene	1.0	8	<1.0	<1.0		<1.0
o-Xylene	1.0	10	2.0	<1.0		<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		<1.0

Comments: _____
*5:1 Dilution was made on 2-Infl **Sample bottle broken

Reviewed By: Tamela Kennedy Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090293-01 - 05

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	3-Inf [*]	3-.5	3-2	3-3	3-1
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	297	276	181	126	256
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	387	125	5.4	3	32
1,2-Dichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	14	2	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	237	133	30	13	79
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	158	108	50	29	124
Vinyl Chloride	1.0	20	21	14	9	19

Comments:

*5:1 Dilution was made on this sample.

Reviewed By: Jamille Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090293-01 - 05

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	3-Infl*	3-.5	3-1	3-2	3-3
Benzene	1.0	5.8	<1.0	<1.0	<1.0	<1.0
Toluene	1.0	10.4	1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	6.60	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0

Comments:

*5:1 Dilution was made on this sample.

Reviewed By:

Tamela K. Kelly

Date

12/15/95

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #G009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/7/93

Sample ID: 090293-06 - 10

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	4-0*	4-.5	4-2	4-3	4-1
Bromodichloromethane	1.0	NA	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	NA	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	NA	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	NA	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	NA	300	171	114	288
Chloroform	1.0	NA	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	NA	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	NA	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	NA	NA	NA	NA	123
1,2-Dichloroethane	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	NA	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	NA	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	NA	212	115	49	199
1,1,2-Trichloroethane	1.0	NA	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	NA	98	27	18	97
Vinyl Chloride	1.0	NA	23	13	9.0	22

Comments: NA - Data not available - Pending QA/QC

*5:1 Dilution was made on this sample.

Reviewed By:

Tanille Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/7/93

Sample ID: 090293-06 - 10

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	4-0	4-5	4-2	4-3	4-1
Benzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Toluene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	NA	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	NA	<1.0	<1.0	<1.0	<1.0

Comments: NA - Data not available, Pending OA/QC.

Reviewed By: Tamela Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/7/93

Sample ID: 090293-11 - 15

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	5-.5*	5-1	5-2	5-3	5-0**
Bromodichloromethane	1.0	NA	<1.0	NA	NA	<5.0
Bromoform	1.0	NA	<1.0	NA	NA	<5.0
Bromomethane	1.0	NA	<1.0	NA	NA	<5.0
Carbon Tetrachloride	1.0	NA	<1.0	NA	NA	<5.0
Chlorobenzene	1.0	NA	<1.0	NA	NA	<5.0
Chloroethane	1.0	NA	361	NA	NA	412
Chloroform	1.0	NA	<1.0	NA	NA	<5.0
Chloromethane	1.0	NA	<1.0	NA	NA	<5.0
2-Chloroethyl vinyl ether	1.0	NA	<1.0	NA	NA	<5.0
Dibromochloromethane	1.0	NA	<1.0	NA	NA	<5.0
1,2-Dichlorobenzene	1.0	NA	<1.0	NA	NA	<5.0
1,3-Dichlorobenzene	1.0	NA	<1.0	NA	NA	<5.0
1,4-Dichlorobenzene	1.0	NA	<1.0	NA	NA	<5.0
1,1-Dichloroethane	1.0	NA	44	NA	NA	298
1,2-Dichloroethane	1.0	NA	<1.0	NA	NA	<5.0
1,1-Dichloroethene	1.0	NA	<1.0	NA	NA	57
Trans-1,2-Dichloroethene	1.0	NA	<1.0	NA	NA	<5.0
1,2-Dichloropropane	1.0	NA	<1.0	NA	NA	<5.0
Cis-1,3-Dichloropropene	1.0	NA	<1.0	NA	NA	<5.0
Trans-1,3-Dichloropropene	1.0	NA	<1.0	NA	NA	<5.0
Methylene Chloride	1.0	NA	<1.0	NA	NA	<5.0
1,1,2,2-Tetrachloroethane	1.0	NA	<1.0	NA	NA	<5.0
Tetrachloroethene	1.0	NA	<1.0	NA	NA	<5.0
1,1,1-Trichloroethane	1.0	NA	139	NA	NA	248
1,1,2-Trichloroethane	1.0	NA	<1.0	NA	NA	<5.0
Trichloroethene	1.0	NA	<1.0	NA	NA	<5.0
Trichlorofluoromethane	1.0	NA	174	NA	NA	206
Vinyl Chloride	1.0	NA	<1.0	NA	NA	<5.0

Comments: NA - Data not available. Pending QA/QC.

*Sample run with headspace. **5:1 Dilution was made on this sample.

Reviewed By: Tanette Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/7/93

Sample ID: 090293-11 - 15

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	5-.5*	5-1	5-2	5-3	5-0
Benzene	1.0	NA	<1.0	<1.0	<1.0	<5*
Toluene	1.0	NA	<1.0	<1.0	<1.0	53
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<5*
Ethyl Benzene	1.0	NA	<1.0	<1.0	<1.0	<5*
m,p-Xylene	1.0	NA	1.1	NA	NA	14
o-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	34
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<5*
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	NA
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	NA

Comments: NA - Data not Available, Pending QA/QC.

*5:1 Dilution was necessary due to the levels of contaminants in the sample.

Reviewed By:

Tim He Kennedy

Date

10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090293-16 - 20

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	6-0*	6-.5	6-1	6-2	6-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	316	281	236	149	88
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	501	139	29	5	3
1,2-Dichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	54	2	1	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	316	140	69	21	11
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	326	141	118	77	59
Vinyl Chloride	1.0	30	21	18	10	6

Comments:

*5:1 Dilution was made on this sample.

Reviewed By: Tanella Kennedy

Date 10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090293-16 - 20

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	6-0*	6-.5	6-1	6-2	6-3
Benzene	1.0	29	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	1.0	62	2.0	1.0	1.0	< 1.0
Chlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl Benzene	1.0	38	1.0	< 1.0	1.0	< 1.0
m,p-Xylene	1.0	39	1.0	< 1.0	1.0	< 1.0
o-Xylene	1.0	45	2.0	< 1.0	1.0	< 1.0
1,2-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Comments: _____
*5:1 Dilution was made on this sample.

Reviewed By: Tamela Kennedy Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090293-21 - 25

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	7-0*	7-.5	7-1	7-2	7-3
Bromodichloromethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon Tetrachloride	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane	1.0	267	264	228	146	85
Chloroform	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chloroethyl vinyl ether	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromochloromethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	1.0	309	72	12	3.0	2.0
1,2-Dichloroethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	1.0	< 5.0	1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Cis-1,3-Dichloropropene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Methylene Chloride	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	1.0	251	117	52	16	9
1,1,2-Trichloroethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane	1.0	300	140	115	72	61
Vinyl Chloride	1.0	17	20	16	9	5

Comments:

*5:1 Dilution was made on influent sample.

Reviewed By: Janelle Kennedy

Date 10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/1/93

Project Name: WJSA/DOE

Date Received: 9/2/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090293-21 - 25

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	7-0*	7-.5	7-1	7-2	7-3
Benzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Toluene	1.0	<5.0	1.0	1.0	1.0	1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	<5.0	1.0	<1.0	1.0	1.0
m,p-Xylene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	<5.0	1.0	<1.0	1.0	1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0

Comments: _____
*5:1 Dilution was made on influent sample.

Reviewed By: Jessie Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/02/93

Project Name: WJSA/DOE

Date Received: 9/07/93

Project Number: 345

Date Analyzed: 9/23/93

Sample ID: NA

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	Raw*				
Bromodichloromethane	1.0	< 10				
Bromoform	1.0	< 10				
Bromomethane	1.0	15				
Carbon Tetrachloride	1.0	< 10				
Chlorobenzene	1.0	< 10				
Chloroethane	1.0	800				
Chloroform	1.0	< 10				
Chloromethane	1.0	< 10				
2-Chloroethyl vinyl ether	1.0	< 10				
Dibromochloromethane	1.0	< 10				
1,2-Dichlorobenzene	1.0	< 10				
1,3-Dichlorobenzene	1.0	< 10				
1,4-Dichlorobenzene	1.0	< 10				
1,1-Dichloroethane	1.0	961				
1,2-Dichloroethane	1.0	< 10				
1,1-Dichloroethene	1.0	169				
Trans-1,2-Dichloroethene	1.0	< 10				
1,2-Dichloropropane	1.0	< 10				
Cis-1,3-Dichloropropene	1.0	< 10				
Trans-1,3-Dichloropropene	1.0	< 10				
Methylene Chloride	1.0	< 10				
1,1,2,2-Tetrachloroethane	1.0	< 10				
Tetrachloroethene	1.0	11				
1,1,1-Trichloroethane	1.0	795				
1,1,2-Trichloroethane	1.0	< 10				
Trichloroethene	1.0	10				
Trichlorofluoromethane	1.0	< 10				
Vinyl Chloride	1.0	< 10.0				

Comments:

*10:1 Dilution was made on this sample.

