

**FENTON'S REAGENT TREATMENT
WORK PLAN**

**PENSKE TRUCK LEASING FACILITY
725 Julie Ann Way
Oakland, California**

November 29, 1999

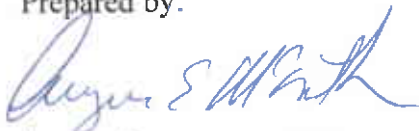
Prepared by:

**SECOR International Incorporated
360 22nd Street, Suite 600
Oakland, California 94610**

Prepared for:

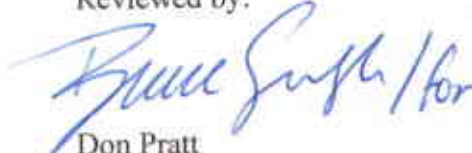
**Penske Truck Leasing Company
Route 10 Green Hills Road
P.O. Box 7635
Reading, PA 19603-7635**

Prepared by:



**Angus E. McGrath, Ph.D.
Principal Geochemist**

Reviewed by:



**Don Pratt
Project Manager**

#JM

November 29, 1999

Mr. Barney Chan
Hazardous Materials Specialist
Alameda County Health Care Services Agency
Environmental Health Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: **Fenton's Reagent Work Plan & 4th Quarter Monitoring
Former Penske Truck Leasing Facility
725 Julie Ann Way
Oakland, CA**

Dear Mr. Chan:

SECOR International Incorporated (SECOR) is submitting this work plan on behalf of Penske Truck Leasing Co., L.P. for the former Penske Truck Leasing Facility at 725 Julie Ann Way, Oakland, California (the Site). The proposed work involves Fenton's reagent treatment of impacted groundwater at the Site. We have attempted to incorporate responses to questions listed in your October 4, 1999 letter. The responses are listed below:

- We believe a pilot study is not deemed necessary due to the current state of knowledge regarding Fenton's reagent;
- Multiple applications are not anticipated at this time;
- Solution pH will be 2 and peroxide concentration will be 5%;
- An estimate of the amount of petroleum hydrocarbons present and the required peroxide mass are included in the work plan; and,
- Initial and confirmation soil samples are not included in the work plan, all monitoring will be conducted with the monitoring wells since they will not be used for treatment.


In addition, SECOR is planning on conducting 4th Quarter monitoring on December 21, 1999. We will conduct polynuclear aromatic hydrocarbon (PAH) analysis and silica gel clean up of TEPH samples as requested.

If you should have any questions concerning this project, please contact Richard G. Saut at (610) 775-7298 or Angus McGrath at (510) 285-2556.

Sincerely,

ok: 228

SECOR International Inc.


Angus E. McGrath, Ph.D.
Principal Geochemist

Attachment

cc: Mr. Richard Saut, Penske Truck Leasing Co.
Mr. Don Pratt, SECOR International Inc.

99 DEC -3 PM 3:05

ENVIRONMENTAL PROTECTION

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1 INTRODUCTION

This work plan describes the scope of work and specific tasks required for the completion of a chemical oxidation treatment of groundwater. A chemical oxidation treatment called Fenton's reagent (hydrogen peroxide, sulfuric acid, and ferrous iron). Fenton's reagent is a strong oxidant that has been used extensively for ex-situ and in-situ groundwater treatment. Fenton's reagent will be used to degrade benzene, toluene, ethyl-benzene, and xylenes (BTEX), and total petroleum hydrocarbons in the gasoline range (TPH_g), and total petroleum hydrocarbons in the diesel range (TPH_d) in aquifer zone soils and groundwater at the ~~at the~~ Penske Truck Leasing Facility (the Site), 725 Julie Ann Way, Oakland, California.

2 SITE HISTORY

In October 1989, one 10,000-gallon unleaded gasoline underground storage tank (UST), one 10,000-gallon diesel UST, and one 550-gallon waste oil UST were removed from the subject site. Following collection of confirmation soil samples, two excavations were conducted to remove residual hydrocarbons residing in subsurface soils.

Following excavation activities and under the direction of the Alameda County Health Care Services Agency (ACHCSA), the former UST excavation was backfilled with clean pea gravel and capped with asphalt.

Soil samples collected from the former UST cavity detected concentrations of total petroleum hydrocarbons (TPH) as gasoline ranging from 22.4 milligrams per kilogram (mg/kg) to 2,100 mg/kg. Concentrations of TPH as diesel ranged from 840 mg/kg to 13,000 mg/kg. Oil and grease were detected in two of the samples collected from the gasoline and diesel UST excavations at concentrations of 54 mg/kg and 35 mg/kg.

During September 1990, six soil borings were advanced in and around the former UST excavations to investigate the extent of impacted soil and groundwater. Three groundwater monitoring wells were installed (MW-1 through MW-3), in the vicinity of the former USTs (Figure 2). TPH as gasoline was detected in soil samples collected from two of the six borings and all of the groundwater monitoring wells at concentrations ranging from 1 to 820 mg/kg at depths ranging from 5 to 20 feet below ground surface (bgs). TPH as diesel was detected in all of the soil borings and wells at concentrations ranging from 32 to 980 mg/kg at depths ranging from 5 to 20 feet bgs. Benzene was also detected in all of the soil borings and wells at concentrations ranging from 0.01 to 3.2 mg/kg. TPH as gasoline was detected in monitoring well MW-1 at a maximum concentration of 170 micrograms per liter ($\mu\text{g/l}$). Groundwater samples collected from monitoring wells MW-2 and MW-3 were below the laboratories minimum detection limit for TPH as gasoline. TPH as diesel in groundwater samples collected from all three of the newly installed monitoring wells at concentrations ranging from 80 to 2,900 $\mu\text{g/l}$. Benzene was detected in all of the groundwater samples collected at concentrations ranging from 0.4 to 20 $\mu\text{g/l}$.

