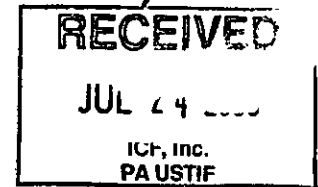




# AMERICAN ENVIRONMENTAL ASSOCIATES, INC.



## UNDERGROUND STORAGE TANK FACILITY REMEDIAL ACTION PLAN

LEO'S #3 CAR WASH  
2938 WEST 26TH STREET  
ERIE, PENNSYLVANIA

FACILITY ID# 25-90615

MILLCREEK TOWNSHIP  
ERIE COUNTY, PENNSYLVANIA

PREPARED: JULY, 2003

5946 Southland Drive • Erie, PA 16509  
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LEO'S #3 CAR WASH  
2938 WEST 26TH STREET  
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## REMEDIAL ACTION PLAN

MILLCREEK TOWNSHIP  
ERIE COUNTY, PENNSYLVANIA

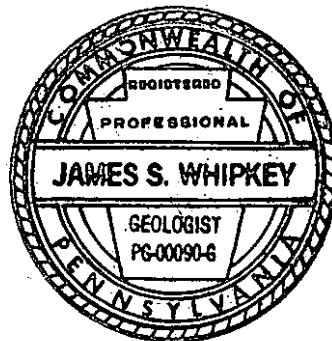
PREPARED FOR:

LEO'S #3 CAR WASH  
2938 WEST 26<sup>TH</sup> STREET  
ERIE, PENNSYLVANIA

PREPARED BY:

AMERICAN ENVIRONMENTAL ASSOCIATES, INC.  
5946 SOUTHLAND DRIVE  
ERIE, PENNSYLVANIA

JAMES SCOTT WHIPKEY  
PROFESSIONAL GEOLOGIST



JULY, 2003

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## **1.0 INTRODUCTION**

American Environmental Associates, Inc. has been contracted by Leo's #3 Car Wash to provide environmental services pursuant to Underground Storage Tank Corrective Action regulations and the Land Recycling and Environmental Remediation Standards Act (Act 2). This Remedial Action Plan (RAP) documents the performance and results of remedial feasibility testing conducted at the site. Recommendations for future remedial actions are also provided.

The site is located at 2938 West 26<sup>th</sup> Street in Erie, Pennsylvania (see Figure 1: Location Map). Corrective actions were initiated in response to a release that was discovered during Underground Storage Tank (UST) system update activities. The release was associated with swing joint located below an unleaded gasoline dispenser.

In November of 2002, February 2003, and April of 2003, twelve monitoring wells were installed at the subject site. Soil samples and groundwater samples were collected and submitted for laboratory analysis of Pennsylvania Department of Environmental Protection's (PADEP) unleaded gasoline parameters. Results of soil analyses indicated elevated concentrations of Benzene and MTBE and results of groundwater analysis indicated elevated concentrations of Benzene, Toluene, Ethylbenzene, Naphthalene, and MTBE (see Figure 2: Field Investigation Map). Separate phase hydrocarbons were detected in two site monitoring wells (MW#3 and MW#4).

## **2.0 REMEDIAL FEASIBILITY TESTING**

On June 24, 2003, a dual phase vacuum enhanced extraction test was performed on monitoring well MW-3. The purpose of the test was to characterize the hydraulic and pneumatic properties of the shallow aquifer and vadose zone and to evaluate high vacuum soil vapor extraction (SVE) as a remedial alternative.

During the test vapor and water were extracted, separated and monitored. An Atlantic Fluidics A-20 (3 Hp) Liquid Ring Pump (LRP) was employed to extract vapors. In order to facilitate fluid extraction, the recovery well (MW#2) was fitted with an airtight seal. A one-inch diameter drop tube was inserted through the seal, approximately 7.5 feet into the water table. Vapors and groundwater were extracted through the drop tube. After separation, groundwater was discharged through a 200-pound carbon vessel. Flow rates were measured visually.

## **2.1 Remedial Feasibility Testing**

The following data was recorded from the extraction well during the test: applied vacuum, water flow rates, vapor flow rate, lower explosive limit (% LEL), photo ionization detector (PID) readings and oxygen (% O<sub>2</sub>). Depth to water was recorded in all monitoring wells prior to and after aquifer testing. Vapor and groundwater recovery was performed simultaneously. Magnahelic gauges were mounted on select monitoring wells and monitored for vacuum response during the test.

### **2.1.1 Vapor Recovery Data**

Testing was initiated by applying a wellhead vacuum of 25 inches of mercury. Airflow was measured through a rotometer mounted on the exhaust port of the LRP. An airflow of 4.0 to 6.0 standard feet per cubic minute (SCFM) was obtained.

Vapor effluent samples were collected and field screened periodically throughout the test. PID readings ranged from 30 to 266 parts per million (ppm). Per cent LEL and O<sub>2</sub> readings were taken in conjunction with the PID. LEL readings ranged from 5 to 28%. O<sub>2</sub> readings ranged from 20.0 to 20.9 %. Table 1 contains a summary of the field screening data.

Hydrocarbon removal rates were calculated using %LEL and airflow obtained from the field measurements. Hydrocarbon removal rates are summarized in Table 1. Vapor recovery rates ranged from 0.05 to 0.27 lbs./hr. Removal rates were calculated using equations developed by the American Petroleum Institute (API). A sample equation is provided below Table 1.

A time-series plot (%LEL, %O<sub>2</sub> and hydrocarbon recovery vs. time) is presented as Chart 1.

A vapor sample was collected at the end of testing. The sample was submitted to Environmental Laboratory Services, Inc. and analyzed for Benzene, Toluene, Ethylbenzene, Xylenes, Methyl-t-butyl ether (MTBE) and Gasoline Range Organics (GRO). The results are summarized below and indicate that appreciable hydrocarbon recovery was still occurring at the end of remedial testing.

Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	GRO
25.8	2.83	3.74	3.78	<0.1	300

Results are reported in ppm.

### 2.1.2 Hydraulic / Pneumatic Influence

Groundwater was recovered at an average of 1.22 gallons per minute (gpm) following stabilization. Monitoring wells MW#1, MW#2, MW#3, MW#4, MW#5, MW#6, MW#7, and MW#8 were gauged prior to and after testing. Drawdown at recovery well MW#2 corresponds to the bottom of the drop tube. Drawdown ranged from -0.04 (MW#4) to -2.91' (MW#3) feet. Groundwater drawdown data is summarized in Table 2.

Magnahelic gauges were mounted on adjacent monitoring wells (MW#1, MW#3, MW#4, MW#6, MW#7 and MW#8) to measure resultant formation vacuums. A maximum vacuum response of 1.5 inches of water was obtained in MW#1. An induced vacuum of 0.1 inches of water was observed in monitoring well MW#8. Vacuum response data is summarized on Table 3. Vacuum response data from select wells is graphed on Chart 2.

Groundwater drawdown data generated during remedial testing indicates that a cone of depression of approximately 57 feet was created while pumping MW#2 at a relatively low flow rate of 1.2 gpm. Trends in the data suggest the cone of depression will be further expanded with

long term pumping. Vacuum response data indicates a zone of influence of approximately 57 feet was achieved during testing.. This data suggests that an applied vacuum of at least 23 inches of mercury is more than adequate to create an SVE radius of influence.

### **3.0 REMEDIAL ALTERNATIVE EVALUATION**

Several recovery/treatment processes are typically used throughout the petroleum remediation industry to remove dissolved and absorbed phase volatile hydrocarbons from the subsurface. The choices usually chosen are air sparging, excavation, pump and treat and soil vapor extraction (SVE).

#### **3.1 Air Sparging**

One remedial action alternative considered was air sparging in conjunction with SVE. The effectiveness of air sparging is sensitive to the type of lithology present in the saturated and unsaturated zones. The formation of gas pockets can cause significant lateral displacement of water, which can cause lateral migration of dissolved phase hydrocarbons. Due to the location of the hydrocarbon impacted area in relation to the subject site property boundary, this method was not considered the best remedial alternative.

#### **3.2 Excavation**

Excavation of impacted soils containing concentrations of hydrocarbons is primarily used as an interim remedial action. Excavation is usually restricted to shallow areas in the unsaturated zone. Excavation will not directly address dissolved phase hydrocarbons. Due to the presence of dissolved hydrocarbons and the site disturbance created by excavation, this method was not considered a practical remedial alternative.

#### **3.3 Pump and Treat**

Another remedial alternative is pump and treat. Pump and treat is useful when removing

liquid and dissolved phases of hydrocarbons or to maintain hydraulic control, but when used as a stand alone technology, will not remove the residual material contributing to the dissolved phase impacts.

### **3.4 Soil Vapor Extraction**

Soil vapor extraction involves the volatilization of hydrocarbons present in the unsaturated zone. SVE, by the introduction of oxygen, would also promote biodegradation in both the saturated and unsaturated zones. SVE is a viable remedial option for the removal of hydrocarbons from the unsaturated and dewatered saturated zones.

## **4.0 PROPOSED REMEDIAL ACTION PLAN**

Based upon evaluation of the data included with this report, a remedial action plan (RAP) involving installation of a dual phase high vacuum extraction (DPE) system is recommended. Monitoring wells MW#1, MW#3, MW#4, MW#5 and MW#6 will be utilized as recovery wells.

Site preparation would include the installation of below grade recovery piping (2-inch diameter, schedule 40 PVC) and modification of the recovery well heads. Trenching would be required for electric, vapor extraction, groundwater recovery piping and a discharge line to the groundwater discharge location.

The proposed remediation system consists of an 7.5 Hp oil sealed liquid ring pump (LRP) to recover liquid and vapor phase fluids. The pump consists of a shrouded rotor which rotates freely within an eccentric casing. There is no metal to metal contact between the rotor and casing. Centrifugal force acting on liquids within the pump causes the liquids to form a ring inside the casing. A fixed port cylinder, concentric with the rotor, directs the gas into the suction ports. Gas is trapped between the blades by the liquid pistons formed by centrifugal force as the liquid recedes from the port cylinder. It is trapped at the point of maximum eccentricity and is then compressed by the liquid ring as it is forced radially inward toward the central port cylinder.