Reviewed By:

Jarvis Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater
Date Sampled: 9/02/93

Project Name: WJSA/DOE
Date Received: 9/07/93

Project Number: 345
Date Analyzed: 9/23/93

Sample ID: NA
Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	Raw*				
Benzene	1.0	137				
Toluene	1.0	129				
Chlorobenzene	1.0	< 10.0				
Ethyl Benzene	1.0	< 10.0				
m,p-Xylene	1.0	344				
o-Xylene	1.0	145				
1,2-Dichlorobenzene	1.0	< 10.0				
1,3-Dichlorobenzene	1.0	< 10.0				
1,4-Dichlorobenzene	1.0	55				

Comments: _____
*10:1 Dilution was made on this sample.

Reviewed By: Tamela Kennedy Date 10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/2/93

Project Name: WJSA/DOE

Date Received: 9/3/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090393-14 - 18

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	8-0*	8-.5	8-1	8-2	8-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	448	351	321	232	163
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	555	124	31	4	2
1,2-Dichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	70	2	1	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	395	184	127	45	20
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	215	173	148	67	30
Vinyl Chloride	1.0	38	26	24	16	10

Comments:

*5:1 Dilution was made on influent sample.

Reviewed By:

Tamelle Kennedy

Date

10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/2/93

Project Name: WISA/DOE

Date Received: 9/3/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090393-14 - 18

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	8.0*	8-.5	8-1	8-2	8-3
Benzene	1.0	56	2	<1.0	<1.0	<1.0
Toluene	1.0	59	2	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	1	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	28	1	<1.0	<1.0	<1.0
m,p-Xylene	1.0	55	2	<1.0	<1.0	<1.0
o-Xylene	1.0	47	2	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0

Comments:

*5:1 Dilution was made on sample.

Reviewed By:

Tamela Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/13/93

Sample ID: 090793-01 - 05

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	9-0*	9-.5	9-1	9-2	9-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	274	217	172	116	79
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	418	183	105	33	9
1,2-Dichloroethane	1.0	5	3	2	<1.0	<1.0
1,1-Dichloroethene	1.0	15	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	263	187	156	102	60
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	134	52	32	18	16
Vinyl Chloride	1.0	17	16	13	9	6

Comments:

*5:1 Dilution was made on influent sample due to the high levels of contaminants.

Reviewed By:

Tanette Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater
Date Sampled: 9/3/93

Project Name: WJSA/DOE
Date Received: 9/4/93

Project Number: 345
Date Analyzed: 9/13/93

Sample ID: 090793-01 - 05
Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	9-0*	9-.5	9-1	9-2	9-3
Benzene	1.0	10	<1.0	<1.0	<1.0	<1.0
Toluene	1.0	9	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	8	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	13	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0

Comments:

*5:1 Dilution was made on influent sample.

Reviewed By:

Tamela Kennedy

Date

12/15/93

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PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/14/93

Sample ID: 090793-16, 8, 9

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	11-L6	10-1	10-2		
Bromodichloromethane	1.0	<1.0	<1.0	<1.0		
Bromoform	1.0	<1.0	<1.0	<1.0		
Bromomethane	1.0	<1.0	<1.0	<1.0		
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Chloroethane	1.0	258	306	221		
Chloroform	1.0	<1.0	<1.0	<1.0		
Chloromethane	1.0	<1.0	<1.0	<1.0		
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0		
Dibromochloromethane	1.0	<1.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,1-Dichloroethane	1.0	28	18	3		
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0		
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0		
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0		
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0		
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0		
Methylene Chloride	1.0	<1.0	<1.0	<1.0		
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0		
Tetrachloroethene	1.0	<1.0	<1.0	<1.0		
1,1,1-Trichloroethane	1.0	66	83	19		
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0		
Trichloroethene	1.0	<1.0	<1.0	<1.0		
Trichlorofluoromethane	1.0	127	151	98		
Vinyl Chloride	1.0	<1.0	<1.0	<1.0		

Comments: _____

Reviewed By: Taralle Kennedy

Date: 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/14/93

Sample ID: 090793-16, 8, 9

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	11-L6	10-1	10-2	**	**
Benzene	1.0	<1.0	<1.0	<1.0		
Toluene	1.0	<1.0	<1.0	<1.0		
Chlorobenzene	1.0	<1.0	<1.0	<1.0		
Ethyl Benzene	1.0	<1.0	<1.0	<1.0		
m,p-Xylene	1.0	<1.0	<1.0	<1.0		
o-Xylene	1.0	<1.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0		

Comments: _____
** Rest of Test 10 vials were broken.

Reviewed By: Tamela Kennedy Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/14/93

Sample ID: 090793-11 - 16

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	11-0*	11-.5	11-1	11-2	11-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	535	385	352	286	197
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	640	231	126	10	3
1,2-Dichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	48	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	460	190	130	51	16
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	473	191	167	140	100
Vinyl Chloride	1.0	36	130	168	49	13

Comments:

*5:1 Dilution was made on this influent sample.

Reviewed By:

Tanelle Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711
Sample Type: Groundwater
Date Sampled: 9/3/93
Project Name: WJSA/DOE
Date Received: 9/4/93
Project Number: 345
Date Analyzed: 9/14/93
Sample ID: 090793-11 - 16
Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	11-0*	11-.5	11-1	11-2	11-3
Benzene	1.0	12	2.0	<1.0	<1.0	<1.0
Toluene	1.0	16	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	6	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	8	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	12	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0

Comments:

*5:1 Dilution was made on this sample.

Reviewed By:

Tamela Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/15/93

Sample ID: 090793-17 - 21

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	12-0*	12-.5	12-1	12-2	12-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	308	279	266	227	184
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	409	233	73	57	16
1,2-Dichloroethane	1.0	<5.0	3.0	3.0	1.0	<1.0
1,1-Dichloroethene	1.0	34	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	277	154	119	69	36
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	175	113	103	78	57
Vinyl Chloride	1.0	33	<1.0	<1.0	<1.0	<1.0

Comments:

*5:1 Dilution was made on this sample.

Reviewed By:

Jamie Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/15/93

Sample ID: 090793-17 - 21

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	12-0*	12-.5	12-1	12-2	12-3
Benzene	1.0	18	6	3	<1.0	<1.0
Toluene	1.0	33	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	15	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	18	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	26	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0

Comments: _____
*5:1 Dilution was made on this sample.

Reviewed By: Tamela Kennedy

Date 10/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/15/93

Sample ID: 090793-22 - 26

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	13-0*	13-.5	13-1	13-2	13-3
Bromodichloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	396	356	324	245	197
Chloroform	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<5.0	3	2	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	483	264	183	61	18
1,2-Dichloroethane	1.0	<5.0	4	2	<1.0	<1.0
1,1-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	354	215	189	120	71
1,1,2-Trichloroethane	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<5.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	244	187	167	105	80
Vinyl Chloride	1.0	49	47	40	27	19

Comments:

*5:1 Dilution made on this sample.

Reviewed By:

Janelle Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/15/93

Sample ID: 090793-22 - 26

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	13-0*	13-.5	13-1	13-2	13-3
Benzene	1.0	7.0	2	< 1.0	< 1.0	< 1.0
Toluene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl Benzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
m,p-Xylene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0

Comments: _____
*5:1 Dilution was made on this sample.

Reviewed By: Tamela Kennedy Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/17/93

Sample ID: 090793-27 - 31

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	14-0*	14-.5	14-1	14-2	14-3
Bromodichloromethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon Tetrachloride	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane	1.0	368	345	323	306	270
Chloroform	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chloroethyl vinyl ether	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromochloromethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	1.0	410	236	224	106	65
1,2-Dichloroethane	1.0	< 5.0	3	3	1	< 1.0
1,1-Dichloroethene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Cis-1,3-Dichloropropene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Methylene Chloride	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	1.0	334	217	206	176	134
1,1,2-Trichloroethane	1.0	< 5.0	2	2	< 1.0	< 1.0
Trichloroethene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane	1.0	221	200	178	149	119
Vinyl Chloride	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0

Comments:

*5:1 Dilution was made on this sample.

