INITIAL SITE INVESTIGATION REPORT

PROJECT SOAR
178 MCGINN DRIVE
ST. ALBANS, VERMONT
Vermont DEC Site # 2008-3843

Site coordinates: 44° 48' 40" N, 73° 08' 23" W
KAS # 410080320

February 2009

Prepared for:

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EXECUTIVE SUMMARY

An Initial Site Investigation has been completed by KAS, Inc. (KAS) at the Project Soar property, located at 178 McGinn Drive in St. Albans, Vermont (VTDEC Site #2008-3843). The Project Soar property (herein referred to as "site") is presently used as a school.

Monitoring Well Installation
Four shallow monitoring wells, designated MW08-1 through MW08-4, were installed on December 30, 2008. No elevated PID readings above 1 part per million volume (ppmv) were observed in the soil samples collected from the soil borings and no petroleum odors or other evidence of petroleum contamination was noted in these samples. Groundwater was observed between 7 and 12 feet below surface grade (bsg) on the day of drilling

Groundwater Monitoring
Depth-to-fluid measurements were collected from monitoring wells MW08-1 through MW08-4 on January 14, 2009. No free phase petroleum product was observed in the monitoring wells. Groundwater was calculated to flow toward the southwest at a hydraulic gradient of 20%.

Groundwater Quality
KAS collected groundwater samples from the newly installed monitoring wells and the on-site supply well on January 14, 2009. No VOCs were reported above detection limits in the groundwater or drinking water samples. Concentrations of total petroleum hydrocarbons (TPH) of 0.89 mg/L and 3.1 mg/L were reported in two of the groundwater samples. There are currently no standards for TPH in groundwater.

Sensitive Receptor Risk Assessment
A sensitive receptor risk assessment was conducted to identify known and potential receptors of petroleum impact from the site. Based on the data collected during the initial site investigation, no sensitive receptors appear to be impacted at this time.

Conclusions and Recommendations
Based on the results of the initial site investigation, KAS recommends that the site be considered for Sites Management Activity Complete (SMAC) status and be removed from the VTDEC Active Hazardous Waste Sites List.

1.0 INTRODUCTION

This report provides a summary of the methodology, results, conclusions, and recommendations completed for the Initial Site Investigation at the Project Soar property located at 178 McGinn Drive in St. Albans, Vermont (see Site Location Map, Appendix A). This work was performed for Northwest Counseling and Support Services (NCSS) in accordance with the Work Plan and Cost Estimate for an Initial Site Investigation at Project Soar dated October 29, 2008 prepared by KAS, Inc. (KAS). The Initial Site Investigation Work Plan and Cost Estimate was approved by the Vermont Department of Environmental Conservation (VTDEC) in a letter dated November 19, 2008.

2.0 SCOPE OF WORK

This Initial Site Investigation was conducted to assess the degree and extent of petroleum impact to soil and groundwater in the vicinity of the former #2 fuel oil underground storage tank (UST) system on the site property. Subsurface contamination was detected during the closure of (1) 12,000-gallon #2 fuel oil underground storage tank (UST) in August 2008.[1] Results of the following investigative tasks performed by KAS are presented: Town of St. Albans file reviews for the site; soil boring advancement and monitoring well installation; soil screening; groundwater and drinking water sampling and analysis; and evaluation of sensitive receptors in the vicinity of the site.

3.0 SITE DESCRIPTION

3.1 Site and Vicinity

The site is located at the terminus of McGinn Drive in the Town of St. Albans, Vermont. The site is occupied by a one story brick and wood structure currently used as a school. A paved parking area is present on the southern portion of the subject property, and the remainder of the property is covered by grass. One 8,000 gallon #2 fuel oil UST currently exists on the property. The Site Map included in Appendix A shows the site and relevant site features.

3.2 Site and Area Features, Topography, Surface Water Bodies, and Drainage

Based on a review of the topographic map included in Appendix A, the site lies at an approximate elevation of 150 feet above mean sea level (AMSL). The coordinates of the property at the site entrance are approximately 44° 48’ 40” North Latitude and 73° 08’ 23” West Longitude. The nearest surface water is a wetland, which is located approximately 500 feet to the west of the subject property. St. Albans Bay is located approximately 1,200 feet to the southwest

The ground surface topography is generally flat, but slopes to the south and west. Based on site

[1] KAS, Inc, Underground Storage Tank Assessment Report: Project Soar, 178 McGinn Drive, St. Albans, Vermont, August 19, 2008.

topography, the surface drainage from the site is anticipated to flow to the southwest towards a wetland and Lake Champlain. Storm water drainage at the property is likely to flow southwest following the topography since no formal drainage system was observed on the property. No drainage swales were noted on the subject property. One drinking water well is present on the site. A sample of the drinking water was obtained during the investigation on January 14, 2009 (see section 6.3).

3.3 Abutters and Nearby Properties

The land use in the surrounding areas consists of agricultural land and residential homes. Land uses adjacent to the subject property during this initial site investigation were as follows:

- South: Residence
- North: Residence
- West: Residence
- East: Agricultural/Residence

The property is abutted by one road (McGinn Drive).

3.4 Utilities

Public utilities in the area include telephone, electricity, and cable. Electrical and telephone lines are located overhead. The subject property and adjacent structures are served by private water and sewer systems. Approximately fifty supply wells are indicated within a 0.5 mile radius according to the DEC's on line water supply well locator[2]. The nearest off-site supply well is located approximately 300 feet to the southwest.

3.5 Previous Hazardous Materials Releases

Contamination was encountered in soils during removal of (1) 12,000-gallon #2 fuel oil underground storage tanks (UST) on August 13, 2008. Soils in the vicinity of a leaking suction fitting located approximately 10 feet north of the UST were reported to have concentrations of up to 254 parts per million volume (ppmv) when subjected to headspace soils testing using a properly-calibrated portable photoionization device (PID). No free product was observed in the UST excavation area. The removed UST was determined to be in excellent condition upon removal with no holes noted in the tank. Based on the information collected to date, the petroleum contamination noted in August 2008 occurred from the leaking suction fitting. The former UST location is shown on the site Map in Appendix A.

#2 Fuel oil is composed of a mixture of hydrocarbons. The main contaminants of concern from the suspected #2 fuel oil release at the site are benzene, toluene, ethylbenzene, xylenes, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, naphthalene, and possibly MTBE. No other releases

[2] Vermont Department of Environmental Conservation, Private Well Locator Database. www.anr.state.vt.us

of hazardous materials are known to have occurred on the site and thus no other contaminants of concern are noted. A MSDS sheet for #2 fuel oil is included in Appendix C.

4.0 HISTORICAL INFORMATION

KAS reviewed the Town of St. Albans Deed Records to determine ownership of the subject property. The current parcel of land resulted from the acquisition of six parcels. A summary of the ownership history of the subject property reveal that the subject property was acquired by NCSS in September 2007. The ownership history is provided below[3]. No potential sources of contamination were noted during review of historical information for the site.

Current Parcel

Grantor	Grantee	Book	Page	Date
St. Albans Town School District	Northwestern Counseling Support Services	213	65-68	9/26/2007

Culmination of Current Parcel was created by the following deeds:

Parcel 1

Grantor	Grantee	Book	Page	Date
George C. and Almira J. Horton	St. Albans Town School District	15	598	7/30/1956
Helen L. Little and Mary E. Little	George C. and Almira J. Horton	11	613	5/27/1946
Peter Little	Helen L. Little and Mary E. Little	7	40	3/19/1927
I.S. and Cornelia Bostwick	Peter Little	38	476	4/21/1885

Parcel 2

Grantor	Grantee	Book	Page	Date
Helen L. and Mary E. Little	St. Albans Town School District	15	599	8/25/1956
Peter Little	Helen L. Little and Mary E. Little	7	40	3/19/1927
I.S. and Cornelia Bostwick	Peter Little	38	476	4/21/1885

Parcel 3

Grantor	Grantee	Book	Page	Date
Edward B. and Gladys R. McGinn	St. Albans Town School District	16	4	8/31/1956

Parcel 4

Grantor	Grantee	Book	Page	Date
Louis P. and Clair T. Shepard	St. Albans Town School District	22	503	3/8/1968

Parcel 5

[3] Town of St. Albans Land Records

Grantor	Grantee	Book	Page	Date
George C. and Almira J. Horton	St. Albans Town School District	22	522	3/31/1968
Helen L. Little and Mary E. Little	George C. and Almira J. Horton	11	613	5/27/1946
Peter Little	Helen L. Little and Mary E. Little	7	40	3/19/1927
I.S. and Cornelia Bostwick	Peter Little	38	476	4/21/1885

Parcel 6

Grantor	Grantee	Book	Page	Date
Allen and Noella Brown	St. Albans Town School District	24	164	10/11/1969
Harold L. Pelkey, executor of the estate of Jessie P. Batchellor	Allen and Noella Brown	14	495	7/29/1954
Helen L. Little and Mary E. Little	Jessie P. and Burton N. Batchellor	11	629	5/27/1946
Peter Little	Helen L. Little and Mary E. Little	7	40	3/19/1927
I.S. and Cornelia Bostwick	Peter Little	38	476	4/21/1885

The present owner of the property is Northwest Counseling and Support Services, Inc, whose main office is located at 107 Fisher Pond Road in St Albans, Vermont. Their contact telephone number is 802-524-6554. The previous owners of the property was the St. Albans Town School District, 169 South Main Street, St. Albans, VT 05478, (802) 527-7191.

Based on a review of the current Town of St. Albans Tax Map, the following is a list of adjacent landowners and Parcel Identifications:

Parcel ID	Address	Contact Information	Location	Description
22-030-010	178 McGinn Drive	NCSS	Site	School
22-030-011	0 McGinn Drive	Melissa Sullivan	West of Site	Woodlot
22-030-009	143 McGinn Drive	Brian G. and Bonnie S. McKenna	South of Site	Residence
22-030-008	142 McGinn Drive	Gerard Trim	South of Site	Residence
22-080-056	565 Lake Road	Louis and Claire Shepard	Southeast of Site	Residence
22-080-054	561 Lake Road	Adam Maurice Rocque	Southeast of Site	Residence
22-080-052	559 Lake Road	Marilyn and Robert Fairbanks	Southeast of Site	Residence
23-080-048	549 Lake Road	Jeffrey and Tammy Boissoneault	East of Site	Residence

5.0 REVIEW OF AVAILABLE GEOLOGIC INFORMATION

Surficial deposits in the area are indicated to be marine clay according to the Surficial Geological Map of the State of Vermont[4]. Records of soils encountered during the UST removal, as well as soil boring logs advanced during this investigation, imply that the site is underlain by fluvial sediments, namely silts and clays with varying amounts of sand and gravel.

Bedrock in the vicinity of the property consists of Lower Ordovician-aged Beldens member of the Beekmantown group according to the Centennial Geologic Map of the State of Vermont (Doll, 1961) [5]. The Belden member is described as a buff to brown heavily scored dolomite and white to blue-gray marble and limestone.

6.0 SUBSURFACE EXPLORATIONS AND LABORATORY ANALYSES

6.1 Pre-Drilling Activities

Prior to the initiation of subsurface activities at the site, a Health and Safety Plan (HASP) was prepared for the site in accordance with Vermont Occupational Safety and Health Administration (VOSHA) requirements.

DigSafe Number 2008-5102476 was obtained prior to the drilling activities. The site was premarked for Digsafe on December 15, 2008.

6.2 Monitoring Well Installation and Field Screening of Subsurface Soils

Four shallow monitoring wells, designated MW08-1 through MW08-4, were installed on December 30, 2008 by ENPRO Services, Inc of Williston, Vermont, under the direct supervision of a KAS geologist. The soil borings were advanced using a geoprobe drill rig. The monitoring well and soil boring locations are indicated on the Site Map (Appendix A). The borings were advanced according to KAS' Soil Boring protocol and the monitoring well was installed according to KAS' Monitoring Well Installation protocol.

During borehole advancement, soil samples were collected from the borings, logged by the supervising geologist and screened for the presence of volatile organic contaminants (VOCs) using a MiniRae portable PID equipped with a 10.6 eV lamp. Prior to screening, the PID was calibrated with isobutylene referenced to benzene. Soils were screened using the KAS Jar/Polyethylene Bag Headspace Screening Protocol. Soil characteristics and contaminant concentrations were recorded by the KAS scientist in detailed soil boring logs and monitoring well construction diagrams presented in Appendix C.

[4] Doll, Charles G., ed., 1961, *Centennial Geologic Map of Vermont*, Vermont Geological Survey.
[5] Doll, Charles G., ed., 1970, *Surficial Geologic Map of Vermont*, Vermont Geological Survey.

Subsurface Sediments and Laboratory Analysis

Subsurface sediments encountered in borings SB08-1 through SB08-4 consisted of silt and clay with varying amounts of sand and gravel. Groundwater observed during drilling ranged from approximately 7 feet bg in MW08-3 and MW08-4 to 12 feet bg in MW08-2. No elevated PID readings were observed in the soil samples collected from the soil borings and no petroleum odors or other evidence of petroleum contamination was noted in these samples.

6.3 Groundwater Sampling and Laboratory Analysis

A groundwater sampling event for the newly installed wells was conducted on January 14, 2009. A summary of the measured depth to water and calculated groundwater elevation is provided in Appendix D. Free phase petroleum product was not observed any of the site monitoring wells during the January 14, 2009 sampling event.

During the sampling event, groundwater samples were collected using a disposable bailer. For Quality Assurance/ Quality Control (QA/QC) purposes, one trip blank and one duplicate sample were submitted along with the groundwater samples.

The groundwater samples collected on January 14, 2009 were submitted to Endyne for laboratory analysis for VOCs by EPA Method 8021B and for TPH by EPA Method 8015-DRO. Additionally, a drinking water sample was collected from the school and submitted for analysis of VOCs by EPA Method 524.2.

The groundwater analytical results for the January 14, 2009 sampling event were compared to the Vermont Groundwater Enforcement Standards (VGES). The supply well results for the January 14, 2009 sampling event were compared to the Vermont Department of Health (VT DOH) drinking water standards. Tabulated results for the initial sampling event can be found in Appendix E. Copies of the laboratory reports are included in Appendix F.

No VOCs were reported above detection limits in the groundwater samples obtained from MW08-1, MW08-2, MW08-3, MW08-4, or the drinking water sample obtained from the school. Total petroleum hydrocarbons (TPH) were reported the samples obtained from MW08-2 and MW08-4 at concentrations of 0.89 mg/L and 3.1 mg/L respectively. There are currently no standards for TPH concentrations in groundwater. Detection limits were below standards for the tested compounds.

The results of the laboratory analysis of the duplicate sample were analyzed using a relative percent difference (RPD) analysis. The RPD is defined as 100 times the difference in reported concentration between sample and duplicate, divided by the mean of the two samples. A small RPD indicates good correlation between sample and duplicate. A RPD could not be calculated because no contaminants were found in either of the two samples. A tabular presentation of duplicate sample data and RPD results is included in Appendix E. Lack of spurious influence on sample results was demonstrated since none of the tested VOCs were reported above detection limits in the trip blank. One unidentified peak was noted in each of the groundwater samples.

7.0 SITE GEOLOGY

Cross sections depicting the site geology are included in Appendix A Surficial geology at the site consists predominately of silt with varying amounts of sand and gravel. No bedrock outcrops were observed at the site during this investigation.

8.0 SITE HYDROGEOLOGY

8.1 Groundwater Flow Direction and Gradient

Depth to groundwater measurements were collected from the on-site monitoring wells on January 14, 2009. The well locations are shown on the Site Map in Appendix A. The depth to water measurements were subtracted from the top-of-casing elevations to obtain the relative water table elevations. No floating free phase petroleum product was detected during gauging or sampling of the monitoring wells. The depth to groundwater ranged from 4.79 to 6.02 feet below grade. Liquid level monitoring data is presented in Appendix C.

The water table elevations were plotted and contoured to denote the groundwater flow at the site (see the Groundwater Elevation Map, Appendix A). The groundwater was calculated to flow toward the southwest at an approximate hydraulic gradient of 20%.

8.2 Contaminant Distribution

8.2.1 Groundwater / Drinking Water

Groundwater analytical data collected at the site indicates that no VOCs were reported above detection limits in the groundwater or drinking water samples. Concentrations of total petroleum hydrocarbons (TPH) from 0.89 mg/L and 3.1 mg/L were reported. There are currently no standards for TPH concentrations in groundwater.

8.2.2 Contaminant Fate and Transport

Based on the fact that no VOCs were reported, and only small amounts of TPH were reported in the groundwater, it is likely that the amount of #2 fuel oil that leaked out of the faulty suction fitting was small and has degraded over time.

9.0 CONCEPTUAL HYDROGEOLOGIC MODEL

9.1 Site Conditions

The site is covered by grass and a paved parking area. Based on a review of field screening data collected at the site, saturated soils beneath the site have fairly low permeability. Groundwater flows to the southwest toward the adjacent stream, wetland, and Lake Champlain at a hydraulic gradient of approximately 20%.

9.2 Potential Sources

Information collected to date suggests that the petroleum contamination that was detected during the UST removal in 2008 may have been caused by a leaking suction fitting. No other sources of contamination are known to exist at the Site.

9.3 Potential Receptors

9.3.1 Buildings in the Vicinity

KAS screened the classrooms adjacent to the monitoring wells with a MiniRae portable PID equipped with a 10.6 eV lamp on December 30, 2008. No PID readings above background were observed in the building. The building does not have a basement.

9.3.2 Utility Corridors

The school is served by overhead telephone and electrical lines. The property is served by private septic and water lines. Given the low levels of TPH detected in the groundwater, the groundwater flow direction, and the distance to the septic and water lines, no impact to the utility corridors is suspected.

9.3.3 Wetlands and Surface Water Bodies

The nearest surface water is a wetland located approximately 500 feet to the west. St. Albans Bay is located approximately 1,200 feet to the southwest. Given the low source strength and the distance to the water bodies, neither of the surface waters are considered to be at risk to petroleum contamination resulting from the site.

9.3.4 Water Supplies Sources

The site and surrounding properties are serviced by private supply wells. Approximately fifty supply wells are indicated within a 0.5 mile radius according to the DEC's on line water supply well locator. The on-site supply well was sampled for VOCs via EPA Method 524.2 on January 14, 2009. No contaminants were detected in the supply well sample.

9.4 Potential Third Party Impacts

There are no known impacted third parties in relation to this site.

10.0 CONCLUSIONS

1. No VOCs were detected in the groundwater or drinking water at the subject property. Low levels of TPH were reported in two of the groundwater samples collected on January 14, 2009.

2. Groundwater was calculated to flow toward the southwest at a hydraulic gradient of approximately 20% on January 14, 2009.

3. No sensitive receptors have been identified at being at potential risk to petroleum impact during this initial site investigation.

11.0 RECOMMENDATIONS

Based on the results of the initial site investigation, KAS recommends that the Project Soar Site be considered for Sites Management Activity Complete (SMAC) status and be removed from the VTDEC Active Hazardous Waste Sites List. This recommendation is offered based upon achievement of the VTDEC October 2001 closure criteria presented below:

1. *The source(s), nature, degree, and extent of the contamination have been adequately defined.*

   The source of the contamination (1000 gallon #2 fuel oil UST) was removed from the site in August 2008.

2. *The site has been evaluated to verify that the source of contamination has been removed, remediated, or adequately contained.*

   Through laboratory analysis of drinking water, and groundwater samples collected from the site, and through soil screening during the drilling investigation, it was verified no detectable VOC contamination is present at the investigated locations. The source of contamination (#2 Fuel Oil UST) was removed in August 2008.

3. *Levels of contaminants are stable, falling, or non-detectable as monitored over a reasonable period of time.*

   Test results indicate levels are below detection at sampled locations. There is currently no standard for TPH in groundwater.

4. *Groundwater Enforcement Standards as listed in the Groundwater Protection Rule and Strategy have been met at compliance points established for the Site.*

   No VOCs were detected above the state VGES during the initial site investigation.

5. *Risk-based guideline concentrations have been met at compliance/exposure points established for any site where exposure to contaminated soils has been determined to pose a threat to human health or the environment.*

   Human contact with any residual contamination remaining in the UST pit would be limited, based on the fact that the pit has been closed.

6. *The site has been evaluated to verify that migration of contaminants from soil to groundwater is not occurring at concentrations which will result in an exceedence of the Groundwater Enforcement Standards beyond the established compliance boundary.*

   Migration of contaminants from soil to groundwater is not deemed to be an issue due to no VOC contamination being reported in the on-site monitoring wells or the supply well.

7. *Risk-based contaminant concentrations must be met for indoor air, if applicable.*

   Not Applicable

8. *Vermont Water Quality Standards and Air Pollution Control Emission Standards must also be met, if applicable.*

   No impact to air quality or surface water was noted during site investigations conducted at the site.

9. *All groundwater monitoring wells used during the site investigation must be properly closed in accordance with Section 12.3.5 in Appendix A of the Vermont Water Supply Rule-Chapter 21, unless a plan has been developed and approved by the Sites Management Section for maintaining the monitoring wells.*

   Following the VTDEC's approval to SMAC, the monitoring wells will be closed in accordance with Section 12.3.5 in Appendix A of the Vermont Water Supply Rule-Chapter 21.

10. *No unacceptable threat to human health or the environment exists at the site from exposure to hazardous materials.*

    The results of the groundwater sample and supply well samples collected during the most recent monitoring event have given no indication of contaminating area sensitive receptors.

11. *Sites subject to Corrective Action provisions contained in the Vermont Hazardous Waste Management Regulations will have met the requirements of those provisions.*

    The site is not subject to Corrective Action provisions contained in the Vermont Hazardous Waste Management Regulations.

12. *Sites subject to regulation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) will have met the requirements of 40 CFR 300-399.*

    The site is not subject to regulation under CERCLA.

13. Any outstanding or overdue balances owed to the state have been paid to the satisfaction of the Waste Management Division.

No outstanding or overdue balances are owed to the state.

12.0 REFERENCES

1. KAS, Inc, August 19, 2008, Underground Storage Tank Assessment Report: 178 McGinn Drive, St. Albans, Vermont.

2. Vermont Department of Environmental Conservation, Private Well Locator Database. www.anr.state.vt.us

3. Land Records viewed in person on January 14, 2009 at the Town of St. Albans offices, St. Albans, Vermont.

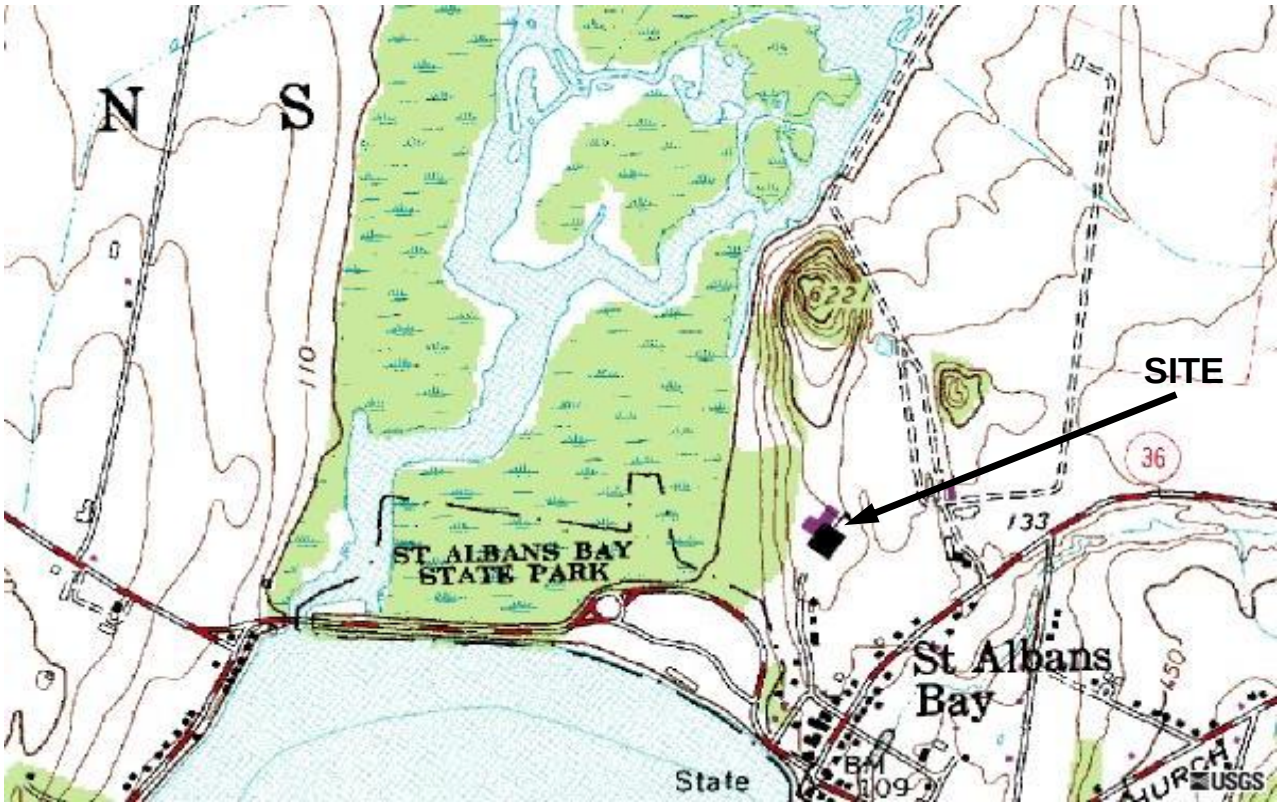
4. Doll, Chuck G., D.P. Stewart, and P. MacClintock, eds., 1970, *Surficial Geologic Map of Vermont*, State of Vermont.