After each revolution, the compressed gas and accompanying liquid are discharged. During the pumping cycle, the gas is in intimate contact with the sealing liquid and compression is nearly isothermal. When handling saturated vapor-gas mixtures, the liquid ring acts as a condenser, greatly increasing the effective capacity of the pump. Seal liquid will be oil supplied via a reservoir mounted on the LRP skid.

The recovered fluids will be pumped through a vapor/liquid knockout tank. Liquids would then be directed, via transfer pump, through liquid phase granular activated carbon absorbers (GACA) to municipal sewage. The manufacturer's carbon adsorbers specifications are attached. A proposed Process and Instrumentation Flow Diagram is also attached as Figure 3.

Vapors will be drawn from the knockout tank through the LRP and vapor phase GACA's and discharged to the atmosphere. Treatment of the vapors will be conducted through two carbon units. The manufacturer's carbon adsorbers specifications are attached. A Request for Determination of Requirement for Plan Approval/Operating Permit (RFD) will be submitted to the PADEP Bureau of Air Quality.

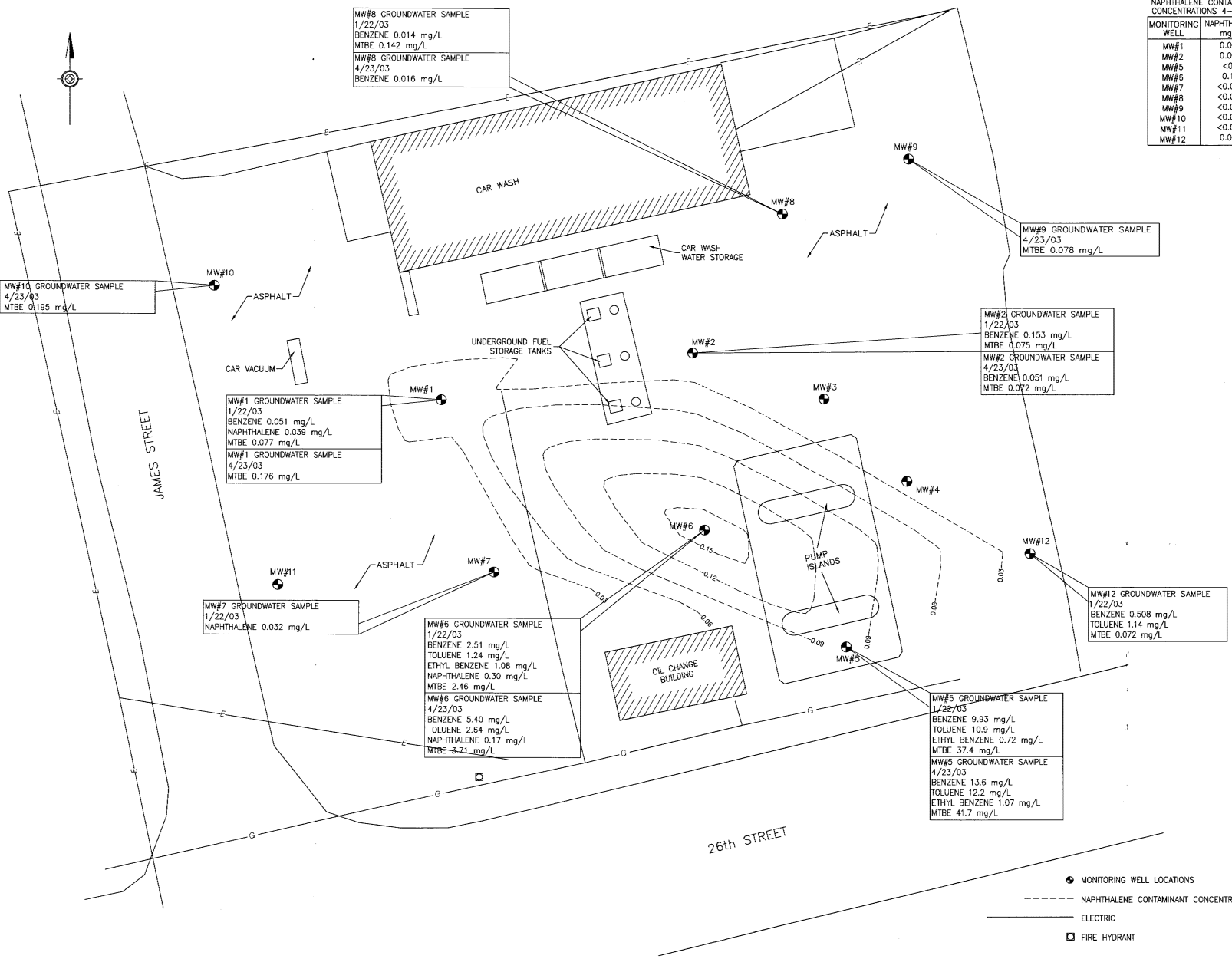
## **5.0 MAINTENANCE AND SAMPLING SCHEDULE**

The remediation system will be checked twice per month to assure proper working conditions. It is anticipated that effluent water will be sampled once a month as per local sewage authority permit requirements. Flow meter measurements from the effluent water will also be taken monthly. Both water and air activated carbon units will be sampled monthly before and between activated carbon units to determine the effectiveness of the units. Groundwater samples will be obtained quarterly from monitoring wells MW#2, MW#7, MW#8, MW#9, and MW#12 to determine the effectiveness of the remediation system. Static water levels will be obtained quarterly from all none pumping monitoring wells. Results of the above referenced sampling will be summarized in a quarterly remedial action status report.

FIGURE 1

MW#8 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.014 mg/L  
MTBE 0.142 mg/L  
MW#8 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 0.016 mg/L

NAPHTHALENE CONTAMINANT CONCENTRATIONS 4-23-03	
MONITORING WELL	NAPHTHALENE mg/L
MW#1	0.038
MW#2	0.002
MW#5	<0.1
MW#6	0.17
MW#7	<0.002
MW#8	<0.002
MW#9	<0.002
MW#10	<0.002
MW#11	<0.002
MW#12	0.017



MW#9 GROUNDWATER SAMPLE  
4/23/03  
MTBE 0.078 mg/L

MW#2 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.153 mg/L  
MTBE 0.075 mg/L  
MW#2 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 0.051 mg/L  
MTBE 0.092 mg/L

MW#1 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.051 mg/L  
NAPHTHALENE 0.039 mg/L  
MTBE 0.077 mg/L  
MW#1 GROUNDWATER SAMPLE  
4/23/03  
MTBE 0.176 mg/L

MW#10 GROUNDWATER SAMPLE  
4/23/03  
MTBE 0.195 mg/L

MW#7 GROUNDWATER SAMPLE  
1/22/03  
NAPHTHALENE 0.032 mg/L

MW#6 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 2.51 mg/L  
TOLUENE 1.24 mg/L  
ETHYL BENZENE 1.08 mg/L  
NAPHTHALENE 0.30 mg/L  
MTBE 2.46 mg/L  
MW#6 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 5.40 mg/L  
TOLUENE 2.54 mg/L  
NAPHTHALENE 0.17 mg/L  
MTBE 3.71 mg/L

MW#12 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.508 mg/L  
TOLUENE 1.14 mg/L  
MTBE 0.072 mg/L

MW#5 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 9.93 mg/L  
TOLUENE 10.9 mg/L  
ETHYL BENZENE 0.72 mg/L  
MTBE 37.4 mg/L  
MW#5 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 13.6 mg/L  
TOLUENE 12.2 mg/L  
ETHYL BENZENE 1.07 mg/L  
MTBE 41.7 mg/L

- MONITORING WELL LOCATIONS
- - - - - NAPHTHALENE CONTAMINANT CONCENTRATION CONTOUR (mg/L)(4-23-03)
- ELECTRIC
- FIRE HYDRANT

NO.	DATE	REVISIONS	
		DESCRIPTION	

DESIGNED BY	DATE	DATE	DATE	DATE	DATE
CHECKED BY					
APPROVED					
SCALE	1"=10'				
DRAWING NO.					