Reviewed By:

Jamille Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 9/17/93

Sample ID: 090793-27 - 31

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	14-0*	14-.5	14-1	14-2	14-3
Benzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl Benzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
m,p-Xylene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0

Comments:

*5:1 Dilution was made on this sample.

Reviewed By:

Jennifer Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 090793-32 - 34

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	15-0*	15-.75	15-1.5		
Bromodichloromethane	1.0	<5.0	<1.0	<1.0		
Bromoform	1.0	<5.0	<1.0	<1.0		
Bromomethane	1.0	<5.0	<1.0	<1.0		
Carbon Tetrachloride	1.0	<5.0	<1.0	<1.0		
Chlorobenzene	1.0	<5.0	<1.0	<1.0		
Chloroethane	1.0	491	482	467		
Chloroform	1.0	<5.0	<1.0	<1.0		
Chloromethane	1.0	<5.0	<1.0	<1.0		
2-Chloroethyl vinyl ether	1.0	<5.0	<1.0	<1.0		
Dibromochloromethane	1.0	<5.0	<1.0	<1.0		
1,2-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		
1,3-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		
1,4-Dichlorobenzene	1.0	<5.0	<1.0	<1.0		
1,1-Dichloroethane	1.0	579	291	274		
1,2-Dichloroethane	1.0	6.0	5	4		
1,1-Dichloroethene	1.0	<5.0	<1.0	<1.0		
Trans-1,2-Dichloroethene	1.0	<5.0	<1.0	<1.0		
1,2-Dichloropropane	1.0	<5.0	<1.0	<1.0		
Cis-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0		
Trans-1,3-Dichloropropene	1.0	<5.0	<1.0	<1.0		
Methylene Chloride	1.0	<5.0	<1.0	<1.0		
1,1,2,2-Tetrachloroethane	1.0	<5.0	<1.0	<1.0		
Tetrachloroethene	1.0	<5.0	<1.0	<1.0		
1,1,1-Trichloroethane	1.0	444	255	247		
1,1,2-Trichloroethane	1.0	<5.0	4	3		
Trichloroethene	1.0	<5.0	<1.0	<1.0		
Trichlorofluoromethane	1.0	NA	NA	NA		
Vinyl Chloride	1.0	<5.0	<1.0	<1.0		

Comments: NA - Data not Available, Pending QA/QC.

*5:1 Dilution was made on this sample.

Reviewed By:

Tanette Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 9/3/93

Project Name: WJSA/DOE

Date Received: 9/4/93

Project Number: 345

Date Analyzed: 11/19/93

Sample ID: 090793-32 - 34

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	15-0*	15-.75	15-1.5		
Benzene	1.0	50	1	< 1.0		
Toluene	1.0	128	< 1.0	< 1.0		
Chlorobenzene	1.0	< 5.0	< 1.0	< 1.0		
Ethyl Benzene	1.0	82	< 1.0	< 1.0		
m,p-Xylene	1.0	111	< 1.0	< 1.0		
o-Xylene	1.0	116	< 1.0	< 1.0		
1,2-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0		
1,3-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0		
1,4-Dichlorobenzene	1.0	< 5.0	< 1.0	< 1.0		

Comments: _____
*5:1 Dilution was made on this sample.

Reviewed By: Tamela Kennedy Date 12/15/95

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 102093-1 - 4

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	16-0	16-.5	16-2	16-3
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	1.0	1.0	1.0
Chloroethane	1.0	NA	NA	NA	NA
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	343	99	5	4
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	14.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	339	171	28	16
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	439	355	229	161
Vinyl Chloride	1.0	30	22	12	7

Comments: NA - Data not available, Pending QA/QC.

Reviewed By: Janice Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 102093-1 - 4

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	16-0	16-.5	16-2	16-3	
Benzene	1.0	10	2	2	<1.0	
Toluene	1.0	5	2	2	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	8	2	2	5	
o-Xylene	1.0	5	2	2	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: _____

Frank Kennedy

Date

12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 102093-5 - 7, Blank

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	16-1-Infl	16-1-L3	16-1-L6	Field 10/16
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	13	<1.0	<1.0	<1.0
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	97	50	53	<1.0
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	339	273	317	<1.0
Vinyl Chloride	1.0	20	15	18	<1.0

Comments: _____

Reviewed By: Janelle Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/2/93

Sample ID: 102093-5 - 7, Blank

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	16-1-Infl	16-1-L3	16-1-L6	Field 10/16	
Benzene	1.0	2	<1.0	<1.0	<1.0	
Toluene	1.0	2	<1.0	<1.0	2	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	
m,p-Xylene	1.0	4	<1.0	<1.0	<1.0	
o-Xylene	1.0	2	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Terrell Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/5/93

Sample ID: 102093-8 - 11

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	17-0	17-.5	17-2	17-3	
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0	
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0	
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0	
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0	
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
Chloroethane	1.0	<1.0	<1.0	<1.0	<1.0	
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0	
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0	
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0	
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0	
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	
1,1-Dichloroethane	1.0	283	48	4	<1.0	
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	
1,1-Dichloroethene	1.0	8	<1.0	<1.0	<1.0	
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0	
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0	
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0	
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0	
1,1,1-Trichloroethane	1.0	306	162	28	14	
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	
Trichloroethene	1.0	3	3	3	3	
Trichlorofluoromethane	1.0	<1.0	<1.0	<1.0	<1.0	
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0	

Comments: _____

Reviewed By: Janelle Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/5/93

Sample ID: 102093-8 - 11

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	17-0	17-.5	17-2	17-3	
Benzene	1.0	7	1	1	< 1.0	
Toluene	1.0	3	< 1.0	< 1.0	< 1.0	
Chlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Ethyl Benzene	1.0	2	< 1.0	< 1.0	< 1.0	
m,p-Xylene	1.0	4	< 1.0	< 1.0	< 1.0	
o-Xylene	1.0	2	< 1.0	< 1.0	< 1.0	
1,2-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	
1,3-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	
1,4-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	

Comments: _____

Reviewed By: Travis Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/5/93

Sample ID: 102093-12 - 16

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	17-1-Infl	17-1-L3	17-1-L6	Field 10/18	Field 10/19
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	8	3	<1.0	<1.0	<1.0
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	78	61	42	<1.0	<1.0
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Jamille Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: 10/17/93

Project Name: WJSA/DOE

Date Received: 10/20/93

Project Number: 345

Date Analyzed: 11/5/93

Sample ID: 102093-12 - 16

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	17-1-Infl	17-1-L3	17-1-L6	Field 10/18	Field 10/19
Benzene	1.0	2	<1.0	<1.0	<1.0	<1.0
Toluene	1.0	<1.0	<1.0	<1.0	2	2
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
m,p-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Tamela Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: See Table

Project Name: WJSA/DOE

Date Received: 8/20/93 - 9/15/93

Project Number: 345

Date Analyzed: 9/24/93

Sample ID: NA

Analyzed By: Deb Cartmell

EPA Method 601 - Purgeable Halocarbons Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	Trip 8/19	Field 8/31	Field 9/1	Field 9/3	Field 9/14
Bromodichloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl vinyl ether	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,2-Dichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cis-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trans-1,3-Dichloropropene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Comments: _____

Reviewed By: Jane H. Kennedy

Date 12/15/93

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems, Inc.
5151 E. Broadway, Suite 600
Tucson, Arizona 85711

Sample Type: Groundwater

Date Sampled: See Table

Project Name: WJSA/DOE

Date Received: 8/20/93 - 9/15/93

Project Number: 345

Date Analyzed: 9/24/93

Sample ID: NA

Analyzed By: Deb Cartmell

EPA Method 602 - Purgeable Aromatics (G.C. - PID) Reported in $\mu\text{g/L}$ (ppb)

Compounds	Limit of Detection	Trip 8/19	Field 8/31	Field 9/1	Field 9/3	Field 9/14
Benzene	1.0	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl Benzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m,p-Xylene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.6
1,2-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Comments: _____

Reviewed By: Tanette Kennedy

Date 12/15/93

CHAIN OF CUSTODY FORM

Arizona Certified Laboratory

Page 1 of 2

Aspen Environmental Laboratory

4730 N. Road, Suite 212 • Tucson, Arizona 85705 • (602) 887-1975 • FAX (602) 887-2352

COMPANY

PSI

ADDRESS

CITY

Tucson

STATE

AZ

ZIP

PROJECT NAME

WJSA/DOE

PROJ. MGR.

Emery/Chris Giggly

PROJECT NUMBER

345

SAMPLES TAKEN FROM:

Doe Site

☐ 24 HOUR RUSH (% Surcharge) ☐ 48 HOUR RUSH (% Surcharge)

SAMPLER'S (SIGNATURE)

PHONE NO.
(MUST INCLUDE)

FAX NO.

