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FINAL REMEDIAL DESIGN
OZONE SPARGE SYSTEM
OSMOSE, INC.
BUFFALO, NEW YORK

NYSDEC Site No. 915143

GT Engineering Project: 011108061

January 19, 1999

Prepared for:

Osmose, Inc,
980 Ellicott Street
Buffalo, New York

Prepared by:

GT Engineering, P.C.
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Latham, New York 12110-1245

#153reps/osmose/8061-rdr.199

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ABBREVIATIONS

BRA	baseline risk assessment
BSA	Buffalo Sewer Authority
BTEX	benzene, toluene, ethylbenzene, and xylene
$C0_2$	carbon dioxide
cfm	cubic feet per minute
cm/sec	centimeters per second
COI	chemicals of interest
CPP	Citizen Participation Plan
CQA	construction quality assurance
ECL	Environmental Conservation Law
EPA	Environmental Protection Agency
FRE	fiberglass reinforced epoxy
FS	feasibility study
FSP	Field Sampling Plan
gpm	gallons per minute
HASP	Health and Safety Plan
hp	horsepower
“Hg	inches of Mercury
IRM	interim remedial measure
kwh	kilowatt hours
LNAPL	light non-aqueous phase liquids
mg/kg	milligrams per kilogram
NAPL	non-aqueous phase liquids
NPT	national pipe thread
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O_2	oxygen
O_3	ozone
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PID	photoionization detector
PLC	programmable logic controller
POTW	publicly owned treatment works
ppm	parts per million
psi	pounds per square inch
PTFE	polytetrafluoroethylene
PVC	polyvinyl chloride

ABBREVIATIONS (continued)

PVDF	polyvinylidene fluoride
QAPP	Quality Assurance Project Plan
QA/QC	quality control/quality assurance
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RI	remedial investigation
RIFS	remedial investigation/feasibility study
ROD	record of decision
ROI	radius of influence
SB	soil borings
scfm	standard cubic feet per minute
SCGs	standards, criteria, and guidance
SVE	soil vapor extraction
TCLP	toxicity characteristic leaching procedure
ug/L	micrograms per liter
UST	underground storage tank
VGAC	vapor-phase granular activated carbon
VOCs	volatile organic compounds

1.0 INTRODUCTION

1.1 General

The Osmose, Inc. (Osmose) site is located at 980 Ellicott Street, Buffalo, New York, and serves as the executive and accounting headquarters, along with research and product production (**Figure 1-1, Site Location Map**). Osmose purchased the site in 1951 and has operated the facility since that time. Osmose currently manufactures a variety of preservatives used in the treatment of lumber and wood products The facility employs approximately 150 people from Buffalo and the surrounding communities.

Hydrocarbon impacts, primarily polynuclear aromatic hydrocarbons (PAHs) and No. 2 fuel oil, were detected at the site during activities associated with closure of three underground storage tanks (USTs) located in the southern parking lot. In December 1995, Osmose submitted a *Feasibility Study* report which recommended source removal, groundwater collection, *in situ* chemical treatment (ozone injection), and monitoring as the preferred remedial alternative. In January 1997 the New York State Department of Environmental Conservation (NYSDEC) issued a Record of Decision (ROD) which formally concurred with the recommended remedial action. As stated in the ROD, the components of the remedy are as follows:

- recovery of Light Non-Aqueous Phase Liquids (LNAPL)
- incineration of LNAPL at an off-site facility
- treatment of impacted site soils with *in situ* injection of ozone
- monitoring of groundwater for compliance
- monitoring of the sanitary sewer which is located beneath Ellicott Street
- monitoring of ambient air during treatment activities
- acquisition of a deed restriction for the property

The remedial program selected was chosen in accordance with the New York State Environmental Conservation Law (ECL) and consistent with the National Oil and Hazardous Substances Pollution Contingency Plan of March 8, 1990.

Osmose has prepared this final (100%) remedial design in accordance with the Remedial Design/Remedial Action (RD/RA) Order on Consent (Index No. B9-0314-90-01) negotiated for the site. The Order requires that the remedial design be conducted in two phases:

- Preliminary Design - The scope of the remedial design should not address less than 30% of the total design and shall be based on project specific data.

- Final Design - The final design documents will be submitted 100% complete with the drawings and specifications ready for bid.

The *Ozone Sparge System Preliminary Remedial Design*, dated August 4, 1998 was submitted to the NYSDEC for review and comment. The Department forwarded comments on the preliminary design in a letter dated September 9, 1998. Responses to these comments were presented to the NYSDEC in a letter dated September 17, 1998 (Ahrens to Walia), and incorporated into this final (100%) remedial design.