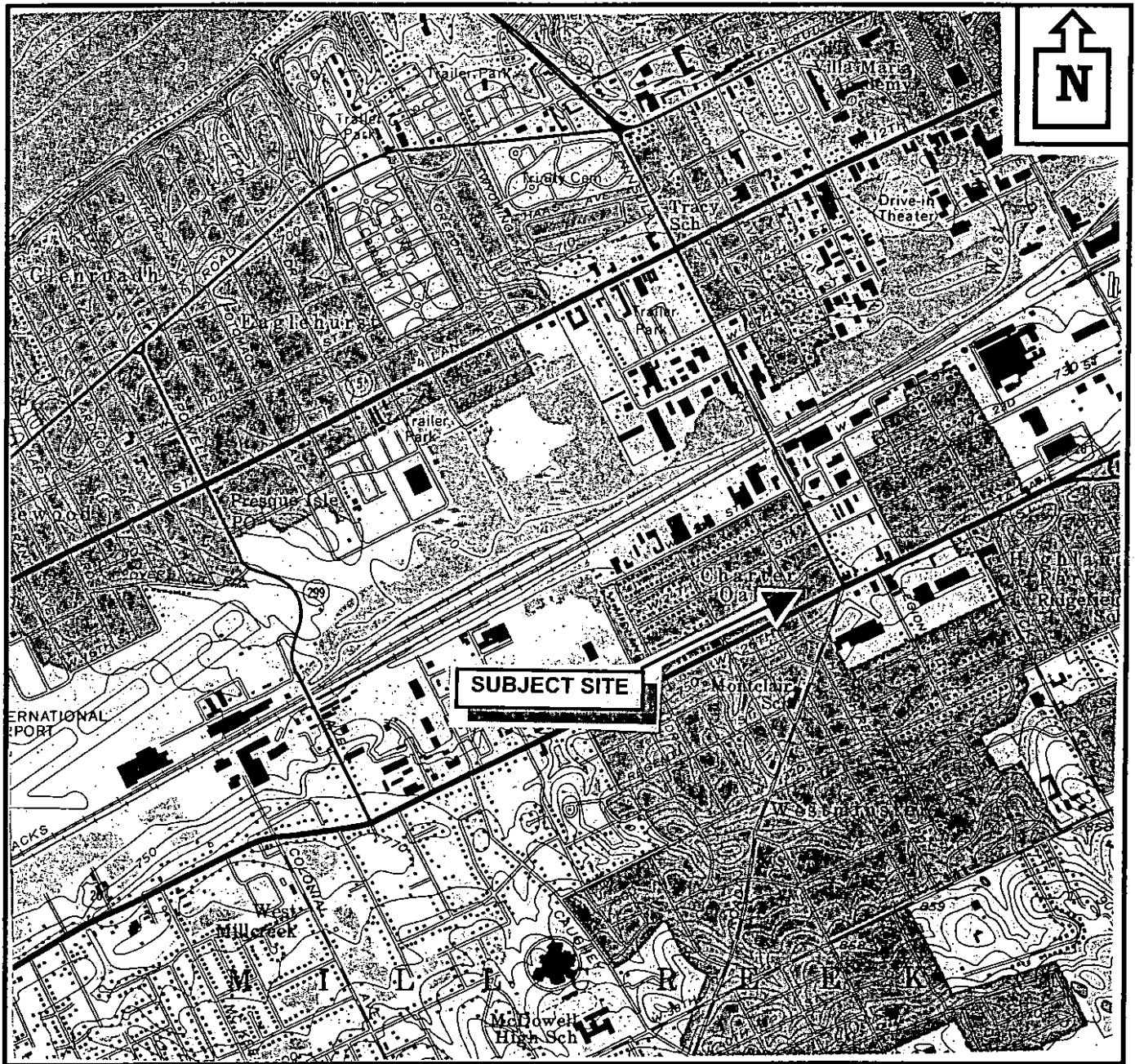
DRAWING TITLE: #3 CAR WASH  
LEO'S CAR WASH  
ERIE, PA  
FIGURE 7:  
NAPHTHALENE CONTAMINANT  
CONCENTRATION MAP

**RAR engineering group, inc.**  
1115 Burke Avenue, New Castle, Pennsylvania 16001  
Telephone: 724.652.0004 Fax: 724.652.3841  
email: enr@engrgr.com

SCALE  
SIGNATURE  
DATE

1 of 1  
SHEET NUMBER

FIGURE 1: LOCATION MAP



## LOCATION MAP

Figure 1

LEO'S #3 CAR WASH  
2938 WEST 26TH STREET  
MILLCREEK TOWNSHIP  
ERIE COUNTY, PENNSYLVANIA

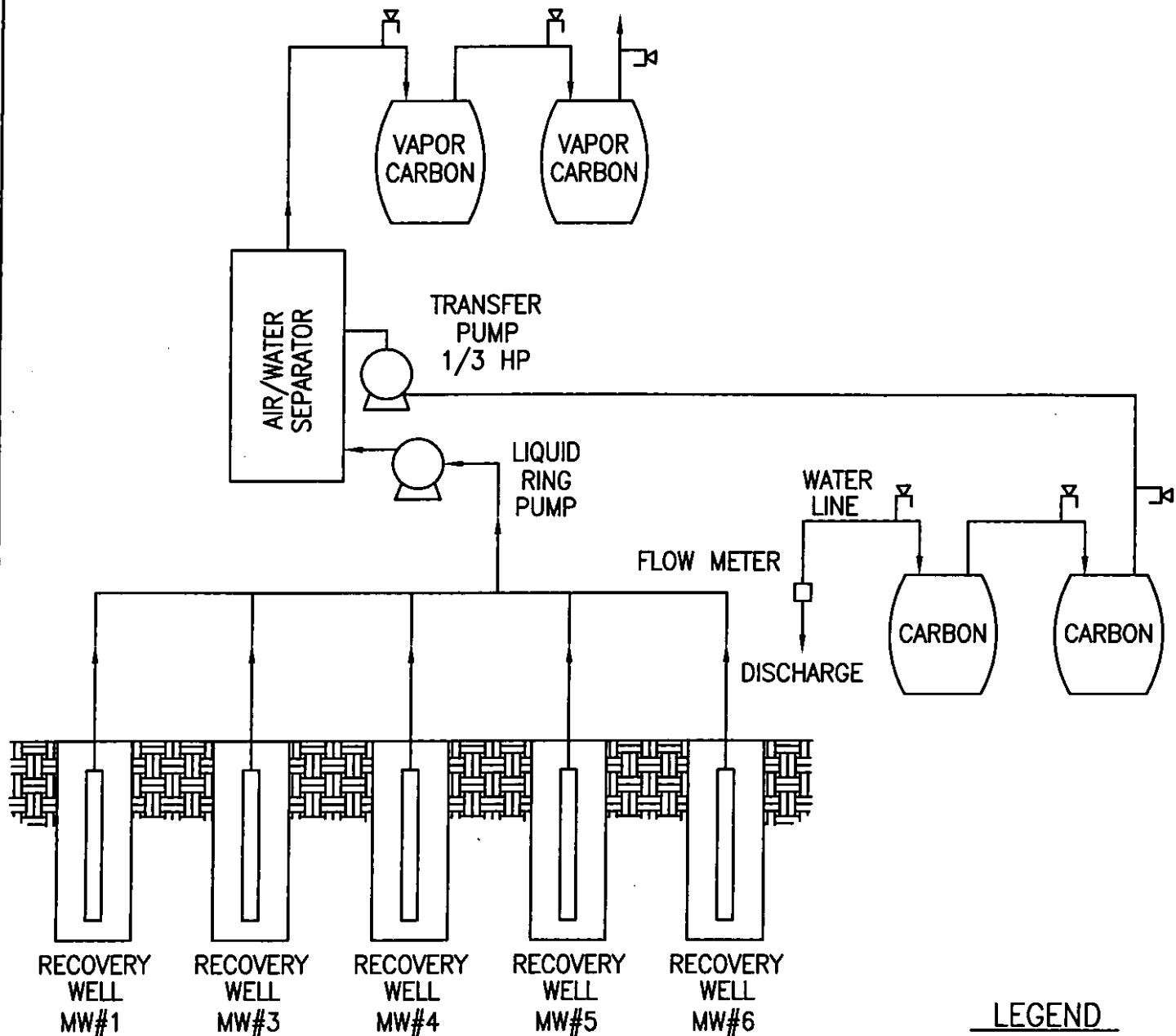
FIGURE 2


FIGURE 2: FIELD INVESTIGATION MAP

FIGURE 3



FIGURE 3: PROCESS AND INSTRUMENTATION  
DIAGRAM



**LEGEND**  
 SAMPLE PORT

**RAR engineering group, inc.**  
 1135 Butler Avenue, New Castle, Pennsylvania 16101  
 telephone 724.652.1004 facsimile 724.652.3814  
 email rarengineering@rarengineering.com