In February 1993 two additional groundwater monitoring wells were installed to better define the extent of groundwater impact. Monitoring well MW-4 and MM-5 were subsequently installed. The locations of these monitoring wells are depicted on Figure 2. TPH as gasoline was detected in soil samples collected from monitoring well MW-4 only at concentrations ranging from 6 to 400 mg/kg at depths ranging from 5 to 15 feet bgs. TPH as diesel was detected within soil samples collected from both monitoring wells MW-4 and MW-5 at concentrations ranging from 21 to 4,100 mg/kg at depths between 5 and 15 feet bgs.

A third site assessment was conducted in July 1994. The objective of this site assessment was to further define the extent of soil and groundwater both downgradient (to the west) and crossgradient (to the north and southwest) of the former USTs. Four additional soil borings were drilled, three of which were converted to groundwater monitoring wells MW-6, MW-7 and

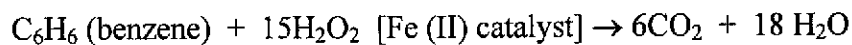
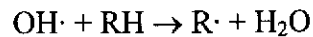
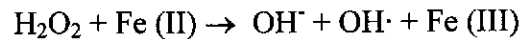
MW-8. TPH as gasoline was detected in soil samples collected borings MW-6, MW-7, MW-8 and BH-4 at concentrations ranging from 1 mg/kg (boring MW-8 at 15.5 feet bgs) to 31 mg/kg (boring MW-7 at 15 feet bgs). TPH as diesel was detected in soil samples collected from boring MW-7, MW-8 and BH-4 at concentrations ranging from 41 mg/kg (boring MW-8 at 10.5 feet bgs) to 5,500 mg/kg (boring MW-7 at 15 feet bgs). Benzene was detected in soil samples collected from borings MW-7, MW-8 and BH-4 at maximum concentrations ranging from 0.8 mg/kg (boring BH-4 at 5 feet bgs) to 0.039 mg/kg (boring MW-8 at 5.5 feet bgs).

Based on the results of the third site assessment, a non-attainment-type zone was established with the concurrence of the ACHCSA. Concentrations of benzene reported in monitoring wells MW-7 and MW-8 (2.7 µg/l) were much lower than the 21 µg/l limit established by the Regional Water Quality Control Board (RWQCB) to protect nearby estuary waters. The ACHCSA was also in concurrence with this limit. Since the concentrations of benzene within groundwater samples collected from monitoring wells MW-3, MW-6, MW-7 and MW-8 located to the northwest and west of the former USTs were lower than the limit established by the ACHCSA and the RWQCB to protect possible downgradient receptors, the attainment zone was established.

Current groundwater monitoring data for each of the monitoring well locations are presented in Figure 3.

3 OVERVIEW OF FENTON'S REAGENT

Fenton's reagent (ferrous iron and hydrogen peroxide) is known to oxidize and in some cases completely mineralize a variety of organic substrates. Although the reaction mechanism is not completely characterized, it is generally accepted that Fenton's reagent generates hydroxyl free radicals (OH·) that in turn react with available organic substrates (R) which undergo oxidation:



A variety of other competing reactions consume the hydroxyl free radical making dosing predictions difficult. However, published studies have documented the ability of Fenton's reagent to degrade many types of organic environmental contaminants, including benzene, toluene, ethyl benzene, xylenes, methyl-tertiary butyl ether (MTBE), trichloroethene (TCE), tetrachloroethene (PCE), pentachlorophenol (PCP), nitrobenzene, and many other difficult to degrade chlorinated hydrocarbons. BTEX compounds have shown particular susceptibility to oxidation by Fenton's reagent. These compounds degrade rapidly and can be completely converted to carbon dioxide. Incomplete degradation products include carboxylic acids and alcohols, which are more rapidly degraded by microbes, and are less toxic than BTEX.

One difficulty in applying Fenton's reagent in-situ is that groundwater concentrations of ferrous iron are typically low, and pH is not low enough in soils and groundwater to maintain the iron required to catalyze the reaction in solution. Dissolved iron precipitates out of solution above pH 5 and cannot catalyze the Fenton's reaction to generate the hydroxyl radical. Pignatello and Baehr (1994) and other researchers have demonstrated that metal complexing agents (chelating agents) such as nitrolotriactic acid (NTA) and gallic acid dissolve iron at pH above 5 and allow for the formation of the hydroxyl radical. Citric acid also functions well as a chelating agent, is not toxic, and is readily available from industrial chemical suppliers.

SECOR Geochemistry conducted several bench-scale tests in its laboratory that have confirmed the ability of Fenton's reagent to treat BTEX compounds and total petroleum hydrocarbons (TPH). Furthermore, field tests conducted by SECOR at other impacted sites have demonstrated that in-situ application of Fenton's reagent can be used to successfully treat BTEX in contaminated groundwater.

