MAY 6, 2011

GROUNDWATER TREATMENT SYSTEM
BENCH AND PILOT TESTING
CORRECTIVE MEASURES STUDY WORK PLAN

ADDENDUM NO. 5

RAYTHEON COMPANY
(FORMER HUGHES AIRCRAFT COMPANY)
1901 WEST MALVERN AVENUE
FULLERTON, CALIFORNIA

PREPARED FOR:
RAYTHEON COMPANY

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

HARGIS + ASSOCIATES, INC.
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May 6, 2011

VIA E-MAIL AND FEDERAL EXPRESS – STANDARD

Mr. William F. Jeffers, PE
Hazardous Substances Engineer
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
9211 Oakdale Avenue
Chatsworth, CA 91311-6505

Re: Transmittal of Groundwater Treatment System, Bench and Pilot Testing, Corrective Measures Study Work Plan, Addendum No. 5, Raytheon Company, 1901 West Malvern Avenue, Fullerton, California

Dear Mr. Jeffers:

Enclosed is one hard copy with one compact disc that contains an electronic copy of the above-referenced report. If you have any questions or require further information, please contact us at 858-455-6500.

Sincerely,

HARGIS + ASSOCIATES, INC.

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ACRONYMS AND ABBREVIATIONS

CACA	Corrective Action Consent Agreement
Calgon	Calgon Carbon Corporation
CMS	Corrective Measures Study
1,1-DCE	1,1-Dichloroethylene
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
gpm	Gallons per minute
H+A	Hargis + Associates, Inc.
Haley	Haley & Aldrich, Inc.
HSP	Health and Safety Plan
psig	Pound-force per square inch gauge
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
the Site	1901 West Malvern Avenue, Fullerton, California
TCE	Trichloroethylene
Trojan	Trojan Technologies
UV	Ultraviolet
VOC(s)	Volatile organic compound(s)

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1.0 INTRODUCTION

This Work Plan comprises Addendum 5 to the Corrective Measures Study (CMS) Work Plan (Hargis + Associates, Inc. [H+A], 2003a) and has been prepared by H+A on behalf of Raytheon Company. The prior Addendum, Addendum 4a to the CMS Work Plan (Pilot Test Work Plan), outlined the pilot testing activities at the Raytheon Company (formerly Hughes Aircraft Company) site located at 1901 West Malvern Avenue, Fullerton, California (the Site) (Figures 1 and 2). The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), concurred with the Pilot Test Work Plan on June 1, 2009 (DTSC, 2009). This CMS Work Plan Addendum 5 (hereafter referred to as the Pilot Test Work Plan Addendum) presents details regarding additional bench and pilot test activities which are proposed to evaluate groundwater treatment technologies that can effectively reduce 1,4-dioxane and volatile organic compound (VOC) concentrations in extracted groundwater. The testing outlined in this Pilot Test Work Plan Addendum will be conducted concurrently with ongoing pilot testing outlined in previously approved Work Plan addenda.

The proposed bench and pilot testing program within the CMS will be conducted in association with the general requirements of a Resource Conservation and Recovery Act (RCRA) Corrective Action Consent Agreement (CACA) (DTSC, 2003). This phase of the program is expected to provide information which may be used to develop a corrective measure for the Site. This Pilot Test Work Plan Addendum proposes pilot testing of a resin that adsorbs 1,4-dioxane/VOCs at the existing pilot test treatment system and bench testing an advanced oxidation treatment process that utilizes ultraviolet (UV) light and peroxide to break down 1,4-dioxane/VOCs using representative groundwater collected from the Site. The data obtained during the proposed pilot and bench testing activities will be used to evaluate alternate groundwater treatment technologies that could be incorporated into the future full-scale treatment system to treat dissolved phase contaminant mass while maintaining consistent compliance with applicable treated groundwater discharge requirements. This proposed Pilot Test Work Plan Addendum would be implemented following DTSC review and approval, and would begin with groundwater sample collection from selected Site wells, which is tentatively scheduled to be initiated in the second quarter of 2011.

1.1 PURPOSE AND SCOPE

The testing activities proposed in this Pilot Test Work Plan Addendum are intended to evaluate effectiveness of selected treatment processes to reduce the concentration of VOCs in extracted groundwater, with a focus on reducing 1,4-dioxane concentrations. The activities outlined in this addendum will be conducted concurrent with additional proposed groundwater assessment (H+A, 2011e), ongoing groundwater monitoring, and ongoing pilot testing activities to facilitate a more complete and representative corrective measure selection process within the CMS.

1.2 BACKGROUND

A summary of previously completed investigations, site conditions, regulatory background, and pilot testing procedures that are subjects of the CACA were presented in the CMS, Additional Groundwater Assessment Work Plan and Pilot Test Work Plans and Pilot Test Summary Report (H+A, 2003a, 2003b, 2004a, 2004b, 2005a, 2008a, 2008b, and 2009d). A description of the geologic and hydrogeologic conditions at and in the vicinity of the Site is provided in Well Construction and Groundwater Monitoring Reports (H+A, 2005b, 2009b, 2009c, and 2011a to 2011d). A description of additional proposed groundwater assessment tasks is provided in an Additional Groundwater Assessment Work Plan Addendum No. 4 (H+A, 2011e). A summary of the status of pilot testing activities and recently completed groundwater assessment activities conducted at the Site are presented in the following sections.

1.2.1 Pilot Testing

This section summarizes the pilot test operation up through the fourth quarter of 2010. The pilot test system consists of three groundwater extraction wells, the treatment system, and the disposal of treated groundwater to the sanitary sewer under a permit issued by the Orange County Sanitation District. The initial phase of pilot testing extracted groundwater from two extraction wells (MW-21 and EW-01), and the current phase of pilot testing is operating using one extraction well (EW-02). The treatment system processes extracted groundwater through an advanced oxidation unit that utilizes ozone and hydrogen peroxide, followed by a granular activated carbon polish prior to disposal to the sanitary sewer.

Initial startup of the pilot groundwater extraction and treatment system took place on Tuesday, July 8, 2008. From July 2008 through November 2009, the pilot system was operated with extraction wells EW-01 and MW-21. Pilot system expansion took place between November 2009 and March 2010 in order to incorporate extraction well EW-02 into the extraction well network. During this time, the system maximum flow rate was also increased from 20 gallons per minute (gpm) to 50 gpm. The pilot system was restarted on March 22, 2010 with extraction and treatment of groundwater from extraction well EW-02 at a rate of approximately 50 gpm. Extraction wells EW-01 and MW-21 are on standby for the current phase of pilot testing, MW-21 will be used for pilot and bench testing outlined in this Pilot Test Work Plan. One or both of these extraction wells may also be used future phases of pilot testing and/or as part of a full-scale pump-and-treat system.

A graphical representation of the system operational time in relation to water level measurements at current extraction well EW-02 and the previously utilized extraction wells EW-01 and MW-21 has been provided (Figure 3). The influent concentrations 1,4-dioxane and 1,1-dichloroethylene (1,1-DCE), the principal VOC in extracted groundwater, have been monitored during the pilot testing (Figure 4). The concentration of both 1,4-dioxane and 1,1-DCE were generally higher during the initial phase of pilot system operations when groundwater was extracted from extraction wells MW-21 and EW-01. Since startup of the pilot system in July 2008, approximately 78.8 pounds of VOCs and 13.2 pounds of 1,4-dioxane have been removed from groundwater through December 2010 (Figure 5).

One of the goals of the pilot testing was to determine if 1,4-dioxane could be treated without formation of bromate, a secondary treatment system byproduct. Bromate is a regulated compound in drinking water, and can be formed from naturally occurring bromide in groundwater when ozonation treatment is used. The effluent of the advanced oxidation treatment system had detections of 1,4-dioxane and bromate during the 2008/2009 initial phase of pilot testing operations when groundwater was extracted from extraction wells MW-21 and EW-01 (Figure 6). In March 2010 the second phase of pilot testing was initiated and groundwater was extracted from extraction well EW-02. During this time, 1,4-dioxane was not detected in the effluent, but bromate was still detected in the effluent of the advanced oxidation treatment system at generally lower concentrations than during the initial phase (Figure 6). The production of bromate limits the feasibility of the current treatment technology and, therefore, the pilot and bench testing outlined in this Pilot Test Work Plan Addendum will evaluate alternate treatment processes that can reduce 1,4-dioxane and VOC concentrations without forming bromate.

1.2.2 Groundwater Assessment

Recent groundwater assessment activities have focused on delineation of the distribution of VOCs, principally 1,1-DCE and 1,4-dioxane in the primary transport zone, which for the purposes of this document will be referred to as the Target Zone (also referred to as Unit B and previously referred to as Conceptual Groundwater Model Alternative 1 [CM1] Hydrostratigraphic Zone CM1-B). VOCs, principally 1,1-DCE and 1,4-dioxane, and to a lesser extent trichloroethylene (TCE), were detected in one of the two recently installed monitor well groups. 1,1-DCE, 1,4-dioxane, and TCE were not detected in any of the three new monitor well screens at monitor well MW-35, which provides lateral control to the south (Figure 7). 1,1-DCE and 1,4-dioxane were detected in one of the three screened intervals at monitor well MW-34, specifically in the screened interval through the Target Zone. Delineation of 1,1-DCE and 1,4-dioxane to the west and southwest of monitor well MW-34 will be evaluated as part of additional proposed groundwater assessment activities (H+A, 2011e).

2.0 PILOT AND BENCH TEST ADDENDUM OVERVIEW

The data obtained during the proposed pilot and bench testing activities will be used to evaluate alternate groundwater treatment technologies. This evaluation may be incorporated into the future full-scale treatment system to treat dissolved phase contaminant mass while maintaining consistent compliance with applicable treated groundwater discharge requirements.

Resin pilot testing consists of two main activities:

1) Configure existing treatment system compound to provide a slip stream of groundwater from extraction well MW-21 to a series of columns containing selected resin. Note, the effluent from the series of columns will be routed to the influent to the existing pilot treatments system.

2) Conduct the resin column pilot testing, as presented in Section 4.

Advanced oxidation bench testing consists of two main activities:

1) Collect source water from selected Site wells and transport to advanced oxidation treatment bench test vendors.

2) Conduct bench testing with multiple concurrent tests, as presented in Section 4.

The results of pilot and bench testing will be evaluated and presented in a summary report.

As stated previously, the operation of the existing pilot test system will continue concurrently with pilot and bench testing activities.

This Pilot Test Work Plan Addendum provides details regarding the pilot/bench test source groundwater and provides an overview of testing procedures. The objectives of the pilot/bench testing activities are:

- to assess performance of the selected resin to meet potential discharge requirements for 1,4-dioxane and VOCs in an influent groundwater stream with concentrations that fluctuate over time;

- to assess performance of UV/peroxide advanced oxidation system to meet potential discharge requirements for 1,4-dioxane and VOCs in an influent groundwater stream with concentrations that fluctuate over time;

- to confirm that the UV/peroxide advanced oxidation system does not generate unacceptable bromate concentrations; and

- to obtain design and utility/consumable information to determine if UV/peroxide advanced oxidation and/or adsorptive resin systems are sustainable technologies that could be used as part of the future full-scale treatment system.

3.0 BENCH TEST SOURCE WATER

Source water for pilot and bench testing activities will be obtained from selected Site wells to obtain groundwater that is expected to be similar to groundwater that would be treated as part of a full-scale groundwater treatment system. The concentrations of 1,1-DCE and 1,4 dioxane in groundwater extracted during pilot testing have varied over time (Figure 4). These concentration variations appear to be related to both periodic seasonal variations and operation of the pilot test system. Therefore, this proposed Pilot Test Work Plan Addendum includes obtaining Site groundwater from one to two locations to assess the performance of selected pilot and bench test technologies under lower and higher 1,4-dioxane and VOC concentrations.