5. Doll, Chuck G., W.M. Cady, J. B. Thompson, Jr., and M.P. Billings eds., 1961, *Centennial Geologic Map of Vermont*, State of Vermont.

6. United States Geological Survey (USGS) Topographic Map dated 1981, viewed on line at http://terraserver-usa.com/image

Appendix A

Maps / Cross Sections



North

KAS Job Number: *511070113*

Source: www.terraserver-usa.com

KAS INC

Northwestern Counseling and Support Services
178 McGinn Drive
St. Albans, Vermont

Site Location Map
USGS Mapping

Date: 12/07/07	Drawing No. 1	Scale: NTS	By: AR

North

KAS Job Number: *511070113*

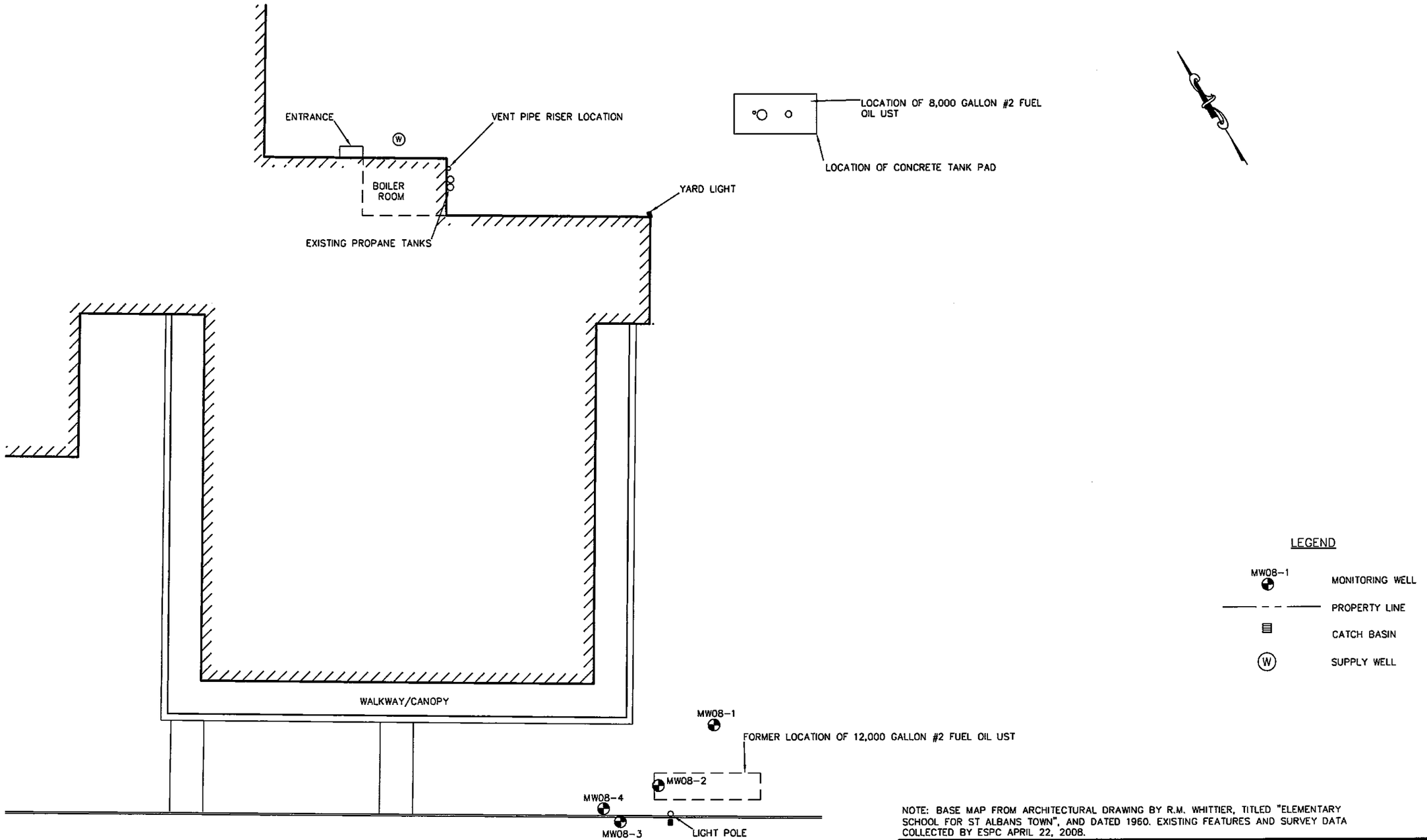
Source: www.terraserver-usa.com

KAS INC

Northwestern Counseling and Support Services
178 McGinn Drive
St. Albans, Vermont

Arial Photograph
USGS Mapping

Date: 02/09/09	Drawing No. 1	Scale: NTS	By: AE



NOTE: BASE MAP FROM ARCHITECTURAL DRAWING BY R.M. WHITTIER, TITLED "ELEMENTARY SCHOOL FOR ST ALBANS TOWN", AND DATED 1960. EXISTING FEATURES AND SURVEY DATA COLLECTED BY ESPC APRIL 22, 2008.

ESPC #: 20094274
KAS #: 510080320
VTDEC #: 2008-3843

KAS

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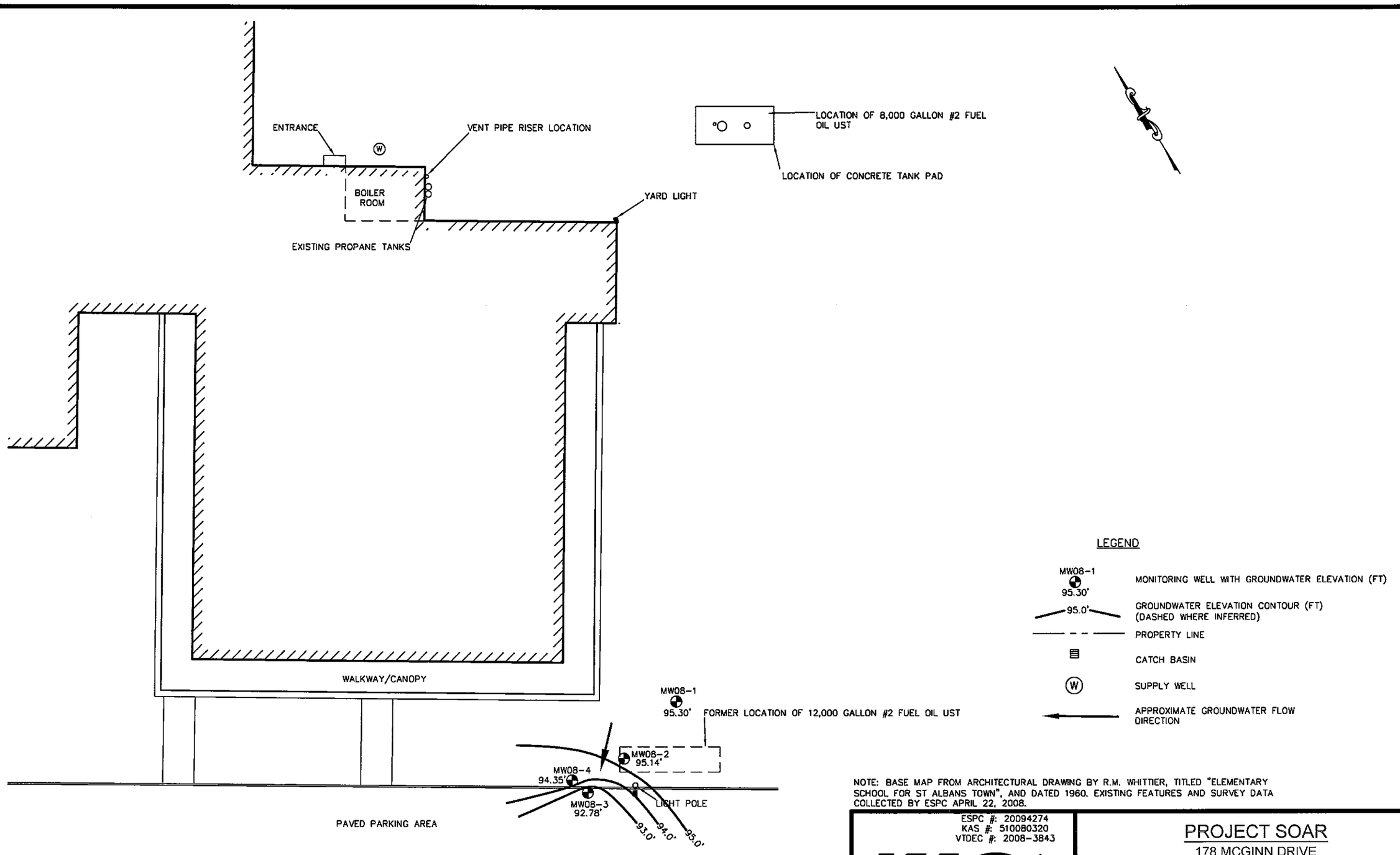
PROJECT SOAR

178 MCGINN DRIVE
ST. ALBANS, VERMONT

SITE

DATE: 2/6/09	DWG #: 1	SCALE: 1"=40'	DRN.: DM	APP.: AE



NOTE: BASE MAP FROM ARCHITECTURAL DRAWING BY R.M. WHITTIER, TITLED "ELEMENTARY SCHOOL FOR ST ALBANS TOWN", AND DATED 1960. EXISTING FEATURES AND SURVEY DATA COLLECTED BY ESPC APRIL 22, 2008.

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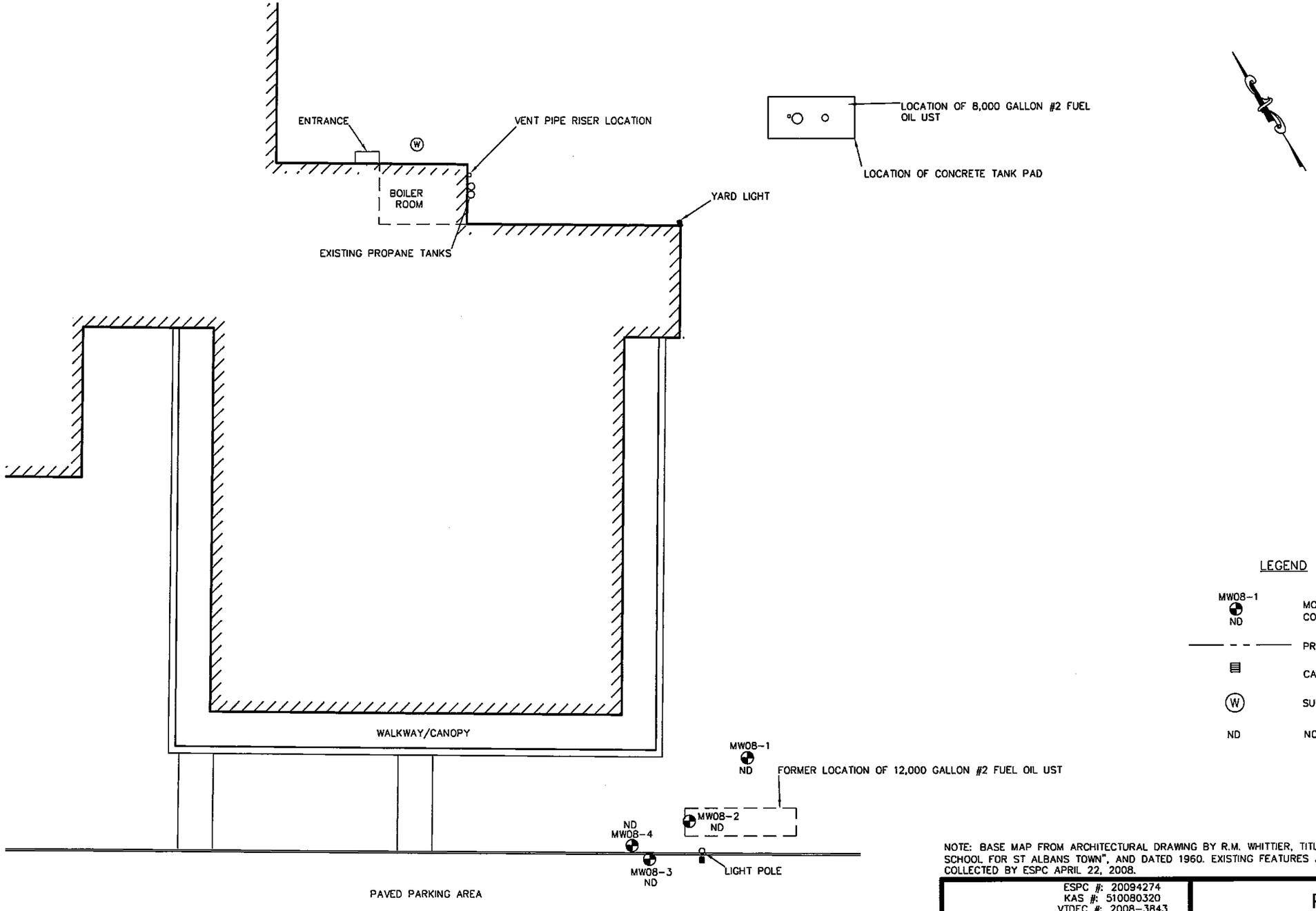
PROJECT SOAR

178 MCGINN DRIVE
ST. ALBANS, VERMONT

GROUNDWATER CONTOUR MAP

MEASURED: 1/14/09

DATE: 2/6/09	DWG #: 2	SCALE: 1"=30'	DRN.: DM	APP.: AE



LEGEND

MW08-1 ND	MONITORING WELL WITH TOTAL TARGETED VOCs CONTAMINANT CONCENTRATION (ppb) (M=8021B)
	PROPERTY LINE
	CATCH BASIN
W	SUPPLY WELL
ND	NONE DETECTED

NOTE: BASE MAP FROM ARCHITECTURAL DRAWING BY R.M. WHITTIER, TITLED "ELEMENTARY SCHOOL FOR ST ALBANS TOWN", AND DATED 1960. EXISTING FEATURES AND SURVEY DATA COLLECTED BY ESPC APRIL 22, 2008.

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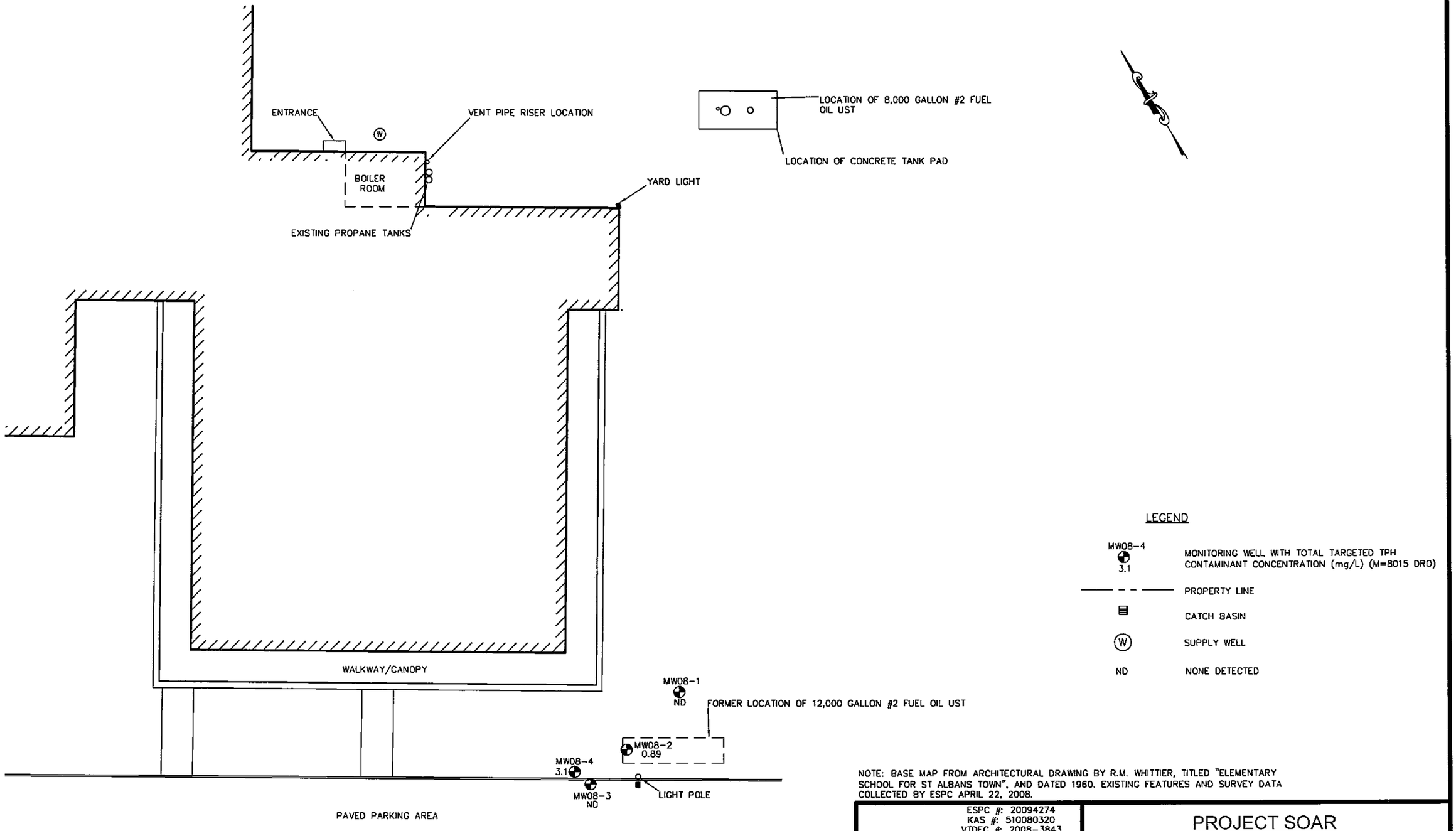
PROJECT SOAR

178 MCGINN DRIVE
ST. ALBANS, VERMONT

VOCs CONTAMINANT CONCENTRATION MAP

SAMPLED: 1/14/09

DATE: 2/6/09	DWG #: 3	SCALE: 1"=30'	DRN.: DM	APP.: AE



LEGEND

MW08-4 3.1	MONITORING WELL WITH TOTAL TARGETED TPH CONTAMINANT CONCENTRATION (mg/L) (M=8015 DRO)
	PROPERTY LINE
	CATCH BASIN
W	SUPPLY WELL
ND	NONE DETECTED

NOTE: BASE MAP FROM ARCHITECTURAL DRAWING BY R.M. WHITTIER, TITLED "ELEMENTARY SCHOOL FOR ST ALBANS TOWN", AND DATED 1960. EXISTING FEATURES AND SURVEY DATA COLLECTED BY ESPC APRIL 22, 2008.

ESPC #: 20094274
KAS #: 510080320
VTDEC #: 2008-3843

KAS

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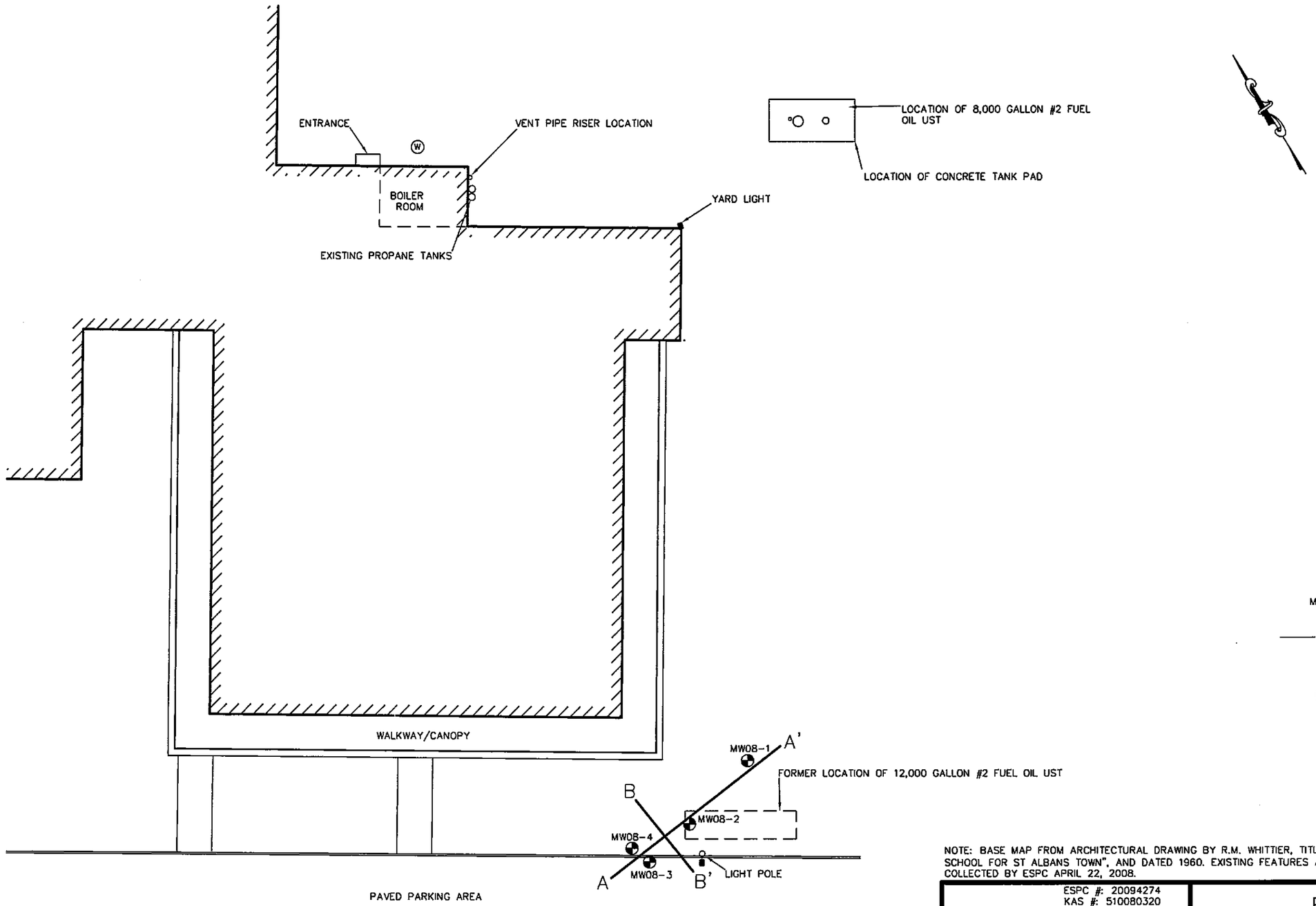
PROJECT SOAR

178 MCGINN DRIVE
ST. ALBANS, VERMONT

TPH CONTAMINANT CONCENTRATION MAP

SAMPLED: 1/14/09

DATE: 2/6/09	DWG #: 4	SCALE: 1"=40'	DRN.: DM	APP.: AE



LEGEND

- MW08-1 — MONITORING WELL
- PROPERTY LINE
- CATCH BASIN
- W — SUPPLY WELL

NOTE: BASE MAP FROM ARCHITECTURAL DRAWING BY R.M. WHITTIER, TITLED "ELEMENTARY SCHOOL FOR ST ALBANS TOWN", AND DATED 1960. EXISTING FEATURES AND SURVEY DATA COLLECTED BY ESPC APRIL 22, 2008.