**LEO'S #3 CAR WASH**  
**2938 WEST 26TH STREET**

**PROCESS AND INSTRUMENTATION DIAGRAM**

ERIE COUNTY

PENNSYLVANIA

SEAL

DESIGNED BY		DATE	
DRAWN BY	BAW	DATE	7/2003
CHECKED BY	JSW	DATE	7/2003
SCALE NOT TO SCALE			
FILE NAME			
REVISION		DATE	

SIGNATURE

DATE

FIGURE A

FIGURE 4: REMEDIAL ACTION PLAN MAP

FIGURE 5

FIGURE 5: BENZENE GROUNDWATER CONTAMINANT  
CONCENTRATION MAP

FIGURE 6

FIGURE 6: TOLUENE GROUNDWATER CONTAMINANT  
CONCENTRATION MAP



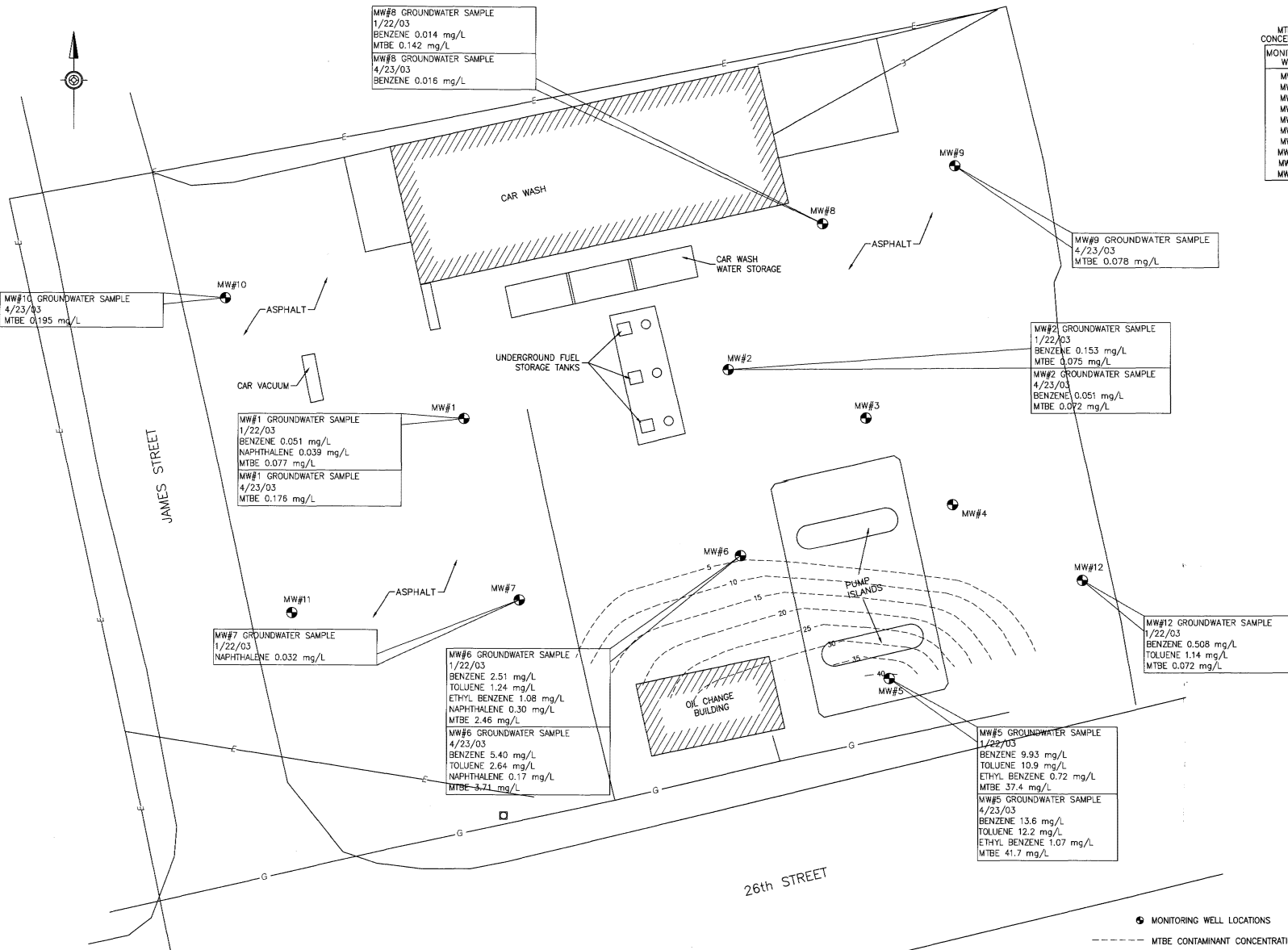
FIGURE 7

FIGURE 7: NAPHTHALENE GROUNDWATER CONTAMINANT  
CONCENTRATION MAP

FIGURE 8

FIGURE 7: NAPHTHALENE GROUNDWATER CONTAMINANT  
CONCENTRATION MAP

FIGURE 8: MTBE GROUNDWATER CONTAMINANT  
CONCENTRATION MAP



MW#8 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.014 mg/L  
MTBE 0.142 mg/L  
MW#8 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 0.016 mg/L

MW#10 GROUNDWATER SAMPLE  
4/23/03  
MTBE 0.195 mg/L

MW#1 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.051 mg/L  
NAPHTHALENE 0.039 mg/L  
MTBE 0.077 mg/L  
MW#1 GROUNDWATER SAMPLE  
4/23/03  
MTBE 0.176 mg/L

MW#7 GROUNDWATER SAMPLE  
1/22/03  
NAPHTHALENE 0.032 mg/L

MW#6 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 2.51 mg/L  
TOLUENE 1.24 mg/L  
ETHYL BENZENE 1.08 mg/L  
NAPHTHALENE 0.30 mg/L  
MTBE 2.46 mg/L  
MW#6 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 5.40 mg/L  
TOLUENE 2.64 mg/L  
NAPHTHALENE 0.17 mg/L  
MTBE 3.71 mg/L

MW#5 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 9.93 mg/L  
TOLUENE 10.9 mg/L  
ETHYL BENZENE 0.72 mg/L  
MTBE 37.4 mg/L  
MW#5 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 13.6 mg/L  
TOLUENE 12.2 mg/L  
ETHYL BENZENE 1.07 mg/L  
MTBE 41.7 mg/L

MW#2 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.153 mg/L  
MTBE 0.075 mg/L  
MW#2 GROUNDWATER SAMPLE  
4/23/03  
BENZENE 0.051 mg/L  
MTBE 0.072 mg/L

MW#9 GROUNDWATER SAMPLE  
4/23/03  
MTBE 0.078 mg/L

MW#12 GROUNDWATER SAMPLE  
1/22/03  
BENZENE 0.508 mg/L  
TOLUENE 1.14 mg/L  
MTBE 0.072 mg/L

MTBE CONTAMINANT CONCENTRATIONS 4-23-03

MONITORING WELL	MTBE mg/L
MW#1	0.176
MW#2	0.072
MW#5	41.7
MW#6	3.71
MW#7	<0.002
MW#8	0.077
MW#9	0.078
MW#10	0.195
MW#11	<0.002
MW#12	0.072

- MONITORING WELL LOCATIONS
- MTBE CONTAMINANT CONCENTRATION CONTOUR (mg/L)(4-23-03)
- ELECTRIC
- FIRE HYDRANT

REVISIONS	
NO.	DATE

DESIGNED BY	DATE	CHECKED BY	DATE	APPROVED	DATE
	7/20/03		7/20/03		

SCALE 1"=10'  
DRAWING NO.

DRAWING TITLE:  
LEO'S #3 CAR WASH  
ERIE, PA  
FIGURE B:  
MTBE CONTAMINANT  
CONCENTRATION MAP

**RAR engineering group, inc.**  
1133 Butler Avenue, New Castle, Pennsylvania 16101  
telephone 724.652.1004 faxnumber 724.652.3814  
email rarengr@rcg.com

DATE  
SEAL  
SIGNATURE

1 of 1  
SHEET NUMBER

TABLE 1

TABLE 1: HYDROCARBON RECOVERY DATA



TABLE 1  
MW-2 HYDROCARBON RECOVERY DATA

LEO'S #3 CAR WASH  
ERIE, PENNSYLVANIA

Data Collected: June 23, 2003

Data Collection Time (Hrs.)	Applied Vacuum (In. of Hg)	PID (ppm)	%O2	%LEL	SCFM	Recovery data	
						Lbs/Hr*	Gallons per minute
0.00	25	30	20.4	5	6.00	0.06	1.10
0.50	22	52	20.2	5	5.00	0.05	0.90
1.50	22	212	20.9	18	4.00	0.14	1.30
2.00	23	208	20.1	26	5.00	0.25	1.50
2.50	23	254	20.1	26	5.00	0.25	1.50
3.00	22	266	20.4	22	5.00	0.21	1.30
3.50	23	214	20.2	25	5.00	0.24	1.00
4.00	23	247	20.2	22	5.00	0.21	1.60
4.50	23	198	20	28	5.00	0.27	1.00
5.00	23	205	20.2	22	5.00	0.21	1.00

Sample Calculation:

$$*lbs/hr = (\%LEL)140(SCFM)(1.36E-5)$$

Adapted from Subsurface Venting from an Underground Aquifer, API Publication #4410, September 1985.

TABLE 2

TABLE 2: GROUNDWATER DRAWDOWN DATA

TABLE 2  
GROUNDWATER DRAWDOWN DATA

LEO'S #3 CAR WASH  
ERIE, PENNSYLVANIA

Data Collected: June 23, 2003

Monitoring Well	0 Hrs		5.25 Hrs		$\Delta h$
	DTP	DTW	DTP	DTW	
MW-1	ND	11.46'	ND	12.32'	0.86'
MW-2	ND	10.55	ND	18.02'	7.47'
MW-3	9.54	10.24'	9.68'	13.15'	2.91'
MW-4	9.04'	10.24'	9.08'	10.28'	0.04'
MW-6	ND	11.39'	ND	11.39'	0.00'
MW-7	ND	8.13'	ND	8.13'	0.00'
MW-8	ND	12.92'	ND	13.62'	0.70'

ND - No LPH detected  
 $\Delta h$  - Groundwater Drawdown  
 DTP - Depth to product (feet)  
 DTW - Depth to water (feet)

TABLE 3

TABLE 3: VACUUM RESPONSE DATA

TABLE 3  
VACUUM RESPONSE DATA

LEO'S #3 CAR WASH  
ERIE, PENNSYLVANIA

Data Collected: June 24, 2003

Monitoring Well	Distance from MW-2 (ft)	0.5 Hrs.	1.0 Hrs.	1.5 Hrs.	2.0 Hrs.	2.5 Hrs.	3.0 Hrs.	3.5 Hrs.	4.0 Hrs.	4.5 Hrs.	5.0 Hrs.
MW-1	57	0.0	0.3	0.8	1.5	1.5	1.5	0.8	0.6	0.6	0.6
MW-3	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MW-4	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MW-6	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MW-7	75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MW-8	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1

Vacuum response data expressed in inches of water

CHART 1



CHART 1: RECOVERY DATA (MW#2)

CHART 1  
 RECOVERY DATA  
 Lower Explosive Limit, Hydrocarbon Recovery and Oxygen  
 Leo's #3 Car Wash  
 Erie, Pennsylvania