Extraction well MW-21 has been selected to represent the higher concentration source groundwater for pilot and bench testing. This well was installed and first sampled in 2003, was connected to the pilot treatment system and operated during initial phase from 2008 to late 2009, and was not operated as part of the pilot treatment system from late 2009 to present. Seasonal variations in the concentration of 1,4-dioxane and 1,1-DCE have been observed in this well prior to its connection to the pilot test system (Table 1; Figure 8, prior to 2008). The concentration of both of these compounds generally declined during initial phase of pilot test operations between 2008 and late 2009, then increased after this well was turned off. Given observed seasonal fluctuations in 1,1-DCE and 1,4-dioxane concentrations, the groundwater sample for bench testing purposes is anticipated to be collected in June 2011 in an attempt to obtain the sample during a time when it is anticipated that the 1,1-DCE and 1,4-dioxane concentrations will be near a potential seasonal high. This extraction well will also be used for the pilot test of the resin. The pilot testing of the resin will be conducted within the existing treatment compound using a slip stream of groundwater from extraction well MW-21 concurrent with the operation of the existing pilot test system.

Extraction well EW-02 has been selected to represent the lower concentration source groundwater for bench testing. This well was installed in late 2009 and was connected to the pilot treatment system in March 2010. The variation in 1,1-DCE and 1,4-dioxane concentrations are less pronounced than those observed in pilot extraction well MW-21 (Figures 8 and 9). The groundwater sample for bench testing purposes will be collected on the same day as the sample collected from well MW-21. Lower concentration source water is not needed for resin pilot testing as the resin pilot testing utilizes a series of columns, where the first column reduces the concentration of VOCs/1,4-dioxane and the monitoring of the second column effectively provides an assessment of lower concentration source water.

3.1 SOURCE WATER COLLECTION PROCEDURES

Source water for the resin pilot test will be obtained during concurrent operation of extraction well MW-21. The duration of the resin pilot test is expected to be several weeks to a month; during this time the operation of existing pilot test extraction wells will be changed. As stated previously, extraction well EW-02 is the only extraction well currently operated. During the resin pilot testing, the extraction rate from extraction well EW-02 will be reduced to approximately 35 gpm and the extraction well MW-21 will be operated at approximately 15 gpm. There are separate influent lines within the treatment system compound from extraction wells EW-02 and MW-21. The influent line from extraction well MW-21 will be tapped to provide a slip stream source of groundwater for the resin pilot test.

Source water for bench testing will be collected from pilot extraction well EW-02 and well MW-21. These source waters will be used in different bench tests as described in Section 4. The volume of source water required for each test varies from several gallons to approximately 30 gallons per test. Smaller volumes of groundwater will be collected either in 1-gallon bottles or 5-gallon totes and shipped in ice packed coolers. Larger volumes of groundwater will be collected in 30-gallon drums shipped in ice-packed overpack drums (Table 2). Groundwater samples will also be collected from each well at time of bench test source water collection for analysis in order to determine the initial VOC, 1,4-dioxane, and bromate concentrations prior to shipment (Table 2).

Bench test groundwater samples from extraction wells EW-02 and MW-21 will be collected from the respective influent pipelines within the treatment system compound. It is anticipated that groundwater samples from extraction well EW-02 will be collected during normal operating conditions. It is anticipated that extraction well MW-21 will be operated for at least an hour prior to collection of groundwater samples from this well.

3.2 SOURCE WATER ANALYSIS

Groundwater samples will be collected from extraction well MW-21 slip stream during the resin pilot test as outlined in Section 4 (influent to first resin column).

Groundwater samples collected concurrently with bench test source water will be analyzed for VOCs using United States Environmental Protection Agency (EPA) Method 8260B; for bromate using EPA Method 317; and for 1,4-dioxane using modified EPA Method 8270. An original and split sample will be collected during the sampling of extraction well EW-02 and well MW-21, with split analyses solely being performed for VOCs and 1,4-dioxane. The original sample from both wells will be analyzed for VOCs on a rush basis to confirm anticipated water quality prior to shipping water to bench test vendors. The original 1,4-dioxane analyses and analyses conducted by the split lab will be conducted on a 1-week turnaround basis. Original groundwater samples, with exception of bromate, will be analyzed by Advanced Technology Laboratories, Inc., Signal Hill, California. The original sample will also be analyzed for bromate by Exova (formerly Bodycote Testing Group), Santa Fe Springs, California. Laboratory split groundwater samples for VOCs and 1,4-dioxane will be analyzed by Exova.

4.0 PILOT AND BENCH TESTING

Two potentially applicable groundwater treatment technologies will be tested as part of this proposed Pilot Test Work Plan Addendum. The first technology relies on resin to adsorb VOCs and 1,4-dioxane contained in extracted groundwater. The second technology relies on an advanced oxidation process to destroy VOCs and 1,4-dioxane in extracted groundwater. The following sections outline the pilot and bench testing procedures for resin and advanced oxidation technologies, respectively.

4.1 RESIN PILOT TESTING

Bench testing conducted at other Raytheon facilities have indicated that Ambersorb 563 (formerly Rohm & Haas) can reduce VOC and 1,4-dioxane concentrations in groundwater. The pilot testing will be conducted to assess the performance of this resin at reducing VOC and 1,4-dioxane concentrations in site-specific groundwater. It is anticipated that pilot testing results can be used to assess the resin vessel configuration, including approximate quantity of resin and estimated frequency of resin regeneration required to treat a nominal flow rate of site-specific groundwater. This information would be used to determine whether use of this resin is a potentially sustainable technology for a full-scale groundwater treatment process.

The resin pilot testing will be conducted by Haley & Aldrich, Inc. (Haley) within the existing treatment system compound located at the Site as outlined in the following sections.

4.1.1 Integrate Resin Pilot Test into Existing Pilot Treatment System

As indicated in Section 3, source water for the resin pilot test will be obtained from a slip stream from extraction well MW-21 during concurrent operation of the existing treatment system. H+A will work with Haley to provide a temporary area to set up resin pilot test equipment within the existing pilot treatment system compound. In general, the resin pilot test equipment comprises the following major system components:

- Equalization tank downstream of the slip stream from extraction well MW-21 pipeline; this equalization tank will have sufficient capacity to continue pilot testing in the event the extraction well turns off for a period of up to 10 hours (on the order of 100 gallons)

- Shut off valve/sample port between equalization tank and first resin column

- Particulate filter between equalization tank and first resin column

- Series of two to three resin columns containing selected resin

- Sample ports after each resin column

- In stream flow meter/totalizer

- Effluent line from last resin column returns treated groundwater back to influent of existing treatment system

The above major equipment is used during the pilot test resin loading cycles, of which two are planned as part of the pilot test (Section 4.1.2). There will also be two steam regeneration cycles conducted during the pilot test. A small portable steam generator, and condenser cooled with potable water, are used during the steam regeneration cycles. The steam generator can be connected to the top of one or more of the resin columns and a condenser is connected to the bottom of the resin column(s) being regenerated. The resin loading and regeneration cycles are described in the following section.

4.1.2 Pilot Testing Resin

Pilot testing will be conducted over a several week period and include the following four cycles: 1) initial resin loading; 2) steam regeneration of lead column; 3) second loading cycle; and 4) the final steam regeneration of all columns.

4.1.2.1 Initial Resin Loading Cycle

After the columns are set up within the treatment system compound and filled with resin, the columns will be initially flushed with potable water and allowed to settle overnight. At the start of the pilot test, all of the columns contain fresh resin which is generally representative of the initial startup of a treatment system with new resin in all of the resin vessels.

The initial loading cycle is anticipated to be operated on a nearly continuous basis for approximately a week. During this time, slip stream water from extraction well MW-21 will be pumped through the columns at a nearly continuous rate until the total VOC concentrations in the lead column effluent reaches approximately 50 percent of the influent concentration or 7 days of continuous operation, whichever occurs first. Water samples will be collected on a periodic basis throughout the initial loading cycle (Table 3) and analyzed for VOCs and 1,4-dioxane.

4.1.2.2 Initial Steam Regeneration Cycle

At the completion of the initial loading cycle, the lead column will be regenerated with a nominal 20-to-25 pound-force per square inch gauge (psig) pressurized steam at a controlled flow rate for approximately 8 to 12 hours. The steam exiting the column will be condensed and the condensate will be collected to evaluate mass loading on the lead column and determine the time necessary for adsorbent regeneration. The condensate samples will be analyzed for VOCs and 1,4-dioxane at different times (Table 4) to determine the number of bed volumes of steam required to regenerate the lead column. The bulk condensate from the initial steam regeneration cycle will be containerized and profiled for appropriate off-site treatment/disposal.

4.1.2.3 Second Resin Loading Cycle

After the lead column has been regenerated, this column will be set as the last column in the series. This arrangement is generally representative of the normal operations where the lead resin vessel is regenerated and placed as the last vessel in the treatment process and the former second vessel becomes lead vessel. In this case, the second column (vessel) is partially loaded with VOCs/1,4-dioxane that broke through the lead vessel during the prior loading cycle.

The second loading cycle is anticipated to be operated on a nearly continuous basis for approximately a week. During this time, slip stream water from extraction well MW-21 will be pumped through the columns at a nearly continuous rate until the total VOC concentrations in the lead column effluent reaches approximately 50 percent of the influent concentration or 7 days of continuous operation, to be determined based on the results of the initial test. Water samples will be collected on a periodic basis through the second loading cycle (Table 3) and analyzed for VOCs and 1,4-dioxane.

4.1.2.4 Final Steam Regeneration Cycle

At the completion of the second loading cycle, all of the columns will be regenerated in a similar fashion as the initial regeneration cycle for the lead column. The steam exiting the column will be condensed and the bulk condensate will be containerized. The bulk condensate will be sampled and analyzed for VOCs and 1,4-dioxane (Table 4) to evaluate system mass balance. The bulk condensate from the final steam regeneration cycle will be containerized and profiled for appropriate off-site treatment/disposal.

4.2 ADVANCED OXIDATION BENCH TESTING

A bench test will be conducted using lower and higher concentration source water to determine equipment sizing and peroxide dosing requirements for UV/peroxide advanced oxidation treatment technology. The bench test will also be used to confirm that bromate is not a secondary by-product of this type of advanced oxidation treatment process. In addition, an abbreviated water test will also be conducted on an alternate UV/peroxide advanced oxidation treatment technology. It is anticipated that the bench testing/abbreviated water test results can be used to determine design parameters and estimate energy and chemical consumption for the respective UV/peroxide advanced oxidation treatment units that may be used as part of full-scale treatment system.

4.2.1 Bench Testing

The advanced oxidation bench testing will be conducted by Calgon Carbon Corporation (Calgon) in Pittsburgh, Pennsylvania, in two generalized steps as outlined in the following sections.

4.2.1.1 Source Water Analysis

As indicated in Section 3, bench test source water will be collected from higher and lower concentration Site wells and shipped under Chain-of-Custody procedures to the bench testing facility in Pittsburgh, Pennsylvania. Prior to initiating bench testing, an original and split sample will be collected from the two source waters (Table 5). The original sample will be analyzed by Calgon for VOCs, 1,4-dioxane, chemical oxygen demand, biological oxygen demand, selected anions, alkalinity, and UV absorption spectrum using their own laboratory. The split sample will be analyzed for VOCs using EPA Method 8260B; for bromate using EPA Method 317; and for 1,4-dioxane using modified EPA Method 8270 by an off-site laboratory. The off-site laboratory will be National Environmental Laboratory Accreditation Program-certified to conduct these analyses, but may not be a California state-certified laboratory. The VOC/1,4-dioxane split sample results will be compared to the results from groundwater samples collected during sample collection at the Site to assess potential loss of VOCs/1,4-dioxane during shipment and storage of the samples. The original sample results will be used to assess UV levels and hydrogen peroxide dosing requirements.