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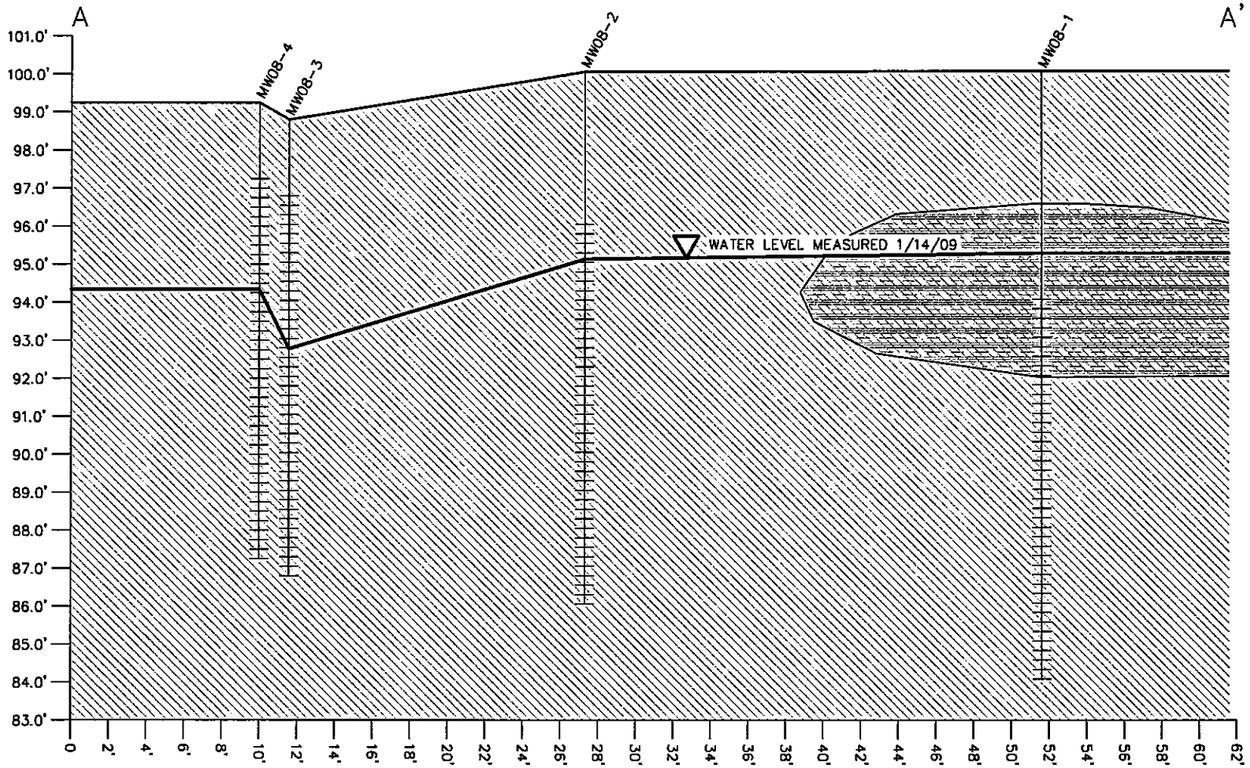
PROJECT SOAR

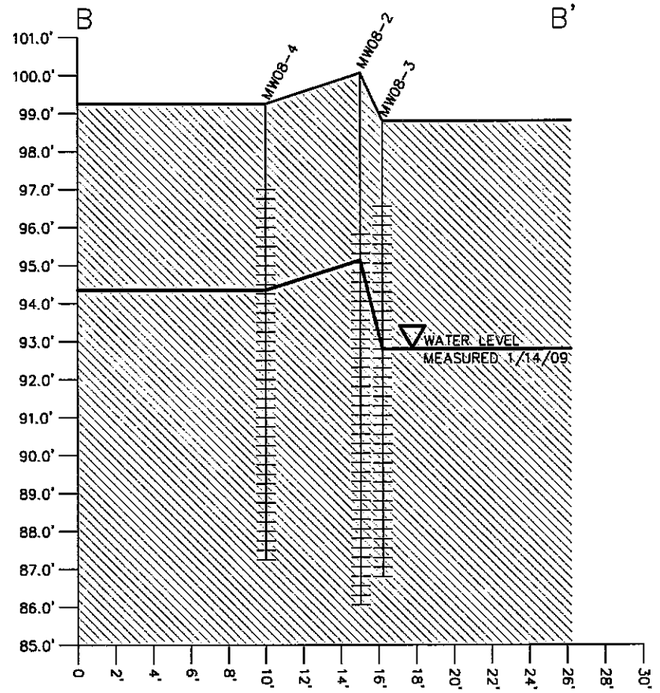
178 MCGINN DRIVE
ST. ALBANS, VERMONT

CROSS SECTION LOCATION MAP

DATE: 2/6/09	DWG #: CS1	SCALE: 1"=30'	DRN.: DM	APP.: AE



CROSS SECTION A–A'
SCALE; VERTICAL : 1"=4'
HORIZONTAL: 1"=8'



CROSS SECTION B–B'
SCALE; VERTICAL : 1"=4'
HORIZONTAL: 1"=8'

LEGEND

ML — SILT

CL — CLAY

MW08-4 — MONITORING WELL

ESPC #: 20094274
KAS #: 510080320
VTDEC #: 2008-3843

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PROJECT SOAR

178 MCGINN DRIVE
ST. ALBANS, VERMONT

CROSS SECTIONS A-A' AND B-B'

DATE: 2/6/09	DWG #: CS2	SCALE: AS NOTED	DRN.: DM	APP.: AE

Appendix B

MSDS Sheets

COMMON SYNONYMS:	CAS REG. NO.:	AIR W/V CONVERSION FACTORS at 25°C (1967)
White spirits Mineral spirits Solvent naphtha Dry cleaning safety solvent	8052-41-3 NIOSH NO.: WJ8925000	5.77 mg/m³ ≃ 1 ppm 0.173 ppm ≃ 1 mg/m³
	APPROXIMATE COMPOSITION: linear and branched alkanes, 30-50% cycloalkanes, 30-40% aromatics, 10-20% benzene, trace olefins, trace	MOLECULAR WEIGHT: 135-145 (average)

REACTIVITY	Stoddard solvent is considered to be a miscellaneous combustible material for compatibility classification purposes. Reactions of such substances with non-oxidizing mineral acids may evolve heat and usually innocuous gases. Those with oxidizing mineral acids or organic peroxides or hydroperoxides may produce heat, fire, and toxic gases, while those with strong oxidizing agents or alkali or alkaline earth elemental metals may produce heat, fire, and innocuous gases. Nitrides evolve heat, fire, and flammable gases. Strong reducing agents evolve heat and flammable gases. Reactions with explosive materials may result in an explosion. There are also unspecified incompatibilities with bases and selected amines (38,507,511).

PHYSCIO-CHEMICAL DATA	• Physical State (at 20°C): liquid	(2)
	• Color: colorless	(2)
	• Odor: mild petroleum	(507)
	• Odor Threshold: 0.9 ppm	(1970)
	• Liquid Density (g/ml at 20°C): 0.77	(507)
	• Freezing/Melting Point (°C): no data	( )
	• Boiling Point (°C): 154-202°	(2)
	• Flash Point (°C): 37.8-60 (variable)	(23,38, 51,507)
	• Flammable Limits in Air, % by Volume: (0.8-1.1) - 6.0	(38,51,506)
	• Autoignition Temperature (°C): 227-260 (variable)	(23,38, 51,506)
	• Vapor Pressure (mm Hg at 20°C): 3	(507)
	• Saturated Concentration in Air (mg/m³ at 20°C): 2.2×10^4 to 2.4×10^4	(ADL estim)
	• Solubility in Water (mg/L at 20°C): insoluble	(507)
	• Viscosity (cp at 20°C): 0.91-0.95	(5)
	• Surface Tension (dyne/cm at 20°C): no data	( )

PHYSICO-CHEMICAL DATA (continued)	• Log (Octanol-Water Partition Coefficient), log K_{ow}: 3.16-7.06 (*) • Soil Adsorption Coefficient, K_{oc}: 700-5.5 x 10^6 (*) • Henry's Law Constant (atm•m^3/mol at 20°C): 4.4×10^{-4} - 7.4 (*) • Bioconcentration Factor: no data ( )
PERSISTENCE IN THE SOIL-WATER SYSTEM	Stoddard solvent hydrocarbons are expected to be relatively mobile and moderately persistent in most soil systems. Persistence in deep soils and ground water may be higher. Volatilization, photooxidation and biodegradation are potentially important fate processes. Surface spills are expected to be weathered by evaporation and photooxidation. Downward migration of weathered surface spills and sub-surface discharges represent a potential threat to underlying ground water. Biodegradation of C_7-C_{12} hydrocarbons is expected to be significant under environmental conditions favorable to microbial oxidation; naturally-occurring, hydrocarbon-degrading microorganisms have been isolated from polluted soils and, to a lesser extent, non-polluted soils.
PATHWAYS OF EXPOSURE	The primary pathway of concern from the soil/ground-water systems is the contamination of ground water drinking water supplies resulting from large spills of Stoddard solvent or leaking underground storage tanks. Vapors from leaked or spilled solvent may diffuse through soils and migrate into structures resulting in inhalation exposures. Inhalation exposures may also occur from the direct volatilization of surface spills. Ingestion with food is not expected to be significant.
HEALTH HAZARD DATA	Signs and Symptoms of Short-term Human Exposure (38): Overexposure to Stoddard solvent causes irritation of the eyes, nose and throat and may cause dizziness. Prolonged overexposure to the liquid may cause skin irritation.
	Toxicity Based on Animal Studies: LD_{50} (mg/kg) oral -- no data skin -- no data LCLo (mg/m^3) inhalation [cat] (47) 10,000-2.5 hr.
	Long-Term Effects: Kidney damage
	Pregnancy/Neonate Data: Negative
	Mutation Data: Negative
	Carcinogenicity: No data

*Range of values for representative hydrocarbons from major component classes (see Table 67-2).

HANDLING PRECAUTIONS (38,507)	Handle only with adequate ventilation • Vapor levels of 500 to 1000 ppm: chemical cartridge respirator with a full facepiece and organic vapor cartridges • 1000 to 5000 ppm: any supplied-air respirator or self-contained breathing apparatus with full facepiece; gas mask with organic vapor canister • Chemical goggles if there is probability of eye contact • The use of impermeable gloves is advised to prevent skin irritation.

EMERGENCY FIRST AID TREATMENT (38,507)	Ingestion: Do not induce vomiting. Get immediate medical attention • Inhalation: Move victim to fresh air. Give artificial respiration if necessary. Get medical attention • Skin: Remove contaminated clothing. Wash skin with soap and water. If irritation persists after washing, get medical attention • Eye: Flush with large amounts of water for 15 minutes. If irritation persists, get medical attention.

ENVIRONMENTAL AND OCCUPATIONAL STANDARDS AND CRITERIA

AIR EXPOSURE LIMITS:

Standards
- OSHA PEL (8-hr TWA): 500 ppm
- AFOSH PEL (8-hr TWA): 500 ppm

Criteria
- NIOSH IDLH (30-min): 5000 ppm
- ACGIH TLV® (8-hr TWA): 100 ppm
- ACGIH STEL (15-min): 200 ppm

WATER EXPOSURE LIMITS:

Drinking Water Standards - None established

EPA Health Advisories - None established

EPA Ambient Water Quality Criteria (355)
- Human Health
  No criterion established; Stoddard solvent is not a priority pollutant.
- Aquatic Life
  No criterion established; Stoddard solvent is not a priority pollutant.

Oil and Grease (2012)

For domestic water supply: Virtually free from oil and grease, particularly from the tastes and odors that emanate from petroleum products.

For aquatic life:

- 0.01 of the longest continuous flow 96-hour LC_{50} to several important freshwater and marine species, each having a demonstrated high susceptibility to oils and petrochemicals;
- levels of oils or petrochemicals in the sediment which cause deleterious effects to the biota should not be allowed;
- surface waters shall be virtually free from floating non-petroleum oils of vegetable and animal origin as well as petroleum-derived oil.

COMMON SYNONYMS:	CAS Reg. No.	NIOSH No.
Fuel oil (unspecified)		LS8950000
Fuel oil No. 1		
Kerosene	8008-20-6	OA5500000
Range oil		
JP-1		
Coal oil		
Fuel oil No. 2	68476-30-2	HZ1800000
Home heating oil		
Diesel oil		
Fuel oil No. 4	68476-31-3	
Residual fuel oil No. 4		
Fuel oil No. 5		
Residual fuel oil No. 5		
Navy special fuel oil		
Fuel oil No. 6	68553-00-4	
Residual fuel oil No. 6		
Bunker C oil		
Fuel oil 1-D		
Diesel oil (light)		
Fuel oil 2-D		
Diesel oil (medium)		

COMPOSITION:
Aliphatic hydrocarbons 64%
Olefinic hydrocarbons 1-2%
Aromatic hydrocarbons 35%

REACTIVITY	Various sources typically report that fuel oils are incompatible with strong acids, alkalies, and strong oxidizers such as liquid chlorine and oxygen. The NFPA reports vigorous reactions, ignition, or explosions involving chlorine, fluorine, or magnesium perchlorate. Fuel oils are considered to be miscellaneous combustible or flammable materials for compatibility classification purposes. Such substances typically evolve heat, fire, and toxic or flammable gases in reactions with oxidizing mineral acids, alkali or alkaline earth elemental metals, nitrides, organic peroxides or hydroperoxides, or strong oxidizing agents. Reactions with explosive materials may result in an explosion, while those with strong reducing agents may evolve heat and flammable gases. Non-oxidizing mineral acids generally evolve heat and innocuous gases (505,507,511).

PHYSICO-CHEMICAL DATA	• Physical State (at 20°C): liquid	(60)
	• Color: colorless to brown	(60)
	• Odor: characteristic kerosene like	(60)
	• Odor Threshold: no data	( )
	• Liquid Density (g/ml at 20°C): fuel oil nos. 2, 6, 2-D - .87-.95; fuel oil nos. 1, 4, 5, 1-D (at 15°C) - .81-.936	(60)
	• Freezing/Melting Point (°C): -48-18	(60)
	• Boiling Point (°C): 151- >588	(60)
	• Flash Point (°C): ranges from 38-74 for various grades of fuel oil no. 1 to 69-169 for grades of fuel oil no. 5	(12,51,60, 504,506, 507)
	• Flammable Limits in Air, % by Volume: 0.6-1.3% to 5.0-7.5% for fuel oil nos. 1 - 5	(51,60 506,507)
	• Autoignition Temperature (°C): 177-329 depending on grade for fuel oil nos. 1 - 5	(51,60,506, 507,513)
	• Vapor Pressure (mm Hg at 21°C): 2.12-26.4	(60)
	• Saturated Concentration in Air (mg/m^3 at 20°C): not available	( )
	• Solubility in Water (mg/L at 20°C): ~5	(2297)
	• Viscosity: fuel oil nos. 1, 2 1-D, 2-D (cp at 21°C) - 1.152-1.965; fuel oil nos. 4, 5, 6 (cp at 38°C) - 14.5-493.5	(60)
	• Surface Tension (dyne/cm at 20°C): 21-32	(60)
	• Log (Octanol-Water Partition Coefficient), log K_{ow}: 3.3-7.06	(*)
	• Soil Adsorption Coefficient, K_{oc}: 962-5.5 x 10^6	(*)
	• Henry's Law Constant ($atm \cdot m^3/mol$ at 20°C): 5.9 x 10^{-6} - 7.4	(*)
	• Bioconcentration Factor: not available	( )

PERSISTENCE IN THE SOIL-WATER SYSTEM	Diesel oil hydrocarbons are expected to have moderate mobility and moderate persistence in most surface soils; persistence in deep soils and ground water may be higher. Volatilization, sorption, photooxidation, and biodegradation are all potential fate processes. Surface spills may be weathered to a limited extent by evaporation; downward migration of weathered surface spills and sub-surface discharges represent a potential threat to underlying ground water. Biodegradation of fuel oil hydrocarbons is expected to occur under environmental conditions favorable to microbial oxidation; naturally-occurring, hydrocarbon-degrading microorganisms have been isolated from polluted soils and, to a lesser extent, non-polluted soils. The hydrocarbons of residual fuel oils are expected to be less mobile (lower aqueous solubility, higher sorption and lower volatility) and more persistent (slower biodegradation) than the lighter diesel oil hydrocarbons.

*Range of values for representative hydrocarbons from major component classes (see Table 66-3).

PATHWAYS OF EXPOSURE	The primary pathway of concern from the soil/ground-water system is the migration of fuel oils to ground water drinking water supplies from leaking underground storage tanks or large spills. Vapors from leaked or spilled fuels may diffuse through soil and migrate into structures resulting in inhalation exposures.

HEALTH HAZARD DATA	Signs and Symptoms of Short-term Human Exposure (54,17): The effects of exposure to fuel oils are expected to resemble those of kerosene. Inhalation of high concentrations may cause headache, nausea, confusion, drowsiness, convulsions and coma. Ingestion may cause nausea, vomiting and in severe cases, drowsiness progressing to coma. Aspiration may cause extensive pulmonary injury. The liquid may produce primary skin irritation.
	Toxicity Based on Animal Studies: LD_{50} (g/kg) oral [rat] 5.1->24 (1924) skin -- no data LC_{50} (mg/m^3) inhalation -- no data
	Long-Term Effects: Kidney damage
	Pregnancy/Neonate Data: Negative
	Mutation Data: Limited evidence
	Carcinogenicity Classification: IARC - none assigned; NTP - none assigned

HANDLING PRECAUTIONS (1967)	No specific respirator guidelines were found for fuel oils. The following guidelines are for kerosene with a boiling range of 175-325°C • Less than or equal to 1000 mg/m^3: chemical cartridge respirator with half-mask facepiece and organic vapor cartridge or supplied air respirator with half-mask facepiece operated in demand mode • 1000-5000 mg/m^3: gas mask with full facepiece and organic canister, supplied-air respirator with full facepiece or self-contained breathing apparatus with full facepiece operated in demand mode • Appropriate protective clothing including gloves, aprons and boots • Chemical goggles if there is probability of eye contact.

EMERGENCY FIRST AID TREATMENT (1932)	Ingestion: Do not induce vomiting. Get medical attention • Inhalation: Move victim to fresh air. Give artificial respiration if necessary. Get medical attention • Skin: Wash contaminated skin with soap and water. If blistering or skin loss has occurred, wash remaining fuel off with sterile water only and treat as a thermal burn. Get medical attention • Eye: Irrigate with large amounts of water. Get medical attention.

ENVIRONMENTAL AND OCCUPATIONAL STANDARDS AND CRITERIA

AIR EXPOSURE LIMITS:

Standards
- OSHA PEL (8-hr TWA): petroleum distillates (naphtha) 500 ppm
- AFOSH PEL (8-hr TWA): petroleum distillates (naphtha) 500 ppm

Criteria
- NIOSH IDLH (30-min): petroleum distillates (naphtha) 10,000 ppm
- ACGIH TLV® (8-hr TWA): petroleum distillates (naphtha) none established
- ACGIH STEL (15-min): petroleum distillates (naphtha) none established

WATER EXPOSURE LIMITS:

Drinking Water Standards - None established

EPA Health Advisories - None established

EPA Ambient Water Quality Criteria (355)
- Human Health
  No criterion established; fuel oils are not priority pollutants
- Aquatic Life
  No criterion established; fuel oils are not priority pollutants

Oil and Grease (2012)

For domestic water supply: Virtually free from oil and grease, particularly from the tastes and odors that emanate from petroleum products.

For aquatic life:

- 0.01 of the longest continuous flow 96-hour LC_{50} to several important freshwater and marine species, each having a demonstrated high susceptibility to oils and petrochemicals;
- levels of oils or petrochemicals in the sediment which cause deleterious effects to the biota should not be allowed;
- surface waters shall be virtually free from floating non-petroleum oils of vegetable and animal origin as well as petroleum-derived oil.

COMPOSITION:
- Linear alkanes
- Branched alkanes
- Cycloalkanes
- Benzenes and alkylbenzenes
- Naphthalenes
- Polynuclear aromatic hydrocarbons (C_{15}-C_{50})

REACTIVITY	Hydrocarbon blends are typically incompatible with strong acids, alkalies, and strong oxidizers. These oils and fuels are usually classified as miscellaneous combustible or flammable materials for compatibility classification purposes. Such substances typically evolve heat, fire, and toxic or flammable gases in reactions with oxidizing mineral acids, alkali or alkaline earth metals, nitrides, organic peroxides or hydroperoxides, or strong oxidizing agents. Reactions with explosive materials may result in an explosion, while those with strong reducing agents may evolve heat and flammable gases. Non-oxidizing mineral acids generally evolve heat and innocuous gases (505,507,511).

PHYSICO-CHEMICAL DATA	• Physical State (at 20°C): oily liquid	(60)
	• Color: yellow-brown; depends on use	(60)
	• Odor: lube oil odor	(60)
	• Odor Threshold: no data	( )
	• Liquid Density (g/ml at 15°C): 0.84-0.96	(60)
	• Freezing/Melting Point (°C): -34.4	(60)
	• Boiling Point (°C): 360	(39)
	• Flash Point (°C): usually 135 or greater	(60)
	• Flammable Limits in Air, % by Volume: no data	( )
	• Autoignition Temperature (°C): usually 163 or greater	(60)
	• Vapor Pressure (mm Hg at 20°C): no data	( )
	• Saturated Concentration in Air (mg/m^3 at 20°C): not pertinent	( )
	• Solubility in Water (mg/L at 20°C): insoluble	(60)
	• Viscosity (cp at 38°C): 275	(60)
	• Surface Tension (dyne/cm at 20°C): 36-37.5	(60)
	• Log (Octanol-Water Partition Coefficient), log K_{OW}: not available	( )
	• Soil Adsorption Coefficient, K_{OC}: not available	( )
	• Henry's Law Constant ($atm \cdot m^3/mol$ at 20°C): not available	( )
	• Bioconcentration Factor: not available	( )

PERSISTENCE IN THE SOIL-WATER SYSTEM	Most constituents are expected to be highly immobile in the soil/ground-water system due to very low water solubilities and high soil sorption. Major loss mechanisms are volatilization and aerobic biodegradation. However, loss rates are slow and oils should be considered persistent. "Weathering" effects seen.

PATHWAYS OF EXPOSURE	The primary pathway of concern from the soil/ground-water system is the migration of mineral base crankcase oil to ground water drinking water supplies. The strong sorption of the oil components militates against this, but increases the possibility of surface water contamination from runoff carrying soil particles to which the oil has been sorbed. Inhalation exposures and ingestion with food are not expected to be significant.

HEALTH HAZARD DATA	Signs and Symptoms of Short-term Human Exposure (60): Ingestion of crankcase oil results in minimal gastrointestinal tract irritation with an increased frequency of bowel passage. Inhalation may cause pulmonary irritation which may increase in severity several hours after exposure. Skin contact may cause dermatitis.
	Toxicity Based on Animal Studies: LD_{50} (g/kg) oral >21.5 [rat] (1924) skin >15 [rodent - species not specified] (13) LC_{50} (mg/m^3) inhalation -- no data
	Long-Term Effects: Dermatitis, respiratory tract irritation
	Pregnancy/Neonate Data: No data
	Mutation Data: Negative
	Carcinogenicity Classification: IARC - Group 3; NTP - none assigned

HANDLING PRECAUTIONS (60)	Protective equipment includes protective gloves and goggles or face shield.