SAMPLE ID.	DATE			TIME TAKEN	MATRIX	LAB ID.	NOTES
	MO.	DAY	YR.				
DOE 5-0	09	01	93	a.m.	H ₂ O	090393-01	
5-1				a.m.		02	
5-3				a.m.		03	
Trip Blank				a.m.		04	
Field Blank				a.m.		05	
DOE 3-0				a.m.		06	
DOE 3-1				a.m.		07	
DOE 3-3				a.m.		08	
DOE 6-1				a.m.		09	

ANALYSIS REQUESTED (Circle Method, Place X in Box)

Number of Containers	Halogenated Volatiles 601 / 8010	Aromatic Volatiles 602 / 8020	BTEX / TPHC 8020 / 8015	Phenols Sub-Phenols 604 / 8040	Pesticides / PCB 608 / 8080	TCLP Organics and Metals	TCLP Metals	Petroleum Hydrocarbons 418.1 (BLS181)	Semi-Volatiles GC MS 625 / 8270	Volatiles GC MS 624 / 8260	SWDA Volatiles 502.2/524	Priority Pollutant Metals (13)	Oil & Grease Method No. 413.1	COD EPA 410.1	BOD EPA 405.1	pH EPA 150.1
									X	X	X	X	X	X	X	X

PROJECT INFORMATION

SAMPLE RECEIPT

RELINQUISHED BY

RELINQUISHED BY

PROJECT:

TOTAL NO. OF CONTAINERS

39

(Signature)

9/1/93

(Signature)

(Time)

P.O. #:

REC'D GOOD CONDITION/COLD

✓

(Printed Name)

(Date)

(Printed Name)

(Date)

PRESERVATIVES:

CUSTODY SEALS

—

(Company)

(Company)

SPECIAL INSTRUCTIONS/COMMENTS:

Chris G. did not send a chain-of-custody when he sent these over (they were part of previous samples)

RECEIVED BY

RECEIVED BY (LABORATORY)

(Signature)

(Time)

(Signature)

(Time)

(Printed Name)

(Date)

(Printed Name)

(Date)

(Company)

(Company)

Deb Cartmell 9/3/93

Page 2 of 2

4730 N. Oracle Road, Suite 212 • Tucson, Arizona 85705 • (602) 887-1975 • FAX (602) 887-2352

ZIP

☐ 24 HOUR RUSH (_____ % Surcharge) ☐ 48 HOUR RUSH (_____ % Surcharge)

FAX NO.

ANALYSIS REQUESTED (Circle Method, Place X in Box)[illegible]

PROJECT INFORMATION		SAMPLE RECEIPT		RELINQUISHED BY		RELINQUISHED BY	
PROJECT:	TOTAL NO. OF CONTAINERS	4		(Signature)	9/1/93	(Signature)	(Time)
P.O. #:	REC'D GOOD CONDITION/COLD	✓		(Printed Name)	Chris Giggly	(Printed Name)	(Date)
PRESERVATIVES:	CUSTODY SEALS	—		(Company)		(Company)	
SPECIAL INSTRUCTIONS/COMMENTS:				RECEIVED BY		RECEIVED BY (LABORATORY):	
				(Signature)	(Time)	(Signature)	(Time)
				(Printed Name)	(Date)	(Printed Name)	(Date)
				(Company)		(Company)

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 Phone: (520) 685-1000 FAX: (520) 685-5000 1-800-496-1485

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 5-0
Laboratory I.D.: 090393-01

Sample Type: Water

Date Sampled: 09/01/1993

Date Received: 09/03/1993

Date Analyzed: 10/12/1993

Project Name: DOE/WJSA

Project Number: 0345

Analyzed By: See Comments

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270

Base Neutral Analyte			Base Neutral Analyte		
MRL**	Result	µg/L (ppb)	MRL**	Result	
N-Nitrosodimethylamine	10	ND	2,6-Dinitrotoluene	10	ND
Bis(2-chloroethyl) Ether	10	ND	Diethyl Phthalate	10	ND
1,2-Dichlorobenzene	10	ND	4-Chlorophenyl Phenyl Ether	10	ND
1,3-Dichlorobenzene	10	ND	Fluorene	10	ND
1,4-Dichlorobenzene	10	ND	4-Nitroaniline	100	ND
Bis(2-chloroisopropyl) Ether	10	ND	N-Nitrosodiphenylamine	10	ND
N-Nitrosodi-n-propylamine	10	ND	4-Bromophenyl Phenyl Ether	10	ND
Hexachloroethane	10	ND	Hexachlorobenzene	10	ND
Nitrobenzene	10	ND	Phenanthrene	10	ND
Isophorone	10	ND	Anthracene	10	ND
Bis(2-chloroethoxy) methane	10	ND	Di-n-butyl Phthalate	10	ND
1,2,4-Trichlorobenzene	10	ND	Fluoranthene	10	ND
Naphthalene	10	ND	Pyrene	10	ND
4-Chloroaniline	10	ND	Butylbenzyl Phthalate	10	ND
Hexachlorobutadiene	10	ND	3,3'-Dichlorobenzidine	100	ND
2-Methylnaphthalene	10	ND	Benz(a)anthracene	10	ND
Hexachlorocyclopentadiene	20	ND	Bis(2-ethylhexyl) Phthalate	10	28
2-Chloronaphthalene	10	ND	Chrysene	10	ND
2-Nitroaniline	40	ND	Di-n-octyl Phthalate	10	ND
Dimethyl Phthalate	10	ND	Benzo(b)fluoranthene	10	ND
Acenaphthylene	10	ND	Benzo(k)fluoranthene	10	ND
3-Nitroaniline	40	ND	Benzo(a)pyrene	10	ND
Acenaphthene	10	ND	Indeno(1,2,3-c,d)pyrene	10	ND
Dibenzofuran	10	ND	Dibenz(a,h)anthracene	10	ND
2,4-Dinitrotoluene	10	ND	Benzo(g,h,i)perylene	10	ND
Acid Analyte			Acid Analyte		
MRL**	Result		MRL**	Result	
Phenol	10	ND	2,4-Dichlorophenol	10	ND
2-Chlorophenol	10	ND	4-Chloro-3-methylphenol	10	ND
Benzyl Alcohol	20	ND	2,4,6-Trichlorophenol	10	ND
2-Methylphenol	10	ND	2,4,5-Trichlorophenol	10	ND
3- and 4-Methylphenol*	10	ND	2,4-Dinitrophenol	100	ND
2-Nitrophenol	10	ND	4-Nitrophenol	100	ND
2,4-Dimethylphenol	10	ND	2-Methyl-4,6-dinitrophenol	40	ND
Benzoic Acid	100	ND	Pentachlorophenol	60	ND

* Extraction performed by PSI Environmental Laboratories.

MRL Method Reporting Limit

** MRL is elevated. Sample extract final volume was twice the value normally obtained by Golden State/CAS Laboratories, Inc.

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 TEL 520-573-6555 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 5-1
Laboratory I.D.: 090393-02
Sample Type: Water