4.2.1.2 UV/Peroxide Testing

The bench testing will be conducted by Calgon and will consist of evaluation of 1,4-dioxane/VOC destruction efficiency for higher and lower concentration source water by varying hydrogen peroxide dosing (using 2 to 3 concentrations) and UV strengths (4 to 5 levels for each hydrogen peroxide dose). Calgon will conduct VOC and residual peroxide analyses to determine optimal UV strength and hydrogen peroxide concentration requirements. A split sample of the treated water for both the higher and lower concentration source water will be collected at the completion of the optimization process and will be sent to an off-site certified laboratory. The split sample will be analyzed for VOCs using EPA Method 8260B; for 1,4-dioxane using EPA Method 8270 Selected Ion Monitoring (SIM); and for bromate using EPA Method 317 (Table 6). The detection level for 1,4-dioxane using EPA Method 8270 SIM will be approximately 0.5 micrograms per liter or lower to assess 1,4-dioxane destruction efficiency.

4.2.2 Abbreviated Test

A limited test will be conducted on another UV/peroxide-based advanced oxidation technology. This test will be conducted by Trojan Technologies (Trojan) in Ontario, Canada. This abbreviated test involves one generalized step as described below.

As indicated in Section 3, bench test source water will be collected from higher and lower concentration Site wells and shipped under Chain-of-Custody procedures to Trojan in Ontario, Canada. Prior to initiating the limited test, an original and split sample will be collected from the two source waters (Table 7). The original sample will be analyzed by Trojan for VOCs, 1,4-dioxane, demand for hydroxyl radical, total organic carbon, alkalinity, pH, UV transmittance, residual chlorine, nitrate, and nitrite using their own laboratory. The split sample will be analyzed for VOCs using EPA Method 8260B and for 1,4-dioxane using modified EPA Method 8270 by an off-site laboratory. The off-site laboratory will be National Environmental Laboratory Accreditation Program-certified to conduct these analyses, but may not be a California state-certified laboratory. The VOC/1,4-dioxane split sample results will be compared to the results from groundwater samples collected during sample collection at the Site to assess potential loss of VOCs/1,4-dioxane during shipment/storage. The original sample results will be used to assess general requirements for an advanced oxidation treatment system.

5.0 HEALTH AND SAFETY

All field work will be completed in accordance with the Site Health and Safety Plan for Phase 2 RCRA Facility Investigation and the Site Health and Safety Plan for Groundwater Extraction and Treatment System Pilot Testing, Corrective Measures Study Work Plan Addendum No. 4 (HSP) (H+A, 1996 and 2009a). The HSP will be modified as necessary to account for activities not previously conducted at the Site.

6.0 PROJECT SCHEDULE AND REPORTING

A project schedule for the proposed pilot testing outlined in this Pilot Test Work Plan Addendum has been outlined in the following table:

MILESTONE	ESTIMATED DURATION	ESTIMATED COMPLETION
DTSC Concurrence	4 weeks	June 2011
Source Water Collection and Shipment	1 week	June 2011
Resin Pilot Testing (includes set-up)	8 weeks	August 2011
Advanced Oxidation Bench Testing	12 weeks	September 2011
Prepare Summary Report	8 weeks	November 2011

Descriptions and results of pilot and bench test activities will be provided in a Pilot/Bench Test Status Report. This report will be submitted to DTSC within approximately 8 weeks after receiving the results of testing outlined in Section 4. This report will include a summary of the testing including a summary of potential future pilot testing, to the extent required.

7.0 REFERENCES CITED

California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), 2003. Corrective Action Consent Agreement, Raytheon Company, 1901 W. Malvern Ave., Fullerton, California 92634, EPA ID No. CAD063109243. Docket HWCA: P3-01/02-001. January 15, 2003.

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Hargis + Associates, Inc. (H+A), 1996. Site Health and Safety Plan for Phase 2 RCRA Facility Investigation, Hughes Aircraft Company, Fullerton, California. December 9, 1996.

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TABLE 1

PREVALENT VOLATILE ORGANIC COMPOUNDS AND 1,4-DIOXANE IN GROUNDWATER SAMPLES COLLECTED FROM MW-21 AND EW-02

			……Concentration (micrograms per liter)……												
			VOLATILE ORGANIC COMPOUNDS (FEDERAL MCL / CALIFORNIA MCL)												Semi-VOCs
Well Identifier	Date Sampled	QA Code	Benzene (5/1)	Carbon Tetrachloride (5/0.5)	Chloroform (80/80)	1,1-DCA (--/5)	1,2-DCA (--/--)	1,1-DCE (7/6)	cis-1,2-DCE (70/6)	PCE (5/5)	1,1,1-TCA (200/200)	1,1,2-TCA (5/5)	TCE (5/5)	TCFM (--/150)	1,4-DIOXANE (3*/1**)
MW-21-200	7/14/2003	ORG	< 0.50	< 0.50	< 0.50	4.4	< 0.50	300	< 0.50	< 0.50	< 0.50	0.99	0.96	< 0.50	43
MW-21	09/23/03	ORG	< 0.50	0.51	2.2	26	< 0.50	1,300	1.3	4.3	1.1	11	29	< 0.50	160
MW-2100	09/23/03	FD	< 0.50	0.53	2.4	26	< 0.50	1,700	1.2	4.7	1.1	12	29	< 0.50	160
MW-21	09/23/03	SPT	< 1.0	< 1.0	2	24	3 E	1,400	1	3	< 1.0	11	27	< 1.0	340
MW-21	10/08/03	ORG	< 25	< 25	< 25	< 25	< 25	1,600	< 25	< 25	< 25	< 25	30	< 25	160
MW-21	12/17/03	ORG	< 0.50	1.8	3.9	62	6.8	3,500	2.3	12	1.6	20	43	< 0.50	150
MW-2100	12/17/03	FD	< 0.50	1.8	4.1	64	7	3,500	2.4	14	1.7	21	45	< 0.50	150
MW-21	12/17/03	SPT	< 1.0	1	4	58	6	2,800	2	9	1	20	40	< 1.0	290
MW-21	03/31/04	ORG	< 5.0	< 5.0	< 5.0	30	< 5.0	2,200	< 5.0	8.1	< 5.0	8.9	23	< 5.0	64 E
MW-21	03/31/04	SPT	< 1.0	< 1.0	< 1.0	30	< 1.0	2,100	< 1.0	< 1.0	< 1.0	< 1.0	20	< 1.0	140 E
MW-21	06/18/04	ORG	< 5.0	< 5.0	< 5.0	23	< 5.0	1,600	< 5.0	6	< 5.0	6.6	22	< 5.0	40
MW-21	09/22/04	ORG	< 5.0	< 5.0	< 5.0	7.5	< 5.0	530	< 5.0	< 5.0	< 5.0	< 5.0	22	< 5.0	13
MW-21	12/10/04	ORG	< 5.0	< 5.0	< 5.0	26	< 5.0	1,700	< 5.0	5.3	< 5.0	8.8	30	< 5.0	35
MW-21	03/17/05	ORG	< 0.50	1.9	4.6	71	8.9	4,600	2.4	12	2.0	27	46	0.53	300
MW-2100	03/17/05	FD	< 0.50	1.8	4.3	66	8.7	4,600	2.3	12	1.9	27	44	< 0.50	330
MW-21	06/22/05	ORG	< 0.50	1.2	2.9	42	5.9	3,000	1.9	8.2	< 0.50	19	37	< 0.50	210 E
MW-21	06/22/05	SPT	< 1.0	1.1	2.9	42	6.2	2,400	1.7	7.2	1.2	18	35	< 1.0	1,100 JE
MW-21	09/22/05	ORG	< 0.50	0.64	1.8	26	4.4	1,700	1.4	4	< 0.50	12	33	< 0.50	250
MW-21	12/19/05	ORG	< 0.50	< 0.50	2.8	31	< 0.50	4,100	< 0.50	7.4	< 0.50	10	18	< 0.50	430
MW-21	03/23/06	ORG	< 5.0	< 5.0	< 5.0	52	< 5.0	4,000	< 5.0	11	< 5.0	14	30	< 5.0	240
MW-21	03/23/06	SPT	< 0.50	< 3.00	< 3.00	40	< 3.00	2,900	< 3.00	< 3.00	< 3.00	< 3.00	30	< 3.00	250
MW-21	06/22/06	ORG	< 0.50	0.89	1.6	22	2.3	2,000	1.2	8.5	< 0.50	6.9	31	< 0.50	120
MW-21	06/22/06	SPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	150
MW-21	09/27/06	ORG	< 2.5	< 2.5	< 2.5	17	< 2.5	1,400	< 2.5	3.3	< 2.5	4.2	30	< 2.5	1,100
MW-21	12/11/06	ORG	< 0.50	0.53	1.2	16	2	1,200	1.4	3.2	< 0.50	5.5	31	< 0.50	150
MW-21	12/11/06	SPT	< 7	< 7	< 7	10 E	< 7	1,000	< 7	< 7	< 7	< 7	30	< 7	180
MW-21	03/14/07	ORG	< 2.5	< 2.5	< 2.5	12 E	3.2	1,400	< 2.5	4.4	< 2.5	8.2	32	< 2.5	330
MW-2100	03/14/07	FD	< 2.5	< 2.5	< 2.5	18 E	3.2	1,400	< 2.5	4.3	< 2.5	8.6	33	< 2.5	320
MW-21	03/14/07	SPT	< 1.0	< 1.0	< 1.0	20 E	< 1.0	1,500	< 1.0	< 1.0	< 1.0	< 1.0	30	< 1.0	450
MW-21	06/20/07	ORG	< 1.0	< 1.0	< 1.0	19	< 1.0	1,400	< 1.0	< 1.0	< 1.0	< 1.0	35	< 1.0	240
MW-21	09/27/07	ORG	< 0.50	< 0.50	< 0.50	5.6	0.72	490	1.8	1.2	< 0.50	2.0	36	< 0.50	51
MW-21	12/13/07	ORG	< 0.50	< 0.50	0.50 U	4.8	< 0.50	320	1.8	0.96	< 0.50	1.4	41	< 0.50	47
MW-2100	12/13/07	FD	< 0.50	< 0.50	0.50 U	5.0	< 0.50	620	1.7	1.0	< 0.50	1.4	42	< 0.50	49
MW-21	12/13/07	SPT	< 5	< 5	< 5	< 5	< 5	480	< 5	< 5	< 5	< 5	40	< 5	54
MW-21	06/25/08	ORG	< 5	< 5	< 5	60	6.9	4,900	< 5	11	< 5	20	34	< 5	370
MW-2100	06/25/08	FD	< 5	< 5	< 5	60	7.0	5,100	< 5	11	< 5	20	34	< 5	380
MW-21	06/25/08	SPT	< 5	< 5	< 5	50	6.0	3,500	< 5	10	< 5	20	30	< 5	440
MW-21	07/08/08	ORG	< 10	< 10	< 10	47	< 10	3,500	< 10	11	< 10	16	26	< 10	410
MW-21	07/09/08	ORG	< 10	< 10	< 10	54	< 10	4,200	< 10	10	< 10	17	25	< 10	360
MW-21	07/10/08	ORG	< 5	< 5	< 5	38	5.2	3,800	< 5	12	< 5	13	23	< 5	330
MW-21	07/15/08	ORG	< 5	< 5	< 5	42	< 5	3,500	< 5	12	< 5	13	30	< 5	290
MW-21	07/16/08	ORG	< 5	< 5	< 5	47	5.5	4,800	< 5	9.7	< 5	14	26	< 5	310
MW-21	07/23/08	ORG	< 10	< 10	< 10	40	< 10	3,500	< 10	< 10	< 10	13	24	< 10	220
MW-21	07/30/08	ORG	< 10	< 10	< 10	41	< 10	3,400	< 10	< 10	< 10	10	20	< 10	230
MW-21	08/06/08	ORG	< 5	< 5	< 5	32	< 5	1,500	< 5	7.0	< 5	7.7	19	< 5	230
MW-21	08/25/08	ORG	< 5	< 5	< 5	21	< 5	1,800	< 5	5.1	< 5	6.3	16	< 5	150
MW-21	09/24/08	ORG	< 2.5	< 2.5	< 2.5	15	< 2.5	1,200	< 2.5	3.4	< 2.5	4.8	16	< 2.5	100
MW-21	10/22/08	ORG	< 2.5	< 2.5	< 2.5	13	< 2.5	1,200	< 2.5	3.2	< 2.5	3.0	14	< 2.5	95
MW-21	11/26/08	ORG	< 2.5	< 2.5	< 2.5	11	< 2.5	1,100	< 2.5	2.6	< 2.5	2.5	12	< 2.5	74