EMERGENCY FIRST AID TREATMENT (60)	Ingestion: Do not lavage or induce vomiting. If victim is conscious, give water or milk. Get medical attention • Inhalation: Move victim to fresh air and perform artificial respiration if necessary. Get medical attention • Skin: Remove contaminated clothing. Wipe off and wash area with soap and water. Get medical attention • Eye: Wash with copious quantity of water. Get medical attention.

ENVIRONMENTAL AND OCCUPATIONAL STANDARDS AND CRITERIA

AIR EXPOSURE LIMITS:

Standards

- OSHA PEL (8-hr TWA): none established
- AFOSH PEL (8-hr TWA): none established

Criteria

- NIOSH IDLH (30-min): none established
- ACGIH TLV® (8-hr TWA): none established
- ACGIH STEL (15-min): none established

WATER EXPOSURE LIMITS:

Drinking Water Standards - None established

EPA Health Advisories - None established

EPA Ambient Water Quality Criteria (355)

- Human Health

  No criterion established; mineral base crankcase oil is not a priority pollutant.

- Aquatic Life

  No criterion established; mineral base crankcase oil is not a priority pollutant.

Oil and Grease (2012)

For domestic water supply: Virtually free from oil and grease, particularly from the tastes and odors that emanate from petroleum products.

For aquatic life:

- 0.01 of the longest continuous flow 96-hour LC_{50} to several important freshwater and marine species, each having a demonstrated high susceptibility to oils and petrochemicals;
- levels of oils or petrochemicals in the sediment which cause deleterious effects to the biota should not be allowed;
- surface waters shall be virtually free from floating non-petroleum oils of vegetable and animal origin as well as petroleum-derived oil.

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Benzene
MSDS 316
BEN2200

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Benzene
CAS Number: 71-43-2
Chemical Formula: C_6H_6
Structural Chemical Formula: C_6H_6
Synonyms: (6)ANNULENE; BENZEEN; BENZEN; BENZENE; BENZIN; BENZINE; BENZOL; BENZOL 90; BENZOLE; BENZOLENE; BENZOLO; BICARBURET OF HYDROGEN; CARBON OIL; COAL NAPHTHA; CYCLOHEXATRIENE; EPA PESTICIDE CHEMICAL CODE 008801; FENZEN; MINERAL NAPHTHA; MOTOR BENZOL; NITRATION BENZENE; PHENE; PHENYL HYDRIDE; POLYSTREAM; PYROBENZOL; PYROBENZOLE
General Use: Manufacture of chemicals including styrene, dyes, and many other organic chemicals. Has been used in artificial leather, linoleum, oil cloth, airplane dopes, lacquers; as solvent for waxes, resins, oils etc.
May also be a minor component of gasoline, petrol.
Exposure should be minimized by use in closed systems.
Handling procedures and control measures should be evaluated for exposure before commencement of use in plant operations.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
benzene	71-43-2	99.9

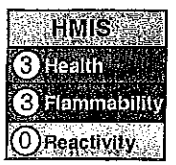
OSHA PEL
TWA: 1 ppm; 3 mg/m^3; STEL: 5 ppm; 15 mg/m^3; from Table Z-2.

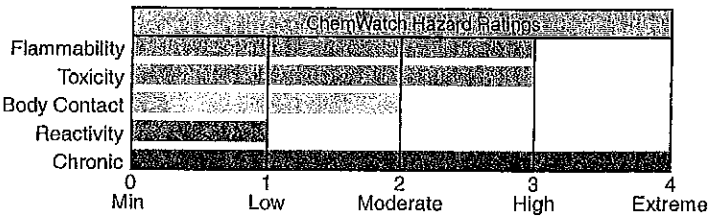
ACGIH TLV
TWA: 10 ppm; 32 mg/m^3.

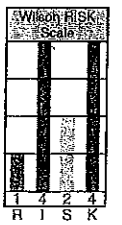
NIOSH REL
TWA: 0.1 ppm. STEL: 1 ppm.

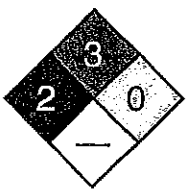
IDLH Level
500 ppm.

Section 3 - Hazards Identification









Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Toxic. Also causes: headache, dizziness, drowsiness. Absorbed through the skin. Chronic: dermatitis, leukemia, bone marrow damage. Carcinogen. Reproductive effects. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact
Target Organs: blood, central nervous system (CNS), bone marrow, eyes, upper respiratory system, skin
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

Inhalation hazard is increased at higher temperatures.

The symptoms of acute exposure to high vapor concentrations include confusion, dizziness, tightening of the leg muscles and pressure over the forehead followed by a period of excitement. If exposure continues the casualty quickly becomes stupefied and lapses into a coma with narcosis.

Effects of inhalation may include nausea, vomiting headache, dizziness, drowsiness, weakness, sometimes preceded by brief periods of exhilaration, or euphoria, irritability, malaise, confusion, ataxia, staggering, weak and rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. Severe exposures may produce blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis and coma characterized by motor restlessness, tremors and hyperreflexia (occasionally preceded by convulsions). Polyneuritis and persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia and agitation may also occur. Two-three weeks after the exposure, nervous irritability, breathlessness and unsteady gait may still persist; cardiac distress and an unusual dicoloration of the skin may be evident for up to four weeks.

Hemotoxicity is not normally a feature of acute exposures although anemia, thrombocytopenia, petechial hemorrhage, and spontaneous internal bleeding have been reported. Fatal exposures may result from asphyxia, central nervous system depression, cardiac and respiratory failure and circulatory collapse; sudden ventricular fibrillation may also be fatal.

Death may be sudden or may be delayed for 24 hours. Central nervous system, respiratory or hemorrhagic complications may occur up to five days after the exposure and may be lethal; pathological findings include respiratory inflammation with edema, and lung hemorrhage, renal congestion, cerebral edema and extensive petechial hemorrhage in the brain, pleurae, pericardium, urinary tract, mucous membrane and skin.

Exposure to toxic levels has also produced chromosome damage.

Eye: The liquid is highly discomforting to the eyes, may be harmful following absorption and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is moderately discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.

Toxic effects may result from skin absorption.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Liquid is an irritant and may cause burning and blistering of skin on prolonged exposure.

Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes.

Benzene is a myelotoxicant known to suppress bone-marrow cell proliferation and to induce hematologic disorders in humans and animals.

Signs of benzene-induced aplastic anemia include suppression off leukocytes (leukopenia), red cells (anemia), platelets (thromocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and hemorrhage. The most significant toxic effect is insidious and often irreversible injury to the blood forming tissue. Leukemia may develop.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

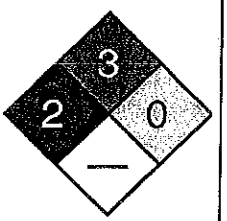
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:
1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.
Consider complete blood count. Evaluate history of exposure.

Section 5 - Fire-Fighting Measures

Flash Point: -11 °C Closed Cup
Autoignition Temperature: 562 °C
LEL: 1.3% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Pollutant - contain spillage. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Storage Requirements: Store in original containers in approved flame-proof area.
No smoking, bare lights, heat or ignition sources.
DO NOT store in pits, depressions, basements or areas where vapors may be trapped. Keep containers securely sealed.
Store away from incompatible materials in a cool, dry well ventilated area.
Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Nitrile gloves; Neoprene gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Respiratory Protection:
Exposure Range >1 to 10 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Note: must change cartridge at beginning of each shift
Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.
Glove Selection Index:

PE/EVAL/PE	A
PVA	A
TEFLON	A
VITON	A
VITON/NEOPRENE	A
NITRILE+PVC	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

BUTYL	C
NITRILE	C
NEOPRENE	C
PVC	C
NATURAL RUBBER	C
BUTYL/NEOPRENE	C

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, highly flammable liquid; floats on water. Characteristic aromatic odor. Highly volatile. Mixes with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils.

Physical State: Liquid
Vapor Pressure (kPa): 9.95 at 20 °C
Vapor Density (Air=1): 2.77
Formula Weight: 78.12
Specific Gravity (H_2O=1, at 4 °C): 0.879 at 20 °C
Water Solubility: 0.18 g/100 g of water at 25 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 80.1 °C (176 °F)
Freezing/Melting Point Range: 5.5 °C (41.9 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (man) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 930 mg/kg
Inhalation (rat) LC_{50}: 10000 ppm/7h
Inhalation (human) LC_{Lo}: 2000 ppm/5m
Inhalation (man) TC_{Lo}: 150 ppm/1y - I
Inhalation (human) TC_{Lo}: 100 ppm
Reproductive effector in rats

IRRITATION
Skin (rabbit): 20 mg/24 hr - mod
Eye (rabbit): 2 mg/24 hr - SEVERE

See NIOSH, *RTECS* CY 1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. It may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm in a base-rich para-brownish soil in 1 and 10 weeks, respectively. It may be subject to biodegradation in shallow, aerobic groundwaters, but probably not under anaerobic conditions. If released to water, it will be subject to rapid volatilization; the half-life for evaporation in a wind-wave tank with a moderate wind speed of 7.09 m/sec was 5.23 hours; the estimated half-life for volatilization from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec is estimated to be 2.7 hours at 20 °C. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation based on a reported biodegradation half-life of 16 days in an aerobic river die-away test. In a marine ecosystem biodegradation occurred in 2 days after an acclimation period of 2 days and 2 weeks in the summer and spring, respectively, whereas no degradation occurred in winter. According to one experiment, it has a half-life of 17 days due to photodegradation which could contribute to removal in situations of cold water, poor nutrients, or other conditions less conductive to microbial degradation. If released to the atmosphere, it will exist predominantly in the vapor phase. Gas-phase will not be subject to direct photolysis but it will react with photochemically produced hydroxyl radicals with a half-life of 13.4 days calculated using an experimental rate constant for the reaction. The reaction time in polluted atmospheres which contain nitrogen oxides or sulfur dioxide is accelerated with the half-life being reported as 4-6 hours. Products of photooxidation include phenol, nitrophenols, nitrobenzene, formic acid, and peroxyacetyl nitrate. It is fairly soluble in water and is removed from the atmosphere in rain.

Ecotoxicity: LC_{50} Clawed toad (3-4 wk after hatching) 190 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 5.8 to 10.9 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 63 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay); LD_{50} Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 12.8 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae) stage 1, 108 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 20 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 5.3×10^{-3}

BCF: eels 3.5

Biochemical Oxygen Demand (BOD): 1.2 lb/lb, 10 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 2.13$

Soil Sorption Partition Coefficient: K_{oc} = woodburn silt loam 31 to 143

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BENZENE
Hazard Class: 3.1
ID No.: 1114
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U019 Toxic Waste; Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001; per CWA Section 307(a); per CAA Section 112 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: .....1999-11 **Review Date:** 2000-07

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Material Safety Data Sheet Collection
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Issue Date: 2000-07

Toluene
MSDS 317
TOL2320

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Toluene **CAS Number:** 108-88-3
Chemical Formula: C_7H_8
Structural Chemical Formula: $C_6H_5CH_3$
Synonyms: ANTISAL 1A; BENZENE,METHYL-; CP 25; METHACIDE; METHANE,PHENYL-; METHYL BENZENE; METHYL BENZOL; METHYLBENZENE; METHYLBENZOL; PHENYL METHANE; PHENYLMETHANE; TOLUEEN; TOLUEN; TOLUENE; TOLUENO; TOLUOL; TOLUOLO; TOLU-SOL
General Use: Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners; in gasoline and aviation fuel. Used in the manufacture of chemicals, dyes, explosives, benzoic acid.
Some grades of toluene may contain traces of xylene and benzene.
Odor threshold: 2 ppm approx. Odor is not a reliable warning property due to olfactory fatigue.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
toluene	108-88-3	> 99.5

OSHA PEL
TWA: 200 ppm; STEL: 300 ppm; from Table Z-2. Other Values: 500 mg/m^3; 10 min peak 8hr ppm.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 375 mg/m^3; STEL: 150 ppm; 560 mg/m^3.

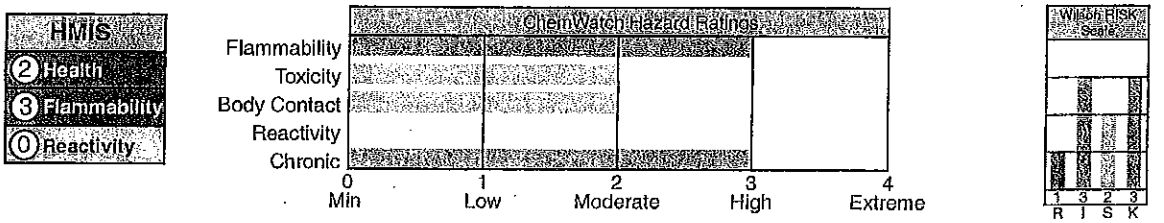
ACGIH TLV
TWA: 50 ppm; 188 mg/m^3.

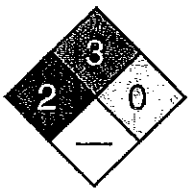
NIOSH REL
TWA: 100 ppm; 375 mg/m^3. STEL: 150 ppm; 560 mg/m^3.

IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 50 ppm; 190 mg/m^3.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sickly, sweet odor. Irritating to the eyes/skin/respiratory tract. Also causes; weakness, headache, dizziness, confusion, and insomnia. Chronic: liver and kidney damage. May cause birth defects. Flammable.

Potential Health Effects

Primary Entry Routes: Inhalation, skin contact/absorbtion.
Target Organs: Skin, liver, kidneys, central nervous system.
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract. Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness.

Serious poisonings may result in respiratory depression and may be fatal.

Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes if exposure is prolonged.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis and it is absorbed by skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Chronic toluene habituation occurs following intentional abuse (glue-sniffing) or from occupational exposure. Ataxia, incoordination and tremors of the hands and feet (as a consequence of diffuse cerebral atrophy), headache, abnormal speech, transient memory loss, convulsions, coma, drowsiness, reduced color perception, frank blindness, nystagmus (rapid, involuntary eye-movements), decreased hearing leading to deafness and mild dementia have all been associated with chronic abuse.

Peripheral nerve damage, encephalopathy, giant axonopathy, electrolyte disturbances in the cerebrospinal fluid and abnormal computer tomographic (CT) scans are common amongst toluene addicts. Although toluene abuse has been linked with kidney disease, this does not commonly appear in cases of occupational toluene exposures. Cardiac and hematological toxicity are however associated with chronic toluene exposure. Cardiac arrhythmia, multifocal and premature ventricular contractions and supraventricular tachycardia are present in 20% of patients who abused toluene-containing paints.

Previous suggestions that chronic toluene inhalation produced human peripheral neuropathy have largely been discounted. However central nervous system (CNS) depression is well documented where blood toluene levels exceed 2.2 mg%. Toluene abusers can achieve transient circulating concentrations of 6.5 mg%. Amongst workers exposed for a median time of 29 years to toluene no subacute effects on neurasthenic complaints and pyschometric test results could be established.

The prenatal toxicity of very high toluene concentrations has been documented for several animal species and man. Malformations indicative of specific teratogenicity have not generally been found. The toxicity described in the literature takes the form of embryo death or delayed fetal growth and delayed skeletal system development. Permanent damage of children has been seen only when mothers had suffered from chronic intoxication as a result of "sniffing".

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Following acute or short-term repeated exposures to toluene:
1. Toluene is absorbed across to alveolar barrier, the blood/air mixture being 11.2/15.6 (at 37 °C) The order of toluene, in expired breath, is of the order of 18 ppm following sustained exposure to 100 ppm.
The tissue/blood proportion is 1/3 except in adipose where the proportion is 8/10.
2.Metabolism by microsomal mono-oxygenation, results in the production of hippuric acid. This may be detected in the urine in amounts between 0.5 and 2.5 g/24hr which represents, on average 0.8 gm/gm of creatinine.
The biological half life of hippuric acid is in the order of 1-2 hours.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
8.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

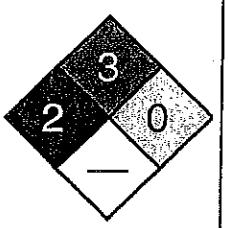
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Hippuric acid in urine	2.5 gm/gm creatinine	End of shift Last 4 hrs of shift	B,NS
Toluene in venous blood	1 mg/L	End of shift	SQ
Toluene in end-exhaled air		End of shift	SQ

NS: Non-specific determinant; also observed after exposure to other material
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: 4 °C Closed Cup
Autoignition Temperature: 480 °C
LEL: 1.2% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Nitric acid with toluene, produces nitrated compounds which are explosive.



Fire Diamond

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; Metal drum; Metal safety cans. Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area; local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; chemical goggles. Full face shield.

DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:

Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

PE/EVAL/PE	A
VITON/CHLOROBUTYL	A
VITON	A
PVA	A
TEFLON	B
SARANEX-23 2-PLY	C
CPE	C
VITON/NEOPRENE	C
SARANEX-23	C
NEOPRENE/NATURAL	C
NITRILE+PVC	C
NITRILE	C
BUTYL	C
PVC	C
NEOPRENE	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 2.93 at 20 °C
Vapor Density (Air=1): 3.2
Formula Weight: 92.14
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 20 °C
Water Solubility: < 1 mg/mL at 18 °C
Evaporation Rate: 2.4 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 111 °C (232 °F) at 760 mm Hg
Freezing/Melting Point Range: -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 636 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm
Inhalation (man) TC_{Lo}: 200 ppm
Inhalation (rat) LC_{50}: > 26700 ppm/1h
Dermal (rabbit) LD_{50}: 12124 mg/kg
Reproductive effector in rats

IRRITATION
Skin (rabbit): 20 mg/24h-moderate
Skin (rabbit): 500 mg - moderate
Eye (rabbit): 0.87 mg - mild
Eye (rabbit): 2 mg/24h - SEVERE
Eye (rabbit): 100 mg/30sec - mild

See NIOSH, *RTECS* XS 5250000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be lost by evaporation from near-surface soil and by leaching to the groundwater. Biodegradation occurs both in soil and groundwater, but it is apt to be slow especially at high concentrations, which may be toxic to microorganisms. The presence of acclimated microbial populations may allow rapid biodegradation. It will not significantly hydrolyze in soil or water under normal environmental conditions. If released into water, its concentration will decrease due to evaporation and biodegradation. This removal can be rapid or take several weeks, depending on temperature, mixing conditions, and acclimation of microorganisms. It will not significantly adsorb to sediment or bioconcentrate in aquatic organisms. If released to the atmosphere, it will degrade by reaction with photochemically produced hydroxyl radicals (half-life 3 hr to slightly over 1 day) or be washed out in rain. It will not be subject to direct photolysis.

Ecotoxicity: LC_{50} Aedes aegypti-4th instar (mosquito larvae) 22 mg/l /Conditions of bioassay not specified; LC_{50} Cyprinodon variegatus (sheepshead minnow) 277-485 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Calandra granaria (grain weevil) 210 mg/l /in air; LC_{50} Cancer magister (crab larvae stage I) 28 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 4.3 ppm 96 hr /Conditions of bioassay not specified; LC_{50} Artemia salina (brine shrimp) 33 mg/l 24 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (striped bass) 7.3 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnows) 55-72 mg/l (embryos), 25-36 mg/l (1-day posthatch protolarvae), and 26-31 mg/l (30-day-old minnows)/ 96 hour /Conditions of bioassay not specified

Henry's Law Constant: 0.0067

BCF: eels 13.2

Biochemical Oxygen Demand (BOD): 0%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.69

Soil Sorption Partition Coefficient: K_{oc} = silty loam 37

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: TOLUENE
Additional Shipping Information: TOLUOL
Hazard Class: 3.1
ID No.: 1294
Packing Group: II
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U220 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001; per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.....1999-11 **Review Date:** 2000-07

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Material Safety Data Sheet Collection
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Issue Date: 2000-07

Ethylbenzene
MSDS 385
ETH3050

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Ethylbenzene **CAS Number:** 100-41-4
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_5 \cdot C_2H_5$
Synonyms: AETHYLBENZOL; BENZENE,ETHYL-; EB; ETHYL BENZENE; ETHYLBENZEEN; ETHYLBENZENE; ETHYLBENZOL; ETILBENZENE; ETYLOBENZEN; PHENYLETHANE
General Use: Used in the manufacture of cellulose acetate, styrene and synthetic rubber; solvent or diluent; component of automotive and aviation gasoline.
Component of many petroleum hydrocarbon solvents, thinners.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethylbenzene	100-41-4	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 125 ppm; 545 mg/m^3.

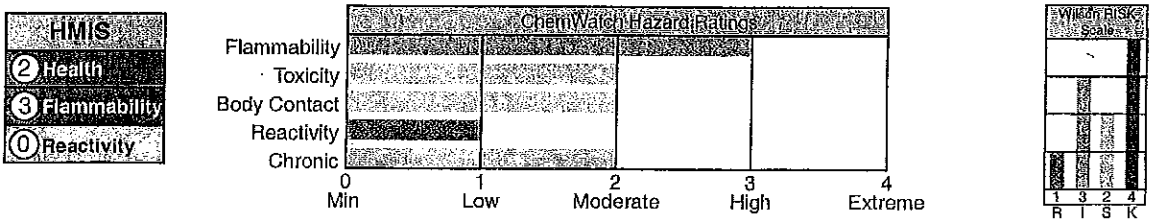
ACGIH TLV
TWA: 100 ppm; 434 mg/m^3;
STEL: 125 ppm; 543 mg/m^3.

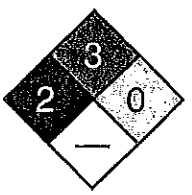
NIOSH REL
TWA: 100 ppm; 435 mg/m^3.
STEL: 125 ppm; 545 mg/m^3.

IDLH Level
800 ppm; LEL.

DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m^3.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pungent odor. Irritating to eyes/skin/respiratory tract. Also causes: chest constriction, vertigo, narcosis, cramps, respiratory paralysis. Chronic: fatigue, sleepiness, headache, blood disorders, lymphocytosis. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact
Target Organs: eyes, respiratory system, skin, central nervous system (CNS), blood
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.

When humans were exposed to the 100 and 200 ppm for 8 hours about 45-65% is retained in the body. Only traces of unchanged ethyl benzene are excreted in expired air following termination of inhalation exposure.

Humans exposed to concentrations of 23-85 ppm excreted most of the retained dose in the urine (mainly as metabolites).

Guinea pigs that died from exposure had intense congestion of the lungs and generalized visceral hyperemia. Rats exposed for three days at 8700 mg/m^3 (2000 ppm) showed changes in the levels of dopamine and noradrenaline in various parts of the brain.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Two drops of the material in to the conjunctival sac produced only slight irritation of the conjunctival membrane but no corneal injury.

Skin: The liquid is discomforting to the skin if exposure is prolonged and is capable of causing skin reactions which may lead to dermatitis.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

The mean rate of absorption of liquid ethyl benzene applied to 17.3 cm2 area of the forearm of seven volunteers for 10-15 minutes was determined to be 38 mg/cm2/hr. Immersion of the whole hand in aqueous solutions of ethyl benzene (112-156 mg/l) for 1 hour yielded mean absorption rates of 118 and 215.7 ug/cm2/hr. The rate of absorption is thus greater than that of aniline, benzene, nitrobenzene, carbon disulfide and styrene.

Repeated application of the undiluted product to the abdominal area of rabbits (10-20 applications over 2-4 weeks) resulted in erythema, edema and superficial necrosis. The material did not appear to be absorbed through the skin in sufficient quantity to produce outward signs of toxicity.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce considerable gastrointestinal discomfort and may be harmful or toxic if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Industrial workers exposed to a maximum level of ethyl benzene of 0.06 mg/l (14 ppm) reported headaches and irritability and tired quickly. Functional nervous system disturbances were found in some workers employed for over 7 years whilst other workers had enlarged livers.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. DO NOT induce vomiting.

Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.

Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink.

Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

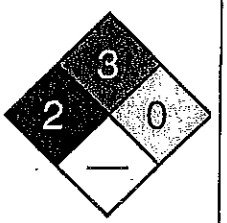
1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance
4. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

6. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

Flash Point: 12.8 °C Closed Cup
Autoignition Temperature: 432 °C
LEL: 1.6% v/v
UEL: 7% v/v



Fire Diamond

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves or Nitrile gloves.
Protective footwear.
Respiratory Protection:
Exposure Range >100 to <800 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Eyewash unit.
Glove Selection Index:
VITON.....A
TEFLON.....A

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid; floats on water. Aromatic solvent odor. Soluble in alcohol, benzene, carbon tetrachloride and ether.

Physical State: Liquid
Vapor Pressure (kPa): 1.333 at 25.9 °C
Vapor Density (Air=1): 3.66
Formula Weight: 106.17
Specific Gravity (H_2O=1, at 4 °C): 0.8670 at 20 °C
Water Solubility: 0.01% by weight
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 136.2 °C (277 °F) at 760 mm Hg
Freezing/Melting Point Range: -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (rat) LD_{50}: 3500 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm/8h
Inhalation (rat) LC_{Lo}: 4000 ppm/4h
Intraperitoneal (mouse) LD_{50}: 2642 mg/kg~
Dermal (rabbit) LD_{50}: 17800 mg/kg~

IRRITATION
Skin (rabbit): 15 mg/24h mild
Eye (rabbit): 500 mg - SEVERE

Liver changes, utheral tract, effects on fertility, specific developmental abnormalities (musculoskeletal system) recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* DA 0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it exist predominantly in the vapor phase based on its vapor pressure where it will photochemically degrade by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially return to earth in rain. It will not be subject to direct photolysis. Releases into water will decrease in concentration by evaporation and biodegradation. The time for this decrease and the primary loss processes will depend on the season, and the turbulence and microbial populations in the particular body of water. Representative half-lives are several days to 2 weeks. Some may be adsorbed by sediment but significant bioconcentration in fish is not expected to occur based upon its octanol/water partition coefficient. It is only adsorbed moderately by soil. It will not significantly hydrolyze in water or soil.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 275 mg/l 96 hr in a static unmeasured bioassay; LC_{50} Pimephales promelas (fathead minnow) 12.1 mg/l/96 hr (confidence limit 11.5 - 12.7 mg/l), flow-through bioassay with measured concentrations, 26.1 °C, dissolved oxygen 7.0 mg/l, hardness 45.6 mg/l calcium carbonate, alkalinity 43.0 mg/l; Toxicity threshold (cell multiplication inhibition test): Pseudomonas putida (bacteria) 12 mg/l ; LC_{50} Palaemonetes pugio (grass shrimp, adult) 14,400 ug/l/24 hr in a static unmeasured bioassay; LC_{50} Palaemonetes pugio (grass shrimp, larva) 10,200 ug/l/24 hr in a static unmeasured bioassay; Toxicity threshold (cell multiplication inhibition test): Microcystis aeruginosa (algae) 33 mg/l; Scenedesmus quadricauda (green algae) > 160 mg/l

Henry's Law Constant: 8.44×10^{-3}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): theoretical 2.8%, 5 days

Octanol/Water Partition Coefficient: log $K_{ow} = 3.15$

Soil Sorption Partition Coefficient: $K_{oc} = 164$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYLBENZENE
Additional Shipping Information: PHENYL ETHANE
Hazard Class: 3.1
ID No.: 1175
Packing Group: II
Label: Flammable Liquid [3]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: .....1999-11 **Review Date:** 2000-07

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Issue Date: 2000-07

Xylene
MSDS 318
XYL2260

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Xylene
CAS Number: 1330-20-7
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
Synonyms: BENZENE,DIMETHYL-; COMPONENT 1 (83%): XYLENES; COMPONENT 2 (17%): ETHYL BENZENE; DIMETHYLBENZENE; DIMETHYLBENZENES; EPA PESTICIDE CHEMICAL CODE 086802; KSYLEN; METHYL TOLUENE; METHYLTOLUENE; VIOLET 3; XILOLI; XYLENE; XYLENEN; XYLOL; XYLOLE
General Use: A strong solvent for general use in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
xylene	1330-20-7	> 95

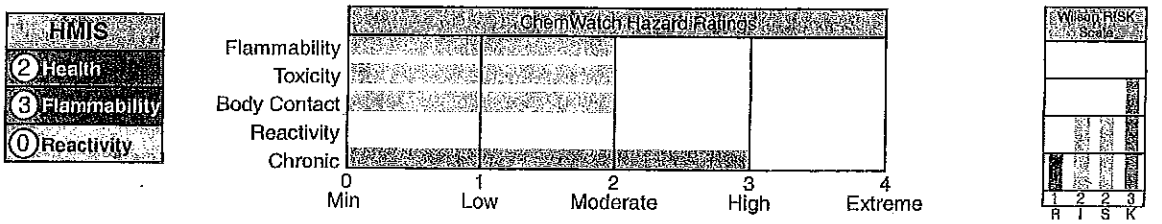
OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

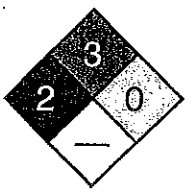
NIOSH REL
TWA: 100 ppm; 435 mg/m^3.
STEL: 150 ppm; 655 mg/m^3.

DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m^3.

ACGIH TLV
TWA: 100 ppm; 434 mg/m^3;
STEL: 150 ppm; 651 mg/m^3.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to the eyes/skin/respiratory tract. Also causes: dizziness, nausea, and drowsiness. Chronic: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is highly discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Small excess risks of spontaneous abortion and congenital malformation was reported amongst women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to xylene:

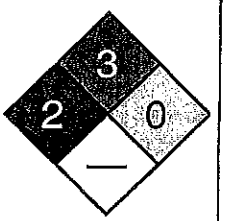
1.Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended. The use of charcoal and cathartics is equivocal.
2.Pulmonary absorption is rapid with about 60-65% retained at rest.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures

Flash Point: 25.6 °C
Autoignition Temperature: 241 °C
LEL: 1.0% v/v
UEL: 7.0% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).



Fire Diamond

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.

Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.
Glove Selection Index:

PE/EVAL/PE	A
PVA	A
VITON	A
TEFLON	A
PVDC/PE/PVDC	C
NATURAL+NEOPRENE	C
NEOPRENE/NATURAL	C
NITRILE+PVC	C
HYPALON	C
NAT+NEOPR+NITRILE	C
BUTYL	C
BUTYL/NEOPRENE	C
NITRILE	C
NEOPRENE	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

PVC.....C

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear colorless flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Water Solubility: Practically insoluble in water
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable

pH (1% Solution): Not applicable.
Boiling Point Range: 137 °C (279 °F) to 140 °C (284 °F)
Freezing/Melting Point Range: -47 °C (-53 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 4300 mg/kg
Inhalation (human) TC_{Lo}: 200 ppm
Inhalation (man) LC_{Lo}: 10000 ppm/6h
Inhalation (rat) LC_{50}: 5000 ppm/4h
Reproductive effector in rats

IRRITATION
Skin (rabbit):500 mg/24h moderate
Eye (human): 200 ppm irritant
Eye (rabbit): 87 mg mild
Eye (rabbit): 5 mg/24h SEVERE

See NIOSH, *RTECS* ZE 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most of the xylenes are released into the atmosphere where they may photochemically degrade by reaction with hydroxyl radicals (half-life 1-18 hr). The dominant removal process in water is volatilization. Xylenes are moderately mobile in soil and may leach into groundwater where they are known to persist for several years, despite some evidence that they biodegrade in both soil and groundwater. Bioconcentration is not expected to be significant.
Ecotoxicity: LC_{50} Rainbow trout 13.5 mg/l/96 hr /Conditions of bioassay not specified; LD_{50} Goldfish 13 mg/l/24 hr /Conditions of bioassay not specified
Henry's Law Constant: 0.22
BCF: estimated at 2.14 to 2.20
Octanol/Water Partition Coefficient: log K_{OW} = 3.12 to 3.20
Soil Sorption Partition Coefficient: K_{OC} = 48 to 68

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: XYLENES
Additional Shipping Information: XYLOLS
Hazard Class: 3.2
ID No.: 1307
Packing Group: III
Label: Flammable Liquid[3] ,

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U239 Toxic Waste; Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: .....1999-11 **Review Date:** 2000-07

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Material Safety Data Sheet Collection
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Issue Date: 2000-07

Unleaded Gasoline
MSDS 467
AUT5000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Unleaded Gasoline
CAS Number: 8006-61-9
Chemical Formula: Mixture of hydrocarbons
Synonyms: AUTOMOTIVE GASOLINE, LEAD-FREE; GASOLINE; MOTOR FUEL; MOTOR SPIRITS; NATURAL GASOLINE; PETROL; UNLEADED PETROL
General Use: Lead free motor fuel for internal combustion engines, 2-stroke and 4-stroke.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
gasoline	8006-61-9	>90
benzene	71-43-2	5 max.

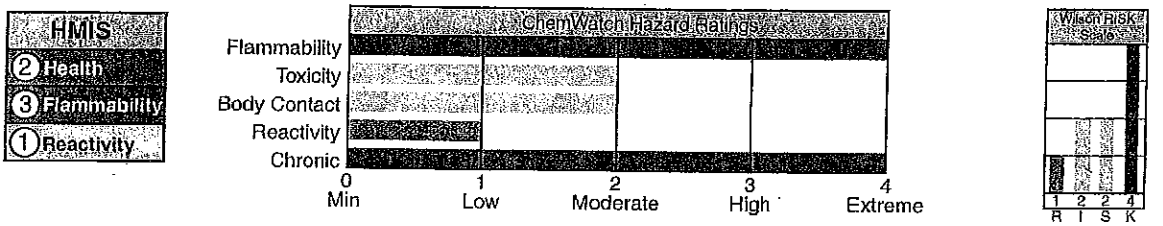
OSHA PEL
No data found.

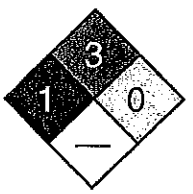
NIOSH REL
No data found.

OSHA PEL Vacated 1989 Limits
TWA: 300 ppm; 900 mg/m^3;
STEL: 500 ppm; 1500 mg/m^3.

ACGIH TLV
TWA: 300 ppm; 890 mg/m^3;
STEL: 500 ppm; 1480 mg/m^3.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear liquid; distinctive odor. Irritating to eyes/skin/respiratory tract. Also causes: dizziness, drunkenness, unconsciousness. Absorbed through skin. Chronic: dermatitis. Possible cancer hazard. Flammable. Can form explosive mixtures in air.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion, skin contact
Target Organs: skin, eye, respiratory system, central nervous system (CNS)

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract and may be harmful if exposure is prolonged. Inhalation hazard is increased at higher temperatures. Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death. WARNING: Intentional misuse by concentrating/inhaling contents may be lethal. High inhaled concentrations of mixed hydrocarbons may produce narcosis characterized by nausea, vomiting and lightheadedness. Inhalation of aerosols may produce severe pulmonary edema, pneumonitis and pulmonary hemorrhage. Inhalation of petroleum hydrocarbons consisting substantially of low molecular weight species may produce irritation of mucous membranes, incoordination, giddiness, nausea, vertigo, confusion, headache, appetite loss, drowziness, tremors and anesthetic stupor. Massive exposures may produce central nervous system depression with sudden collapse and deep coma; fatalities have been recorded. Irritation of the brain and/or apneic anoxia may produce convulsions. Although recovery following overexposure is generally complete, cerebral micro- hemorrhage of focal post-inflammatory scarring may produce eleptiform seizures some months after the exposure. Pulmonary episodes may include chemical pneumonitis with edema and hemorrhage. The lighter hydrocarbons may produce kidney and neurotoxic effects. Liquid paraffins may produce anesthesia and depressant actions leading to weakness, dizziness, slow and shallow respiration, unconsciousness, convulsions and death. C_{5-7} paraffins may also produce polyneuropathy. Aromatic hydrocarbons accumulate in lipid-rich tissues (typically the brain, spinal cord and peripheral nerves) and may produce functional impairment manifested by nonspecific symptoms such as nausea, weakness, fatigue, vertigo; severe exposures may produce inebriation or unconsciousness. Many of the petroleum hydrocarbons are cardiac sensitizers and may cause ventricular fibrillations.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration. The vapor is discomforting to the eyes. Petroleum hydrocarbons may produce pain after direct contact with the eyes. Slight, but transient, disturbances of the corneal epithelium may also result. The aromatic fraction may produce irritation and lachrymation. The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The material is moderately discomforting to the skin if exposure is prolonged. The material contains a component that may be absorbed through the skin and may cause drying of the skin, which may lead to dermatitis from repeated exposures over long periods. Toxic effects may result from skin absorption. Open cuts, abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing dermatitis condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis. Ingestion of petroleum hydrocarbons may produce irritation of the pharynx, esophagus, stomach and small intestine with edema and mucosal ulceration. Resulting symptoms include a burning sensation in the mouth and throat. Large amounts may produce narcosis with nausea and vomiting, weakness or dizziness, slow and shallow respiration, swelling of the abdomen, unconsciousness and convulsions. Myocardial injury may produce arrhythmias, ventricular fibrillation and electrocardiographic changes. Central nervous system depression may also occur. Light aromatic hydrocarbons produce a warm, sharp, tingling sensation on contact with taste buds and may anesthetize the tongue. Aspiration into the lungs may produce coughing, gagging, and a chemical pneumonitis with pulmonary edema and hemorrhage.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes. Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following. Chronic poisoning may occur from vapor inhalation or skin absorption. The most significant toxic effect is insidious and irreversible injury to the blood-forming tissue by benzene. Leukemia may develop. Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes. Gasoline "sniffing" has caused severe nerve damage. Repeated or prolonged exposure to mixed hydrocarbons may produce narcosis with dizziness, weakness, irritability, concentration and/or memory loss, tremor in the fingers and tongue, vertigo, olfactory disorders, constriction of visual field, paresthesias of the extremities, weight loss and anemia and degenerative changes in the liver and kidney. Chronic exposure by petroleum workers to the lighter hydrocarbons has been associated with visual disturbances, damage to the central nervous system, peripheral neuropathies (including numbness and paresthesias), psychological and neurophysiological deficits, bone marrow toxicities (including hypoplasia, possibly due to benzene) and hepatic and renal involvement. Chronic dermal exposure to petroleum hydrocarbons may result in defatting which produces localized dermatoses. Surface cracking and erosion may also increase susceptibility to infection by microorganisms.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital, or doctor.

Eye Contact: Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water). Wash affected areas thoroughly with water (and soap if available). Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

6. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

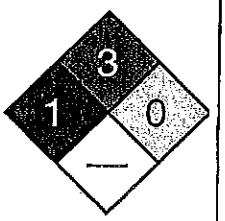
Section 5 - Fire-Fighting Measures

Flash Point: -43 °C

Autoignition Temperature: 280 °C

LEL: 1.4% v/v

UEL: 7.6% v/v



Fire Diamond

Extinguishing Media: Foam. Dry chemical powder. Bromochlorodifluoromethane (BCF) (where regulations permit). Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable. Severe fire hazard when exposed to heat, flame and/or oxidizers. Vapor forms an explosive mixture with air. Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition. Heating may cause expansion/decomposition with violent rupture of containers. On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with oxidizing agents, i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc., as ignition may result.

Fire-Fighting Instructions: Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. If safe, switch off electrical equipment until vapour fire hazard removed.

Use water delivered as a fine spray to control fire and cool adjacent area. Avoid spraying water onto liquid pools. Do not approach containers suspected to be hot. Cool fire exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately. Avoid breathing vapors and contact with skin and eyes. Control personal contact by using protective equipment. Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind. Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. No smoking, naked lights or ignition sources. Increase ventilation. Stop leak if safe to do so.

Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite. Use only spark-free shovels and explosion proof equipment. Collect recoverable product into labeled containers for recycling. Absorb remaining product with sand, earth or vermiculite. Collect solid residues and seal in labelled drums for disposal. Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation. Wear protective clothing when risk of exposure occurs. Use in a well-ventilated area. Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked. Avoid smoking, bare lights, heat or ignition sources. When handling, DO NOT eat, drink or smoke. Vapor may ignite on pumping or pouring due to static electricity. DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling. Avoid contact with incompatible materials. Keep containers securely sealed. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately. Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can, metal drum. Packing as recommended by manufacturer. Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area. If inhalation risk of overexposure exists, wear a NIOSH approved organic-vapor respirator. Correct respirator fit is essential to obtain adequate protection. In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or PVC gloves. Safety footwear. Do NOT use this product to clean the skin.

Respiratory Protection:

Exposure Range >300 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to 15,000 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >15,000 to 300,000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >300,000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Ensure that there is ready access to eye wash unit. Ensure there is ready access to an emergency shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Purple, highly flammable, volatile liquid with characteristic sharp odor. Floats on water. Consists of a complex mixture of hydrocarbons with small amounts of residual benzene from the refining operations.

Physical State: Liquid
Vapor Pressure (kPa): 53.33 at 20 °C
Vapor Density (Air=1): > 2
Formula Weight: Not applicable.
Specific Gravity (H_2O=1, at 4 °C): 0.72-0.735 at 15 °C
Water Solubility: Insoluble
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 38.89 °C (102 °F)
Freezing/Melting Point Range: Not available
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not available.

Section 10 - Stability and Reactivity

Stability/Polymerization: Presence of incompatible materials. Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Unless otherwise specified, data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (rat) LD50: 18800 mg/kg

IRRITATION
Skin (rabbit): 500 mg/24h mild

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
Biochemical Oxygen Demand (BOD): 8%, 5 days

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible. Follow all applicable federal, state, and local laws. Incinerate residue at an approved site. Recycle containers where possible, or dispose of in an authorized landfil.
BEWARE: Empty solvent, paint, lacquer and flammable liquid drums present a severe explosion hazard if cut by flame torch or welded. Even when thoroughly cleaned or reconditioned, the drum seams may retain sufficient solvent to generate an explosive atmosphere in the drum.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: MOTOR SPIRIT OR GASOLINE OR PETROL
Additional Shipping Information: PETROL
Hazard Class: 3.1
ID No.: 1203
Packing Group: II
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: .....1999-11 **Review Date:** 2000-07

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Material Safety Data Sheet Collection

Fuel Oil No. 2

MSDS No. 469

Date of Preparation: 10/81 Revision: B, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Fuel oil no. 2
Chemical Formula: Unspecified or Variable
CAS Number: 68476-30-2
Synonyms: #2 home heating oil; API no. 2 fuel oil; diesel oil; gas oil; home heating oil no. 2; number 2 burner fuel; number 2 fuel oil
Derivation: Residue from distillation (straight run or cracked) of crude oil.
General Use: Used as a fuel in atomizing burners for domestic and industrial heating, in engines of heavy units (ships, trucks, trains), as a source of synthesis gas, in drilling muds, and for mosquito control (coats breeding waters).
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Fuel oil no. 2, ca 100% vol (complex mixture (< 95%) of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons)
Trace Impurities: water and sediment (< 0.05% vol), carbon residue (< 0.35%), ash (< 0.01% wt), sulfur (< 0.7% wt) and benzene (< 100 ppm).

OSHA PEL
As petroleum distillates
8-hr TWA: 500 ppm (2000 mg/m^3)

ACGIH TLV
As diesel fuel
Notice of impending change (1997):
TWA: 100 mg/m^3, *Skin*

NIOSH REL
As petroleum distillates
10-hr TWA: 350 mg/m^3
Ceiling (15 min): 1800 mg/m^3

IDLH Level
As petroleum distillates
1,100 ppm

DFG (Germany) MAK
None established

Section 3 - Hazards Identification

ANSI Signal Word: Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Fuel oil no. 2 is an amber to brown, slighty viscous liquid with a petroleum odor. It can be irritating to the skin and respiratory tract. This low viscosity fuel oil presents a significant aspiration hazard following ingestion, which can result in chemical pneumonitis and respiratory failure. Also Causes: vomiting, diarrhea, central nervous system (CNS) depression, increased rate of respiration, rapid heart beat, and cyanosis (blue coloration of the skin caused by oxygen deficiency). Fuel oil no. 2 can be an environmental hazard if spilled. This flammable liquid is a moderate fire hazard. When heated to decomposition, it will emit acrid smoke and irritating fumes.

Wilson Risk Scale	
R	1
I	2
S	2
K	2

HMIS	
H	1*
F	2
R	0
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion
Target Organs: Skin, CNS, cardiovascular system (CVS), respiratory system, mucous membranes
Acute Effects
Inhalation: Respiratory tract irritation, headache, dizziness, euphoria, nausea, increased respiration rate, tachycardia (excessively rapid heart beat), cyanosis, stupor, convulsions, and unconsciousness can result from inhalation of fuel oil no. 2 mist.
Eye: Contact may result in irritation.
Skin: Contact may cause irritation.
Ingestion: Gastrointestinal irritation, vomiting, diarrhea, and in severe cases, CNS depression, progressing to coma and death, can result. Since intestinal absorption of longer chain hydrocarbons is minimal, aspiration into lungs following ingestion is a more significant exposure route; it may result in transient CNS depression, hemorrhaging and pulmonary edema, progressing to renal (kidney) involvement, chemical pneumonitis, and respiratory failure.
Carcinogenicity: IARC lists distillate (light) fuel oils as Group 3 (not classifiable as to carcinogenicity to humans). ACGIH lists a notice of impending change for diesel fuels as TLV-A3 (Animal carcinogen). NTP and OSHA do not list fuel oil no. 2 as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Prolonged and repeated skin contact can cause dermatitis, irritate the hair follicles and may block the (oil) sebaceous glands, producing a rash of acne pimples, usually on the arms and legs. Repeated exposures producing CNS effects may lead to permanent nervous system damage.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain and/or irritation develop.
Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water followed by washing the exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. *Do not* induce vomiting unless the poison control center advises otherwise.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Gastric lavage for treatment of ingestion is contraindicated due to aspiration hazard. Administer charcoal slurry cathartic (30 g/240 mL diluent). In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases and obtain chest x-ray.

Section 5 - Fire-Fighting Measures

Flash Point: 136 °F (57.78 °C)
Flash Point Method: CC
Autoignition Temperature: 494 °F (257 °C)
LEL: 0.6% v/v
UEL: 7.5% v/v

NFPA

Flammability Classification: OSHA Class II Combustible Liquid.
Extinguishing Media: Use dry chemical, carbon dioxide, foam, water fog or spray. Water may be ineffective in putting out a fire involving fuel oil no. 2, and a solid water stream may spread the flames; however, a water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.
Unusual Fire or Explosion Hazards: Can form explosive mixtures in air. In still air, the heavier-than-air vapors of fuel oil no. 2 may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.
Hazardous Combustion Products: Heating fuel oil no. 2 to decomposition can produce thick acrid smoke and irritating fumes.
Fire-Fighting Instructions: If tank, rail car or tank truck is involved in fire isolate for 1/2 mile (800 m). *Do not* release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Isolate area for at least 80-160 ft (25-50 m) in all directions. Water spray or fire fighting foam may suppress vapor, but may not prevent ignition in closed spaces. Use natural barriers or oil spill control booms to confine oil slicks on surface water.
Small Spills: Absorb fuel oil no. 2 with vermiculite, earth, sand or similar material.
Large Spills
Containment: For large spills, consider downwind evacuation of at least 1000 ft (300 m). Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.
Cleanup: Ground all equipment. Spills can be absorbed with materials such as peat, activated carbon, polyurethane foam, or straw. Sinking agents, gelling agents, dispersants, and mechanical systems can also be used to treat oil spills. Use clean non-sparking tools to collect absorbed material.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor or mist inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations as low as possible. Wear protective gloves (or use barrier cream) and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

Storage Requirements: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (See Sec. 10). Periodically inspect stored materials. Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.106) for a Class II Combustible Liquid.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local exhaust ventilation at the site of chemical release designed for flammable vapors/mists. Where possible, transfer fuel oil no. 2 from drums or other storage containers to process containers. Minimize sources of ignition in surrounding low-lying areas.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), use an SCBA.
Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of Viton™ or nitrile rubber, if possible, or alternatively, polyvinyl chloride, chlorinated polyethylene or neoprene to prevent skin contact. Butyl rubber may degrade after contact and is not recommended. Wear protective eyeglasses per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid

Appearance and Odor: Amber to brown, slightly viscous; petroleum odor

Odor Threshold: 0.082 ppm

Formula Weight: N/A

Specific Gravity (H_2O=1, at 4 °C): 0.8654 at 59 °F (15 °C)

Water Solubility: Slightly soluble

Boiling Point: 450 °F (232 °C)

Freezing Point: -50.8 °F (-46 °C)

Viscosity: 268 centistoke at 100 °F (37.8 °C)

Surface Tension: 25 dynes/cm, estimated

Henry's Law Constant (H): 29 to 68 atm-m^3/mole at 77 °F (25 °C), estimated

Octanol/Water Partition Coefficient: log K_{ow} = 8.2 to 9.7

Soil Sorption Coefficient (K_{oc}): $1x10^4$, estimated

Section 10 - Stability and Reactivity

Stability: Fuel oil no. 2 is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include strong oxidizing agents.