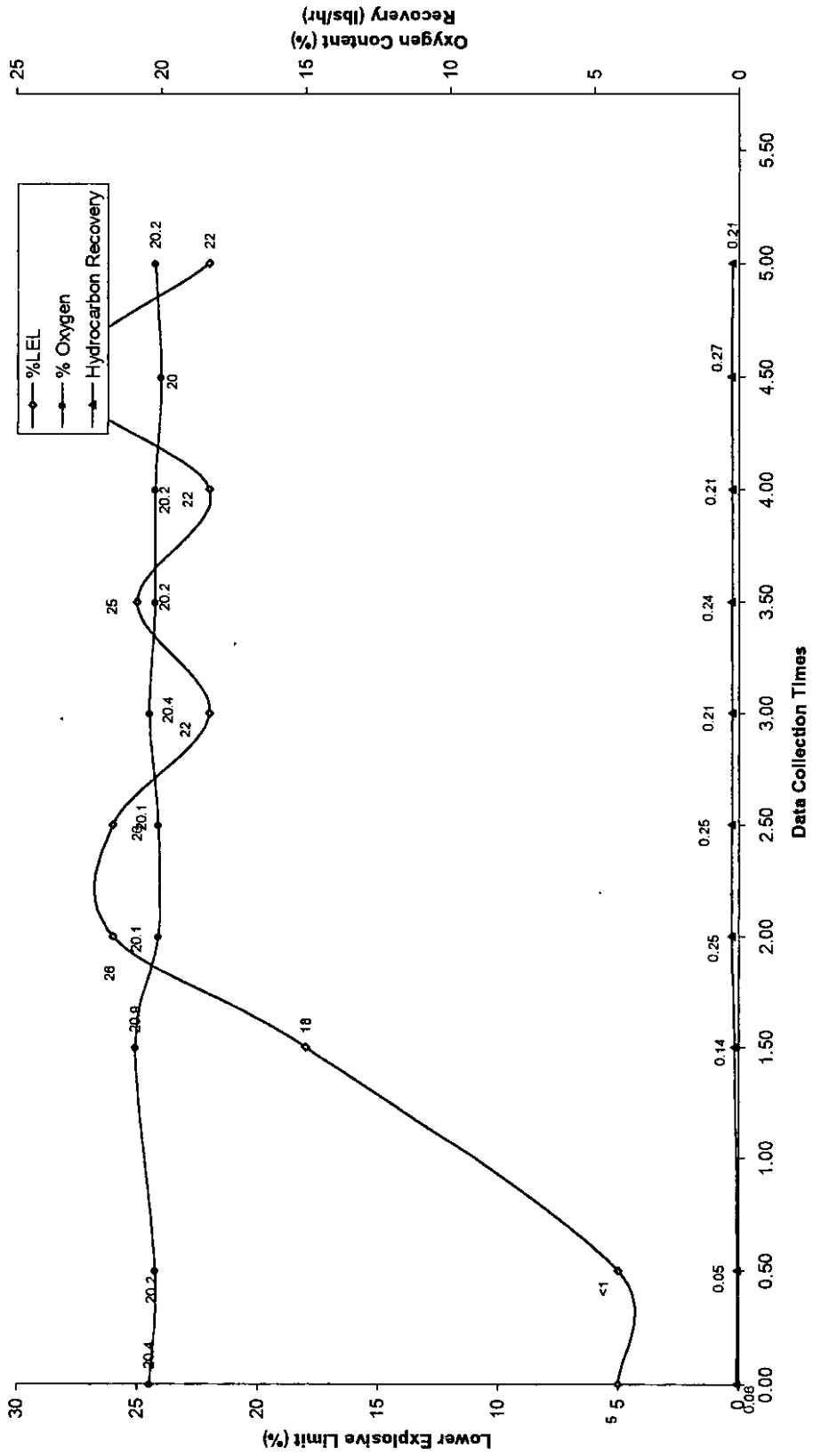
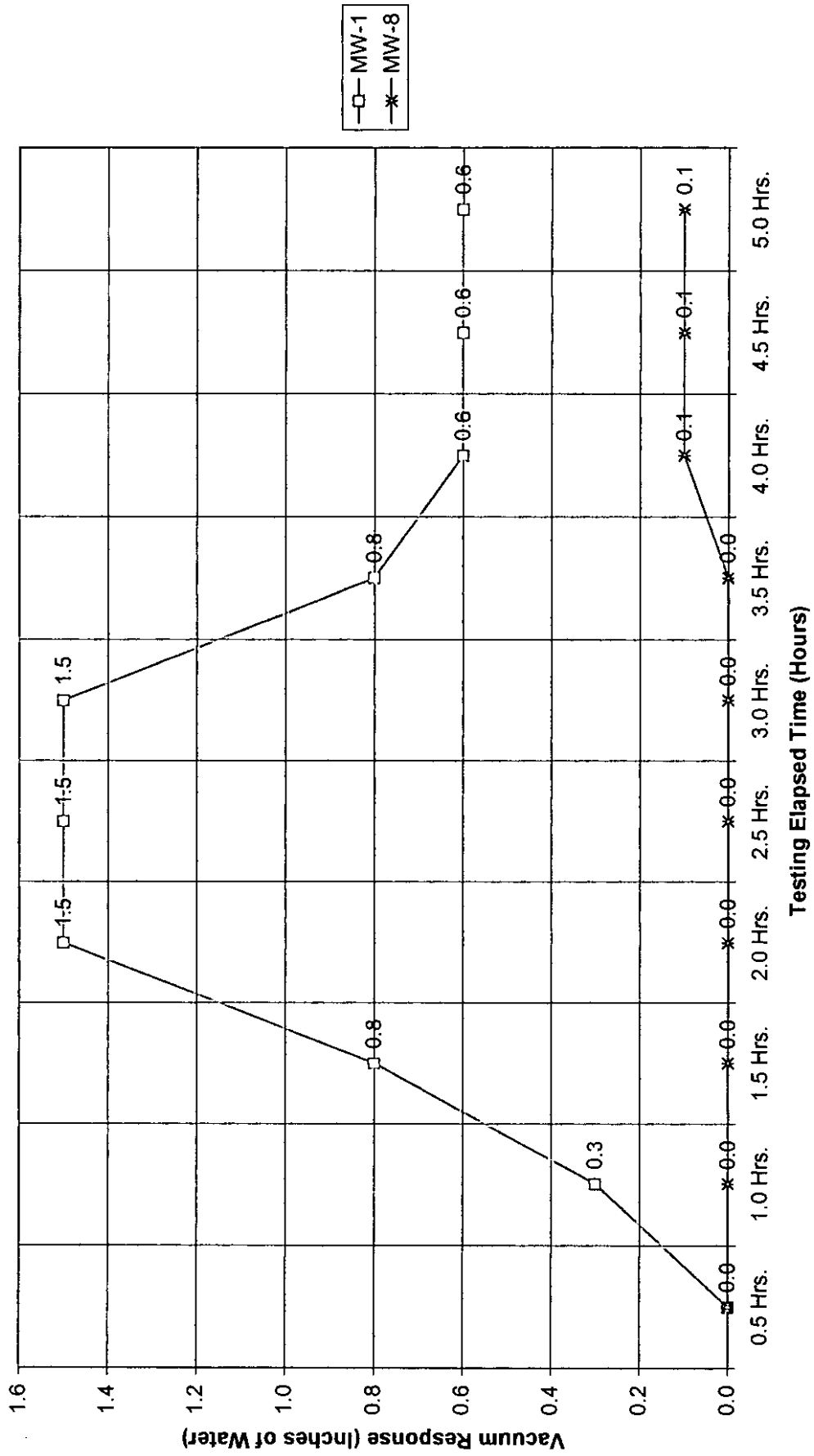


CHART 2

CHART 2: VACUUM RESPONSE DATA (MW#2)

Chart 2  
 Vacuum Response Data  
 LEO'S #3 CAR WASH ERIE, PA



Spec. 1

SPEC. 1: CARBON ADSORBERS SPECIFICATIONS



CALGON CARBON CORPORATION

# EQUIPMENT BULLETIN VENTSORB

## GENERAL DESCRIPTION

VentSorb canisters – each containing 180 pounds of activated carbon – are ideal for low-flow air purification applications at industrial and municipal facilities. These economical adsorption systems control small volume organic contaminant and/or odorous gas emissions from:

- Storage tank vents
- Reactor vents
- API separator vents
- Sludge thickener tanks at waste treatment plants
- Sewer gas vents, wet stations and weir boxes at chemical and municipal waste treatment plants
- Chemical plant wastewater holding tanks
- Laboratory hood exhausts
- Landfills
- Airstripper off-gases

The 55-gallon VentSorb canisters contain all the elements found in a full-scale adsorption system vessel; activated carbon, inlet connection and distributor, and an outlet connection for the purified air stream. Air is distributed across the carbon bed with a corrosion-resistant stainless steel septum.

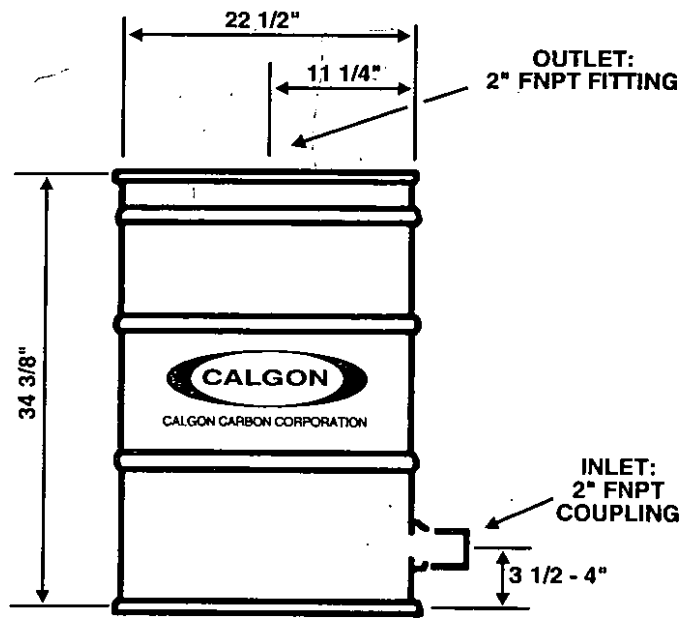
## FEATURES AND BENEFITS

VentSorb canisters offer industrial and municipal users several important features and benefits, including:

- Effective treatment to remove a variety of vapor phase organic contaminants and odor-causing compounds.
- Continuous treatment at varying flow rates and concentrations.
- Simple installation and operation.
- Flexibility to be installed in series or multiple units in parallel.
- Supplied with the type of activated carbon selected specifically for the application.
- Practical disposal option, as pre-approved spent carbon canisters may be returned to Calgon Carbon Corporation for safe carbon reactivation.
- Low cost per unit makes carbon treatment economical.