TABLE 1

PREVALENT VOLATILE ORGANIC COMPOUNDS AND 1,4-DIOXANE IN GROUNDWATER SAMPLES COLLECTED FROM MW-21 AND EW-02

			……Concentration (micrograms per liter)……												
			VOLATILE ORGANIC COMPOUNDS (FEDERAL MCL / CALIFORNIA MCL)												Semi-VOCs
Well Identifier	Date Sampled	QA Code	Benzene (5/1)	Carbon Tetrachloride (5/0.5)	Chloroform (80/80)	1,1-DCA (--/5)	1,2-DCA (--/--)	1,1-DCE (7/6)	cis-1,2-DCE (70/6)	PCE (5/5)	1,1,1-TCA (200/200)	1,1,2-TCA (5/5)	TCE (5/5)	TCFM (--/150)	1,4-DIOXANE (3*/1**)
Well MW-21 (continued)															
MW-21	02/25/09	ORG	< 2.5	< 2.5	< 2.5	**7**	< 2.5	**720**	< 2.5	< 2.5	< 2.5	< 2.5	**12**	< 2.5	**83**
MW-21	03/18/09	ORG	< 2.5	< 2.5	< 2.5	**7.7**	< 2.5	**900**	< 2.5	< 2.5	< 2.5	**2.5**	**11**	< 2.5	**54**
MW-21	04/29/09	ORG	< 2.5	< 2.5	< 2.5	**7.8**	< 2.5	**860**	< 2.5	< 2.5	< 2.5	< 2.5	**14**	< 2.5	**65**
MW-21	05/27/09	ORG	< 2.5	< 2.5	< 2.5	**8.4**	< 2.5	**940**	< 2.5	< 2.5	< 2.5	**2.5**	**14**	< 2.5	**71**
MW-21	06/29/09	ORG	< 0.5	< 0.5	**0.64**	**7.4**	**0.81**	**860**	**0.63**	**2.1**	< 0.5	**2.1**	**17**	< 0.5	**68**
MW-21	07/22/09	ORG	< 1.0	< 1.0	< 1.0	**8.4**	< 1.0	**870**	**1.0**	**1.6**	< 1.0	**1.9**	**16**	< 1.0	**65**
MW-21	08/14/09	ORG	< 2.5	< 2.5	< 2.5	**8.8**	< 2.5	**900**	< 2.5	< 2.5	< 2.5	< 2.5	**18**	< 2.5	**72**
MW-21	09/11/09	ORG	< 2.5	< 2.5	< 2.5	**8.3**	< 2.5	**1,100**	< 2.5	< 2.5	< 2.5	< 2.5	**14**	< 2.5	**63**
MW-21	10/08/09	ORG	< 2.5	< 2.5	< 2.5	**9.2**	< 2.5	**830**	< 2.5	< 2.5	< 2.5	< 2.5	**19**	< 2.5	**76**
MW-21	12/09/09	ORG	< 0.50	< 0.50	< 0.50	**1.7**	< 0.50	**200**	< 0.50	< 0.50	< 0.50	< 0.50	**12**	< 0.50	**11**
MW-21	03/05/10	ORG	< 1.0	< 1.0	< 1.0	**2.9**	< 1.0	**370**	< 1.0	< 1.0	< 1.0	< 1.0	**14**	< 1.0	**21**
MW-21	06/11/10	ORG	< 2.0	< 2.0	< 2.0	**8.6**	< 2.0	**800**	< 2.0	< 2.0	< 2.0	< 2.0	**22**	< 2.0	**40**
MW-21	06/11/10	SPT	< 1	< 1	< 1	**7**	< 1	**850**	< 1	**1**	< 1	**2**	**21**	< 1	**47**
MW-21	09/08/10	ORG	< 2.0	< 2.0	< 2.0	**12**	< 2.0	**1,000**	< 2.0	< 2.0	< 2.0	< 2.0	**21**	< 2.0	**74**
MW-21	12/06/10	ORG	< 5.0	< 5.0	< 5.0	**25**	< 5.0	**2,300**	< 5.0	< 5.0	< 5.0	**7.6**	**23**	< 5.0	**250**
MW-21	12/06/10	SPT	< 5	< 5	< 5	**10**	< 5	**1,600**	< 5	< 5	**5**	< 5	**10**	< 5	**360**
MW-21 Historical Range			< 0.50 - < 25	< 0.50 - 1.9	< 0.50 - 4.6	< 0.50 - 71	< 0.50 - 8.9	200 - 4,900	< 0.50 - 2.4	< 0.50 - 12	< 0.50 - 2.0	< 0.50 - 27	< 0.50 - 46	< 0.50 - 0.53	11 - 1,100
EW-02	10/30/09	ORG	< 0.50	< 0.50	< 0.50	**0.70**	< 0.50	**52**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**24**
EW-200	10/30/09	FD	< 0.50	< 0.50	< 0.50	**0.73**	< 0.50	**55**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**23**
EW-02	03/22/10	ORG	< 0.50	< 0.50	< 0.50	**0.92**	< 0.50	**82**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**22**
EW-02	03/23/10	ORG	< 0.50	< 0.50	< 0.50	**0.94**	< 0.50	**82**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**24**
EW-02	03/24/10	ORG	< 0.50	< 0.50	< 0.50	**0.85**	< 0.50	**74**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**25**
EW-02	03/25/10	ORG	< 0.50	< 0.50	< 0.50	**0.79**	< 0.50	**70**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**22**
EW-02	03/26/10	ORG	< 0.50	< 0.50	< 0.50	**0.83**	< 0.50	**76**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**19**
EW-02	04/01/10	ORG	< 0.50	< 0.50	< 0.50	**0.88**	< 0.50	**81**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**29**
EW-02	04/09/10	ORG	< 0.50	< 0.50	< 0.50	**0.90**	< 0.50	**85**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**31**
EW-02	04/13/10	ORG	< 0.50	< 0.50	< 0.50	**1.4**	< 0.50	**120**	< 0.50	< 0.50	< 0.50	**0.59**	< 0.50	< 0.50	**43**
EW-02	04/23/10	ORG	< 0.50	< 0.50	< 0.50	**1.0**	< 0.50	**91**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**35**
EW-02	05/25/10	ORG	< 0.50	< 0.50	< 0.50	**1.1**	< 0.50	**100**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**38**
EW-02	06/10/10	ORG	< 0.50	< 0.50	< 0.50	**1.4**	< 0.50	**120**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0	**40**
EW-02	07/08/10	ORG	< 0.50	< 0.50	< 0.50	**1.5**	< 0.50	**160**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**48**
EW-02	08/02/10	ORG	< 0.50	< 0.50	< 0.50	**1.3**	< 0.50	**150**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**42**
EW-02	09/02/10	ORG	< 0.50	< 0.50	< 0.50	**1.4**	< 0.50	**160**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**42**
EW-02	10/07/10	ORG	< 0.50	< 0.50	< 0.50	**1.4**	< 0.50	**140**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**39**
EW-02	11/11/10	ORG	< 0.50	< 0.50	< 0.50	**1.1**	< 0.50	**140**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**33**
EW-02	12/07/10	ORG	< 0.50	< 0.50	< 0.50	**1.0**	< 0.50	**130**	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	**29**
EW-02 Historical Range			< 0.50	< 0.50	< 0.50	< 0.50 - 1.5	< 0.50	52 - 160	< 0.50	< 0.50	< 0.50	< 0.50 - 0.59	< 0.50	< 0.50	19 - 48

NOTE: Detections are shown in **BOLD** type.

FOOTNOTES

1,1-DCA = 1,1-Dichloroethane
1,2-DCA = 1,2-Dichloroethane
1,1-DCE = 1,1-Dichloroethene
cis-1,2-DCE = cis-1,2-Dichloroethene
PCE = Tetrachloroethene
(<) = Less than; the value is the Limit of Detection for that compound
Semi-VOCs = Semivolatile organic compounds
E = Data qualified as Estimated in accordance with quality control criteria.

1,1,1-TCA = 1,1,1-Trichloroethane
1,1,2-TCA = 1,1,2-Trichloroethane
TCE = Trichloroethene
TCFM = Trichlorofluoromethane

NA = Not analyzed for constituent
FD = Field duplicate sample
SPT = Split sample
ug/L = Micrograms per Liter
U = Data qualified as Unusable because quality control criteria were not met.
J = Data qualified as Estimated; does not meet calibration range acceptance criteria.

ORG = Original sample
QA = Quality Assurance
MCL = Maximum contaminant level
* = 1,4-Dioxane Action Level of 3 ug/L
** = California Notification Level for 1,4-Dioxane of 1 ug/L

TABLE 2
BENCH TEST SOURCE WATER AND ANALYTICAL TESTING

	APPROXIMATE VOLUME (gallons)[1]	SAMPLE CONTAINER[2]	SHIP TO
BENCH TESTING			
UV/Peroxide Bench Test	30	30-gal drum	Calgon Carbon, Pittsburgh, PA
Abbreviated UV/Peroxide Test	10	1-gal or 5-gal containers	Trojan Technologies, Ontario, Canada
INITIAL ANALYTICAL			
Original Sample			
VOCs (Same Day Rush)		3 x 40-ml vials	Advanced Technologies Laboratory, Signal Hill, CA
1,4-Dioxane (1 week TAT)		1-liter amber bottle	Advanced Technologies Laboratory, Signal Hill, CA
Bromate (1 week)		125 ml poly	Exova, Santa Fe Springs, CA
Split Sample			
VOCs (1 week TAT)		3 x 40-ml vials	Exova, Santa Fe Springs, CA
1,4-Dioxane (1 week TAT)		1-liter amber bottle	Exova, Santa Fe Springs, CA

FOOTNOTES

[1] Sample volume approximate per well, to be verified prior to collection.
[2] 30-gallon drums to be packed in ice-filled overpack drums;
1-gallon or 5-gallon containers to be packed in ice filled coolers.

gal = Gallon
ml = Milliliter
TAT = Turnaround time
UV = Ultraviolet
VOCs = Volatile organic compounds

TABLE 3
RESIN PILOT TEST ANALYTICAL TESTING, LOADING CYCLES

Day	Sample Location	Turnaround Time[1]	Rationale/Comment
INITIAL LOADING CYCLE			
1	Influent to lead column	24 hr	Establish influent concentration
1	Effluent from each column	24 hr	Confirm resin is properly loaded in columns
2	Effluent from each column	Hold	Archive for potential analysis
3	Effluent from each column	Hold	Archive for potential analysis
4	Influent to lead column	Standard	Establish influent concentration
4	Effluent from each column	Hold	Archive for potential analysis
5	Effluent from each column	24 hr	Used to evaluate resin loading and project breakthrough
6	Effluent from each column	24 hr	Used to evaluate resin loading and project breakthrough. May not be necessary pending Day 5 results.
7	Influent to lead column	Standard	Establish influent concentration. May not be necessary pending Day 6 results.
7	Effluent from each column	24 hr	Used to evaluate resin loading and project breakthrough. May not be necessary pending Day 6 results.
SECOND LOADING CYCLE			
1	Influent to lead column	24 hr	Establish influent concentration
1	Effluent from each column	24 hr	Confirm resin is properly loaded in columns
2	Effluent from each column	Hold	Archive for potential analysis
3	Effluent from each column	Hold	Archive for potential analysis
4	Influent to lead column	Standard	Establish influent concentration
4	Effluent from each column	24 hr	Used to evaluate resin loading and project breakthrough
5	Effluent from each column	24 hr	Used to evaluate resin loading and project breakthrough. May not be necessary pending Day 4 results.
6	Effluent from each column	24 hr	Used to evaluate resin loading and project breakthrough. May not be necessary pending Day 5 results.
7	Influent to lead column	Standard	Establish influent concentration. May not be necessary pending Day 6 results.
7	Effluent from each column	24 hr	Used to evaluate resin loading and project breakthrough. May not be necessary pending Day 6 results.