Conditions to Avoid: Heat and ignition sources.

Hazardous Decomposition Products: Thermal oxidative decomposition of fuel oil no. 2 can produce various hydrocarbons, hydrocarbon derivatives, partial oxidation products (carbon dioxide (CO_2), carbon monoxide (CO), sulfur dioxide (SO_2)).

Section 11- Toxicological Information

Toxicity Data:*

Skin Effects:
Rabbit, skin, standard Draize test: 500 mg/24 hr, resulted in moderate irritation.

Acute Dermal Effects:
Rabbit, skin, LD: > 5 g/kg

Acute Oral Effects:
Rat, oral, LD_{50}: 12 g/kg

Eye Effects:
Rabbit, eye, standard Draize test: 100 mg/30 seconds, resulted in mild irritation.

Section 11- Toxicological Information - *continued*

Toxicity Data:*

Tumorigenicity:
Mouse, skin: 243 g/kg/97 weeks, administered intermittently, caused skin and appendage tumors (carcinogenic by RTECS criteria).

Multiple Dose Toxicity Data:
Rabbit, skin: 100 mL/kg/12 days, continuously, caused irritative dermatitis, weight loss or decreased weight gain, and death.

* See NIOSH, *RTECS* (LS8930000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Juvenile American shad, TLm/24 hr: 200 ppm; bluegill, LC_{50} = 95 mg/L/96 hr; carp, LC_{50} = 8.2 mg/L/24 hr; pumpkin seed, LC_{50} = 1.9 mg/L/24 hr. Through its coating action, this material can pose a hazard to aquatic biota including water birds, plankton, algae and fish.

Environmental Fate: Based on a calculated BCF ($1.02x10^4$ to $1.4x10^4$), bioconcentration could be an important environmental fate process; however, it may be limited for the chief components of fuel oil no. 2 due to metabolism.

Environmental Degradation: It may biodegrade in water and soil, or volatilize from water (half-life of 4.4- 4.8 hours from a model river) and moist soil surfaces, but adsorption may attenuate the rate of these processes. In the atmosphere, fuel oil no. 2 will rapidly degrade by reaction with photochemically produced hydroxyl radicals (estimated half-life 1 day or less).

Soil Adsorption/Mobility: A high Koc indicates significant sorption and low mobility in the soil column.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Material may be sprayed into an incinerator. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Fuel oil (1, 2, 4, 5 or 6)
Shipping Symbols: D
Hazard Class: 3
ID No.: NA1993
Packing Group: III
Label: Flammable Liquid
Special Provisions (172.102): B1

Packaging Authorizations
a) **Exceptions:** 173.150
b) **Non-bulk Packaging:** 173.203
c) **Bulk Packaging:** 173.242

Quantity Limitations
a) **Passenger, Aircraft, or Railcar:** 60 L
b) **Cargo Aircraft Only:** 220 L

Vessel Stowage Requirements
a) **Vessel Stowage:** A
b) **Other:** –

Section 15 - Regulatory Information

EPA Regulations:
Classified as a RCRA Hazardous Waste (40 CFR 261.21), Characteristic of Ignitability
RCRA Hazardous Waste Number: D001
Listed as a CERCLA Hazardous Substance (40 CFR 302.4), Unlisted Hazardous Waste, Characteristic of Ignitability, per RCRA Section 3001
CERCLA Final Reportable Quantity (RQ), 100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, as petroleum distillates)

Section 16 - Other Information

References: 1, 73, 103, 136, 190, 223, 230, 231

Prepared By..... HM Spliethoff, MS
Industrial Hygiene Review..... PA Roy, MPH, CIH
Medical Review ..... T Thoburn, MD, MPH

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Material Safety Data Sheets Collection:

Sheet No. 312
Trichloroethylene

Issued: 7/79 Revision: F, 9/92

Section 1. Material Identification

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Trichloroethylene (C_2HCl_3) Description: Derived by treating tetrachloroethane with lime or other alkali in the presence of water, or by thermal decomposition of tetrachloroethane followed by steam distillation. Stabilizers such as epichlorohydrin, isobutanol, carbon tetrachloride, chloroform, benzene, or pentanol-2-triethanolamine are then added. Used as a degreasing solvent in electronics and dry cleaning, a chemical intermediate, a refrigerant and heat-exchange liquid, and a diluent in paint and adhesives; in oil, fat, and wax extraction and in aerospace operations (flushing liquid oxygen). Formerly used as a fumigant (food) and anesthetic (replaced due to its hazardous decomposition in closed-circuit apparatus).

Other Designations: CAS No. 79-01-6; acetylene trichloride; Algylen; Anamenth; Benzinol; Cecolene; Chlorylen; Dow-Tri; ethylene trichloride; Germalgene; Narcogen; Triasol; trichloroethene; TCE; 1,1,3-trichloroethylene.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 2
S 2*
K 3
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2†
F 2
R 0
PPE‡
† Chronic Effects
‡ Sec. 8

Cautions: TCE is irritating and toxic to the central nervous system (CNS). Inhalation of high concentrations have lead to death due to ventricular fibrillation. Chronic exposure may lead to heart, liver, and kidney damage. The liquid is absorbed through the skin. Although it has a relatively low flash point, TCE burns with difficulty.

Section 2. Ingredients and Occupational Exposure Limits

Trichloroethylene, < 100% [contains stabilizers (Sec. 1)].

1991 OSHA PELs
8-hr TWA: 50 ppm (270 mg/m³)
15-min STEL: 200 ppm (1080 mg/m³)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
10-hr TWA: 25 ppm (~135 mg/m³)

1992-93 ACGIH TLVs
TWA: 50 ppm (269 mg/m³)
STEL: 200 ppm (1070 mg/m³)

1990 DFG (Germany) MAK
Ceiling: 50 ppm (270 mg/m³)
Category II: Substances with systemic effects
Half-life: 2 hr to shift length
Peak Exposure Limit: 250 ppm, 30 min average value; 2 peaks/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 160 ppm/83 min caused hallucinations and distorted perceptions.
Human, lymphocyte: 5 mL/L caused DNA inhibition.
Rabbit, skin: 500 mg/24 hr caused severe irritation.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.
Mouse, oral, TD_{Lo}: 455 mg/kg administered intermittently for 78 weeks produced liver tumors.

* See NIOSH, *RTECS* (KX4550000), for additional irritation, mutation, reproductive, tumorigenic and toxicity data.

Section 3. Physical Data

Boiling Point: 189 °F (87 °C)
Freezing Point: -121 °F (-85 °C)
Viscosity: 0.0055 Poise at 77 °F (25 °C)
Molecular Weight: 131.38
Density: 1.4649 at 20/4 °C
Refraction Index: 1.477 at 68 °F (20 °C/D)
Odor Threshold: 82 to 108 ppm (*not an effective warning*)

Vapor Pressure: 58 mm Hg at 68 °F (20 °C); 100 mm Hg at 32 °F (0 °C)
Saturated Vapor Density (Air = 0.075 lbs/ft³; 1.2 kg/m³): 0.0956 lbs/ft³; 1.53 kg/m³
Water Solubility: Very slightly soluble; 0.1% at 77 °F (25 °C)
Other Solubilities: Highly soluble in organic solvents (alcohol, acetone, ether, carbon tetrachloride, & chloroform) and lipids.
Surface Tension: 29.3 dyne/cm

Appearance and Odor: Clear, colorless (sometimes dyed blue), mobile liquid with a sweet chloroform odor.

Section 4. Fire and Explosion Data

Flash Point: 90 °F (32 °C) CC	**Autoignition Temperature:** 788 °F (420 °C)	**LEL:** 8% (25 °C); 12.5% (100 °C)	**UEL:** 10% (25 °C); 90% (100 °C)

Extinguishing Media: A Class 1C Flammable Liquid. Although it has a flash point of 90 °F, TCE burns with difficulty. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapor/air mixtures may explode when ignited. Container may explode in heat of fire. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection against TCE. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: TCE slowly decomposes in the presence of light and moisture to form corrosive hydrochloric acid. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include alkalis (sodium hydroxide), chemically active metals (aluminum, beryllium, lithium, magnesium, sodium, potassium, and titanium), epoxides, and oxidants (nitrogen tetraoxide, perchloric acid). Contact with 1-chloro-2,3-epoxy propane or the mono and di 2,3-epoxypropyl ethers of 1,4-butanediol + 2,2-bis-4(2',3'-epoxypropoxy)-phenylpropane can, in the presence of catalytic quantities of halide ions, cause dehydrochlorination of TCE to explosive dichloroacetylene. **Conditions to Avoid:** Exposure to light, moisture, ignition sources, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of TCE (above 300 °C) or exposure to ultraviolet light can produce carbon dioxide (CO_2) and toxic dichloro acetylene (explosive), chlorine, hydrogen chloride, and phosgene gas.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies have rated TCE's carcinogenicity: IARC (Class 3, limited animal evidence & insufficient human data), Germany MAK (Class B, justifiably suspected of having carcinogenic potential), & NIOSH (Class X, carcinogen defined with no further categorization). **Summary of Risks:** TCE vapor is irritating to the eyes, nose, and respiratory tract and inhalation of high concentrations can lead to severe CNS effects such as unconsciousness, ventricular arrythmias, and death due to cardiac arrest. Mild liver dysfunction was also seen at levels high enough to produce CNS effects. Contact with the liquid is irritating to the skin and can lead to dermatitis by defatting the skin. Chronic toxicity is observed in the victims increasing intolerance to alcohol characterized by 'degreasers flush', a transient redness of the face, trunk, and arms. The euphoric effect of TCE has led to craving, and habitual sniffing of its vapors.

Continue on next page

Section 6. Health Hazard Data, *Continued*

TCE crosses the placental barrier and thus exposes the fetus (any effects are yet unknown). There are increased reports of menstrual disorders in women workers and decreased libido in males at exposures high enough to cause CNS effects. TCE is eliminated unchanged in expired air and as metabolites (trichloroacetic acid & trichloroethanol) in blood and urine. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the nervous system, skin, heart, liver, and kidney. **Target Organs:** Respiratory, central & peripheral nervous, and cardiovascular (heart) systems, liver, kidney, and skin. **Primary Entry Routes:** Inhalation, skin and eye contact, and ingestion (rarely). **Acute Effects:** Vapor inhalation can cause eye, nose, and throat irritation, nausea, blurred vision, overexcitement, headache, drunkenness, memory loss, irregular heartbeat (resulting in sudden death), unconsciousness, and death due to cardiac failure. Skin contact with the liquid can cause dryness and cracking and prolonged exposure (generally if the victim is unconscious) can cause blistering. Eye contact can cause irritation and watering, with corneal epithelium injury in some cases. Ingestion of the liquid can cause lip, mouth, and gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Effects may persist for several weeks or months after repeated exposure. Symptoms include giddiness, irritability, headache, digestive disturbances, mental confusion, intolerance to alcohol (degreasers flush), altered color perception, loss or impairment of sense of smell, double vision, and peripheral nervous system function impairment including persistent neuritis, temporary loss of sense of touch, and paralysis of the fingers from direct contact with TCE liquid.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Do not give milk, as its fat content (TCE is lipid soluble) may inhance gastrointestinal absorption of TCE. **Note to Physicians:** TCE elimination seems to be triphasic with half lives at 20 min, 3 hr, and 30 hr. Some success is seen in treating patients with propranolol, atropine, and disulfiram. Monitor urine and blood (lethal level = 3 to 110 µg/mL) metabolites. BEI = 100 mg/g creatinine (trichloroacetic acid) in urine, *sample at end of workweek.* BEI = 4 mg/L (trichloroethanol) in blood, *sample at end of shift at end of the workweek.* These tests are not 100% accurate indicators of exposure; monitor TCE in expired air as a confirmatory test.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container for later disposal. For large spills, flush to containment area where density stratification will form a bottom TCE layer which can be pumped and containerized. Report any release in excess of 1000 lbs. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, LC_{50} = 44,700 µg/L/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 40.7 mg/L/96 hr. **Environmental Degradation:** In air, TCE is photooxidized with a half-life of 5 days and reported to form phosgene, dichloroacetyl chloride, and formyl chloride. In water it evaporates rapidly in minutes to hours. TCE rapidly evaporates and may leach since it does not absorb to sediment. **Soil Absorption/Mobility:** TCE has a Log K_{oc} of 2, indicating high soil mobility. **Disposal:** Waste TCE can be poured on dry sand and allowed to vaporize in isolated location, purified by distillation, or returned to supplier. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) with an acid scrubber to remove halo acids. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33 & 261.31): No. U228 & F002 (*spent solvent*)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001, CWA Sec. 311 (b)(4), & CWA Sec. 307 (a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear chemical safety goggles (cup-type or rubber framed, equipped with impact-resistant glass), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. At any detectable concentration, wear a SCBA with a full facepiece operated in pressure demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made from Viton or Neoprene to prevent skin contact. *Do not* use natural rubber or polyvinyl chloride (PVC). **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in steel drums, in a cool, dry, well-ventilated area away from sunlight, heat, ignition sources, and incompatibles (Sec. 5). Store large quantities in galvanized iron, black iron, or steel containers; small amounts in dark (amber) colored glass bottles. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Design processes so that the operator is not directly exposed to the solvent or its vapor. Do not use open electric heaters, high-temperature processes, arc-welding or open flames in TCE atmospheres. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, respiratory, cardiac, central and peripheral nervous systems, and liver and kidney function. Employ air and biological monitoring (BEIs). Instruct employees on safe handling of TCE.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Trichloroethylene
DOT Hazard Class: 6.1
ID No.: UN1710
DOT Packing Group: III
DOT Label: Keep Away From Food
DOT Special Provisions (172.102): N36, T1

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 60L
b) Cargo Aircraft Only: 220L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MD

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Material Safety Data Sheets Collection:
Sheet No. 313
Perchloroethylene
Issued: 11/78 Revision: E, 9/92

(32)

Section 1. Material Identification

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Perchloroethylene (C_2Cl_4) Description: By chlorination of hydrocarbons and pyrolysis of the carbon tetrachloride that is formed, or by catalytic oxidation of 1,1,2,2-tetrachloroethane. Used in dry cleaning and textile processing, metal degreasing, insulating fluid and cooling gas in electrical transformers, production of adhesives, aerosols, paints, and coatings; as a chemical intermediate, a solvent for various applications, extractant for pharmaceuticals, a pesticide intermediate, and an antihelminthic (parasitic worm removal) agent in veterinary medicine.
Other Designations: CAS No. 127-18-4, Ankilostin, carbon dichloride, Didakene, ethylene tetrachloride, Perchlor, Perclene, Perk, Tetracap, tetrachloroethylene.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 0
* Skin absorption

NFPA
0 / 2 / 0 / -

HMIS
H 2†
F 0
R 0
PPE‡
† Chronic effects
‡ Sec. 8

Cautions: Perchloroethylene is a central nervous system depressant, causes liver and kidney damage (from acute or chronic exposures), and is considered an IARC Class 2B carcinogen (animal sufficient evidence, human inadequate data).

Section 2. Ingredients and Occupational Exposure Limits

Perchloroethylene, < 99%. Impurities include a small amount of amine or phenolic stabilizers.

1991 OSHA PEL
8-hr TWA: 25 ppm (170 mg/m³)

1990 IDLH Level
500 ppm

1990 NIOSH REL
NIOSH-X Carcinogen
Limit of Quantitation: 0.4 ppm

1992-93 ACGIH TLVs
TWA: 50 ppm (339 mg/m³)
STEL: 200 ppm (1357 mg/m³)

1990 DFG (Germany) MAK
TWA: 50 ppm (345 mg/m³)
Category II: substances with systemic effects
Half-life: < 2 hr
Peak Exposure Limit: 100 ppm, 30 min average value, 4/shift

1985-86 Toxicity Data*
Man, inhalation, TC_{Lo}: 280 ppm/2 hr caused conjunctival irritation and anesthesia.
Human, lung: 100 mg/L caused unscheduled DNA synthesis.
Rat, oral, LD_{50}: 3005 mg/kg; caused somnolence, tremor, and ataxia.
Rat, inhalation, TC_{Lo}: 200 ppm/6 hr given intermittently over 2 years produced leukemia and testicular tumors.
Rabbit, eye: 162 mg caused mild irritation.
Rabbit, skin: 810 mg/24 hr caused severe irritation.

* See NIOSH, *RTECS* (KX3850000), for additional irritation, mutation, reproductive, tumorigenic, & toxicity data.

Section 3. Physical Data

Boiling Point: 250 °F (121.2 °C)
Freezing Point: -8 °F (-23.35 °C)
Vapor Pressure: 13 mm Hg at 68 °F (20 °C)
Surface Tension: 31.74 dyne/cm at 68 °F (20 °C)
Viscosity: 0.84 cP at 77 °F (25 °C)
Refraction Index: 1.50534 at 68 °F (20 °C)
Molecular Weight: 165.82

Density: 1.6311 at 59 °F (15/4 °C)
Water Solubility: 0.02% at 77 °F (25 °C)
Other Solubilities: Miscible with alcohol, ether, benzene, chloroform, and oils.
Odor Threshold: 47 to 71 ppm (poor warning properties since olfactory fatigue is probable)
Evaporation Rate: 0.15 gal/ft²/day at 77 °F (25 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.081 lb/ft³ or 1.296 kg/m³

Appearance and Odor: Colorless liquid with an ether-like odor.

Section 4. Fire and Explosion Data

Flash Point: Nonflammable	**Autoignition Temperature:** Nonflammable	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2). For large fires, use water spray, fog, or regular foam.
Unusual Fire or Explosion Hazards: Vapors are heavier than air and collect in low-lying areas.
Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Perchloroethylene is stable up to 932 °F (500 °C) in the absence of catalysts, moisture, and oxygen but deteriorates rapidly in warm, moist climates. It is slowly decomposed by light. Amine or phenolic stabilizers are usually added. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Slowly (faster in presence of water) corrodes aluminum, iron, and zinc. It is incompatible with chemically active metals (i.e., barium, beryllium, and lithium (explodes with lithium shavings), strong oxidizers, sodium hydroxide, caustic soda, potash, and nitric acid. Perchloroethylene forms an explosive mixture with dinitrogen tetraoxide and reacts with activated charcoal at 392 °F (200 °C) to yield hexachloroethane and hexachlorobenzene. **Conditions to Avoid:** Contact with moisture and incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of perchloroethylene can produce carbon dioxide and toxic chlorine, hydrogen chloride, and phosgene gas (also produced by contact with UV light).

Section 6. Health Hazard Data

Carcinogenicity: Perchloroethylene is listed as a carcinogen by The IARC (Group 2B, animal sufficient evidence, human inadequate data),(164) NTP (Class 2, reasonably anticipated as a carcinogen, with limited human evidence and sufficient animal evidence),(169) NIOSH (Class-X, carcinogen defined with no further explanation),(164) and DFG (MAK-B, justifiably suspected of having carcinogenic potential)(164). There is some controversy regarding human carcinogenicity because even though there is an increased number of cancers of the skin, colon, lung, urogenital tract, and lympho-sarcomas; the dry cleaning workers studied were also exposed to other chemicals. **Summary of Risks:** Perchloroethylene is stored in the fatty tissue and slowly metabolized with the loss of chlorine. The half-life of its urinary metabolite (trichloroacetic acid) is 144 hours. Perchloroethylene exerts the majority of its toxicity on the central nervous system causing symptoms ranging from light-headedness and slight 'inebriation' to unconsciousness. Liver damage is possible after severe acute or minor long-term exposure. It has a synergistic effect with toluene.

Continue on next page

Section 6. Health Hazard Data, *continued*

Medical Conditions Aggravated by Long-Term Exposure: Nervous, liver, kidney, or skin disorders. **Target Organs:** Liver, kidney, eyes, upper respiratory tract, skin, and central nervous system. **Primary Entry Routes:** Inhalation and skin and eye contact. **Acute Effects:** Exposure to high levels can cause liver damage which may take several weeks to develop. Vapor exposure can cause slight smarting of the eyes and throat (in high concentrations). In human studies, exposure to 2000 ppm/5 min caused mild CNS depression; 600 ppm/10 min caused numbness around the mouth, dizziness, and incoordination; 100 ppm/7 hr caused mild eye, nose, and throat irritation, flushing of the face and neck, headache, somnolence, and slurred speech. Skin contact may produce dermatitis because of perchloroethylene's defatting action (more common after repeated exposure). Direct eye contact causes tearing and burning but no permanent damage. Ingestion is rare but can cause irritation of the lips, mouth and gastrointestinal tract, irregular heartbeat, nausea & vomiting, diarrhea (possibly blood stained), drowsiness, unconsciousness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Prolonged exposure can cause impaired memory, extremity (hands, feet) weakness, peripheral neuropathies, impaired vision, muscle cramps, liver damage (fatty degeneration, necrosis, yellow jaundice, and dark urine) and kidney damage (oliguric uremia, conjestion and granular swelling).