## VENTSORB SPECIFICATIONS

Vessel: ..... Open head 16 gauge steel canister  
 Max Operating Pressure: ..... 4 psig  
 Cover: ..... Removable steel cover, 12 gauge bolt ring with polycord gasket  
 Internal Coating: ..... Heat cured 100% phenolic  
 External Coating: ..... High solids enamel  
 Temperature: ..... 350°F (intermittent) (176.7°C)  
 Inlet: ..... 2" FNPT: 304 stainless steel screen distributor  
 Outlet: ..... 2" FNPT  
 Max Flow: ..... 100 cfm (2.83m<sup>3</sup>/min)  
 Carbon: ..... 180 pounds Pellet BG or BPL 4x10 or VPR  
 Ship Weight: ..... 247 pounds (112.3kg)  
 Identification: ..... VentSorbs sequentially numbered for reference



VENTSORB DIMENSIONS



## TYPICAL VENTSORB APPLICATIONS

Chemical, petrochemical, food, pulp and paper, and many other industrial plants – along with municipal sewage treatment facilities – are frequent users of VentSorb units for continuous control of vented emissions. Here are a few examples of user applications:

**Storage Tank Vents** – VentSorb units are widely used to control evaporative losses vented from storage tanks. Typically, these vapors are emitted during tank filling and emptying. In one application, a glycerin manufacturer is using the canisters to purify ambient air drawn into storage tanks during product transfer. The adsorption process helps prevent contamination of the company's glycerin product. The VentSorb units provide over six months of service for this application.

**Reactor Vents** – A pesticide manufacturer is using multiple VentSorb units on five reactor vessels to control trace amounts of odorous methylamine and diethylamine (which are by-products of a caustic scrubbing process). Each VentSorb unit handles a 30 cfm air stream containing 15 ppm of amine vapors. The units provide over three months of service for this application.

**API Separator Vents** – A major refinery is using VentSorb units to control odorous emissions from settling basins where oil is separated from wastewater that is discharged in condensate, blowdown or drain systems. For this application, API separators are covered and vented to comply with local air pollution control regulations. The air stream is pulled through two VentSorb units, operating in parallel configuration, at 100 cfm.

## VENTSORB INSTALLATION

VentSorb canisters are shipped ready for installation. Each canister is self-supporting and should be placed on a level, accessible area as near as possible to the emission source. Installation is simple, requiring just a flexible hose or pipe to connect the vent to the 2-inch FNPT bottom inlet of the canister.

If the VentSorb will be vented directly to outside air, a U-shaped outlet pipe or rain hat – such as a pipe tee – is recommended to prevent precipitation from entering the unit.

VentSorb canisters operate from a continuous suction across the vent. The suction can be produced by a blower or by using the positive pressure inside the tank or process vessel. In many cases, the pressure or surge of pressure within the tank or vessel is sufficient to overcome the pressure drop across the canister – thus eliminating the need for a blower. Please consult pressure drop data in this bulletin for more information.

Maximum recommended air flow through a VentSorb is 100 cfm. If higher flows are encountered, plant operators should install two or more canisters in parallel configuration.

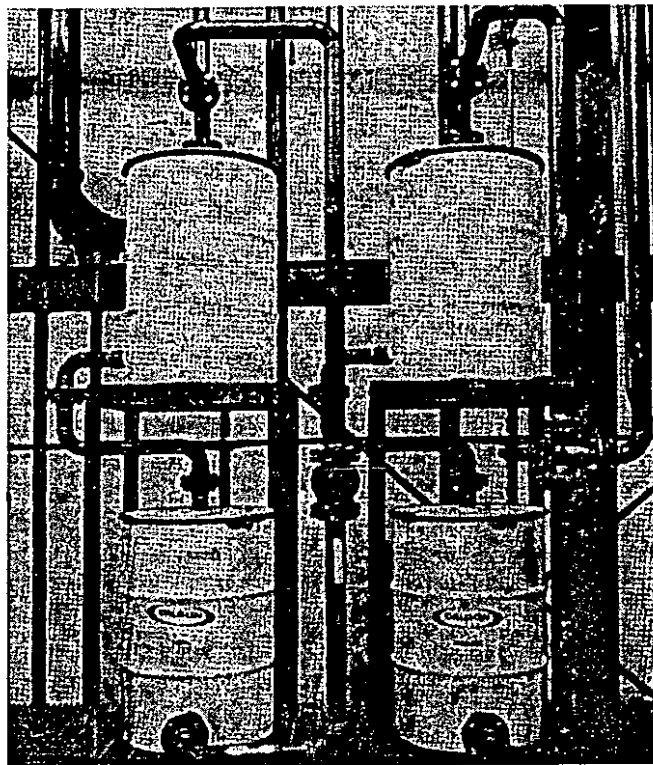
When VentSorb canisters are used to control vapors from organic solvent storage tanks, the following precautions are recommended:

- A safety relief valve must be provided. This protects the storage tank should the VentSorb become plugged or blocked in any fashion. Such a vent would open in this emergency situation, thereby relieving pressure.
- Under appropriate conditions, a flame arrestor and/or

backflow preventer must be installed as shown in this bulletin's storage tank installation drawing. This prevents backflow of air through the VentSorb when the storage tank is empty.

- Pre-wetting the carbon helps dissipate excessive heat that may be caused by high organic compound concentration (>0.5 to 1.0 Vol. %).

Also, if VentSorb canisters are used to control organic emissions from airstrippers or other high moisture content air streams, Calgon Carbon Corporation recommends that humidity in the air stream be reduced to under 50 percent. Lower humidity optimizes adsorptive capacity of the carbon. In addition, for similar applications that generate a condensate, Calgon Carbon Corporation recommends installation of a drain on the inlet piping.



Four VentSorb units at a chemical plant are installed to operate in series and in parallel. More than 25 odorous and/or toxic vapors are controlled by 80 VentSorb units at this plant.

## RETURN OF VENTSORBS

Arrangements should be made at the time of purchase regarding the future return of canisters containing spent carbon. Calgon Carbon Corporation will provide instructions on how to sample the spent carbon and arrange for carbon acceptance testing. The spent carbon is reactivated by Calgon Carbon Corporation and all of the contaminants are thermally destroyed. Calgon Carbon Corporation will not accept VentSorb units for landfill, incineration or other means of disposal.

No VentSorb units can be returned to the company unless the carbon acceptance procedure has been completed, an acceptance number provided, and the return labels (included with the units at the time of purchase) are attached.

VentSorb units must be drained – and inlet/outlet connections must be plugged – prior to return to Calgon Carbon Corporation.

## THEORETICAL VENTSORB CAPACITIES

Theoretical Ventsorb Capacity Lb Adsorbed/VentSorb\*

	<u>BOILING POINT/°C</u>	<u>MOLECULAR WEIGHT</u>	<u>10 PPM</u>	<u>100 PPM</u>	<u>1,000 PPM</u>
Acrylonitrile	77.3	53.1	6	12	24
Benzene	80.1	78.1	14	23	36
n-Butane	-0.5	58.1	4	8	13
Carbon Tetrachloride	76.8	153.8	40	56	76
Dichloroethylene	37.0	97.0	12	21	35
Methylene	40.2	84.9	3	7	18
Freon 114	3.8	170.9	11	19	33
n-Hexane	68.7	86.2	18	25	34
Styrene	145.2	104.1	45	57	71
Toluene	110.6	92.1	34	44	58
Trichloroethylene	87.2	131.4	33	50	73

\* Theoretical capacity based on 70 degrees F., atmospheric pressure, less than 50 percent humidity and 180 pounds of carbon using isotherm data for Pellet BG carbon.

### VENTSORB CARBON LIFE ESTIMATE

This table lists the theoretical adsorption capacities for several compounds. The adsorption capacity for nonpolar organics increases with the boiling point, molecular weight and concentration of the air contaminant. Estimate the life of a VentSorb canister for other organic compounds by matching them with compounds of similar boiling point and molecular weight in this table. Low molecular weight (less than 50) and/or highly polar compounds such as formaldehyde, methane, ethanol, etc., will not be readily adsorbed at low concentrations.

Note: The standard VentSorb canister contains 180 pounds of Pellet BG carbon. When removing hydrogen sulfide and mercaptans from moist air vented from sewage operations, greater efficiency will be achieved by using a VentSorb canister which contains specially impregnated IVP carbon. A VentSorb containing IVP carbon can remove up to 40 pounds of hydrogen sulfide and 15 pounds of methyl mercaptan.

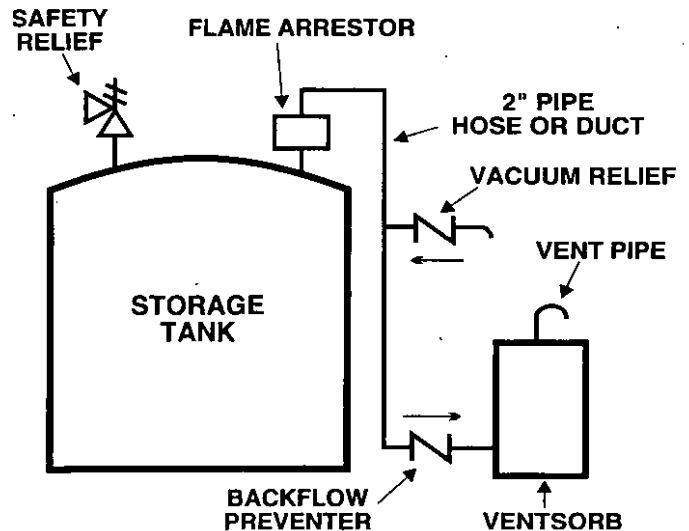
### VENTSORB SAFETY CONSIDERATIONS

While complying with recommended installation instructions, plant operators should also be aware of these additional heat-related safety considerations:

1. When contacting with activated carbon, some types of chemical compounds – such as those from the ketone and aldehyde families and some organic acids or organic sulfur compounds – may react on the carbon surface causing severe exotherms or temperature excursions. **If you are unaware or unsure of the reaction of an organic compound on activated carbon, appropriate tests should be performed before putting a VentSorb in service.**
2. Heat of adsorption can lead to severe temperature excursions at high concentrations of organic compounds. Heating may be controlled by diluting the inlet air, time weighting the inlet concentration to allow heat to dissipate, or pre-wetting the carbon.
3. **Do not use VentSorbs with IVP carbon in petrochemical or chemical industry applications.**

4. IVP carbon can liberate heat by reacting chemically with oxygen. To prevent heat within a vessel, the carbon must not be confined without adequate air flow to dissipate the heat. In situations where there is insufficient or disrupted air flow through the vessel, the chemical reaction can be prevented by sealing the inlet and outlet connections to the vessel.