FOOTNOTES

[1] Samples to be analyzed by State Certified laboratory for volatile organic compounds using EPA Method 8260B and 1,4-dioxane using Modified EPA Method 8270; note selected effluent samples to be analyzed for 1,4-dioxane using EPA Method 8270 Selected Ion Monitoring (SIM).

EPA = United States Environmental Protection Agency
hr = Hour

TABLE 4
RESIN PILOT TEST ANALYTICAL TESTING, REGENERATION CYCLES

Bed Volume	Condensate Description[1]	Turnaround Time[2]	Rationale/Comment
INITIAL REGENERATION CYCLE			
Pre-Heat	Condensate from lead column	Hold	Assess steam regeneration efficiency
0-0.5	Condensate from lead column	Hold	
0.5-1.0	Condensate from lead column	Hold	
1.0-1.5	Condensate from lead column	Hold	
1.5-2.0	Condensate from lead column	Hold	
2.0-2.5	Condensate from lead column	Hold	
2.5-3.0	Condensate from lead column	Hold	
3.0-3.5	Condensate from lead column	Hold	
3.5-4.0	Condensate from lead column	Hold	
4.0-4.5	Condensate from lead column	Hold	
4.5-5.0	Condensate from lead column	24 hr	
Bulk Condensate	Condensate from lead column	Standard	Assess contaminant mass balance
Potable Water Flush		Standard	Assess steam regeneration efficiency
FINAL REGENERATION CYCLE			
4.5-5.0	Condensate from all test columns	Standard	Assess steam regeneration efficiency
Bulk Condensate	Condensate from all test columns	Standard	Assess system mass balance

FOOTNOTES

[1] Condensate from early bed volume samples may contain non-aqueous phase liquid (NAPL), if so a separate sample of NAPL will also be analyzed.

[2] Samples to be analyzed by State Certified laboratory for volatile organic compounds using EPA Method 8260B and 1,4-dioxane using Modified EPA Method 8270.

EPA = United States Environmental Protection Agency

TABLE 5
ADVANCED OXIDATION SOURCE WATER ANALYTICAL TESTING

SOURCE WATER[1]	PARAMETERS	ANALYTICAL LABORATORY	
		Original Sample (Calgon)	**Spilt Sample (Off-Site Certified Laboratory)**
MW-21	Volatile organic compounds	X	EPA Method 8260B
	1,4-Dioxane	X	Modified EPA Method 8270
	Bromate		EPA Method 317
	Chemical oxygen demand	X	
	Biological oxygen demand	X	
	Selected anions and alkalinity	X	
	UV absorption spectrum	X	
EW-02	Volatile organic compounds	X	EPA Method 8260B
	1,4-Dioxane	X	Modified EPA Method 8270
	Bromate		EPA Method 317
	Chemical oxygen demand	X	
	Biological oxygen demand	X	
	Selected anions and alkalinity	X	
	UV absorption spectrum	X	

FOOTNOTES

[1] Samples to be collected from composited source water prior to conducting bench testing.

EPA = United States Environmental Protection Agency
UV = Ultraviolet

TABLE 6
ADVANCED OXIDATION BENCH TEST ANALYTICAL TESTING

SOURCE WATER	UV LEVEL[1]	HYDROGEN PEROXIDE DOSING[2]	PARAMETERS	ANALYTICAL LABORATORY	
				Original Sample (Calgon)	Spilt Sample (Off-Site Certified Laboratory)
MW-21	1	1	VOCs, 1,4-dioxane and residual peroxide	X	
	2	1		X	
	3	1		X	
	4	1		X	
	1	2		X	
	2	2		X	
	3	2		X	
	4	2		X	
	Optimized		VOCs	X	EPA Method 8260B
			1,4-Dioxane	X	EPA Method 8270 SIM
			Residual peroxide	X	
			Bromate		EPA Method 317
EW-02	1	1	VOCs, 1,4-dioxane and residual peroxide	X	
	2	1		X	
	3	1		X	
	4	1		X	
	1	2		X	
	2	2		X	
	3	2		X	
	4	2		X	
	Optimized		VOCs	X	EPA Method 8260B
			1,4-Dioxane	X	EPA Method 8270 SIM
			Residual peroxide	X	
			Bromate		EPA Method 317

FOOTNOTES

[1] Four to five UV levels to be tested, four illustrated in table.
[2] Two to three peroxide dosing to be tested, two illustrated in table.

EPA = United States Environmental Protection Agency
SIM = Selected Ion Monitoring
UV = Ultraviolet
VOCs = Volatile organic compounds

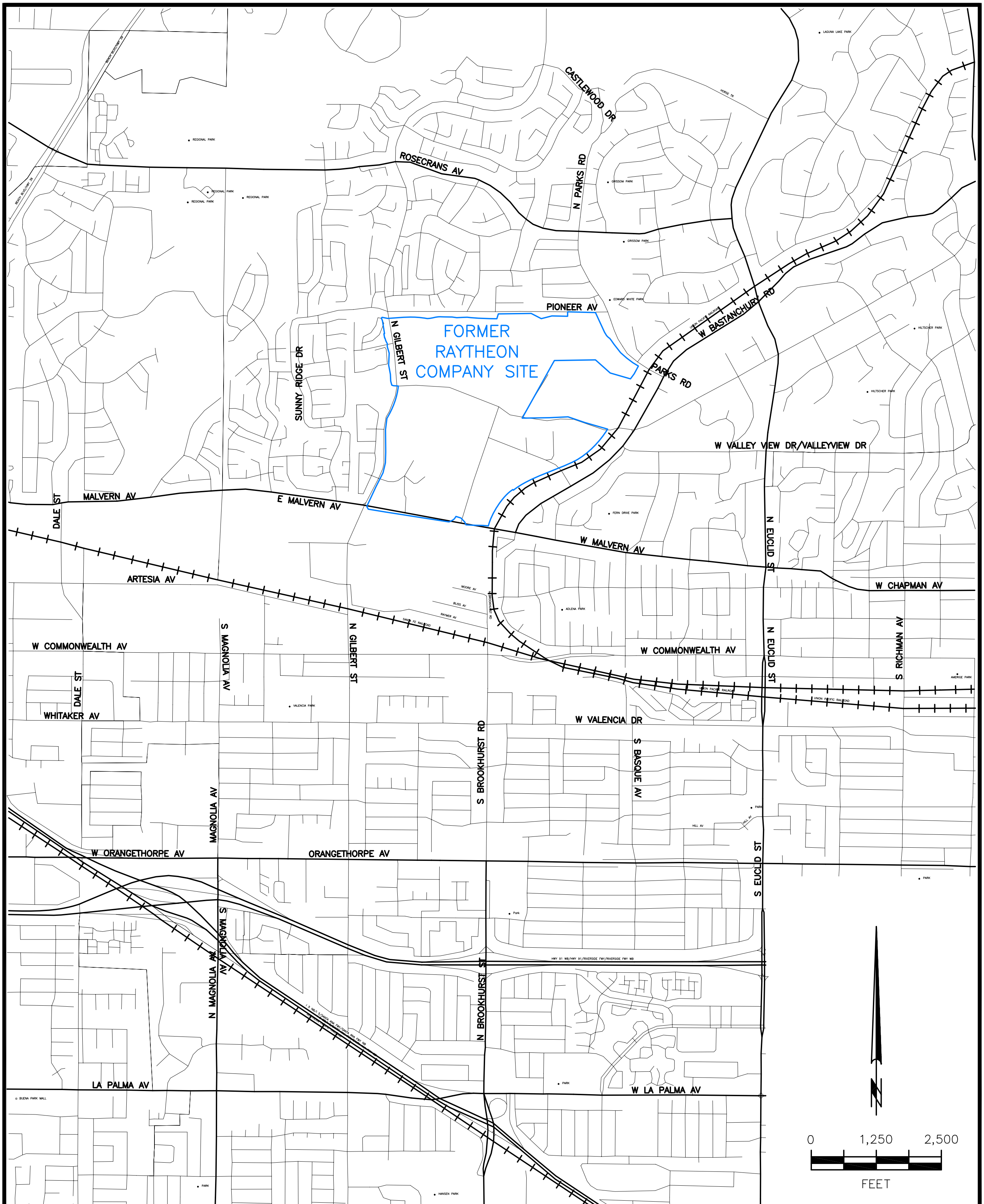
TABLE 7
ADVANCED OXIDATION ABBREVIATED TEST SOURCE WATER ANALYTICAL TESTING

SOURCE WATER[1]	PARAMETERS	ANALYTICAL LABORATORY	
		Original Sample (Trojan Technologies)	Spilt Sample (Off-Site Certified Laboratory)
MW-21	Volatile organic compounds	X	EPA Method 8260B
	1,4-Dioxane	X	Modified EPA Method 8270
	Demand for hydroxyl radical	X	--
	Total organic carbon	X	--
	Alkalinity, pH	X	--
	UV transmittance	X	--
	Residual chlorine	X	--
	Nitrate and nitrite	X	--
EW-02	Volatile organic compounds	X	EPA Method 8260B
	1,4-Dioxane	X	Modified EPA Method 8270
	Demand for hydroxyl radical	X	--
	Total organic carbon	X	--
	Alkalinity, pH	X	--
	UV transmittance	X	--
	Residual chlorine	X	--
	Nitrate and nitrite	X	--

FOOTNOTES

[1] Samples to be collected from composited source water prior to conducting bench testing.