FIRST AID ***Rescuers must not enter areas with potentially high perchloroethylene levels without a self-contained breathing apparatus.*** Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. *Never administer adrenalin!* **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Be sure victim's head is positioned to avoid aspiration of vomitus into the lungs. **Note to Physicians:** Monitor level of consciousness, EEG (abnormalaties may indicate chronic toxicity), blood enzyme levels (for 2 to 3 wk after exposure), EKG, adequacy of respirations & oxygenation, and liver and kidney function. *BEIs:* C_2Cl_4 in expired air (10 ppm), sample prior to last shift of work week; C_2Cl_4 in blood (1 mg/L), sample prior to last shift of work week; trichloroacetic acid in urine (7 mg/L), sample at end of workweek.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources (although noncombustible, it forms toxic vapors from thermal decomposition). For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of spill and await reclamation or disposal. Report any release in excess of 1 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, perchloroethylene evaporates and some leaches to groundwater. It may absorb slightly to soils with heavy organic matter. Biodegradation may be important in anaerobic soils. In water, it is subject to rapid volatilization with an estimated half-life from <1 day to several weeks. In air, it exists mainly in the vapor-phase and is subject to photooxidation with a half-life of 30 minutes to 2 months. **Ecotoxicity Values:** Guppy (*Poecilia reticulata*), LC_{50} = 18 ppm/7 days; fathead minnow (*Pimephales promelas*), LC_{50} = 18.4 mg/L/96 hr, flow through bioassay. **Disposal:** Consider recovery by distillation. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) or fluidized bed incineration at 842 to 1796 °F (450 to 980 °C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U210
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per CWA Sec. 307 (a)]
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear a faceshield (8 inch minimum) per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use a supplied-air respirator or SCBA with a full facepiece operated in pressure demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of butyl rubber, Neoprene, or Viton to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from sunlight, and incompatibles. Do not store sludge from vapor degreasers in tightly-sealed containers and keep outside until disposal is arranged. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Check stabilizer levels frequently and ventilation equipment (air velocity, static pressure, air valve) at least every 3 months. Install an air dryer in ventlines to storage tanks to prevent moisture from rusting and weakening the tank and contaminating or discoloring its contents. Purge all tanks before entering for repairs or cleanup. Build a dike around storage tanks capable of containing all the liquid. Ground tanks to prevent static electricity. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize liver, kidney, and nervous system function, and the skin. Alcoholism may be a predisposing factor.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Tetrachloroethylene
DOT Hazard Class: 6.1
ID No.: UN1897
DOT Packing Group: III
DOT Label: Keep away from food
Special Provisions (172.102): N36, T1

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 60 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

Appendix C

Soil Boring Logs and Monitoring Well Construction Diagrams

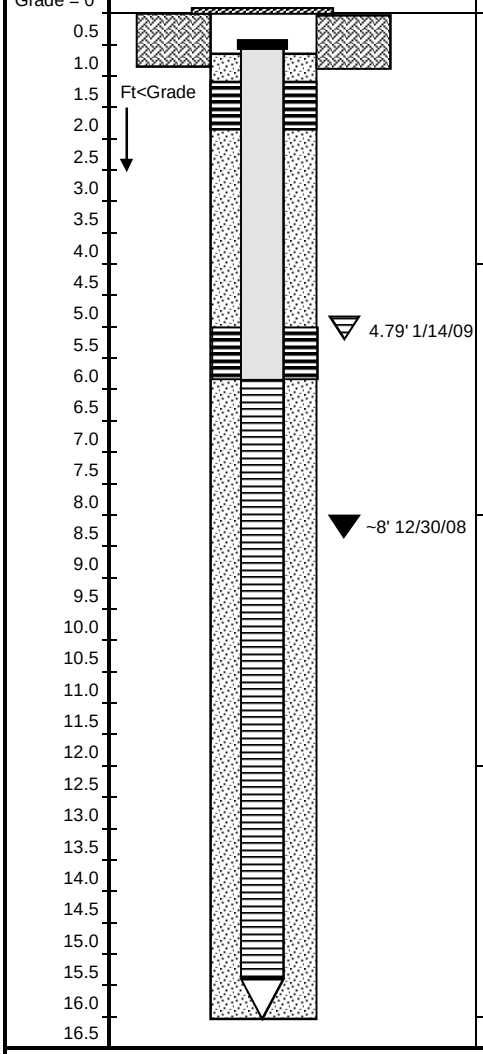
BORING LOG AND WELL CONSTRUCTION DIAGRAM

Well No: MW08-1

Site: Project Soar

Town, State: St. Albans, Vermont

KAS Project #:	410080320	Date Installed:	12/30/2008
VTDEC Site #:	2008-3843	Drilling Method:	Earthprobe
Drilled by :	ENPRO Services, Inc	Boring Diameter.:	2"
Driller:	Bob/Tim	Development Method:	Not developed
Logged by:	AE	Screened Length:	10 Feet



Pen/Rec(') / BlowCounts	Interval (') / PID (ppm)	Soil Characteristics	Letter Symbol
		Top Soil Surface	
4/0.4 N/A	0-4 0.1	Dry, medium brown, Silt with Sand (ML)	ML
4/2.7 N/A	4-8 0.1	Moist to wet, blue gray and orange mottled, Lean Clay with Sand (CL)	CL
4/3.1 N/A	8-12 0.1	Dry to moist, blue gray, Sandy Silt with Gravel (ML) 8'-8.4': Angular and sub-angular fine to coarse Gravel	ML
4/2.7 N/A	12-16 0.1	Moist to wet, blue gray, Silt with Sand (ML)	ML
		Set Well at 16 feet	

Graphic Symbol

Legend

- Road Box with Bolt Down Cover, Set in Cement.
- Existing Surface.
- Bentonite Seal Placed in Annulus.
- Grade #1 Silica Sand Pack Placed in Annulus.
- Drill Cuttings Placed in Annulus.
- Locking Plug.
- 1" ID, Schedule 40 PVC Riser.
- 1" ID, Schedule 40 PVC, 0.010"-Slotted Well Screen
- Plug Point
- Approximate Water Level During Drilling, below grade
- Static Water Level, below top of casing

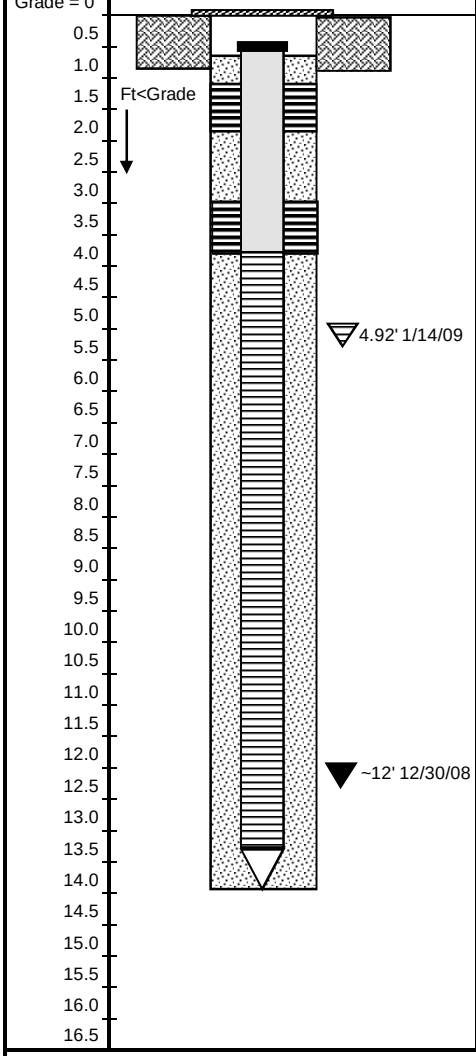
BORING LOG AND WELL CONSTRUCTION DIAGRAM

Well No: MW08-2

Site: Project Soar

Town, State: St. Albans, Vermont

KAS Project #:	410080320	Date Installed:	12/30/2008
VTDEC Site #:	2008-3843	Drilling Method:	Earthprobe
Drilled by :	ENPRO Services, Inc	Boring Diameter.:	2"
Driller:	Bob/Tim	Development Method:	Not developed
Logged by:	AE	Screened Length:	10 Feet



Pen/Rec(') / BlowCounts	Interval (') / PID (ppm)	Soil Characteristics (Top Soil Surface)	Letter Symbol
4/2.4 N/A	0-4 0.1	Dry to moist, medium brown, Sandy Silt with Gravel (ML) 3.5'-3.8': Angular fine to coarse gravel and fine to coarse sand layer	ML
4/3.3 N/A	4-8 0.1	Dry to moist, medium brown, Sandy Silt with Gravel (ML)	ML
4/4 N/A	8-12 0.1	Dry to moist, medium brown, Gravelly Silt (ML)	ML
2.4/2.4 N/A	12-14 0.1	Moist to wet, blue gray, Gravelly Silt (ML)	ML
		Refusal at 14 feet - set well	

Graphic Symbol

Legend

- Road Box with Bolt Down Cover, Set in Cement.
- Existing Surface.
- Bentonite Seal Placed in Annulus.
- Grade #1 Silica Sand Pack Placed in Annulus.
- Drill Cuttings Placed in Annulus.
- Locking Plug.
- 1" ID, Schedule 40 PVC Riser.
- 1" ID, Schedule 40 PVC, 0.010"-Slotted Well Screen
- Plug Point
- Approximate Water Level During Drilling, below grade
- Static Water Level, below top of casing

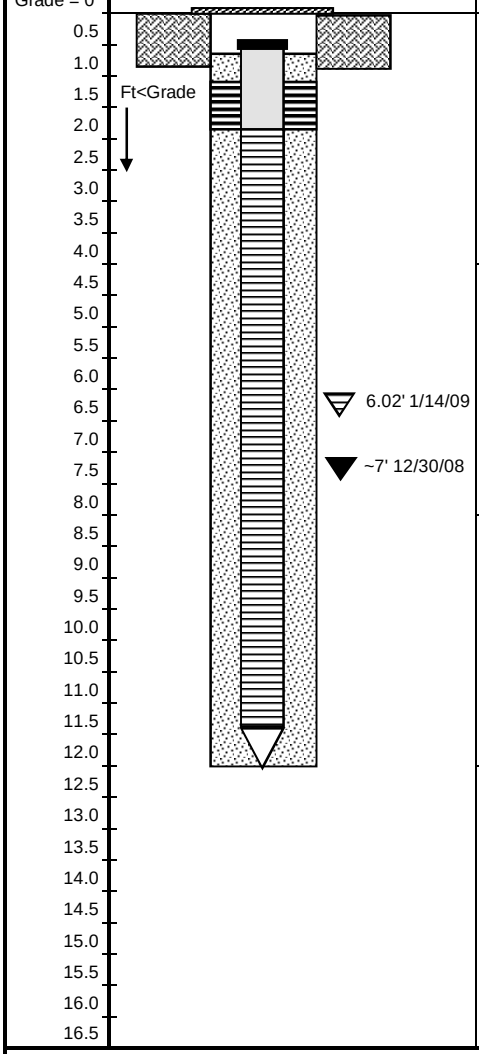
BORING LOG AND WELL CONSTRUCTION DIAGRAM

Well No: MW08-3

Site: Project Soar

Town, State: St. Albans, Vermont

KAS Project #:	410080320	Date Installed:	12/30/2008
VTDEC Site #:	2008-3843	Drilling Method:	Earthprobe
Drilled by :	ENPRO Services, Inc	Boring Diameter.:	2"
Driller:	Bob/Tim	Development Method:	Not developed
Logged by:	AE	Screened Length:	10 Feet



Well Construction	Pen/Rec(') / BlowCounts	Interval (') / PID (ppm)	Soil Characteristics	Letter Symbol	Graphic Symbol
			Top Soil Surface		
	4/2.7 N/A	0-4 0.1	Dry to moist, medium brown, Sandy Silt with Gravel (ML)	ML	
	4/2.5 N/A	4-8 0.1	Dry to wet, medium brown, Gravelly Silt with Sand (ML)	ML	
	4/1.6 N/A	8-12 0.1	Moist to wet, medium brown, Sandy Silt with Gravel (ML)	ML	
			Refusal at 12 feet - set well		

Legend

- Road Box with Bolt Down Cover, Set in Cement.
- Existing Surface.
- Bentonite Seal Placed in Annulus.
- Grade #1 Silica Sand Pack Placed in Annulus.
- Drill Cuttings Placed in Annulus.
- Locking Plug.
- 1" ID, Schedule 40 PVC Riser.
- 1" ID, Schedule 40 PVC, 0.010"-Slotted Well Screen
- Plug Point
- Approximate Water Level During Drilling, below grade
- Static Water Level, below top of casing

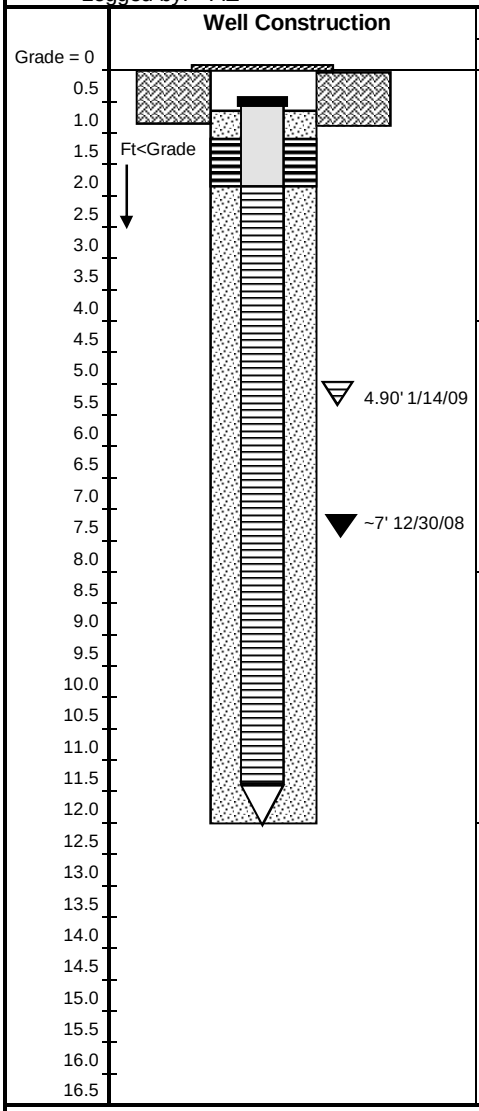
BORING LOG AND WELL CONSTRUCTION DIAGRAM

Well No: MW08-4

Site: Project Soar

Town, State: St. Albans, Vermont

KAS Project #:	410080320	Date Installed:	12/30/2008
VTDEC Site #:	2008-3843	Drilling Method:	Earthprobe
Drilled by :	ENPRO Services, Inc	Boring Diameter.:	2"
Driller:	Bob/Tim	Development Method:	Not developed
Logged by:	AE	Screened Length:	10 Feet



Well Construction	Pen/Rec(')	Interval (')	Soil Characteristics	Letter Symbol
	BlowCounts	PID (ppm)	Top Soil Surface	
	4/2.3	0-4	Moist to wet, medium brown, Sandy Silt with Gravel (ML)	ML
	N/A	0.1		
	4/3.3	4-8	Moist to wet, medium brown, Sandy Silt (ML)	ML
	N/A	0.1		
	4/2.1	8-12	Moist to wet, medium brown, Silt with Sand (ML)	ML
	N/A	0.1		
			Refusal at 12 feet - set well	

Graphic Symbol

Legend

- Road Box with Bolt Down Cover, Set in Cement.
- Existing Surface.
- Bentonite Seal Placed in Annulus.
- Grade #1 Silica Sand Pack Placed in Annulus.
- Drill Cuttings Placed in Annulus.
- Locking Plug.
- 1" ID, Schedule 40 PVC Riser.
- 1" ID, Schedule 40 PVC, 0.010"-Slotted Well Screen
- Plug Point
- Approximate Water Level During Drilling, below grade
- Static Water Level, below top of casing

Appendix D

Liquid Level Monitoring Data

Liquid Level Monitoring Data
Project Soar
St. Albans, Vermont

January 14, 2009

Well I.D.	Top of Casing Elevation	Depth to Product	Depth to Water	Product Thickness	Specific Gravity of Product	Water Equivalent	Corrected Depth to Water	Corrected Water Table Elevation
MW08-1	100.09	-	4.79	-	-	-	-	95.30
MW08-2	100.06	-	4.92	-	-	-	-	95.14
MW08-3	98.80	-	6.02	-	-	-	-	92.78
MW08-4	99.25	-	4.90	-	-	-	-	94.35

Notes:
All Values Reported in Feet
Top-of-Casing Elevations Measured in Feet Above Mean Sea Level
Elevations surveyed on December 31, 2008

Appendix E

Sampling Summary Data

Groundwater Quality Summary
Project Soar
St. Albans, Vermont

PARAMETER	Sample Date: 1/14/2009				
	MW08-1	MW08-2	MW08-3	MW08-4	**VGES**
MTBE	ND<2.0	ND<2.0	ND<2.0	ND<2.0	40
Benzene	ND<1.0	ND<1.0	ND<1.0	ND<1.0	5
Toluene	ND<1.0	ND<1.0	ND<1.0	ND<1.0	1,000
Ethylbenzene	ND<1.0	ND<1.0	ND<1.0	ND<1.0	700
Xylenes	ND<2.0	ND<2.0	ND<2.0	ND<2.0	10,000
Total BTEX	ND	ND	ND	ND	-
1,3,5-Trimethylbenzene	ND<1.0	ND<1.0	ND<1.0	ND<1.0	350
1,2,4-Trimethylbenzene	ND<1.0	ND<1.0	ND<1.0	ND<1.0	
Naphthalene	ND<1.0	ND<1.0	ND<1.0	ND<1.0	20
Total VOCs	ND	ND	ND	ND	-
TPH	ND<0.40	**0.89**	ND<0.40	**3.1**	-

NOTES:
VGES = Vermont Groundwater Enforcement Standard
ND<1.0 = not detected above laboratory detection limit
TBQ<1.0 = Trace below quantitation limit
NA = not applicable, not analyzed
All Values Reported in ug/L (ppb) except TPH which is reported in mg/L
Detections are **Bolded**. Shaded areas indicate exceedance of the applicable VGES.
VOC ANALYSIS: EPA Method 8260B; TPH 8015 DRO

Drinking Water Quality Summary
Project Soar
St. Albans, Vermont

PARAMETER	Sampling Date 1/14/09		
	Supply Well	MCL	VHA
MTBE	ND<0.5	---	40.0
Benzene	ND<0.5	5.0	---
Toluene	ND<0.5	1,000.0	---
Ethylbenzene	ND<0.5	700.0	---
Xylenes	ND<0.5	10,000.0	---
Total BTEX	ND	-	-
1,3,5-Trimethylbenzene	ND<0.5	---	5.0
1,2,4-Trimethylbenzene	ND<0.5	---	4.0
Naphthalene	ND<0.5	---	20.0
Total VOCs	ND	-	-

NOTES:
VGES = Vermont Groundwater Enforcement Standard
ND<1.0 = not detected above laboratory detection limit
TBQ<1.0 = Trace below quantitation limit
NA = not applicable, not analyzed
All Values Reported in ug/L (ppb)
Detections are **Bolded**. Results reported above MCLs or VHAs are shaded.
--- means that no drinking water standard has been established for this parameter.
VOC ANALYSIS: 524.2

Quality Assurance and Control Summary
Project Soar
St. Albans, Vermont

PARAMETER	MONITORING DATE 1/14/2009			
	Trip Blank	MW08-2	MW08-2 Duplicate	**VGES**
MTBE	ND<2.0	ND<2.0	ND<2.0	40
Benzene	ND<1.0	ND<1.0	ND<1.0	5
Toluene	ND<1.0	ND<1.0	ND<1.0	1,000
Ethylbenzene	ND<1.0	ND<1.0	ND<1.0	700
Xylenes	ND<2.0	ND<2.0	ND<2.0	10,000
Total BTEX	ND	ND	ND	-
1,3,5-Trimethylbenzene	ND<1.0	ND<1.0	ND<1.0	350
1,2,4-Trimethylbenzene	ND<1.0	ND<1.0	ND<1.0	
Naphthalene	ND<1.0	ND<1.0	ND<1.0	20
Total VOCs	ND	ND	ND	-

NOTES:
Results reported above detection limits are indicated in bold
ND<X - Not Detected (Detection Limit)
TBQ <X = Trace Below Quantitation Limit
All values reported in ug/l (ppb)
Values greater than the VGES are shaded.
EPA Method 8021B used for laboratory analysis

Appendix F

Analytical Reports

ENDYNE Inc.
Environmental Laboratories

Laboratory Report

KAS, Inc.	100306
PO Box 787	
Williston, VT 05495	
Atten: Angela Emerson	

PROJECT: Project Soar #410080320
WORK ORDER: **0901-00619**
DATE RECEIVED: January 15, 2009
DATE REPORTED: January 22, 2009
SAMPLER: AE

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody located at the end of this report.

The column labeled Lab/Tech in the accompanying report denotes the laboratory facility where the testing was performed and the technician who conducted the assay. A "W" designates the Williston, VT lab under NELAC certification ELAP 11263; "R" designates the Randolph, VT facility under certification NH 2037 and "N" the Plattsburgh, NY lab under certification ELAP 11892. "Sub" indicates the testing was performed by a subcontracted laboratory. The accreditation status of the subcontracted lab is referenced in the corresponding NELAC and Qual fields.

This NELAC column also denotes the accreditation status of each laboratory for each reported parameter. "A" indicates the referenced laboratory is NELAC accredited for the parameter reported. "N" indicates the laboratory is not accredited. "U" indicates that NELAC does not offer accreditation for that parameter in that specific matrix. Test results denoted with an "A" meet all National Environmental Laboratory Accreditation Program requirements except where denoted by pertinent data qualifiers. Test results are representative of the samples as they were received at the laboratory.

Endyne, Inc. warrants, to the best of its knowledge and belief, the accuracy of the analytical test results contained in this report, but makes no other warranty, expressed or implied, especially no warranties of merchantability or fitness for a particular purpose.

Reviewed by:

Harry B. Locker, Ph.D.
Laboratory Director

CLIENT: KAS, Inc.
PROJECT: Project Soar #410080320
REPORT DATE: 1/22/2009

WORK ORDER: **0901-00619**
DATE RECEIVED: 01/15/2009

TEST METHOD: EPA 8021B

001 Site: Trip Blank — Date Sampled: 1/13/09 15:42 — Analysis Date: 1/16/09 W EPG

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Methyl-t-butyl ether (MTBE)	< 2.0	ug/L	N		Benzene	< 1.0	ug/L	N	
Toluene	< 1.0	ug/L	N		Ethylbenzene	< 1.0	ug/L	N	
Xylenes, Total	< 2.0	ug/L	N		1,3,5-Trimethylbenzene	< 1.0	ug/L	N	
1,2,4-Trimethylbenzene	< 1.0	ug/L	N		Naphthalene	< 2.0	ug/L	N	
Surr. 1 (Bromobenzene)	101	%	N		Unidentified Peaks	0		N	

TEST METHOD: EPA 8015B

002 Site: MW08-1 — Date Sampled: 1/14/09 09:30 — Analysis Date: 1/16/09 W MDP

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Extraction Mod. EPA 3510C	Completed		U		C7-C10 TPH	< 0.40	mg/L	U	
C10-C26 TPH-DRO	< 0.40	mg/L	U		C26-C40 TPH	< 0.40	mg/L	U	
Tot. Petroleum Hydrocarbons	< 0.40	mg/L	U		Hydrocarbon Window	NA		U	

TEST METHOD: EPA 8021B

002 Site: MW08-1 — Date Sampled: 1/14/09 09:30 — Analysis Date: 1/19/09 W EPG

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Methyl-t-butyl ether (MTBE)	< 2.0	ug/L	N		Benzene	< 1.0	ug/L	N	
Toluene	< 1.0	ug/L	N		Ethylbenzene	< 1.0	ug/L	N	
Xylenes, Total	< 2.0	ug/L	N		1,3,5-Trimethylbenzene	< 1.0	ug/L	N	
1,2,4-Trimethylbenzene	< 1.0	ug/L	N		Naphthalene	< 2.0	ug/L	N	
Surr. 1 (Bromobenzene)	101	%	N		Unidentified Peaks	1		N	

TEST METHOD: EPA 8015B

003 Site: MW08-2 — Date Sampled: 1/14/09 09:20 — Analysis Date: 1/16/09 W MDP

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Extraction Mod. EPA 3510C	Completed		U		C7-C10 TPH	< 0.40	mg/L	U	
C10-C26 TPH-DRO	< 0.40	mg/L	U		C26-C40 TPH	0.67	mg/L	U	
Tot. Petroleum Hydrocarbons	0.89	mg/L	U		Hydrocarbon Window	C22-C34		U	

TEST METHOD: EPA 8021B

003 Site: MW08-2 — Date Sampled: 1/14/09 09:20 — Analysis Date: 1/16/09 W EPG

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Methyl-t-butyl ether (MTBE)	< 2.0	ug/L	N		Benzene	< 1.0	ug/L	N	
Toluene	< 1.0	ug/L	N		Ethylbenzene	< 1.0	ug/L	N	
Xylenes, Total	< 2.0	ug/L	N		1,3,5-Trimethylbenzene	< 1.0	ug/L	N	
1,2,4-Trimethylbenzene	< 1.0	ug/L	N		Naphthalene	< 2.0	ug/L	N	
Surr. 1 (Bromobenzene)	101	%	N		Unidentified Peaks	1		N	

CLIENT: KAS, Inc.
PROJECT: Project Soar #410080320
REPORT DATE: 1/22/2009

WORK ORDER: **0901-00619**
DATE RECEIVED: 01/15/2009

TEST METHOD: EPA 8015B

004 | Site: MW08-3 | Date Sampled: 1/14/09 08:45 | Analysis Date: 1/16/09 | W MDP

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Extraction Mod. EPA 3510C	Completed		U		C7-C10 TPH	< 0.40	mg/L	U	
C10-C26 TPH-DRO	< 0.40	mg/L	U		C26-C40 TPH	< 0.40	mg/L	U	
Tot. Petroleum Hydrocarbons	< 0.40	mg/L	U		Hydrocarbon Window	NA		U	