Project Name: DOE/WJSA

Date Sampled: 09/01/1993

Project Number: 0345

Date Received: 09/03/1993

P.O. Number: None

Date Analyzed: 10/12/1993

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL**	Result	Base Neutral Analyte	MRL**	Result
N-Nitrosodimethylamine	10	ND	2,6-Dinitrotoluene	10	ND
Bis(2-chloroethyl) Ether	10	ND	Diethyl Phthalate	10	ND
1,2-Dichlorobenzene	10	ND	4-Chlorophenyl Phenyl Ether	10	ND
1,3-Dichlorobenzene	10	ND	Fluorene	10	ND
1,4-Dichlorobenzene	10	ND	4-Nitroaniline	100	ND
Bis(2-chloroisopropyl) Ether	10	ND	N-Nitrosodiphenylamine	10	ND
N-Nitrosodi-n-propylamine	10	ND	4-Bromophenyl Phenyl Ether	10	ND
Hexachloroethane	10	ND	Hexachlorobenzene	10	ND
Nitrobenzene	10	ND	Phenanthrene	10	ND
Isophorone	10	ND	Anthracene	10	ND
Bis(2-chloroethoxy) methane	10	ND	Di-n-butyl Phthalate	10	ND
1,2,4-Trichlorobenzene	10	ND	Fluoranthene	10	ND
Naphthalene	10	ND	Pyrene	10	ND
4-Chloroaniline	10	ND	Butylbenzyl Phthalate	10	ND
Hexachlorobutadiene	10	ND	3,3'-Dichlorobenzidine	100	ND
2-Methylnaphthalene	10	ND	Benz(a)anthracene	10	ND
Hexachlorocyclopentadiene	20	ND	Bis(2-ethylhexyl) Phthalate	10	ND
2-Chloronaphthalene	10	ND	Chrysene	10	ND
2-Nitroaniline	40	ND	Di-n-octyl Phthalate	10	ND
Dimethyl Phthalate	10	ND	Benzo(b)fluoranthene	10	ND
Acenaphthylene	10	ND	Benzo(k)fluoranthene	10	ND
3-Nitroaniline	40	ND	Benzo(a)pyrene	10	ND
Acenaphthene	10	ND	Indeno(1,2,3-c,d)pyrene	10	ND
Dibenzofuran	10	ND	Dibenz(a,h)anthracene	10	ND
2,4-Dinitrotoluene	10	ND	Benzo(g,h,i)perylene	10	ND
Acid Analyte	MRL**	Result	Acid Analyte	MRL**	Result
Phenol	10	ND	2,4-Dichlorophenol	10	ND
2-Chlorophenol	10	ND	4-Chloro-3-methylphenol	10	ND
Benzyl Alcohol	20	ND	2,4,6-Trichlorophenol	10	ND
2-Methylphenol	10	ND	2,4,5-Trichlorophenol	10	ND
3- and 4-Methylphenol*	10	ND	2,4-Dinitrophenol	100	ND
2-Nitrophenol	10	ND	4-Nitrophenol	100	ND
2,4-Dimethylphenol	10	ND	2-Methyl-4,6-dinitrophenol	40	ND
Benzoic Acid	100	ND	Pentachlorophenol	60	ND

* Extraction performed by PSI Environmental Laboratories.

MRL Method Reporting Limit

** MRL is elevated. Sample extract final volume was twice the value normally obtained by Golden State/CAS Laboratories, Inc.

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tamelle Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85711 602-571-6565 FAX 602-571-6560 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 5-3
Laboratory I.D.: 090393-03
Sample Type: Water

Project Name: DOE/WJSA

Date Sampled: 09/01/1993

Project Number: 0345

Date Received: 09/03/1993

P.O. Number: None

Date Analyzed: 10/12/1993

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds
EPA Methods 3510/8270
µg/L (ppb)

Base Neutral Analyte	MRL**	Result	Base Neutral Analyte	MRL**	Result
N-Nitrosodimethylamine	10	ND	2,6-Dinitrotoluene	10	ND
Bis(2-chloroethyl) Ether	10	ND	Diethyl Phthalate	10	ND
1,2-Dichlorobenzene	10	ND	4-Chlorophenyl Phenyl Ether	10	ND
1,3-Dichlorobenzene	10	ND	Fluorene	10	ND
1,4-Dichlorobenzene	10	ND	4-Nitroaniline	100	ND
Bis(2-chloroisopropyl) Ether	10	ND	N-Nitrosodiphenylamine	10	ND
N-Nitrosodi-n-propylamine	10	ND	4-Bromophenyl Phenyl Ether	10	ND
Hexachloroethane	10	ND	Hexachlorobenzene	10	ND
Nitrobenzene	10	ND	Phenanthrene	10	ND
Isophorone	10	ND	Anthracene	10	ND
Bis(2-chloroethoxy) methane	10	ND	Di-n-butyl Phthalate	10	ND
1,2,4-Trichlorobenzene	10	ND	Fluoranthene	10	ND
Naphthalene	10	ND	Pyrene	10	ND
4-Chloroaniline	10	ND	Butylbenzyl Phthalate	10	ND
Hexachlorobutadiene	10	ND	3,3'-Dichlorobenzidine	100	ND
2-Methylnaphthalene	10	ND	Benz(a)anthracene	10	ND
Hexachlorocyclopentadiene	20	ND	Bis(2-ethylhexyl) Phthalate	10	ND
2-Chloronaphthalene	10	ND	Chrysene	10	ND
2-Nitroaniline	40	ND	Di-n-octyl Phthalate	10	ND
Dimethyl Phthalate	10	ND	Benzo(b)fluoranthene	10	ND
Acenaphthylene	10	ND	Benzo(k)fluoranthene	10	ND
3-Nitroaniline	40	ND	Benzo(a)pyrene	10	ND
Acenaphthene	10	ND	Indeno(1,2,3-c,d)pyrene	10	ND
Dibenzofuran	10	ND	Dibenz(a,h)anthracene	10	ND
2,4-Dinitrotoluene	10	ND	Benzo(g,h,i)perylene	10	ND
Acid Analyte	MRL**	Result	Acid Analyte	MRL**	Result
Phenol	10	ND	2,4-Dichlorophenol	10	ND
2-Chlorophenol	10	ND	4-Chloro-3-methylphenol	10	ND
Benzyl Alcohol	20	ND	2,4,6-Trichlorophenol	10	ND
2-Methylphenol	10	ND	2,4,5-Trichlorophenol	10	ND
3- and 4-Methylphenol*	10	ND	2,4-Dinitrophenol	100	ND
2-Nitrophenol	10	ND	4-Nitrophenol	100	ND
2,4-Dimethylphenol	10	ND	2-Methyl-4,6-dinitrophenol	40	ND
Benzoic Acid	100	ND	Pentachlorophenol	60	ND

* Extraction performed by PSI Environmental Laboratories.

MRL Method Reporting Limit

** MRL is elevated. Sample extract final volume was twice the value normally obtained by Golden State/CAS Laboratories, Inc.

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanisha Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85711 Telephone: (520) 573-6550 FAX: (520) 573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 3-0
Laboratory I.D.: 090393-06

Sample Type: Water

Date Sampled: 09/01/1993

Date Received: 09/03/1993

Date Analyzed: 10/12/1993

Project Name: DOE/WJSA

Project Number: 0345

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL**	Result	Base Neutral Analyte	MRL**	Result
N-Nitrosodimethylamine	10	ND	2,6-Dinitrotoluene	10	ND
Bis(2-chloroethyl) Ether	10	ND	Diethyl Phthalate	10	ND
1,2-Dichlorobenzene	10	ND	4-Chlorophenyl Phenyl Ether	10	ND
1,3-Dichlorobenzene	10	ND	Fluorene	10	ND
1,4-Dichlorobenzene	10	ND	4-Nitroaniline	100	ND
Bis(2-chloroisopropyl) Ether	10	ND	N-Nitrosodiphenylamine	10	ND
N-Nitrosodi-n-propylamine	10	ND	4-Bromophenyl Phenyl Ether	10	ND
Hexachloroethane	10	ND	Hexachlorobenzene	10	ND
Nitrobenzene	10	ND	Phenanthrene	10	ND
Isophorone	10	ND	Anthracene	10	ND
Bis(2-chloroethoxy) methane	10	ND	Di-n-butyl Phthalate	10	ND
1,2,4-Trichlorobenzene	10	ND	Fluoranthene	10	ND
Naphthalene	10	ND	Pyrene	10	ND
4-Chloroaniline	10	ND	Butylbenzyl Phthalate	10	ND
Hexachlorobutadiene	10	ND	3,3'-Dichlorobenzidine	100	ND
2-Methylnaphthalene	10	ND	Benzo(a)anthracene	10	ND
Hexachlorocyclopentadiene	20	ND	Bis(2-ethylhexyl) Phthalate	10	ND
2-Chloronaphthalene	10	ND	Chrysene	10	ND
2-Nitroaniline	40	ND	Di-n-octyl Phthalate	10	ND
Dimethyl Phthalate	10	ND	Benzo(b)fluoranthene	10	ND
Acenaphthylene	10	ND	Benzo(k)fluoranthene	10	ND
3-Nitroaniline	40	ND	Benzo(a)pyrene	10	ND
Acenaphthene	10	ND	Indeno(1,2,3-c,d)pyrene	10	ND
Dibenzofuran	10	ND	Dibenz(a,h)anthracene	10	ND
2,4-Dinitrotoluene	10	ND	Benzo(g,h,i)perylene	10	ND
Acid Analyte	MRL**	Result	Acid Analyte	MRL**	Result
Phenol	10	ND	2,4-Dichlorophenol	10	ND
2-Chlorophenol	10	ND	4-Chloro-3-methylphenol	10	ND
Benzyl Alcohol	20	ND	2,4,6-Trichlorophenol	10	ND
2-Methylphenol	10	ND	2,4,5-Trichlorophenol	10	ND
3- and 4-Methylphenol*	10	ND	2,4-Dinitrophenol	100	ND
2-Nitrophenol	10	ND	4-Nitrophenol	100	ND
2,4-Dimethylphenol	10	ND	2-Methyl-4,6-dinitrophenol	40	ND
Benzoic Acid	100	ND	Pentachlorophenol	60	ND

* Extraction performed by PSI Environmental Laboratories.