EPA = United States Environmental Protection Agency
UV = Ultraviolet



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8/09	RPT NO. 532.65	410-7298	A

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FIGURE 1. SITE LOCATION

Apr 04, 2011 - 5:05pm ADH - T:\2011\500-599\532 Raytheon\Hydrogeology\WaterQual\210-3933.dwg

EXPLANATION

EW-01	EXISTING PILOT TEST EXTRACTION WELL
MW-16	GROUNDWATER MONITOR WELL
P-09	PERCHED ZONE PIEZOMETER
MW-25	GROUNDWATER PIEZOMETER
	EXISTING CONVEYANCE PIPELINE
	EXISTING EFFLUENT DISPOSAL PIPELINE TO SEWER CONNECTION
609	FORMER RAYTHEON BUILDING, DEMOLISHED MID-2000
RETAIL	RETAIL AND COMMERCIAL BUILDINGS OF AMERIGE HEIGHTS DEVELOPMENT
	DRIVEWAYS, PARKING LOTS AND OTHER HARDSCAPE OF SITE RE-DEVELOPMENT

NOTE: NAD83 DATUM

RAYTHEON COMPANY
FULLERTON, CALIFORNIA

EXISTING PILOT TEST SYSTEM

HARGIS + ASSOCIATES, INC.
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FIGURE 2

PREP BY AMB REV BY SPN RPT NO. 532.21 210-3933 A

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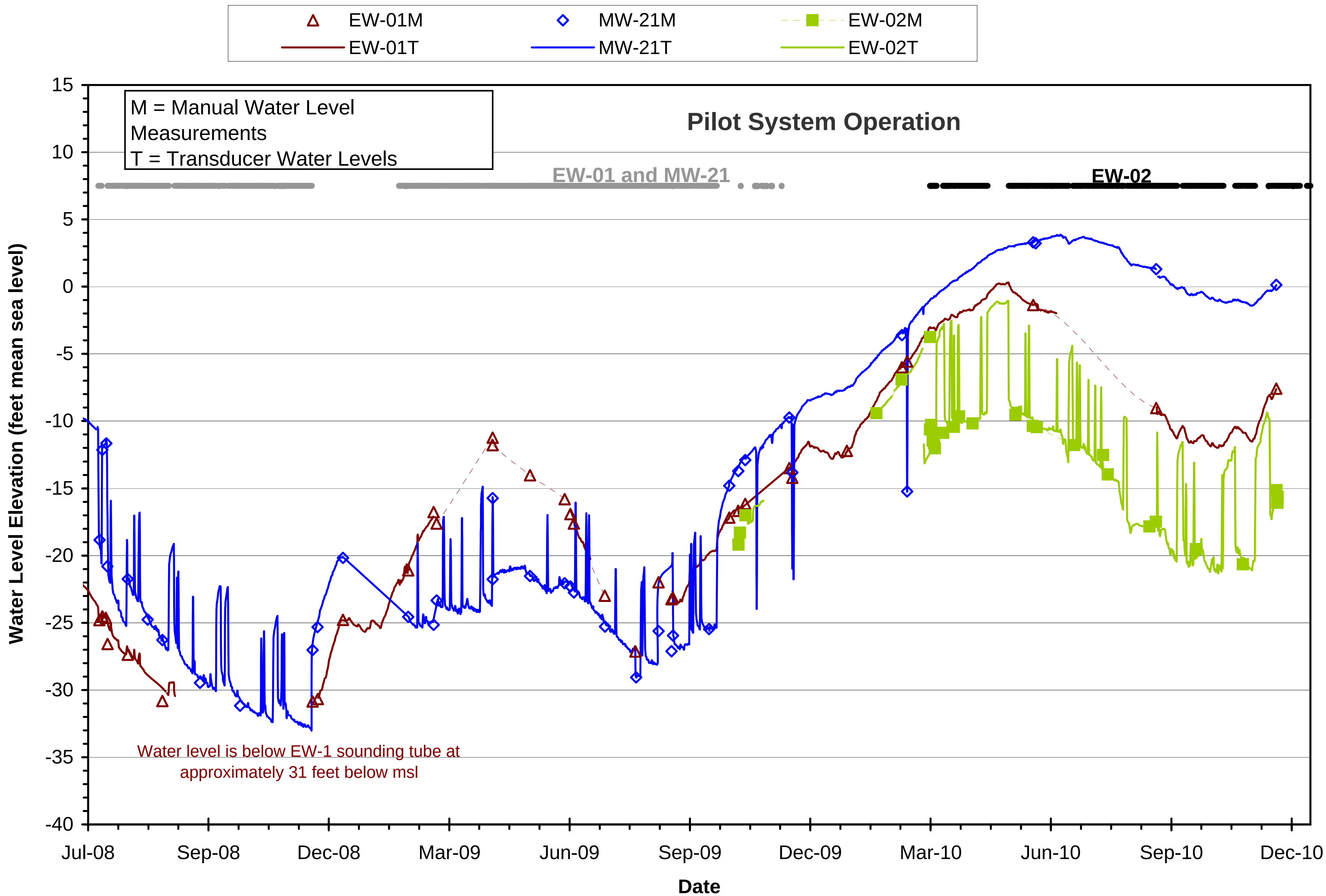

FIGURE 3.
PILOT GROUNDWATER EXTRACTION AND TREATMENT SYSTEM OPERATION AND EXTRACTION WELL WATER LEVELS

532 Rpt 2011-04 Fig 3.xls

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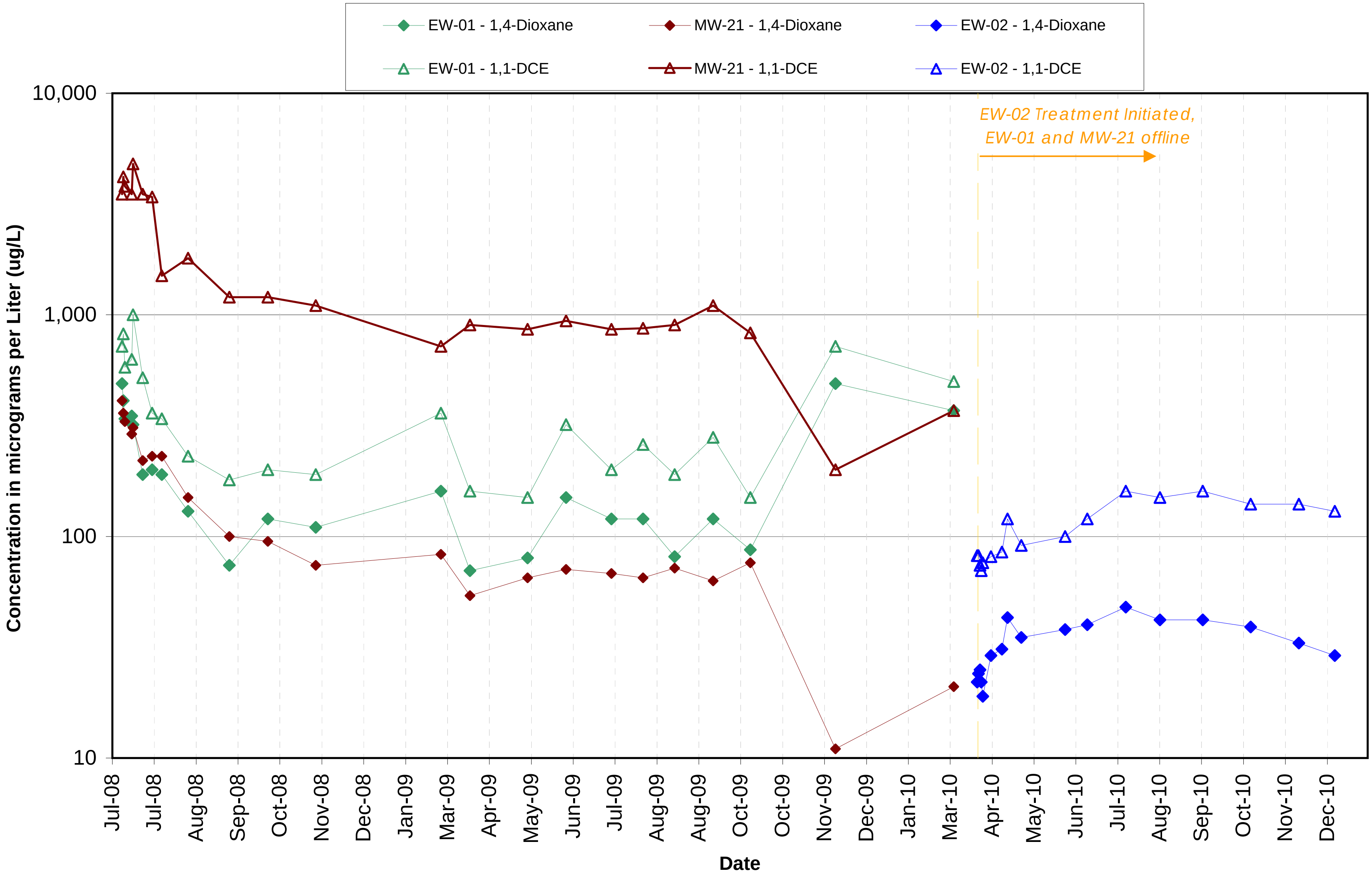


FIGURE 4. 1,1-DICHLOROETHYLENE AND 1,4-DIOXANE IN EXTRACTION WELLS EW-01, MW-21, AND EW-02

532 Rpt 2011-04 Fig 4.xls

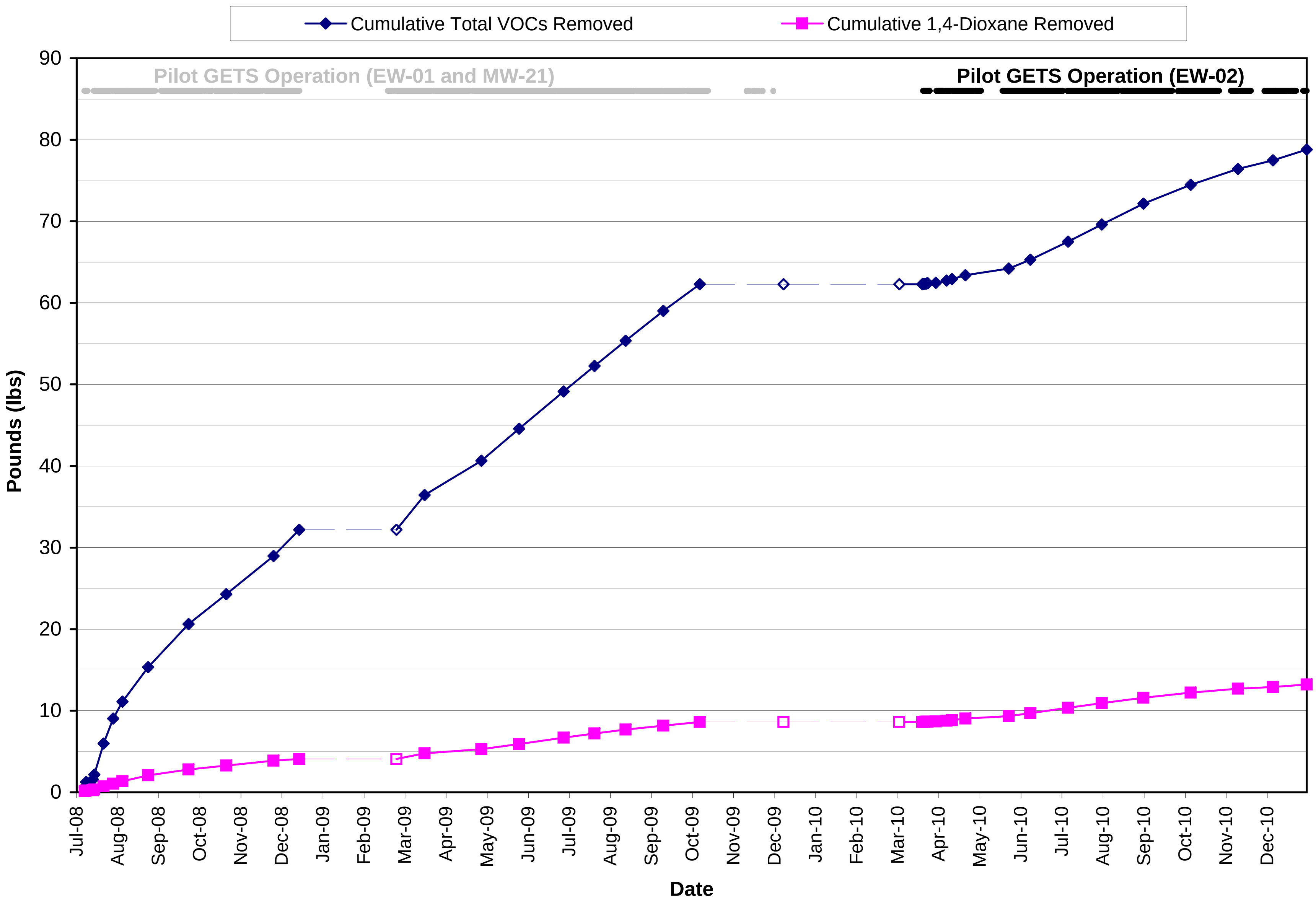
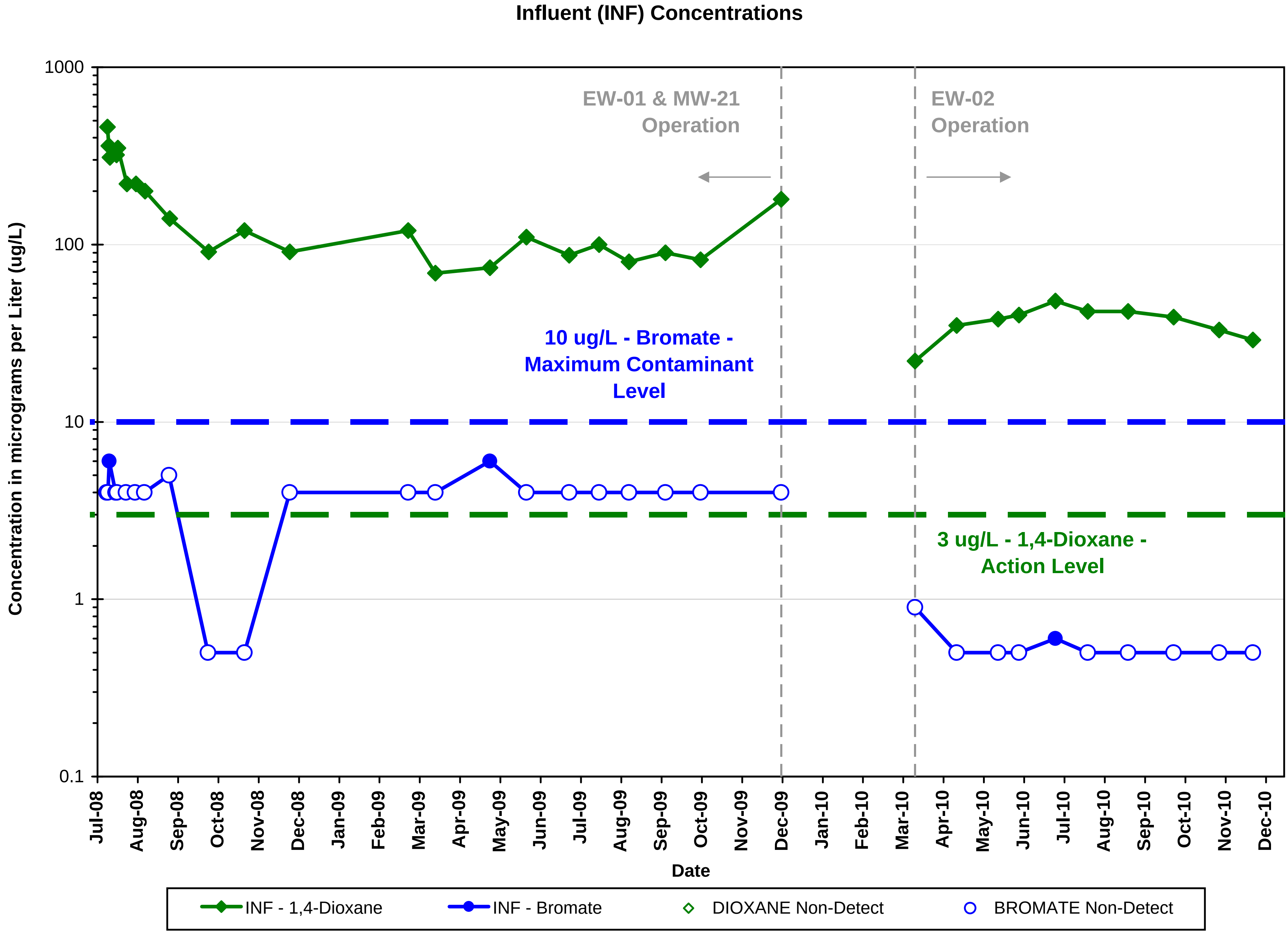