3.1 FENTON'S REAGENT BENCHSCALE TEST

SECOR has previously conducted a bench-scale test at other sites to determine the most effective dosing for in-situ Fenton's reagent treatment. The site evaluated for Fenton's reagent treatment contained sediments with a moderate particle size and buffer capacity. The reactions included five 250 milliliter (mL) reaction vessels that were prepared by mixing 100 grams of soil, 50

milliliters (mL) of groundwater, and 250 microliters (μL) of MTBE gasoline. Two different treatments were tested:

- Fenton's reagent with acidification; and
- Fenton's reagent without acidification (pH adjustment).

Peroxide concentrations were set at 0 (for control sample), 1, 2 and 4% using a 35% peroxide concentrate solution. Iron concentrations were set at 250 milligrams per liter (mg/L) Fe(II) for each 50 milliliter (mL) of groundwater added to soil. The pH of the Fenton's reagent sample was acidified to pH between 3.5 and 4 prior to Fe(II) addition and peroxide addition. The control and no acidification sample had no pH adjustment (pH ~ 6 to 7).

Table 1: Laboratory Bench-scale Test Results for BTEX Oxidation by Fenton's Reagent.

Treatment	Benzene $\mu\text{g/L}$	Toluene $\mu\text{g/L}$	Ethyl-Benzene $\mu\text{g/L}$	Xylenes $\mu\text{g/L}$	TPH $\mu\text{g/L}$
Control	930	14000	2400	14000	96000
1.0 % H_2O_2	<0.5	<0.5	<0.5	<0.5	<50
2.0 % H_2O_2	<0.5	<0.5	<0.5	<0.5	<50
4.0 % H_2O_2	<0.5	<0.5	<0.5	<0.5	<50
4.0% H_2O_2^*	<0.5	<0.5	<0.5	<0.5	<50

* = no pH adjustment, pH > 6.

Results of the bench scale test indicate that BTEX and TPH are degraded effectively by Fenton's reagent with and without acidification.

∴ better not to used acidification

3.2 LABORATORY STUDY CONCLUSIONS

Based on the results of the bench scale study conducted by SECOR and other academic researchers, Fenton's reagent has great potential for treating TPH and BTEX in groundwater. The limitations are permeability of the aquifer and alkalinity of the groundwater and soils. The higher the pH and alkalinity are, the lower the reactivity of Fenton's reagent. Treatment is most beneficial in high permeability, low pH (pH of less than 7) aquifers where injection of peroxide is easy and the pH can be decreased with minimal effort.

4 OBJECTIVES

The objective of this chemical oxidation treatment is to oxidize BTEX and TPH in groundwater and aquifer sediments in the impacted zones of the Site. Treatment effectiveness will be evaluated through groundwater sampling from the monitoring wells in the impacted zone, since treatment will be through Geoprobe™ injections spaced at 5 to 10 foot intervals. Treatment is expected to last approximately three weeks. Additional injections will be considered should significant rebound occur. Sufficient information concerning the effectiveness of Fenton's reagent as an oxidant of petroleum hydrocarbons is available that a pilot study is not necessary prior to full-scale treatment.

5 SCOPE OF WORK

The scope of the chemical oxidation treatment involves geochemical assessment before, during, and after Fenton's reagent treatment. The treatment includes three main tasks:

1. Initial sampling of the treatment zone for contamination and geochemical parameters (BTEX, TPH_g, and TPH_d will be monitored during Quarterly Sampling);
2. Injection of acid and hydrogen peroxide; and
3. Post treatment monitoring.

5.1 TREATMENT TASKS

The following section provides a task-by-task description of the work that will be conducted to implement Fenton's reagent treatment at the Site.

5.1.1 Task 1 -- Baseline Evaluation of Geochemical Parameters

Baseline sampling of impacted wells will be conducted to test the reliability of field test kits, and determine the initial concentration of geochemical parameters. Pretest sampling will be conducted for Fenton's reagent treatment in wells. Geochemical parameters for monitoring Fenton's reagent effectiveness will include oxidation-reduction potential (ORP), pH, specific conductivity, hydrogen peroxide, dissolved oxygen (DO), and ferrous iron concentrations. Samples for BTEX, TPH_g, and TPH_d will be taken prior to treatment during the previous Quarterly monitoring event. Soil borings will not be used for verification of treatment because they are not reliable and vary between locations too much for before and after comparisons. The most reliable estimate of hydrocarbon contamination is the measurement of groundwater concentrations. Therefore the monitoring wells will be used for assessment and will not be used for injection of peroxide.

Groundwater purging will be accomplished using a submersible pump not a bailer. Groundwater sampling will be accomplished using a pre-cleaned disposable bailer. Additionally, purged groundwater will not be treated on-site with carbon or Fentons Reagent and will not be discharged to the storm drain. Purged groundwater will be containerized within 55-gallon open top drums and temporarily stored on-site pending receipt of laboratory analytical results. Following the receipt of laboratory analytical results the accumulated groundwater will be transported off-site to a Penske approved treatment facility for disposal.

5.1.2 Task 2 -- Fenton's Reagent Preparation and Injection

This section outlines the preparation of Fenton's reagent solutions, the treatment, and the sequence to be used for Fenton's reagent treatment

5.1.2.1 Reagent Preparation

Fenton's reagent will be prepared mixing tap water with acid and 50% peroxide within a 200 gallon tank. Each of the treatment reagents will require secondary containment and careful handling. An addendum to the Health and Safety Plan (HASP) will be prepared prior to initiation of field activities. It will outline chemical handling and worker safety requirements for each ingredient for Fenton's reagent.