MRL Method Reporting Limit

** MRL is elevated. Sample extract final volume was twice the value normally obtained by Golden State/CAS Laboratories, Inc.

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanille Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 (602) 571-6565 FAX (602) 571-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 3-3
Laboratory I.D.: 090393-08

Sample Type: Water

Date Sampled: 09/01/1993

Date Received: 09/03/1993

Date Analyzed: 10/13/1993

Analyzed By: See Comments

Project Name: DOE/WJSA

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tianelle Kennedy 1-24-94

Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85705 TEL 520-573-6550 FAX 520-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: Method Blank

Laboratory I.D.: Method Blank

Sample Type: Water

Date Sampled: 09/01/1993

Date Received: 09/03/1993

Date Analyzed: 10/12/1993

Project Name: DOE/WJSA

Project Number: 0345

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL**	Result	Base Neutral Analyte	MRL**	Result
N-Nitrosodimethylamine	10	ND	2,6-Dinitrotoluene	10	ND
Bis(2-chloroethyl) Ether	10	ND	Diethyl Phthalate	10	ND
1,2-Dichlorobenzene	10	ND	4-Chlorophenyl Phenyl Ether	10	ND
1,3-Dichlorobenzene	10	ND	Fluorene	10	ND
1,4-Dichlorobenzene	10	ND	4-Nitroaniline	100	ND
Bis(2-chloroisopropyl) Ether	10	ND	N-Nitrosodiphenylamine	10	ND
N-Nitrosodi-n-propylamine	10	ND	4-Bromophenyl Phenyl Ether	10	ND
Hexachloroethane	10	ND	Hexachlorobenzene	10	ND
Nitrobenzene	10	ND	Phenanthrene	10	ND
Isophorone	10	ND	Anthracene	10	ND
Bis(2-chloroethoxy) methane	10	ND	Di-n-butyl Phthalate	10	ND
1,2,4-Trichlorobenzene	10	ND	Fluoranthene	10	ND
Naphthalene	10	ND	Pyrene	10	ND
4-Chloroaniline	10	ND	Butylbenzyl Phthalate	10	ND
Hexachlorobutadiene	10	ND	3,3'-Dichlorobenzidine	100	ND
2-Methylnaphthalene	10	ND	Benzo(a)anthracene	10	ND
Hexachlorocyclopentadiene	20	ND	Bis(2-ethylhexyl) Phthalate	10	86
2-Chloronaphthalene	10	ND	Chrysene	10	ND
2-Nitroaniline	40	ND	Di-n-octyl Phthalate	10	ND
Dimethyl Phthalate	10	ND	Benzo(b)fluoranthene	10	ND
Acenaphthylene	10	ND	Benzo(k)fluoranthene	10	ND
3-Nitroaniline	40	ND	Benzo(a)pyrene	10	ND
Acenaphthene	10	ND	Indeno(1,2,3-c,d)pyrene	10	ND
Dibenzofuran	10	ND	Dibenz(a,h)anthracene	10	ND
2,4-Dinitrotoluene	10	ND	Benzo(g,h,i)perylene	10	ND

Acid Analyte	MRL**	Result	Acid Analyte	MRL**	Result
Phenol	10	ND	2,4-Dichlorophenol	10	ND
2-Chlorophenol	10	ND	4-Chloro-3-methylphenol	10	ND
Benzyl Alcohol	20	ND	2,4,6-Trichlorophenol	10	ND
2-Methylphenol	10	ND	2,4,5-Trichlorophenol	10	ND
3- and 4-Methylphenol*	10	ND	2,4-Dinitrophenol	100	ND
2-Nitrophenol	10	ND	4-Nitrophenol	100	ND
2,4-Dimethylphenol	10	ND	2-Methyl-4,6-dinitrophenol	40	ND
Benzoic Acid	100	ND	Pentachlorophenol	60	ND

* Extraction performed by PSI Environmental Laboratories.

MRL Method Reporting Limit

** MRL is elevated. Sample extract final volume was twice the value normally obtained by Golden State/CAS Laboratories, Inc.

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Janette Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85705-5020 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: See Below

Laboratory I.D.: See Below

Sample Type: Water

Date Sampled: 09/01/1993

Date Received: 09/03/1993

Date Analyzed: 10/12/1993

Analyzed By: See Comments

Project Name: DOE/WJSA

Project Number: 0345

P.O. Number: None

Surrogate Recovery Summary Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270

Sample Name	Lab Code	P e r c e n t R e c o v e r y					TPH
		2FP	PHL	TBP	NBZ	FBP	
090393-01	LA3002-17	48	27	60	57	77	64
090393-02	LA3002-18	29	16	30	59	71	56
090393-03	LA3002-19	38	22	39	48	67	45
090393-06	LA3002-20	53	32	53	35	54	50
Method Blank	LA3002-MB	63	33	70	81	93	97

EPA Acceptance Criteria	21-100	10-94	10-123	35-114	43-116	33-141
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2FP 2-Fluorophenol
PHL Phenol-D₆
TBP 2,4,6-Tribromophenol
NBZ Nitrobenzene-D₅
FBP 2-Fluorobiphenyl
TPH Terphenyl-D₁₄

Comments:

Golden State/CAS Laboratories, Inc.
6925 Canoga Avenue
Canoga Park, CA 91303

Reviewed By:

Tanella Kennedy 1-24-94
Date

CHAIN OF CUSTODY FORM

Arizona Certified Laboratory

4730 N. Oracle Road, Suite 212 • Tucson, Arizona 85706 • (602) 887-1875 • FAX (602) 887-2352

COMPANY PSI Environmental Laboratories
 ADDRESS 4730 N. Oracle #212
 CITY TUCSON STATE AZ ZIP 85705
 PROJECT NAME DO.E. PROJ. MGR. Tanelle Kennedy
 PROJECT NUMBER _____ SAMPLES TAKEN FROM: _____
☐ 24 HOUR RUSH (_____ % Surcharge) ☐ 48 HOUR RUSH (_____ % Surcharge)

GS JOB# LA933002

ANALYSIS REQUESTED (Circle Method, Place X in Box)

Number of Containers	Halogenated Volatiles 601 / 8010	Aromatic Volatiles 602 / 8020	BTEX / TPHC 8020 / 8015	Phenols, Sub-Phenols 604 / 8040	Pesticides / PCB 608 / 8080	TCLP Organics and Metals	TCLP Metals	Petroleum Hydrocarbons 418.1 (BLS181)	Semi-Volatiles GC MS 624 / 8270	Volatiles GC MS 624 / 8260	SWDA Volatiles 502.2/524	Priority Pollutant Metals (13)	Oil & Grease Method No. 413.1	COD EPA 410.1	BOD EPA 405.1	pH EPA 150.1
									X	X	X	X	X	X	X	X

SAMPLER'S (SIGNATURE)

PHONE NO. (602) 887-1945
 (MUST INCLUDE)
 FAX NO. (602) 887-2352

SAMPLE ID.	DATE			TIME TAKEN	MATRIX	LAB ID.	NOTES
	MO.	DAY	YR.				
090793-11	09	03	93	a.m.	H2O	LA3002-10	
-13				a.m.		11	
-15				a.m.		12	
-22				a.m.		13	
-26				a.m.		14	
Field Blank				a.m.		15	
- Trip Blank				a.m.		16	
				a.m.			
				a.m.			