FIGURE 5.

PILOT GROUNDWATER EXTRACTION AND TREATMENT SYSTEM MASS REMOVAL



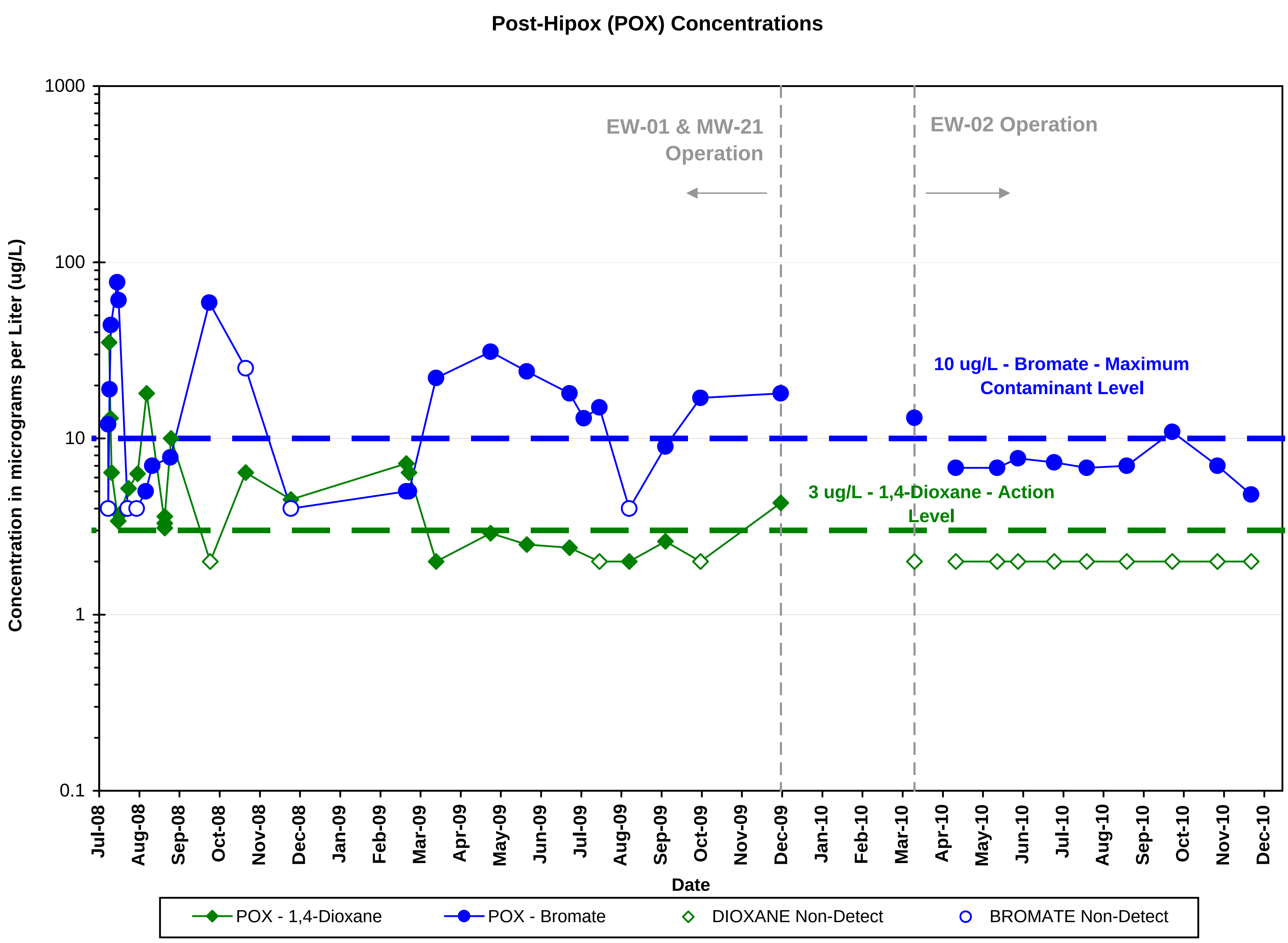
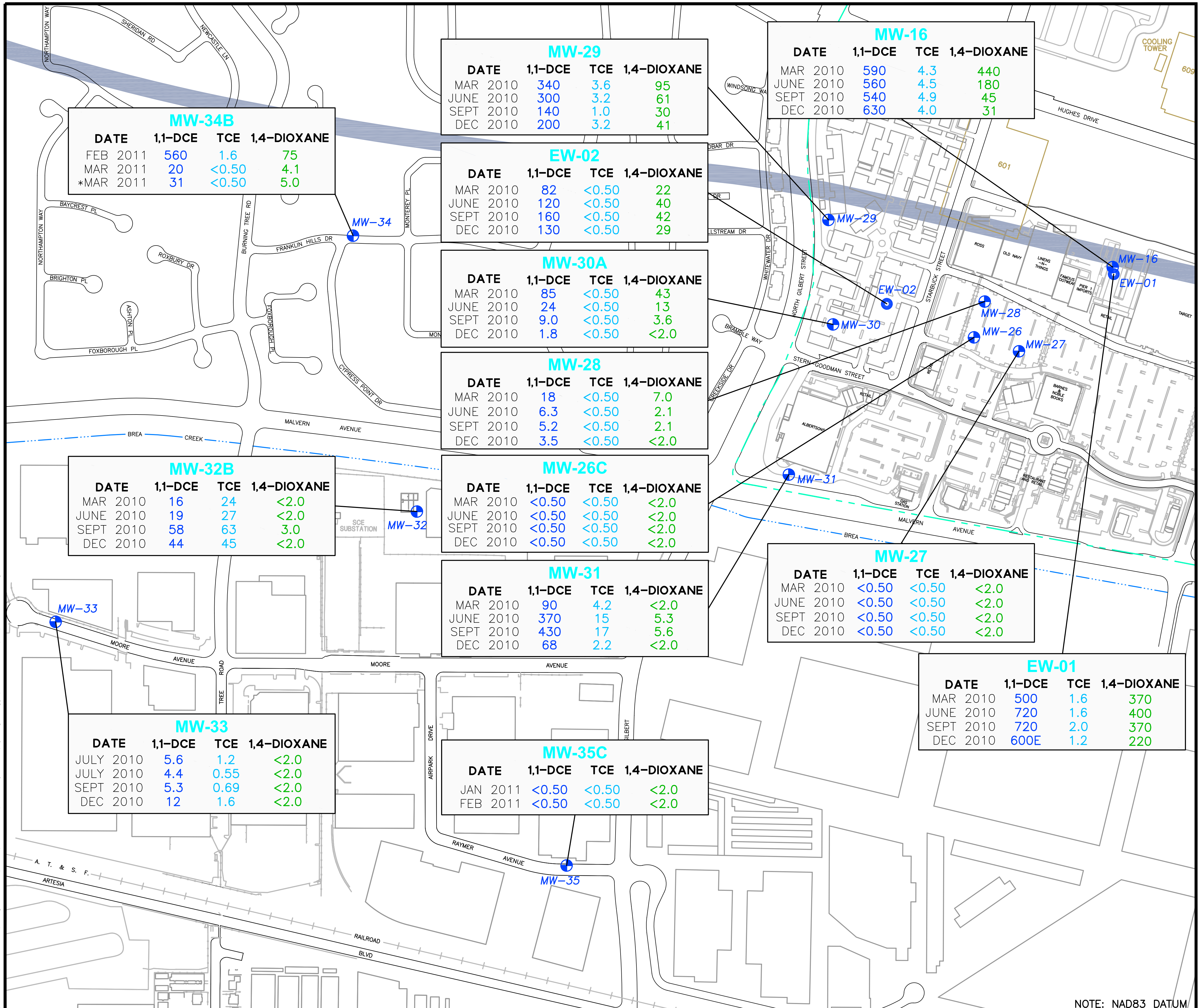


FIGURE 6. 1,4-DIOXANE AND BROMATE IN INFLUENT AND POST-OX. SAMPLES



MW-29

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	340	3.6	95
JUNE 2010	300	3.2	61
SEPT 2010	140	1.0	30
DEC 2010	200	3.2	41

MW-16

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	590	4.3	440
JUNE 2010	560	4.5	180
SEPT 2010	540	4.9	45
DEC 2010	630	4.0	31