**NOTE: CONTACT YOUR LOCAL CALGON CARBON CORPORATION TECHNICAL SALES REPRESENTATIVE FOR CLARIFICATION OR TO ANSWER ANY QUESTIONS.**



Typical VentSorb Installation  
at Storage Tank

## CALGON CARBON CORPORATION AIR PURIFICATION SYSTEMS

VentSorb is a unit specifically designed for a variety of small applications. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for a greater range of flow rates and carbon usages to meet specific applications.

## WARRANTY

There are no expressed or implied warranties – or any warranty of merchantability or fitness – for a particular purpose associated with the sale of this product.

## LIMITATION OF LIABILITY

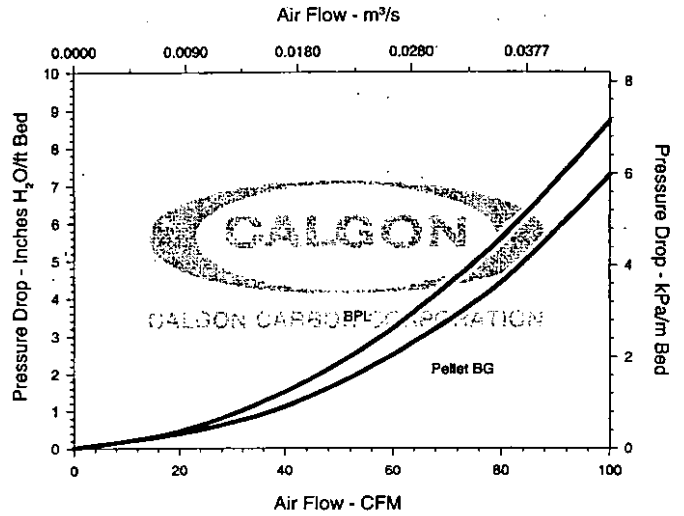
The Purchaser's exclusive remedy for any cause of action arising out of purchase and use of the VentSorb, including but not limited to breach of warranty, negligence and/or indemnification, is expressly limited to a maximum of the purchase price of the VentSorb unit as sold. All claims of whatsoever nature shall be deemed waived unless made in writing within forty-five (45) days of the occurrence giving rise to the claim. In no event shall Calgon Carbon Corporation for any reason be liable for incidental or consequential damages, damages in excess of the purchase price of the VentSorb unit, loss of profits or fines imposed by governmental agencies.

Application information provided in this bulletin is based upon theoretical data. Calgon Carbon Corporation assumes no responsibility for the use of the information in this product bulletin.

If at any time our products or services do not meet your requirements or expectations, or if you would like to suggest any ideas for improvement, please call us at 1-800-548-1999.

For detailed information on the products described in this bulletin, please contact one of our Regional Sales Offices located nearest to you:

## VENTSORB PRESSURE DROP



Pressure drop through a VentSorb unit is a function of the process air flow as shown in the graph. A VentSorb canister can handle up to 100 cfm at a pressure drop of less than 15 inches water column. If higher flows or lower pressure drop is needed, multiple canisters may be installed in parallel operation. The maximum canister pressure should not exceed 4 psig.

## 1-800-4-CARBON

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Fax (908) 526-2467

#### Region III

Richmond, CA  
Tel (510) 412-1010  
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#### Region II

Pittsburgh, PA  
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1-800-4-CARBON  
Fax (412) 787-6676

#### Region IV

Houston, TX  
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Fax (713) 690-7909

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Singapore Office  
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#### Canada

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#### Europe

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Calgon Far East  
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Fax (412) 787-4523

Calgon Carbon Corporation's activated carbon products are continuously being improved and changes may have taken place since this publication went to press.





# EQUIPMENT BULLETIN FLOWSORB®

## GENERAL DESCRIPTION

Designed for low-flow water treatment applications, prefabricated 55-gallon Flowsorb® canisters contain all the operating elements found in a full-scale adsorption system. These small, economical treatment systems hold 165 pounds of granular activated carbon for applications including:

- Small wastewater streams
- Groundwater remediation
- Underground storage tank leaks
- Well pump tests
- Product purification or decolorization
- Tank cleaning water treatment
- Batch water or product treatment
- Carbon adsorption pilot testing
- Emergency spill treatment
- Monitoring well water treatment

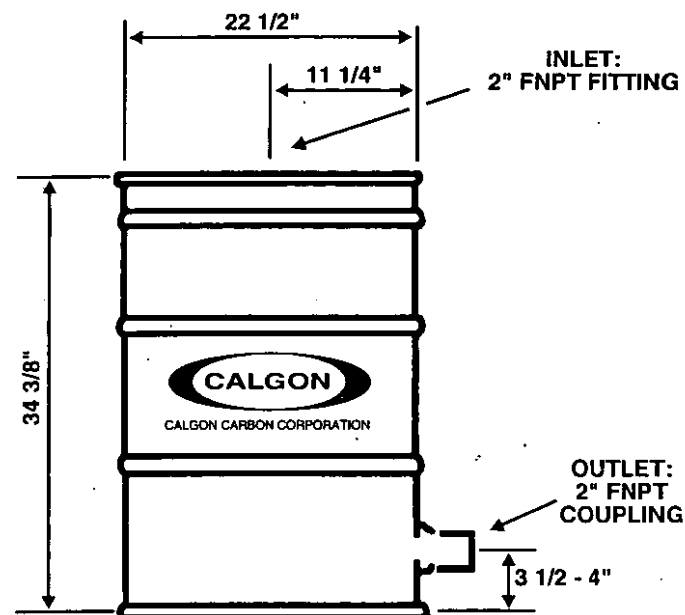
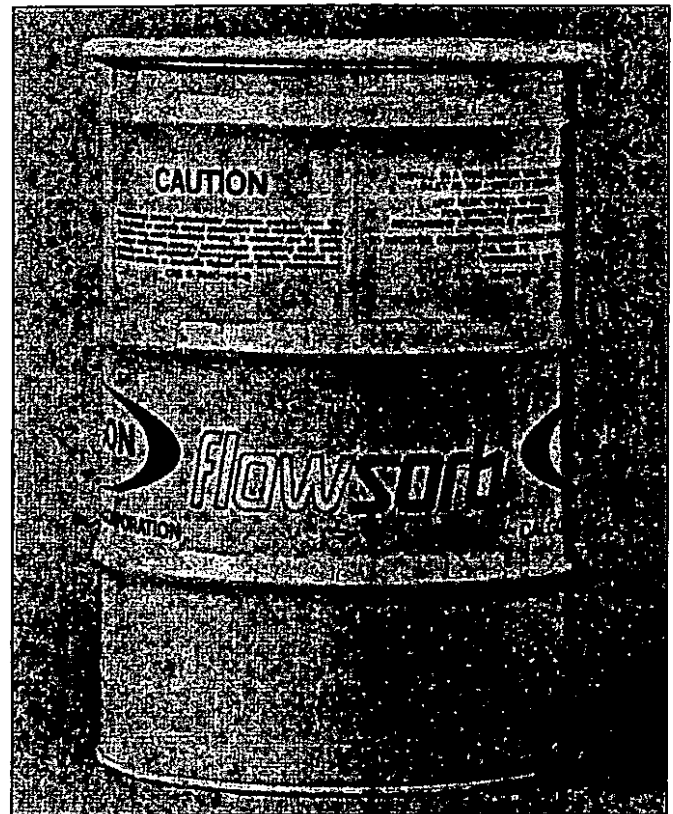
## FEATURES

Flowsorb offers several features and benefits to industrial, commercial and municipal users including:

- Sturdy 16 gauge steel construction
- Continuous treatment at varying flow rates and concentrations
- Simple installation and operation
- Space above carbon bed facilitates flow distribution or backflushing
- Flexibility to be used in series or parallel operation
- Supplied with virgin or reactivated carbon
- Practical disposal option, as pre-approved spent carbon canisters may be returned to Calgon Carbon Corporation for safe carbon reactivation
- Low cost per unit makes carbon treatment economical

## FLOWSORB SPECIFICATIONS

Vessel: ..... Open head 16 gauge steel canister  
Maximum Operating Pressure: ..... 5 psig  
Cover: ..... Removable steel cover, 12 gauge bolt ring with butyl rubber sponge gasket  
Internal Coating: ..... Heat cured phenolic epoxy  
External Coating: ..... Baked enamel (gray)  
Temperature Limit: ..... 150° F (65.6° C) continuous  
..... 350° F (176.7° C) intermittent  
Inlet: ..... 2" FNPT Nylon fitting  
Outlet: ..... 2" FNPT Galvanized steel coupling;  
..... 304 stainless steel collector in nylon drum fitting  
Carbon: ..... 165 pounds granular activated carbon:  
..... Specify Filtrasorb 300 or reactivated grade  
Ship Weight: ..... 232 pounds (105 kg)  
Identification: ..... Sequentially numbered for traceability



FLOWSORB DIMENSIONS

# TYPICAL FLOWSORB OPERATING PARAMETERS

Flow Rate: ..... 10 gpm (37.8 l/m)  
 Contact Time: ..... 4.5 minutes  
 Pressure Drop: ..... < 1 psi (clean water and carbon)  
 Operating Pressures: ..... Recommend operation at less than 5 psig, but higher pressures, up to 12 psig, possible with tight cover closure

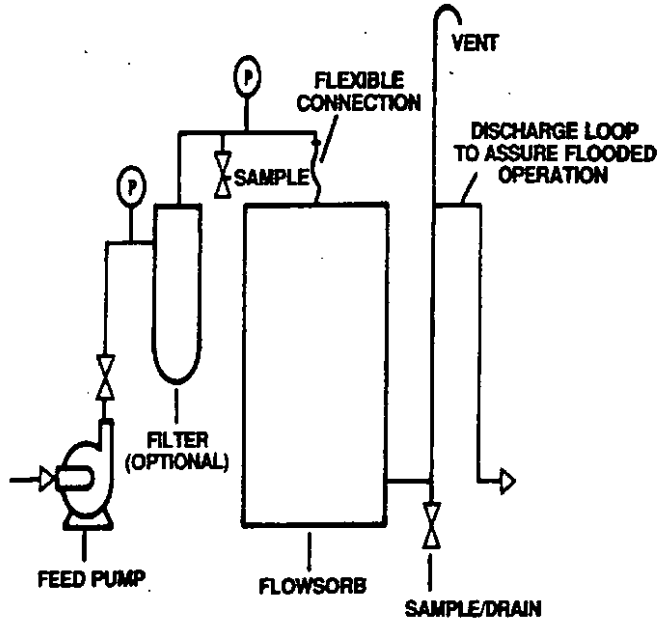
## FLOWSORB INSTALLATION

Flowsorb canisters are shipped with dry activated carbon; the carbon must be wetted and deaerated prior to use. This procedure displaces air from the internal structure of the carbon granule, thus assuring that the liquid to be treated is in contact with the carbon surface.