PROJECT INFORMATION		SAMPLE RECEIPT		RELINQUISHED BY		RELINQUISHED BY	
PROJECT:	TOTAL NO. OF CONTAINERS	7		(Signature)	J. Trauek 1:00	(Signature)	
P.O. #:	REC'D GOOD CONDITION/COLD			(Printed Name)	J. Trauek 9/15/93	(Printed Name)	
PRESERVATIVES:	CUSTODY SEALS			(Company)	PSI Env. Labs	(Company)	
SPECIAL INSTRUCTIONS/COMMENTS (X) DENOTES SAMPLES TO BE RUN PER - J. KENNEDY 10-8-93				RECEIVED BY		RECEIVED BY (LABORATORY)	
				(Signature)		(Signature)	
				(Printed Name)		(Printed Name)	
				(Company)		(Company)

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client:
Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 13-0
Laboratory I.D.: 090793-22

Sample Type: Water

Date Sampled: 09/03/1993

Date Received: 09/07/1993

Date Analyzed: 10/13/1993

Analyzed By: See Comments

Project Name: DOE

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanisha Kennedy 1-21-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 13-3
Laboratory I.D.: 090793-26

Sample Type: Water

Date Sampled: 09/03/1993

Date Received: 09/07/1993

Date Analyzed: 10/13/1993

Analyze By: See Comments

Project Name: DOE

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.
6925 Canoga Avenue
Canoga Park, CA 91303

Reviewed By:

Tanella Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: Blank

Laboratory I.D.: Method Blank

Sample Type: Water

Date Sampled: 09/03/1993

Date Received: 09/07/1993

Date Analyzed: 10/13/1993

Analyzed By: See Comments

Project Name: DOE

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.
6925 Canoga Avenue
Canoga Park, CA 91303

Reviewed By:

Tanesh Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:

Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: See Below

Laboratory I.D.: See Below

Sample Type: Water

Date Sampled: 09/03/1993

Date Received: 09/07/1993

Date Analyzed: 10/13/1993

Analyzed By: See Comments

Project Name: DOE

Project Number: 0345

P.O. Number: None

Surrogate Recovery Summary
Base Neutral/Acid Semivolatile Organic Compounds
EPA Methods 3510/8270

Sample Name	Lab Code	P e r c e n t R e c o v e r y					TPH
		2FP	PHL	TBP	NBZ	FBP	
090393-08	LA3002-4	54	25	48	93	80	86
090793-22	LA3002-13	68	35	76	98	85	90
090793-26	LA3002-14	53	25	64	91	79	93
Method Blank	LA3002-MB	69	34	81	100	85	87

EPA Acceptance Criteria	21-100	10-94	10-123	35-114	43-116	33-141
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2FP 2-Fluorophenol
PHL Phenol-D₆
TBP 2,4,6-Tribromophenol
NBZ Nitrobenzene-D₅
FBP 2-Fluorobiphenyl
TPH Terphenyl-D₁₄

Comments:

Golden State/CAS Laboratories, Inc.
6925 Canoga Avenue
Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: *

Laboratory I.D.: *

Sample Type: Water

Date Sampled: 09/03/1993

Date Received: 09/07/1993

Date Analyzed: 10/13/1993

Analyzed By: See Comments

Project Name: DOE

Project Number: 0345

P.O. Number: None

Matrix Spike/Duplicate Matrix Spike Summary
Base Neutral/Acid Semivolatile Organic Compounds
EPA Methods 3510/8270
 $\mu\text{g/L}$ (ppb)

Percent Recovery

Analyte	Spike Level		Sample Result	Spike Result		MS		EPA Acceptance Criteria	Relative Percent Difference
	MS	DMS		MS	DMS				
Phenol	10.0	10.0	ND	4.50	4.59	45	46	12-89	2
2-Chlorophenol	10.0	10.0	ND	9.36	9.71	94	97	27-123	4
1,4-Dichlorobenzene	10.0	10.0	ND	6.64	7.78	66	78	36-97	16
N-Nitrosodi-n-propylamine	10.0	10.0	ND	10.8	11.6	108	116	41-116	7
1,2,4-Trichlorobenzene	10.0	10.0	ND	6.59	7.83	66	78	39-98	9
4-Chloro-3-methylphenol	10.0	10.0	ND	7.23	7.56	72	76	23-97	3
Acenaphthene	10.0	10.0	ND	9.67	10.3	97	103	46-118	6
4-Nitrophenol	10.0	10.0	ND	2.68	2.60	27	26	10-80	2
2,4-Dinitrotoluene	10.0	10.0	ND	8.62	8.87	86	89	24-96	3
Pentachlorophenol	10.0	10.0	ND	3.80	4.03	38	40	9-103	6
Pyrene	10.0	10.0	ND	9.48	10.8	95	108	26-127	13

ND None Detected at or above the method reporting limit

Comments: *OC performed on a sample from another source.

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanille Kennedy 1-24-94
Date

GOLDEN STATE/CAS
LABORATORIES, INC.

6925 CANOGA AVENUE,
CANOGA PARK, CA 91304
818 587 5550 ■ FAX # 818 587 5555

Chain of Custody Record
Analytical Services Request

1/2

CLIENT NAME PSI		ADDRESS/PHONE/FAX Ph # 602 573-6565 Fax # 602 573-6550		ANALYSES REQUESTED				GSAS JOB # LA933575		
PROJECT NAME/LOCATION DO E/Tenn			CLIENT PROJECT NO. 0345		EPA 625/6270					
PROJECT MANAGER J. Preuberg		SAMPLER(S) CLG		P.O. NO. —						
SAMPLE IDENTIFICATION NO.	DATE	TIME	LAB SAMPLE NO.	SAMPLE MATRIX						REQUESTED TURNAROUND TIME
101993-25	10/18/93		LA3375-1	H₂O	X		510day These samples are past EPA holding time, please perform analysis as requested. Thank you.			
101993-26			2		X					
101993-28			3		X					
101993-29			4		X					
101993-30			5		X					
101993-32			6		X					
101993-33			7		X					
101993-34			8		X					
101993-36			9		X					
101993-37			10		X					
101993-38			11		X					
101993-40			12		X					
RELINQUISHED BY: (Signature) Patsy Tanizawa			DATE 11/30/93	TIME 1000	RECEIVED BY: (Signature)		DATE 12-1-93	TIME 0930		
RELINQUISHED BY: (Signature)			DATE	TIME	RECEIVED BY: (Signature)		DATE	TIME		
RELINQUISHED BY: (Signature)			DATE	TIME	RECEIVED BY: (Signature)		DATE	TIME		
SEND INVOICE TO: SAME AS USUAL					WHITE COPY: Accompanies Samples YELLOW COPY: Sampler					

GOLDEN STATE/CAS
LABORATORIES, INC.

6925 CANOGA AVENUE,
CANOGA PARK, CA 91304
818 587 5550 ■ FAX # 818 587 5555

Chain of Custody Record
Analytical Services Request

2/2

CLIENT NAME PSI		ADDRESS/PHONE/FAX PH # 602 573-6565 FAX # 602 573-6550		ANALYSES REQUESTED				GSAS JOB # LA933325		
PROJECT NAME/LOCATION DOE/Tenn			CLIENT PROJECT NO. 0345		EPA 625/10270					
PROJECT MANAGER J. PRELBERG		SAMPLER(S) CL6		P.O. NO. —						
SAMPLE IDENTIFICATION NO.	DATE	TIME	LAB SAMPLE NO.	SAMPLE MATRIX					REQUESTED TURNAROUND TIME	REMARKS
101993-41	10/18/93		1A3375-13	H ₂ O	X					5-10 day These samples are past EPA holding times, please perform analysis as requested. Thank you
101993-42			14		X					
RELINQUISHED BY: (Signature) Peter Tanaka			DATE 11/30/93	TIME 1000	RECEIVED BY: (Signature) [Signature]				DATE 12-1-93	TIME 0930
RELINQUISHED BY: (Signature)			DATE	TIME	RECEIVED BY: (Signature)				DATE	TIME
RELINQUISHED BY: (Signature)			DATE	TIME	RECEIVED BY: (Signature)				DATE	TIME
SEND INVOICE TO: SAME AS USUAL					WHITE COPY: Accompanies Samples YELLOW COPY: Sampler

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:

Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 16A-0

Laboratory I.D.: 101993-25

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	8	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tarell Kennedy

1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:
Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 16A-3
Laboratory I.D.: 101993-26

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:

Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 16A-9

Laboratory I.D.: 101993-28

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			

Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy

1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client:
Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 17A-0

Laboratory I.D.: 101993-29

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	13	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	7	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Janette Kennedy 1-24-94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 17A-3
Laboratory I.D.: 101993-30
Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			

Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy

1-24-94

Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:
Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 17A-9
Laboratory I.D.: 101993-32

Sample Type: Water
Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-24-44
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT

State of Arizona License #0009

Client:

Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 18A-0

Laboratory I.D.: 101993-33

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	15	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	8	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			

Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 18A-3
Laboratory I.D.: 101993-34

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachloropheno!	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanisha Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:

Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 18A-9

Laboratory I.D.: 101993-36

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/13/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			

Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanelle Kennedy 1-24-94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client:
Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 19A-0
Laboratory I.D.: 101993-37

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/13/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	13	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	6	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			

Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-24-94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 19A-3
Laboratory I.D.: 101993-38

Sample Type: Water
Date Sampled: 10/18/1993

Date Received: 10/19/1993

Project Name: DOE/Tenn

Project Number: 0345

Date Analyzed: 12/13/1993

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tamela Kennedy 1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 19A-9
Laboratory I.D.: 101993-40
Sample Type: Water