Hydrogen peroxide (peroxide) will be purchased and used from 55-gallon drums at a concentration of 50%. Peroxide concentrations under 52% are considered non-hazardous, and only require proper labeling and secondary containment. A 50% peroxide solution will be used for this study. The peroxide will be diluted ten-fold in the treatment tank to generate an injection solution containing approximately 5 % peroxide and enough acid to generate a pH of 2. ← why 2, if test shows act units w/o pH had

Solutions will be transferred between containers using a trash pump and grout pump. Once prepared, the reagents for Fenton's treatment will be injected into the ground using a Geoprobe™ rig.

5.1.2.2 Fenton's Reagent Treatment Design

The Fenton's reagent treatment system is designed to maximize the quantity of peroxide added into the impacted zone. A Geoprobe™ rig will bore down to groundwater (as estimated by the depth to water in the adjacent monitoring wells). The probe will be pulled back a distance of one foot, the tip knocked out, and acidified peroxide will be injected through the Geoprobe™ boring. Prior to injection of acidified peroxide, tap water will be injected into the boring to test the permeability of the injection point. The volume of peroxide injected will depend on the permeability of the soil, and the generation of back-spray. The peroxide hoses will be monitored using a pressure gauge to determine the back-pressure generated by the solution injection and the reaction in the aquifer. Typically Geoprobe™ injections do not generate significant back-pressure.

Injections will be made on 10 foot spacings in a grid fashion to ensure effective dosing. Approximately 50 to 100 gallons of acidified 5% peroxide solution will be injected at each point. Should pressure build-up or back spray occur injection at that location will cease and a new boring will be made. Initial injections will be made on a ten foot radius spacing to prevent chemical upwelling from a previous boring.

Figure 4 contains a layout of the treatment area. The highest density of injection points will be around MW-1 and MW-7. Treatment within the tank cavity will be located on 10 to 20 foot spacings, but peroxide volumes injected in the tank cavity will be approximately 200 gallons or greater of 5% solution depending on the ability of the injection point to take the solution.

Appendix A contains calculations of the total mass of TPH at the site based on the median diesel concentration (2.45 mg/L) found in groundwater in the source area (adsorbed hydrocarbon concentrations were assumed to be 5 times the groundwater concentration). The ratio of

check/OK

hydrogen peroxide required per lb of TPH treated was assumed to be 150:1 due to side reactions and other oxidant demands in the aquifer. The outcome of the mass requirements was a total hydrogen peroxide dose of approximately 2,000 gallons of 50% hydrogen peroxide, or approximately 36 55-gallon drums.

5.1.2.3 Fenton's Reagent Injection

Approximately 90 injection points will be treated, and the treatment time per injection point is estimated to be between 1 and 1.5 hours. This includes pushing the probe to depth (approximately 8 feet), testing the injection point with water, injecting peroxide, rinsing the probe with water, and removing the probe (grouting will be completed at the end of the treatment). Because water depth is so shallow (approximately 6 feet) treatment will extend below the surface of the groundwater to ensure that sufficient confinement pressure is achieved prior to injection of peroxide.

only 2' into aquifer?
Peroxide will be transferred from a mixing tank where the acidified peroxide solution is prepared (see Section 5.1.2.1), into the Geoprobe™ hopper. Transfer of the peroxide solution will be made using a high flow peristaltic pump to limit the contact of the peroxide with mechanical pumps.

The flow rate of peroxide from the grout pump will be set between 2 and 4 gallons per minute (gpm) depending on the ability of the injection point to take the solution. Approximately 100 gallons of peroxide will be injected into each boring depending on the back-pressure and back-flow around the annulus of the well. Any back spray or flow will be immediately treated with sodium dithionite, which is a chemical reductant that will quench the peroxide. A dilute dithionite solution will also be sprayed onto the ground surface in the areas where peroxide has been spilled. The abandoned tank cavity will receive between four and eight injections of 100 to 200 gallons a piece depending on the flow rate.

5.1.3 Task 3 – Post Treatment Monitoring

Groundwater wells will be monitored during the treatment and one month after treatment to evaluate the efficiency of BTEX, TPH_g, and TPH_d oxidation. Parameters for analysis will include ORP, pH, specific conductivity, hydrogen peroxide, DO, sulfate, BTEX, TPH_g, and TPH_d (hydrogen peroxide will be omitted during the 1 month sampling). Samples will be taken after proper bailing, and purge water will be stored in 55-gallon drums until tested. : Purging will be accomplished using a submersible pump not hand bailing. Additionally, groundwater will not be treated on-site and will not be discharged to the storm drain.

6 DATA EVALUATION AND REPORTING

The main objective of this treatment is to reduce BTEX, TPH_g, and TPH_d concentrations at the Site. The data evaluation and report will focus on the predicted mass losses of contaminant based on the changes in concentration in the wells of the treatment zone. BTEX, TPH_g, and TPH_d concentrations will be analyzed to determine the efficiency of the treatment. Geochemical parameters will be compared with VOC concentrations to determine how the contaminants were impacted by increased peroxide concentrations. The full report will include:

- Description of the chemical mixing and injection procedures;
- Description of the frequency and parameters measured during monitoring and treatment;
- Compilation of field and analytical results;
- Evaluation of field and analytical results;
- Correlation calculations with respect to dosing assessments; and
- Evaluation of the effectiveness of the treatment in degrading specific compounds;

A draft report and supporting analytical results will be submitted to Penske for review. Upon Penske's approval of draft report a final report will be submitted to Alameda County and the Regional Water Quality Control Board and other appropriate regulatory agencies.