Prior to operation, each canister must be filled with clean water; the water should be introduced into the bottom outlet connection. The unit should set for approximately 48 hours — this allows most of the carbon's internal surface to become wetted, as shown on the wetting curve below.

After wetting, the carbon bed can be deaerated by draining the canister and again filling the canister upflow with clean water. This procedure will eliminate any air pockets which may have formed between the carbon granules. The Flowsorb is now ready for operation.

Canisters should be set on a flat, level surface and piped as recommended in the installation illustration. The influent pipe connection should be attached to the unit by using a flexible connection, as some minor deflection of the lid may occur if pressure builds due to filtration or other flow blockage downstream.



TYPICAL FLOWSORB INSTALLATION

Flowsorb discharge piping should include an elevated piping loop to assure that the canister remains flooded with water at all times. In addition to the piping loop, a drain connection is recommended on the discharge piping; this allows drainage of the unit prior to disconnection or temporary shutdown.

A filter should be installed if the liquid to be treated contains substantial amounts of suspended solids. A simple cartridge or screen filter helps prevent pressure buildup in the carbon bed.

## FLOWSORB OPERATION

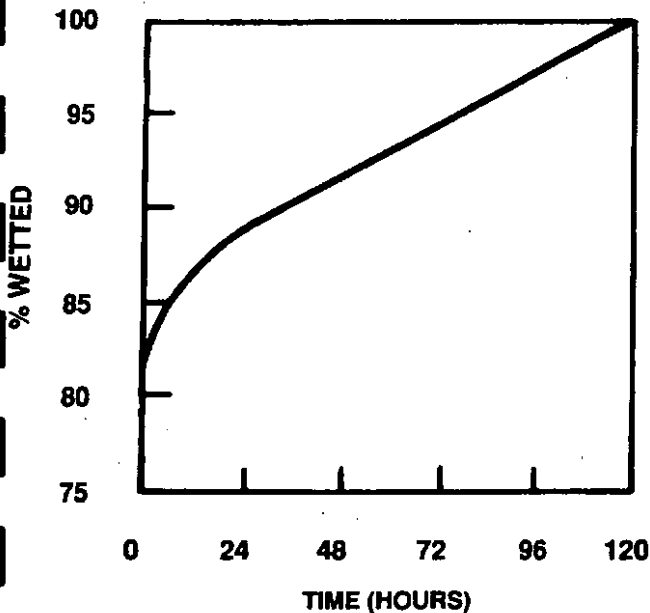
Flowsorb canisters should be full of clean water before treatment begins. Flow rate to the canister should be determined based on required contact time between the liquid and the carbon media. In groundwater treatment applications, the recommended contact time is typically 8-10 minutes with a resultant flow of approximately 5 gpm. Consult your Calgon Carbon Corporation Technical Sales Representative for advice about proper contact time for your application.

Flowsorbs can be manifolded in parallel operation for higher flow rates. For series operation, two Flowsorbs can be piped together sequentially, as normal pressure drop will not exceed the recommended operating pressure.

These canisters have space for bed expansion and can be backflushed by introducing clean water or liquid at approximately 20-25 gpm to the outlet and taking backflush water from the inlet.

If the operating pressure is expected to exceed 5 psig, an application of adhesive caulk at the lid gasket is recommended to prevent leakage. With all surfaces dry, apply the adhesive caulk to the lid recess and lip of the drum per the manufacturer's procedure and set the Flowsorb gasket into the lid recess. After allowing the caulk to set, install the drum lid and tighten the bolt ring.

WETTING CURVE FOR GAC  
 (77°F/25°C)



## THEORETICAL FLOWSORB TREATMENT CAPACITY FOR TYPICAL CASES

	Case 1	Case 2	Case 3
Benzene	Conc. Gallons	Conc. Gallons	Conc. Gallons
Toluene	20 ppb } 1,600,000	200 ppb } 400,000	2 ppm } 85,000
Xylene	40 ppb } 1,600,000	400 ppb } 400,000	4 ppm } 85,000
	40 ppb } 1,600,000	400 ppb } 400,000	4 ppm } 85,000
	Case 4	Case 5	Case 6
TCE	Conc. Gallons	Conc. Gallons	Conc. Gallons
PCE	50 ppb } 1,900,000	500 ppb } 550,000	5 ppm } 125,000
	50 ppb } 1,900,000	500 ppb } 550,000	4 ppm } 125,000
	Case 7	Case 8	Case 9
Phenol	Conc. Gallons	Conc. Gallons	Conc. Gallons
Total SOC	1 ppm } 230,000	10 ppm } 50,000	100 ppm } 10,000
	10 ppm } 230,000	100 ppm } 50,000	1,000 ppm } 10,000

Each case represents a groundwater or wastewater stream that contains the combination of contaminants listed. The treatment capacity indicates the total gallons of that particular water that may be treated before any of the specific contaminants are present in the treated water as noted. Theoretical capacity based on 5 gpm, water at 70°F or less and 165 pounds of Filtrasorb 300. Background TOC is less than 1 ppm except phenol cases as noted. Contaminants reduced to < 5 ppb, except phenol case which is for 95% phenol reduction.

### HOW TO ESTIMATE FLOWSORB LIFE

The treatment table on this page lists the volume of water that can be purified by the Flowsorb for typical contamination situations. However, most applications involve a unique mixture of organic chemical contaminants including some chemicals that adsorb at different capacities or strengths. Please consult with your Calgon Carbon Technical Sales Representative for more information about carbon usage rates.

### RETURN OF FLOWSORBS

Arrangements should be made at the time of purchase regarding the future return of canisters containing spent carbon. Calgon Carbon will provide instructions on how to sample the spent carbon and arrange for carbon acceptance testing. The spent carbon is reactivated by Calgon Carbon and all of the contaminants are thermally destroyed. The company will not accept Flowsorbs for landfill, incineration or other means of disposal.

Flowsorbs cannot be returned to Calgon Carbon unless the carbon acceptance procedure has been completed, an acceptance number provided, and the return labels (included with the units at the time of purchase) are attached.

Flowsorbs must be drained — and inlet/outlet connections must be plugged — prior to return to Calgon Carbon.

### SAFETY CONSIDERATIONS

It is unlikely that a worker would be able to physically enter a Flowsorb canister. However, the following information and precautions apply to a partially closed canister or situations where carbon is to be removed from the canister and stored elsewhere.

Wet or dry activated carbon preferentially removes oxygen from air. In closed or partially closed containers, oxygen depletion may reach hazardous levels. If workers must enter a vessel containing carbon, appropriate sampling and work procedures should be followed for potentially low-oxygen spaces — including all applicable federal and state requirements.

### CALGON CARBON CORPORATION LIQUID PURIFICATION SYSTEMS

Flowsorb is a unit specifically designed for a variety of small flow applications. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for a greater range of flow rates and carbon usages to meet specific applications.

## WARRANTY

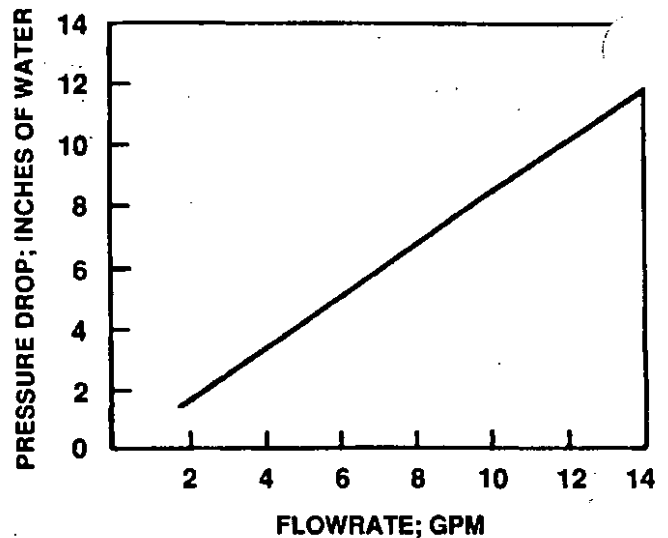
There are no expressed or implied warranties – or any warranty of merchantability or fitness – for a particular purpose associated with the sale of this product.

## LIMITATION OF LIABILITY

The Purchaser's exclusive remedy for any cause of action arising out of purchase and use of the Flowsorb, including but not limited to breach of warranty, negligence and/or indemnifications, is expressly limited to a maximum of the purchase price of the Flowsorb unit as sold. All claims of whatsoever nature shall be deemed waived unless made in writing within forty-five (45) days of the occurrence giving rise to the claim. In no event shall Calgon Carbon Corporation for any reason be liable for incidental or consequential damages, in excess of the purchase price of the Flowsorb unit, loss of profits or fines imposed by governmental agencies.

For information regarding incidents involving human and environmental exposure, please call (412) 787-6700 and ask for the Regulatory and Trade Affairs Department.

## FLOWSORB PRESSURE DROP



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If at any time our products or services do not meet your requirements or expectations, or if you would like to suggest any ideas for improvement, please call us at 1-800-548-1999. From outside the U.S. please call +1-412-787-6700.

# 1-800-4-CARBON

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CALGON CARBON CORPORATION