Project Name: DOE/Tenn

Date Sampled: 10/18/1993
Date Received: 10/19/1993

Project Number: 0345

Date Analyzed: 12/13/1993

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-34-94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: Field Blank

Laboratory I.D.: 101993-41

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/13/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanelle Kennedy

1-24-94
Date

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client:	Peroxidation Systems Inc. 5151 E. Broadway, Suite 600 Tucson, AZ 85711	Sample I.D.:	Trip Blank
		Laboratory I.D.:	101993-42
		Sample Type:	Water
		Date Sampled:	10/18/1993
Project Name:	DOE/Tenn	Date Received:	10/19/1993
Project Number:	0345	Date Analyzed:	12/13/1993
P.O. Number:	None	Analyzed By:	See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benzo(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 12/14/94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LAB5

ANALYTICAL REPORT State of Arizona License #0009

Client: Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: Method Blank

Laboratory I.D.: Method Blank

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			
Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy

1-24-94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT State of Arizona License #0009

Client:
Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: Method Blank

Laboratory I.D.: Method Blank

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/06/1993

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Analyzed By: See Comments

Base Neutral/Acid Semivolatile Organic Compounds EPA Methods 3510/8270 µg/L (ppb)

Base Neutral Analyte	MRL	Result	Base Neutral Analyte	MRL	Result
N-Nitrosodimethylamine	5	ND	2,6-Dinitrotoluene	5	ND
Bis(2-chloroethyl) Ether	5	ND	Diethyl Phthalate	5	ND
1,2-Dichlorobenzene	5	ND	4-Chlorophenyl Phenyl Ether	5	ND
1,3-Dichlorobenzene	5	ND	Fluorene	5	ND
1,4-Dichlorobenzene	5	ND	4-Nitroaniline	20	ND
Bis(2-chloroisopropyl) Ether	5	ND	N-Nitrosodiphenylamine	5	ND
N-Nitrosodi-n-propylamine	5	ND	4-Bromophenyl Phenyl Ether	5	ND
Hexachloroethane	5	ND	Hexachlorobenzene	5	ND
Nitrobenzene	5	ND	Phenanthrene	5	ND
Isophorone	5	ND	Anthracene	5	ND
Bis(2-chloroethoxy) methane	5	ND	Di-n-butyl Phthalate	5	ND
1,2,4-Trichlorobenzene	5	ND	Fluoranthene	5	ND
Naphthalene	5	ND	Pyrene	5	ND
4-Chloroaniline	5	ND	Butylbenzyl Phthalate	5	ND
Hexachlorobutadiene	5	ND	3,3'-Dichlorobenzidine	20	ND
2-Methylnaphthalene	5	ND	Benz(a)anthracene	5	ND
Hexachlorocyclopentadiene	10	ND	Bis(2-ethylhexyl) Phthalate	5	ND
2-Chloronaphthalene	5	ND	Chrysene	5	ND
2-Nitroaniline	20	ND	Di-n-octyl Phthalate	5	ND
Dimethyl Phthalate	5	ND	Benzo(b)fluoranthene	5	ND
Acenaphthylene	5	ND	Benzo(k)fluoranthene	5	ND
3-Nitroaniline	20	ND	Benzo(a)pyrene	5	ND
Acenaphthene	5	ND	Indeno(1,2,3-c,d)pyrene	5	ND
Dibenzofuran	5	ND	Dibenz(a,h)anthracene	5	ND
2,4-Dinitrotoluene	5	ND	Benzo(g,h,i)perylene	5	ND
Aniline	5	ND			

Acid Analyte	MRL	Result	Acid Analyte	MRL	Result
Phenol	5	ND	2,4-Dichlorophenol	5	ND
2-Chlorophenol	5	ND	4-Chloro-3-methylphenol	5	ND
Benzyl Alcohol	10	ND	2,4,6-Trichlorophenol	5	ND
2-Methylphenol	5	ND	2,4,5-Trichlorophenol	5	ND
3- and 4-Methylphenol*	5	ND	2,4-Dinitrophenol	50	ND
2-Nitrophenol	5	ND	4-Nitrophenol	50	ND
2,4-Dimethylphenol	5	ND	2-Methyl-4,6-dinitrophenol	20	ND
Benzoic Acid	50	ND	Pentachlorophenol	30	ND

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

* Quantified as 4-methylphenol.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanisha Kennedy 1-24-94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:

Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: 16A-9

Laboratory I.D.: 101993-28

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/10/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Matrix Spike/Duplicate Matrix Spike Summary
Base Neutral/Acid Semivolatile Organic Compounds
EPA Methods 3510/8270
 $\mu\text{g/L}$ (ppb)

Percent Recovery

Analyte	Spike Level		Sample Result	Spike Result		MS		EPA Acceptance Criteria	Relative Percent Difference
	MS	DMS		MS	DMS				
Phenol	50.0	50.0	ND	18.2	16.8	36	34	12-89	8
2-Chlorophenol	50.0	50.0	ND	38.0	35.6	76	71	27-123	7
1,4-Dichlorobenzene	50.0	50.0	ND	41.2	37.0	81	74	36-97	11
N-Nitrosodi-n-propylamine	50.0	50.0	ND	40.2	36.4	80	73	41-116	10
1,2,4-Trichlorobenzene	50.0	50.0	ND	41.7	38.3	83	77	39-98	8
4-Chloro-3-methylphenol	50.0	50.0	ND	40.5	38.0	81	76	23-97	6
Acenaphthene	50.0	50.0	ND	47.7	45.4	95	91	46-118	5
4-Nitrophenol	50.0	50.0	ND	14.2	13.4	28	27	10-80	6
2,4-Dinitrotoluene	50.0	50.0	ND	49.4	45.2	*98	90	24-96	9
Pentachlorophenol	50.0	50.0	ND	38.0	34.2	76	68	9-103	11
Pyrene	50.0	50.0	ND	46.5	41.4	93	83	26-127	9

ND None Detected at or above the method reporting limit

* Spike recoveries were outside acceptance limits due to matrix effects. Laboratory control spike was acceptable, therefore, data was approved.

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Janelle Kennedy 1-24-94

PSI Environmental Laboratories

2595 E. Airport Drive Tucson, Arizona 85706 602-573-6565 FAX 602-573-6550 1-800-PSI-LABS

ANALYTICAL REPORT

State of Arizona License #0009

Client:

Peroxidation Systems Inc.
5151 E. Broadway, Suite 600
Tucson, AZ 85711

Sample I.D.: See Below

Laboratory I.D.: See Below

Sample Type: Water

Date Sampled: 10/18/1993

Date Received: 10/19/1993

Date Analyzed: 12/06 - 12/13/1993

Analyzed By: See Comments

Project Name: DOE/Tenn

Project Number: 0345

P.O. Number: None

Surrogate Recovery Summary
Base Neutral/Acid Semivolatile Organic Compounds
EPA Methods 3510/8270

Sample Name	Lab Code	P e r c e n t R e c o v e r y					TPH
		2FP	PHL	TBP	NBZ	FBP	
101993-25	LA3375-1	48	35	101	87	95	80
101993-26	LA3375-2	43	32	88	77	87	81
101993-28	LA3375-3	41	29	67	75	89	80
101993-29	LA3375-4	48	35	96	84	98	85
101993-30	LA3375-5	44	30	78	78	90	81
101993-32	LA3375-6	45	30	86	77	93	96
101993-33	LA3375-7	49	34	105	78	96	90
101993-34	LA3375-8	46	33	86	77	92	86
101993-36	LA3375-9	41	28	74	71	80	77
101993-37	LA3375-10	54	39	100	85	96	87
101993-38	LA3375-11	43	33	83	77	86	78
101993-40	LA3375-12	44	31	77	78	91	83
101993-41	LA3375-13	47	34	84	87	100	88
101993-42	LA3375-14	48	35	94	89	102	89
Method Blank	LA3375-MB	28	22	47	47	55	58
Method Blank	LA3375-MB	55	32	104	96	96	71

EPA Acceptance Criteria 21-100 10-94 10-123 35-114 43-116 33-141

2FP 2-Fluorophenol
PHL Phenol-D₆
TBP 2,4,6-Tribromophenol
NBZ Nitrobenzene-D₆
FBP 2-Fluorobiphenyl
TPH Terphenyl-D₁₄

Comments:

Golden State/CAS Laboratories, Inc.

6925 Canoga Avenue

Canoga Park, CA 91303

Reviewed By:

Tanette Kennedy 1-24-94
Date

DATE

FILMED

7/01/94

END