7 QUALITY ASSURANCE AND QUALITY CONTROL

A quality assurance and quality control (QA/QC) plan for groundwater sampling and analysis has been developed for the site. All procedures will be conducted following these procedures to ensure that sampling is conducted appropriately and reliably. Water monitoring will be conducted in accordance to the plan developed for the site with the addition of the field test methods proposed in this Work Plan.

ORP, pH, and DO will be measured using a field ion selective electrode meter (ISE meter). These represent the most effective methods for analysis in the field. Quality of data will be ensured through careful field calibration using ISE meter and electrode manufacturers recommended methods and solutions.

Hydrogen peroxide HACH field test kits will to be used to monitor reaction chemistry. The HACH hydrogen peroxide test kit is a reliable field test kit that quantifies the relative concentrations of hydrogen peroxide in groundwater. All HACH kits are self-calibrating. Background measurements will be taken to account for interferences from ions that interfere with accurate measurements.

Laboratory analyses will be overseen by EPA-certified technicians and will be certified using EPA-certified standards and procedures. The laboratory methods followed for this pilot test include: EPA 8020 for BTEX, and EPA 8015 for total purgeable hydrocarbons (TPH_g and TPH_d).

All data will be reviewed by SECOR personnel for consistency and potential laboratory or field errors. Where appropriate, statistical and geochemical modeling tools will be used to determine if data is self-consistent and reliable.

8 SCHEDULE

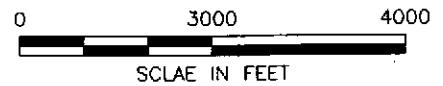
The anticipated schedule to complete the tasks contained in this letter is as follows:

Task 1 - Baseline Evaluation	Three weeks after regulatory approval of Work Plan
Task 2 – Fenton’s Reagent Injection	Six weeks after regulatory approval of Work Plan
Task 3 – Post Injection Monitoring	Four weeks after completion of treatment
Task 4 – Data Compilation and Reporting	One month after final sampling analytical results have been received

It is anticipated that completion of the work will require approximately 2.5 to 3.5 months, assuming no major scheduling conflicts. Should there be any scheduling problems, Penske will be notified of the change in schedule. After Penske approval of the change in schedule, the appropriate regulatory agencies will be contacted and informed of the new schedule.



SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC MAP
 OAKLAND EAST, CALIFORNIA
 (PHOTOREVISED 1980)

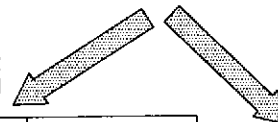


SECOR
International Incorporated

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FIGURE 1
 FORMER PENSKE TRUCKING COMPANY
 725 JULIE ANN WAY
 OAKLAND, CALIFORNIA
SITE LOCATION MAP

HISTORICAL RANGE OF REGIONAL SHALLOW GROUNDWATER FLOOR DIRECTION

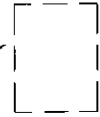


REPAIR SHOP

OFFICE

● BM (6.62)

APPROXIMATE EXTENT OF FORMER TANK EXCAVATIONS



MW-2 (-0.50')

MW-3 (-0.63')

MW-6 (-0.69')

OW-2

OW-1

MW-4 (-1.39')

MW-1 (-0.92')

MW-5 (-0.69')

MW-7 (-0.40')

MW-8 (-0.38')

GARAGE

DRAINAGE DITCH

JULIE ANN WAY

LEGEND



MW-1 APPROXIMATE LOCATION OF EXISTING GROUNDWATER WELLS



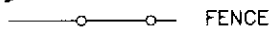
BM SURVEY BENCH MARK (BASED ON CITY OF OAKLAND DATUM (-3 FEET BELOW MEAN SEA LEVEL))

(-0.92')

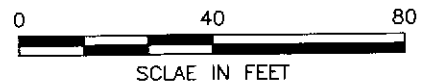
GROUNDWATER ELEVATION CONTOUR IN FEET 12/22/99

1.00

GROUNDWATER ELEVATION CONTOUR (FEET)