TEST METHOD: EPA 8021B

004 | Site: MW08-3 | Date Sampled: 1/14/09 08:45 | Analysis Date: 1/19/09 | W EPG

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Methyl-t-butyl ether (MTBE)	< 2.0	ug/L	N		Benzene	< 1.0	ug/L	N	
Toluene	< 1.0	ug/L	N		Ethylbenzene	< 1.0	ug/L	N	
Xylenes, Total	< 2.0	ug/L	N		1,3,5-Trimethylbenzene	< 1.0	ug/L	N	
1,2,4-Trimethylbenzene	< 1.0	ug/L	N		Naphthalene	< 2.0	ug/L	N	
Surr. 1 (Bromobenzene)	101	%	N		Unidentified Peaks	1		N	

TEST METHOD: EPA 8015B

005 | Site: MW08-4 | Date Sampled: 1/14/09 09:05 | Analysis Date: 1/16/09 | W MDP

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Extraction Mod. EPA 3510C	Completed		U		C7-C10 TPH	< 0.40	mg/L	U	
C10-C26 TPH-DRO	1.4	mg/L	U		C26-C40 TPH	1.7	mg/L	U	
Tot. Petroleum Hydrocarbons	3.1	mg/L	U		Hydrocarbon Window	C18-C34		U	

TEST METHOD: EPA 8021B

005 | Site: MW08-4 | Date Sampled: 1/14/09 09:05 | Analysis Date: 1/19/09 | W EPG

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Methyl-t-butyl ether (MTBE)	< 2.0	ug/L	N		Benzene	< 1.0	ug/L	N	
Toluene	< 1.0	ug/L	N		Ethylbenzene	< 1.0	ug/L	N	
Xylenes, Total	< 2.0	ug/L	N		1,3,5-Trimethylbenzene	< 1.0	ug/L	N	
1,2,4-Trimethylbenzene	< 1.0	ug/L	N		Naphthalene	< 2.0	ug/L	N	
Surr. 1 (Bromobenzene)	102	%	N		Unidentified Peaks	1		N	

TEST METHOD: EPA 8021B

006 | Site: Duplicate | Date Sampled: 1/14/09 09:20 | Analysis Date: 1/16/09 | W EPG

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Methyl-t-butyl ether (MTBE)	< 2.0	ug/L	N		Benzene	< 1.0	ug/L	N	
Toluene	< 1.0	ug/L	N		Ethylbenzene	< 1.0	ug/L	N	
Xylenes, Total	< 2.0	ug/L	N		1,3,5-Trimethylbenzene	< 1.0	ug/L	N	
1,2,4-Trimethylbenzene	< 1.0	ug/L	N		Naphthalene	< 2.0	ug/L	N	
Surr. 1 (Bromobenzene)	99	%	N		Unidentified Peaks	1		N	

Laboratory Report

CLIENT: KAS, Inc.
PROJECT: Project Soar #410080320
REPORT DATE: 1/22/2009

WORK ORDER: **0901-00619**
DATE RECEIVED: 01/15/2009

TEST METHOD: EPA 524.2

007 | Site: Supply Well | Date Sampled: 1/14/09 09:40 | Analysis Date: 1/20/09 | W EPG

Parameter	Result	Unit	Nelac	Qual	Parameter	Result	Unit	Nelac	Qual
Dichlorodifluoromethane	< 0.5	ug/L	A		Chloromethane	< 0.5	ug/L	A	
Vinyl chloride	< 0.5	ug/L	A		Bromomethane	< 0.5	ug/L	A	
Chloroethane	< 0.5	ug/L	A		Trichlorofluoromethane	< 0.5	ug/L	A	
1,1-Dichloroethene	< 0.5	ug/L	A		Methylene chloride	< 2.0	ug/L	A	
Methyl-t-butyl ether (MTBE)	< 0.5	ug/L	A		trans-1,2-Dichloroethene	< 0.5	ug/L	A	
1,1-Dichloroethane	< 0.5	ug/L	A		2,2-Dichloropropane	< 0.5	ug/L	A	
cis-1,2-Dichloroethene	< 0.5	ug/L	A		Bromochloromethane	< 0.5	ug/L	A	
Chloroform	< 0.5	ug/L	A		1,1,1-Trichloroethane	< 0.5	ug/L	A	
Carbon tetrachloride	< 0.5	ug/L	A		1,1-Dichloropropene	< 0.5	ug/L	A	
Benzene	< 0.5	ug/L	A		1,2-Dichloroethane	< 0.5	ug/L	A	
Trichloroethene	< 0.5	ug/L	A		1,2-Dichloropropane	< 0.5	ug/L	A	
Dibromomethane	< 0.5	ug/L	A		Bromodichloromethane	< 0.5	ug/L	A	
cis-1,3-Dichloropropene	< 0.5	ug/L	A		Toluene	< 0.5	ug/L	A	
trans-1,3-Dichloropropene	< 0.5	ug/L	A		1,1,2-Trichloroethane	< 0.5	ug/L	A	
Tetrachloroethene	< 0.5	ug/L	A		1,3-Dichloropropane	< 0.5	ug/L	A	
Dibromochloromethane	< 0.5	ug/L	A		Chlorobenzene	< 0.5	ug/L	A	
Ethylbenzene	< 0.5	ug/L	A		1,1,1,2-Tetrachloroethane	< 0.5	ug/L	A	
Xylenes, Total	< 1.0	ug/L	A		Styrene	< 0.5	ug/L	A	
Bromoform	< 0.5	ug/L	A		Isopropylbenzene	< 0.5	ug/L	A	
1,1,2,2-Tetrachloroethane	< 0.5	ug/L	A		Bromobenzene	< 0.5	ug/L	A	
n-Propylbenzene	< 0.5	ug/L	A		1,2,3-Trichloropropane	< 0.5	ug/L	A	
2-Chlorotoluene	< 0.5	ug/L	A		1,3,5-Trimethylbenzene	< 0.5	ug/L	A	
4-Chlorotoluene	< 0.5	ug/L	A		t-Butylbenzene	< 0.5	ug/L	A	
1,2,4-Trimethylbenzene	< 0.5	ug/L	A		s-Butylbenzene	< 0.5	ug/L	A	
4-Isopropyltoluene	< 0.5	ug/L	A		1,3-Dichlorobenzene	< 0.5	ug/L	A	
1,4-Dichlorobenzene	< 0.5	ug/L	A		n-Butylbenzene	< 0.5	ug/L	A	
1,2-Dichlorobenzene	< 0.5	ug/L	A		1,2,4-Trichlorobenzene	< 0.5	ug/L	A	
Hexachlorobutadiene	< 0.5	ug/L	A		Naphthalene	< 0.5	ug/L	U	
1,2,3-Trichlorobenzene	< 0.5	ug/L	A		Surr. 1 (4-Bromofluorobenzene)	100	%	A	
Surr. 2 (1,2-Dichlorobenzene d4	101	%	A						

ENDYNE, INC.
160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

CHAIN-OF-CUSTODY-RECORD

38149

Special Reporting Instructions: PCF Rates

Project Name: Project Soar #41080320	Reporting Address: KAS, Inc P.O. Box 787 Williston, VT 05495	Billing Address: KAS, Inc P.O. Box 787 Williston, VT 05495
Endyne Order ID: (Lab Use Only) 0901-00619 -O -I -S	Company: KAS, Inc Contact Name/Phone #: Angela Emerson	Sampler Name: Angela Emerson Phone #: (802) 353-0482

Ref # (Lab Use Only)	Sample Identification	Matrix	GRAB	COMP	Date/Time	Sample Containers No.	Sample Containers Type/Size	Field Results/Remarks	Analysis Required	Sample Preservation	Rush
	Trip Blank	H_2O	X		1/13/09; 1542	2	40mL		19	HCL	
	MW08-1	H_2O	X		1/14/09; 0930	2	40mL		19, 23		
	MW08-2	H_2O	X		1/14/09; 0920	2	40mL		19, 23		
	MW08-3	H_2O	X		1/14/09; 0845	2	40mL		19, 23		
	MW08-4	H_2O	X		1/14/09; 0905	2	40mL		19, 23		
	Duplicate	H_2O	X		1/14/09; 0920	2	40mL		19		
	Supply Well	H_2O	X		1/14/09; 0940	2	40mL		29		

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Angela Emerson	1/14/09; 1405		1/15 1029	Eileen Toomey	1/15 @ 10:35

New York State Project: Yes _____ No ✓

Requested Analyses

1	pH	6	TKN	11	Total Solids	16	Sulfate	21	1664 TPH/FOG	26	8270 PAH
2	Chloride	7	Total P	12	TSS	17	Coliform (Specify)	22	8015 GRO	27	PP13 Metals
3	Ammonia N	8	Total Diss. P	13	TDS	18	COD	23	8015 DRO	28	RCRA8 Metals
4	Nitrite N	9	BOD	14	Turbidity	19	8021B	24	8260/8260B	29	524.2
5	Nitrate N	10	Alkalinity	15	Conductivity	20	8010/8020	25	8270 B/N or Acid	30	
31	Metals (As Is, Total, Diss.) Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zn										
32	TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides)					33					
34	Other										

LAB USE ONLY
Delivery: Client
Temp: 4.5
Comments:

Appendix G

Site Photographs

PHOTOGRAPHIC DOCUMENTATION

Project Soar

178 McGinn Drive

St. Albans, Vermont

12/30/2008

Drilling Monitoring Well MW08-1

Drilling Monitoring Well MW08-2

PHOTOGRAPHIC DOCUMENTATION

Project Soar

178 McGinn Drive

St. Albans, Vermont

12/30/2008

Drilling Monitoring Well MW08-3

Drilling Monitoring Well MW08-4

PHOTOGRAPHIC DOCUMENTATION

Project Soar

178 McGinn Drive

St. Albans, Vermont

12/30/2008

Subject property looking northeast

Appendix H

Field Notes

Project Soar
178 McGinn Drive
Site Visit Checklist
Job # 410080320

DATE: 4/14/09 TECH: AE

Equipment Needed: WLI or 1" Interface Probe, Sampling Materials and Equipment, Magetometer.

1. Please measure DTP/DTW in the monitoring well on Site.

2. Collect EPA Method 8021B and 8015 - TPH DRO samples from MW08-1. The wells are 1-inch diameter. Collect a duplicate sample as well.

3. Collect a drinking water sample from the school and submit it for EPA Method 524.2.

4. Make sure you write VT PCF Project on the Chain of Custody.

5. Screen the airspace of the classrooms adjacent to the former UST and record observations in your field book.

	DTB	DTP	DTW	Time
MW08-1	16'	—	4.79	0930
MW08-2	14'	—	4.92	0920
MW08-3	12'	—	6.02	0845
MW08-4	12'	—	4.90	0905

Trip Blank 4/13/09 / 1545

Duplicate MW08-2 / 0920

Supply Well Sample

Location Kitchen Sink Time 0940

PROJECT #: 410080320 SITE NAME: Project Soar DATE: 12/30/08

BORING #: 1 Run 1 Time 0825 Depth range 0-4

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 85
Type: Silt
Group Name Silt w/ Sand
Group Symbol ML

Dilatancy: none / slow / rapid
Toughness: low / medium / high
Plasticity: nonplastic / low / medium / high
Dry Strength: none / low / medium / high / very high

Coarse Sand: % 15 — fine / medium / coarse
Gravel: % — fine / coarse
Angularity: angular / subangular / subrounded / rounded
Gradation: well / poor
Cementation: weak / moderate / strong
Moisture: dry / moist / wet
Remarks

Blow Counts —
Penetr/Recovery 48/15
HCl Reaction: none / weak / strong
Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Color M. Brown
PID 0.1

BORING #: 1 Run 2 Time 0832 Depth range 4-8

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 85
Type: Clay
Group Name Lean Clay w/ Sand
Group Symbol CL

Dilatancy: none / slow / rapid
Toughness: low / medium / high
Plasticity: nonplastic / low / medium / high
Dry Strength: none / low / medium / high / very high

Coarse Sand: % 10 — fine / medium / coarse
Gravel: % 5 — fine / coarse
Angularity: angular / subangular / subrounded / rounded
Gradation: well / poor
Cementation: weak / moderate / strong
Moisture: dry / moist / wet
Remarks

Blow Counts —
Penetr/Recovery 48/32
HCl Reaction: none / weak / strong
Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Color Blue Gray/Orange Mottled 32-34" layer of M-C sand & fine gravel
PID 0.1

44°48'40N
013°08'23W

Driller: ENPRO

PROJECT #: 410080320 SITE NAME: Project Soar DATE: 12/30/08

BORING #: 1 **Run** 3 **Time** 0840 **Depth range** 8-12

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 70 *Type:* Silt

Group Name Silt w/ Sand Sandy Silt w/ Gravel

Group Symbol ML

Dilatancy	none / slow / rapid	**Coarse**		**Angularity**	**Blow Counts**
Toughness	low / medium / high	*Sand*	%15 fine / medium / coarse	angular / subangular / subrounded / rounded	Penetr/Recovery 48/37
Plasticity	nonplastic / low / medium / high	*Gravel*	%15 fine / coarse	angular / subangular / subrounded / rounded	**HCl Reaction** none / weak / strong
Dry Strength	none / low / medium / high / very high	*Gradation*	well / poor / bimodal		**Structure** stratified / laminated / slickensided / fissured / lensed / blocky / homogenous
		Cementation	weak / moderate / strong		
		Moisture	dry / moist / wet		

Remarks orange mottled

Color Blue Gray

8.0-8.4": Angular - sub angular f-c gravel

PID 0.1

BORING #: 1 **Run** 4 **Time** 0930 **Depth range** 12-16

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 80 *Type:* Silt

Group Name Silt w/ Sand

Group Symbol ML

Dilatancy	none / slow / rapid	**Coarse**		**Angularity**	**Blow Counts**
Toughness	low / medium / high	*Sand*	% 15 fine / medium / coarse	angular / subangular / subrounded / rounded	Penetr/Recovery 48/32
Plasticity	nonplastic / low / medium / high	*Gravel*	% 5 fine / coarse	angular / subangular / subrounded / rounded	**HCl Reaction** none / weak / strong
Dry Strength	none / low / medium / high / very high	*Gradation*	well / poor / bimodal		**Structure** stratified / laminated / slickensided / fissured / lensed / blocky / homogenous
		Cementation	weak / moderate / strong		
		Moisture	dry / moist / wet		

Remarks

Color Blue Gray

PID 0.1

Driller: ENPRO

PROJECT #: 410080320 SITE NAME: Project Soar DATE: 12/30/08

BORING #: 2 Run 1 Time 0915 Depth range 0-4

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 10
Type: silt
Group Name Sandy silt w/ Gravel
Group Symbol ML

Dilatancy: none, slow, rapid
Toughness: low, medium, high
Plasticity: nonplastic, low, medium, high
Dry Strength: none, low, medium, high, very high

Coarse Sand: % 15 — fine, medium, coarse
Gravel: % 15 — fine, coarse
Angularity: angular, subangular, subrounded, rounded
Gradation: well, poor, bimodal
Cementation: weak, moderate, strong
Moisture: dry, moist, wet
Remarks

Blow Counts
Penetr/Recovery 48/29
HCl Reaction: none, weak, strong
Structure: stratified, laminated, slickensided, fissured, lensed, blocky, homogenous

Color M. Brown
PID 0.1

3.5-3.8': Angular F-C Gravel & F-C Sand layer

BORING #: 2 Run 2 Time 0920 Depth range 4-8

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 55
Type: silt
Group Name Sandy Silt w/ Gravel
Group Symbol ML

Dilatancy: none, slow, rapid
Toughness: low, medium, high
Plasticity: nonplastic, low, medium, high
Dry Strength: none, low, medium, high, very high

Coarse Sand: % 30 — fine, medium, coarse
Gravel: % 15 — fine, coarse
Angularity: angular, subangular, subrounded, rounded
Gradation: well, poor, bimodal
Cementation: weak, moderate, strong
Moisture: dry, moist, wet
Remarks

Blow Counts
Penetr/Recovery 48/40
HCl Reaction: none, weak, strong
Structure: stratified, laminated, slickensided, fissured, lensed, blocky, homogenous

Color M. Brown
PID 0.1

Driller: ENPRO

PROJECT #: 410080320 SITE NAME: Project Soar DATE: 12/30/08

BORING #: 2 Run 3 Time 0950 Depth range 8-12

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 65 Type: silt

Group Name Gravelly Silt

Group Symbol ML

Dilatancy	none / slow / rapid	Coarse Sand	% 5	fine / medium / coarse	Angularity	angular / subangular / subrounded / rounded
Toughness	low / medium / high	Gravel	% 10	fine / coarse		
Plasticity	nonplastic / low / medium / high	Gradation	well	poor	bimodal	
Dry Strength	none / low / medium / high / very high	Cementation	weak	moderate	strong	
		Moisture	dry	moist	wet	

Blow Counts —

Penetr/Recovery 48/48

HCl Reaction: none / weak / strong

Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Remarks

Color M. Brown

PID 0.1

BORING #: 2 Run 4 Time 1000 Depth range 12-14

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 55 Type: Silt

Group Name Gravelly Silt

Group Symbol ML

Dilatancy	none / slow / rapid	Coarse Sand	% 5	fine / medium / coarse	Angularity	angular / subangular / subrounded / rounded
Toughness	low / medium / high	Gravel	% 10	fine / coarse		
Plasticity	nonplastic / low / medium / high	Gradation	well	poor	bimodal	
Dry Strength	none / low / medium / high / very high	Cementation	weak	moderate	strong	
		Moisture	dry	moist	wet	At 12'

Blow Counts —

Penetr/Recovery 48/29

HCl Reaction: none / weak / strong

Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Remarks

Refusal @ 14' - soft well

Color Blue Gray

PID 0.1

Driller: ENPRO

PROJECT #: 410080320 SITE NAME: Project Soar DATE: 12/30/08

BORING #: 3 Run 1 Time 1015 Depth range 0-4

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 60
Type: SIH
Group Name Sandy silt w/Gravel
Group Symbol ML

Dilatancy: none, slow, (rapid)
Toughness: low, medium, high
Plasticity: nonplastic, low, medium, high
Dry Strength: none, low, medium, high, very high

Coarse — Angularity

Sand % 20: fine, (medium), coarse — angular, subangular, subrounded, rounded
Gravel % 20: fine, (coarse) — angular, subangular, subrounded, rounded

Gradation: (well), poor, bimodal
Cementation: weak, moderate, (strong)
Moisture: (dry), moist, wet

Remarks

Blow Counts

Penetr/Recovery 48/32

HCl Reaction: none, weak, strong

Structure: ~~Structure~~, (stratified), laminated, slickensided, fissured, lensed, blocky, homogenous

Color M. Brown

PID 0.1

BORING #: 3 Run 2 Time 1032 Depth range 4-8

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 65
Type: SIH
Group Name Gravelly silt w/Sand
Group Symbol ML

Dilatancy: none, slow, (rapid)
Toughness: low, medium, high
Plasticity: nonplastic, low, medium, high
Dry Strength: none, low, medium, high, very high

Coarse — Angularity

Sand % 15: fine, (medium), coarse — angular, (subangular), (subrounded), rounded
Gravel % 20: fine, (coarse) — angular, (subangular), subrounded, rounded

Gradation: (well), poor, bimodal
Cementation: weak, moderate, (strong)
Moisture: (dry), moist, wet @ 7'

Remarks

Blow Counts

Penetr/Recovery 48/30

HCl Reaction: none, weak, strong

Structure: ~~Structure~~, (stratified), laminated, slickensided, fissured, lensed, blocky, homogenous

Color M. Brown

PID 0.1

Driller: ENPRO

PROJECT #: 410080320 SITE NAME: Project Soar DATE: 12/30/08

BORING #: 3 Run 3 Time 1100 Depth range 8-12

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 60
Type: silt

Group Name Sandy silt w/ Gravel
Group Symbol ML

Dilatancy: none / slow / (rapid)
Toughness: low / medium / high
Plasticity: nonplastic / low / medium / high
Dry Strength: none / low / medium / high / very high

Coarse
Sand % 25: fine / (medium) / coarse
Gravel % 15: fine / (coarse)

Angularity
Sand: angular / subangular / (subrounded) / rounded
Gravel: (angular) / (subangular) / subrounded / rounded

Gradation: well / poor / bimodal
Cementation: weak / moderate / strong
Moisture: dry / (moist) / (wet) @ 4' 9"

Remarks Refusal @ 12' - Set Well

Blow Counts
Penetr/Recovery 48/19
HCl Reaction: none / weak / strong
Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Color M. Brown
Till
PID 0.1

BORING #: 4 Run 1 Time 1109 Depth range 0-4

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % 65
Type: silt

Group Name Sandy silt w/ Gravel
Group Symbol ML

Dilatancy: none / slow / (rapid)
Toughness: low / medium / high
Plasticity: nonplastic / low / medium / high
Dry Strength: none / low / medium / high / very high

Coarse
Sand % 20: fine / (medium) / coarse
Gravel % 15: fine / (coarse)

Angularity
Sand: angular / subangular / subrounded / rounded
Gravel: angular / subangular / subrounded / rounded

Gradation: well / poor / bimodal
Cementation: weak / moderate / strong
Moisture: dry / (moist) / wet

Remarks

Blow Counts
Penetr/Recovery 48/27
HCl Reaction: none / weak / strong
Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Color M. Brown
PID 0.1

Driller: ENPRO

PROJECT #: 410080320 SITE NAME: Project Soar DATE: 12/30/08

BORING #: 4 Run 2 Time 1130 Depth range 4-8

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % Silt To
Type:

Group Name Sandy silt
Group Symbol ML

Dilatancy	none / slow / rapid	Coarse Sand	% 20	Angularity	angular / subangular / subrounded / rounded
Toughness	low / medium / high		fine / medium / coarse		
Plasticity	nonplastic / low / medium / high	Gravel	% 10		angular / subangular / subrounded / rounded
			fine / coarse		
Dry Strength	none / low / medium / high / very high	Gradation	well / poor / bimodal		
		Cementation	weak / moderate / strong		
		Moisture	dry / moist / wet		

Blow Counts

Penetr/Recovery 48/40

HCl Reaction: none / weak / strong

Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Remarks

Color M. Brown

PID 0.1

BORING #: 4 Run 3 Time 1140 Depth range 8-12

Sample Type: Split Spoon (SS) Auger Flight (AF) Shelby Tube (ST) Rock Core (RC)

Fines: % Silt
Type:

Group Name silt w/sand
Group Symbol ML

Dilatancy	none / slow / rapid	Coarse Sand	% 15	Angularity	angular / subangular / subrounded / rounded
Toughness	low / medium / high		fine / medium / coarse		
Plasticity	nonplastic / low / medium / high	Gravel	% 5		angular / subangular / subrounded / rounded
			fine / coarse		
Dry Strength	none / low / medium / high / very high	Gradation	well / poor / bimodal		
		Cementation	weak / moderate / strong		
		Moisture	dry / moist / wet		

Blow Counts

Penetr/Recovery 48/25

HCl Reaction: none / weak / strong

Structure: stratified / laminated / slickensided / fissured / lensed / blocky / homogenous

Remarks Refusal set well @ 12'

Color M. Brown

PID 0.1

Driller: ENPRO

DIG SAFE CALL PREPARATION FORM

KAS Contractor ID: 56908 (Digsafe)
(ufpo)

Project name: Project Soar

Project number: 41008032O

DIG SAFE # VT, NH, ME, MA, RI: 888-344-7233
DIGSAFELY/UFPO NY 800-962-7962

NAME OF CALLER Angela Emerson

PHONE # 802-383-0486

MUNICIPALITY St. Albans STATE VT

PROPERTY ADDRESS 178 McGinn Drive

NEAREST INTERSECTING STREET Cherry St.

EXTENT OF WORK/DEPTH OF WELLS 4 MW's - 15' Deep

START DATE 12/18/08 START TIME 1130

YOUR COMPANY KAS, Inc

EXCAVATOR DOING THE WORK ENPRO SERVICES

EXCAVATOR TOWN AND STATE Williston, VT

COMPANIES NOTIFIED Comcast, Fairpoint, Vermont Gas Systems, CVPS

2008 - 5102476