MW-34B

DATE	1,1-DCE	TCE	1,4-DIOXANE
FEB 2011	560	1.6	75
MAR 2011	20	<0.50	4.1
*MAR 2011	31	<0.50	5.0

EW-02

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	82	<0.50	22
JUNE 2010	120	<0.50	40
SEPT 2010	160	<0.50	42
DEC 2010	130	<0.50	29

MW-30A

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	85	<0.50	43
JUNE 2010	24	<0.50	13
SEPT 2010	9.0	<0.50	3.6
DEC 2010	1.8	<0.50	<2.0

MW-28

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	18	<0.50	7.0
JUNE 2010	6.3	<0.50	2.1
SEPT 2010	5.2	<0.50	2.1
DEC 2010	3.5	<0.50	<2.0

MW-32B

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	16	24	<2.0
JUNE 2010	19	27	<2.0
SEPT 2010	58	63	3.0
DEC 2010	44	45	<2.0

MW-26C

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	<0.50	<0.50	<2.0
JUNE 2010	<0.50	<0.50	<2.0
SEPT 2010	<0.50	<0.50	<2.0
DEC 2010	<0.50	<0.50	<2.0

MW-27

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	<0.50	<0.50	<2.0
JUNE 2010	<0.50	<0.50	<2.0
SEPT 2010	<0.50	<0.50	<2.0
DEC 2010	<0.50	<0.50	<2.0

MW-31

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	90	4.2	<2.0
JUNE 2010	370	15	5.3
SEPT 2010	430	17	5.6
DEC 2010	68	2.2	<2.0

EW-01

DATE	1,1-DCE	TCE	1,4-DIOXANE
MAR 2010	500	1.6	370
JUNE 2010	720	1.6	400
SEPT 2010	720	2.0	370
DEC 2010	600E	1.2	220

MW-33

DATE	1,1-DCE	TCE	1,4-DIOXANE
JULY 2010	5.6	1.2	<2.0
JULY 2010	4.4	0.55	<2.0
SEPT 2010	5.3	0.69	<2.0
DEC 2010	12	1.6	<2.0

MW-35C

DATE	1,1-DCE	TCE	1,4-DIOXANE
JAN 2011	<0.50	<0.50	<2.0
FEB 2011	<0.50	<0.50	<2.0

EXPLANATION

MW-27	GROUNDWATER MONITOR WELL
EW-01	GROUNDWATER EXTRACTION WELL
1,1-DCE	1,1-DICHLOROETHENE
TCE	TRICHLOROETHENE
<	LESS THAN; VALUE IS THE LIMIT OF DETECTION FOR THAT COMPOUND
E	RESULT QUALIFIED AS "ESTIMATED" IN ACCORDANCE WITH QUALITY CONTROL CRITERIA
609	FORMER RAYTHEON BUILDING, DEMOLISHED MID-2000
	CURRENT RESIDENTIAL AND COMMERCIAL BUILDINGS
	DRIVEWAYS, PARKING LOTS AND OTHER HARDSCAPE OF SITE RE-DEVELOPMENT
	SITE BOUNDARY

NOTES:

1. ALL CONCENTRATIONS ARE IN MICROGRAMS PER LITER.
2. ONLY ORIGINAL SAMPLE RESULTS POSTED.

* RESULTS BASED ON HIGHEST CONCENTRATION IN MULTIPLE PURGE VOLUME SAMPLES COLLECTED MARCH 15, 2011.

0 400 800

FEET

RAYTHEON COMPANY

FULLERTON, CALIFORNIA

SELECTED VOLATILE ORGANIC COMPOUNDS AND 1,4-DIOXANE IN THE TARGET ZONE (UNIT B)

HARGIS + ASSOCIATES, INC
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04/11

FIGURE 7

PREP BY CGAR REV BY SPN RPT NO. 532.31 410-8218 A

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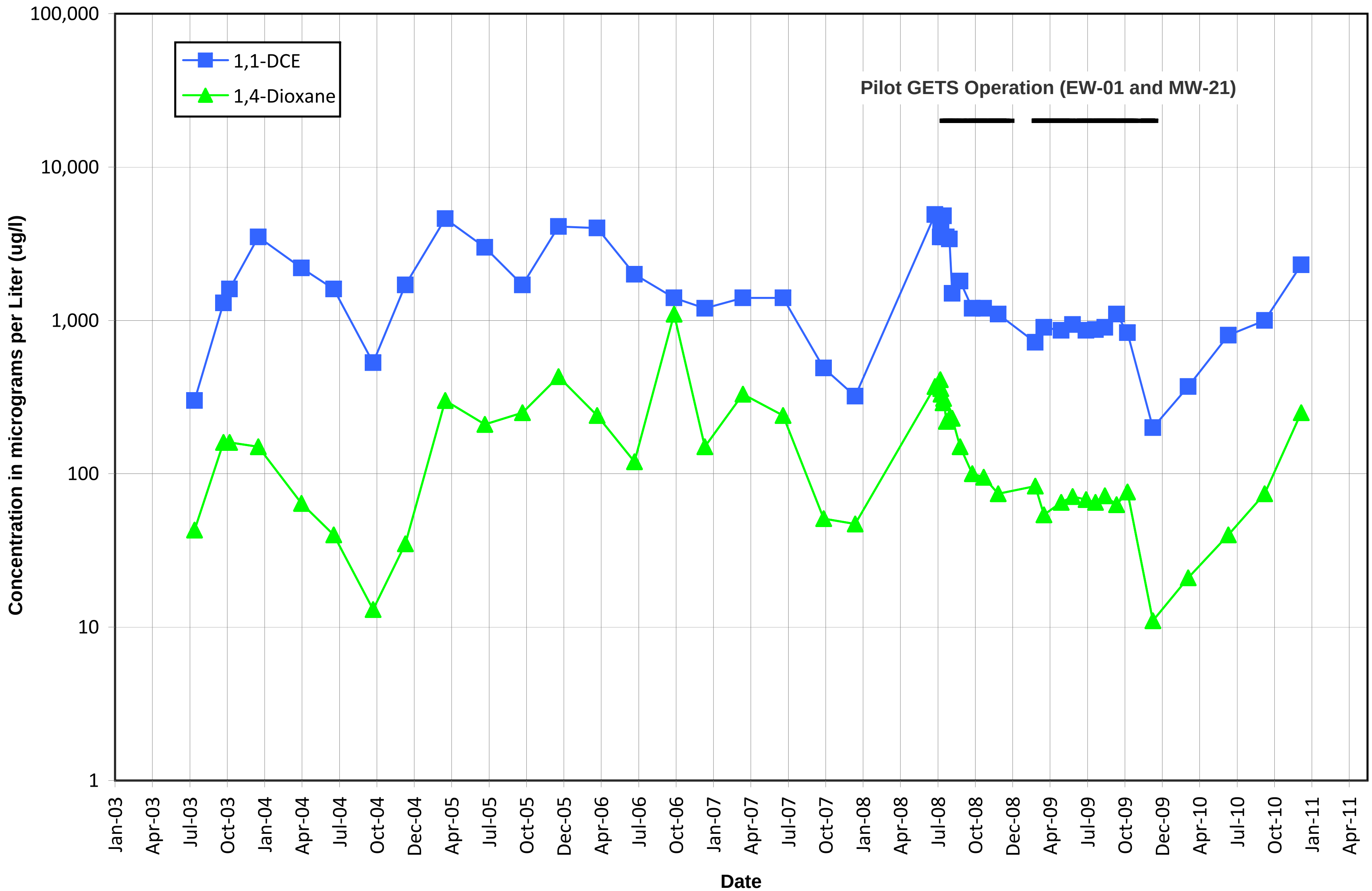

FIGURE 8. 1,1-DICHLOROETHYLENE AND 1,4-DIOXANE IN GROUNDWATER SAMPLES COLLECTED FROM WELL MW-21

532 Rpt 2011-04 Fig 8.xls

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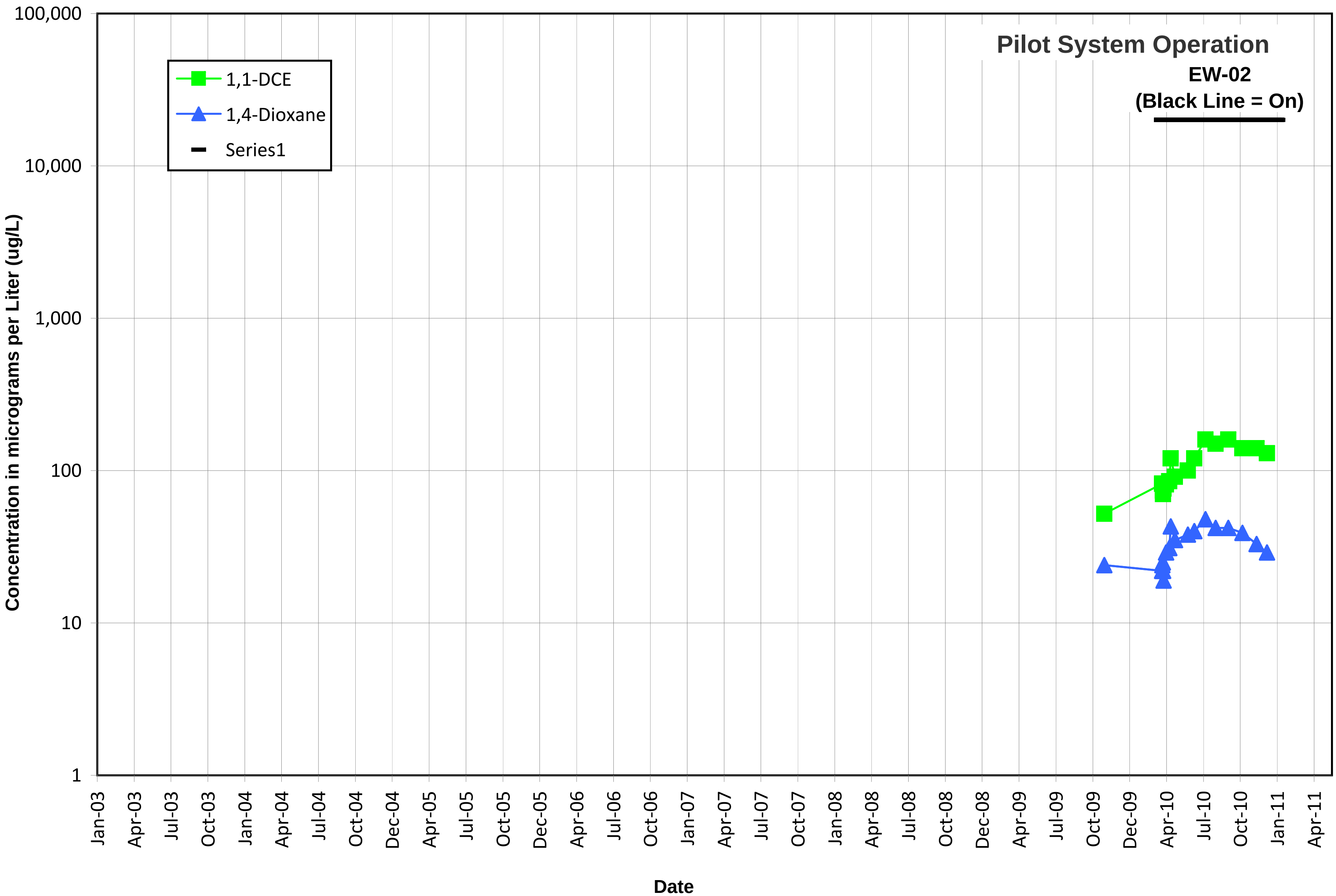

FIGURE 9. 1,1-DICHLOROETHYLENE AND 1,4-DIOXANE IN GROUNDWATER SAMPLES
COLLECTED FROM EXTRACTION WELL EW-02