FENCE



SCALE IN FEET

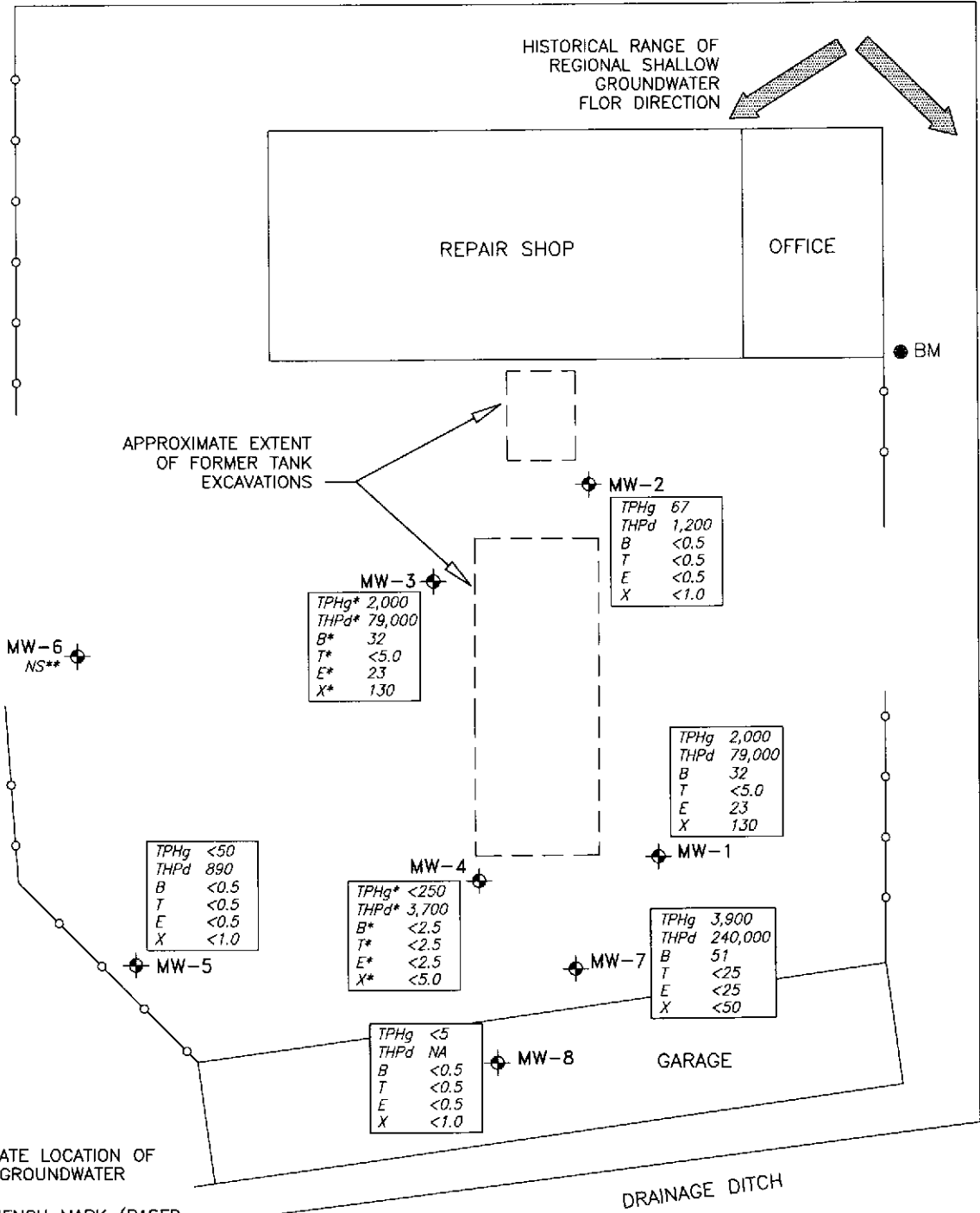
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SECOR
International Incorporated

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DATE	10NOV99
JOB NO.	014.07694.001

FIGURE 2
FORMER PENSKO TRUCKING COMPANY
725 JULIE ANN WAY
OAKLAND, CALIFORNIA
SHALLOW GROUNDWATER CONTOURS
FOURTH QUARTER, 1998

JULIE ANN WAY



APPROXIMATE EXTENT OF FORMER TANK EXCAVATIONS

HISTORICAL RANGE OF REGIONAL SHALLOW GROUNDWATER FLOW DIRECTION

REPAIR SHOP

OFFICE

BM

MW-2

TPHg	67
THPd	1,200
B	<0.5
T	<0.5
E	<0.5
X	<1.0

MW-3

TPHg*	2,000
THPd*	79,000
B*	32
T*	<5.0
E*	23
X*	130

MW-6
NS**

MW-1

TPHg	2,000
THPd	79,000
B	32
T	<5.0
E	23
X	130

MW-5

TPHg	<50
THPd	890
B	<0.5
T	<0.5
E	<0.5
X	<1.0

MW-4

TPHg*	<250
THPd*	3,700
B*	<2.5
T*	<2.5
E*	<2.5
X*	<5.0

MW-7

TPHg	3,900
THPd	240,000
B	51
T	<25
E	<25
X	<50

MW-8

TPHg	<5
THPd	NA
B	<0.5
T	<0.5
E	<0.5
X	<1.0

GARAGE

DRAINAGE DITCH

LEGEND

- ⊕ MW-1 APPROXIMATE LOCATION OF EXISTING GROUNDWATER WELLS
- BM SURVEY BENCH MARK (BASED ON CITY OF OAKLAND DATUM (-3 FEET BELOW MEAN SEA LEVEL))
- FENCE

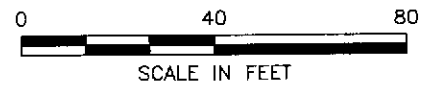
ANALYTES:

- TPHg — TOTAL PETROLEUM HYDROCARBONS AS GASOLINE
- THPd — TOTAL PETROLEUM HYDROCARBONS IN DIESEL RANGE
- B — BENZENE
- T — TOLUENE
- E — ETHYLBENZENE
- X — XYLENES
- NS — NOT SAMPLED

CHEMICAL ANALYTICAL RESULTS:

ANALYTE	12/22/98 SAMPLING CONCENTRATION (mg/l)
TPHg	2,000
THPd	79,000
B	32
T	<5.0
E	23
X	130

* 10/1/98 SAMPLING
** ND RESULTS FROM 11/22/94

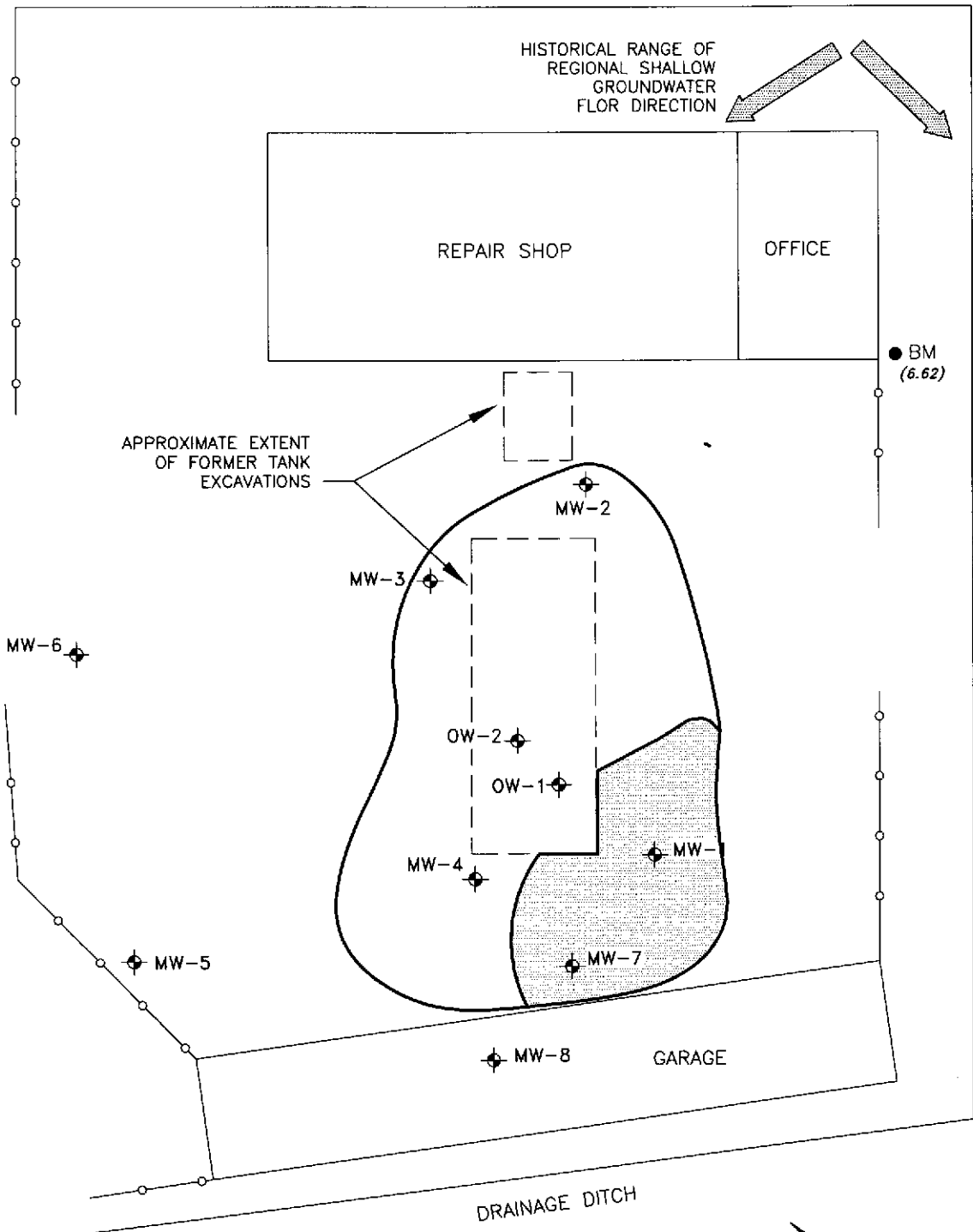


SECOR
International Incorporated

DRAWN	GEL
APPR	AEM
DATE	10NOV99
JOB NO.	014.07694.001

FIGURE 3
FORMER PENSKE TRUCKING COMPANY
725 JULIE ANN WAY
OAKLAND, CALIFORNIA
**BENZENE CONCENTRATIONS
FOURTH QUARTER, 1998**

199812.271039 X:\OAKLAND\ACAD\PENSKE\PENSKE-014.07694.001-001.DWG 11/10/99



LEGEND

⊕ MW-1

APPROXIMATE LOCATION OF EXISTING GROUNDWATER WELLS

● BM

SURVEY BENCH MARK (BASED ON CITY OF OAKLAND DATUM (-3 FEET BELOW MEAN SEA LEVEL))

—

FENTON'S TREATMENT AREA

▨

AREA OF HIGHER DENSITY INJECTION

○—○

FENCE

0 40 80

SCALE IN FEET

SECOR
International Incorporated

DRAWN	GEL
APPR	AEM
DATE	10NOV99
JOB NO.	014.07694.001

FIGURE 4
FORMER PENSKE TRUCKING COMPANY
725 JULIE ANN WAY
OAKLAND, CALIFORNIA
**FENTON'S REAGENT
TREATMENT AREA**

APPENDIX A

Hydrogen Peroxide Mass Estimation for Treatment of TPH

TPHs part 4 gts

TPH d part 4 gts

1 2, 1.3, 13, 380

79, 63, 280, 1200

2 .067, 3.2, ND, ND

1.2, 3.5, 1.3, 0.34

3 ND



8

4 ND, 2.4, 3.9, 0.58

3.7, 670, 11, 9.3

7 3.9, .71, .14, 45

240, 89, 1.6, 290

$$3399 / 40 = 85 \text{ ppm}$$

**Hydrogen Peroxide Mass Estimation for Treatment of TPH
at the Former
Penske Facility, 725 Julie Ann Way,
Oakland, California**

The mass of hydrogen peroxide required to remediate the groundwater and aquifer sediments at the Former Penske Facility, 725 Julie Ann Way, Oakland, California (the site), was calculated using the following assumptions and conversions.

The dose required per injection point was calculated as follows:

Calculation of treatment zone volume:

Length (L) = 140 feet (ft), Width (W) = 80 ft, treatment depth interval or H (height) = 4ft

$$\begin{aligned} &= L * W * H \\ &= 44,800 \text{ cubic feet (ft}^3\text{)} \end{aligned}$$

Total volume = 44,800 ft³

$$\text{Total volume in liters (L)} = 44,800 \text{ ft}^3 \times 7.48 \frac{\text{gal}}{\text{ft}^3} \times 3.785 \frac{\text{L}}{\text{gal}} = 1,268,369 \text{ L}$$

Assuming a porosity of 30%, or 70% soil ($\frac{70 \text{ parts soil}}{100 \text{ parts total}}$):

$$\begin{aligned} \text{Total soil volume} &= \text{Volume} \times \left(\frac{70 \text{ parts soil}}{100 \text{ parts total}} \right) \\ &= 1,268,369 \text{ L} \times \left(\frac{70 \text{ parts soil}}{100 \text{ parts total}} \right) = 887,858 \text{ L soil} \end{aligned}$$

$$\text{Total Water Volume} = 1,268,369 \text{ L} \times \left(\frac{30 \text{ parts soil}}{100 \text{ parts total}} \right) = 380,510 \text{ L water}$$

$$\begin{aligned} \text{Total mass of dry soil assuming a density of } \rho_s &= 2.65 \frac{\text{kg soil}}{\text{L soil}} : \\ &= 887,858 \text{ L soil} \times 2.65 \frac{\text{kg soil}}{\text{L soil}} = 2,352,824 \text{ kg soil} \end{aligned}$$

The median contaminant level in groundwater for the site is $2.45 \frac{\text{mg TPH}}{\text{L}}$ and the concentration in soils is assumed to be 5 times that or $12.25 \frac{\text{mg TPH}}{\text{kg}}$, therefore the total mass of TPH in groundwater and soil in the source area is:

1969 gal of 50%

or 1969^{#s} ~~gal~~ of 5% *

100 mg pt x 100 gal (5%) = 10000 }

w/ outside cavity ← 9690 gal }

$$\text{Groundwater TPH} = (2.45 \frac{\text{mg TPH}}{\text{L}}) \times \text{water volume (L)}$$

$$= 2.45 \frac{\text{mg TPH}}{\text{L}} \times 380,510 \text{ L} * \frac{1\text{g}}{1000\text{mg}} * \frac{1\text{kg}}{1000\text{g}} = 0.932 \text{ kg}$$

$$\text{Soil TPH mass} = 12.25 \frac{\text{mg TPH}}{\text{kg}} \times 2,352,824 \text{ kg} * \frac{1\text{g}}{1000\text{mg}} * \frac{1\text{kg}}{1000\text{g}} = 28.8 \text{ kg}$$

$$\text{Total Mass of TPH in pounds} = 28.81 \text{ kg} * 2.2 \frac{\text{lb}}{\text{kg}} = 65.5 \text{ lb}$$

Based on the estimated mass of TPH, the required mass of hydrogen peroxide for treatment is estimated to be approximately 150 times the hydrocarbon mass or: ?

$$\text{Hydrogen peroxide required} = \text{mass of TPH} * 150 = 65.5 \text{ lb} * 150 = 9,825 \text{ lb}$$

Assuming a 50% peroxide solution for treatment the total mass of solution required is twice the calculated mass or 19,650 lb of 50% peroxide or:

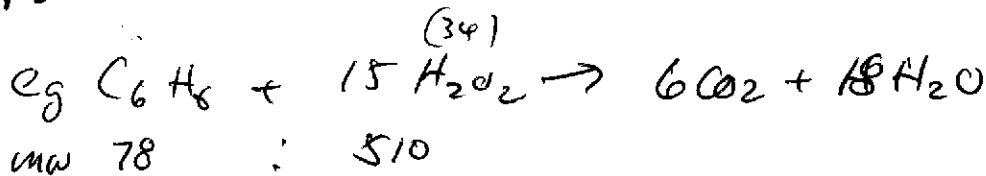
$$\text{Volume of Hydrogen Peroxide} = 19,650 \text{ lb} * \frac{1 \text{ gal}}{9.98 \text{ lb}} = 1,969 \text{ gallons of } 50\% \text{ H}_2\text{O}_2$$

Therefore, SECOR will use 36 55-gallon drums of 50% hydrogen peroxide for the treatment. Assuming that approximately 100 injection points will be used, each injection point will receive 100 gallons of 5% hydrogen peroxide. Outside of the tank cavity, all injection points will receive approximately 50 gallons. All excess hydrogen peroxide will be injected into the tank cavity to completely destroy all residual hydrocarbons.

$$36(55)(.5) = 990$$

$$\frac{(100)(100)}{\text{inpts}} = 10,000 \text{ gal}$$

$$\frac{19,690 \text{ gallons}}{5\%}$$



$$\frac{510}{78} = 6.5$$