This final design is consistent with all applicable standards, criteria, and appropriate environmental and public health guidance and requirements identified in the ROD. The attached specifications require the utilization of currently accepted construction practices and techniques.

1.2 Background

The investigation phase of the project was conducted from August 1990 to August 1993. Polynuclear aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene, and xylenes (BTEX) associated with the brushing grade creosote and fuel oil have been identified as the chemicals of interest (COIs) at the site. A hydrocarbon mass balance calculation (conducted prior to LNAPL recovery) indicated the following distribution of hydrocarbons existed on-site:

- 75% of hydrocarbon mass existed as LNAPL
- 24% of hydrocarbon mass was adsorbed to site soils (21% in the saturated zone; 3% in the unsaturated zone)
- 1% of hydrocarbon mass existed in the dissolved phase

The remedial strategy for the site was to recover a sufficient quantity of LNAPL to allow *in situ* chemical treatment (zone injection) of the adsorbed residuals. Recent bench scale testing indicated that sufficient LNAPL has been recovered to begin the chemical treatment of adsorbed soils.

A baseline human health risk assessment was completed as part of the subsurface investigation work. Additionally, several Interim Remedial Measures (IRMs), field pilot tests, and bench scale tests have been conducted to gather information to support the preparation of this remedial design for the site.

1.3 Project Purpose and Approach

As mentioned above, the objective of this report is to present the final (100%) design of the ozone treatment system for the Osmose site.

The design, construction, and operation of this project will be undertaken on a design/build basis with GT Engineering, P.C. providing the design and construction quality assurance services and its affiliate Fluor Daniel GTI, Inc. (Fluor Daniel GTI) serving as the construction contractor. This approach has the advantage of expediting the overall design and construction schedules and will result in a higher level of quality control by limiting responsibility for both design and construction to a single design/build team. The format of this final remedial design and the level of design detail is reflective of a design/build approach.

Fluor Daniel GTI will perform the following services during construction activities:

- Review construction subcontractor submittals
- Attend conferences and project meetings
- Provide full time construction manager on-site during installation activities

All work will be performed in strict adherence to the site's Health and Safety Plan (HASP). The HASP previously prepared for the site has been revised to include the specific work tasks associated with the RD/RA action and updated to current OSHA criteria. This revised project HASP is included in **Appendix A**.

1.4 Citizen Participation

Osmose is committed to maintaining public relations during the implementation of the remedial action at the site. The citizen participation program will help promote public understanding of the remedial action activities occurring at the facility. A Citizen Participation Plan (CPP) has been developed which includes Osmose's intended notification activities during the design and construction activities of the project. The CPP is included as **Appendix B**.

2.0 BASIS FOR DESIGN

2.1 Remedial Action Objectives

Remedial action objectives (RAOs) for the site were developed during the Feasibility Study based on an evaluation of the data from various investigation studies conducted at the site, the site risk assessment, and from review of the applicable standards, criteria, and guidance values (SCGs). The RAOs were formally presented in the ROD based upon the Administrative Record of the NYSDEC. The objective of the remedial action at the Osmose site is to protect human health and the environment by remediating the source of impacts and eliminating exposure pathways. The following RAOs exist for the site:

Media	RAO
LNAPL	Recovery of LNAPL, off site disposal
On-site Soils	Total PAHs* $\leq$ 473 mg/kg Total Carcinogenic PAHs $\leq$ 50 mg/kg Total Benzo{a}pyrene $\leq$ 10 mg/kg Total VOCs $\leq$ 10 mg/kg
Groundwater	Maintain NYS groundwater standards at three point-of-compliance monitoring wells (MW-11, MW-14, and MW-28)

* = total based on the 16 PAH analytes on the EPA's priority pollutant list

Because the potential exposure scenarios to impacted soils are similar, the RAO for on-site soils pertain to both on-site biocell soils and on-site non-biocell soils. Additionally, these RAOs require that Osmose maintain cover (e.g. asphalt) over the affected soils and file appropriate Declaration of Covenants and Restrictions (deed notification) on the subject property. A deed notification has been filed by Osmose (dated July 20, 1995), which defines the impacted portion of the site (operable unit) and defines conditions, covenants, and restrictions for that area.

As presented in the Feasibility Study, hydrocarbon impacts have not been identified within the clay layer on-site; any impacts to the clay have primarily been located on the bottom surface. For this reason, along with the physical properties of the clay, treatment of the clay is not required. Additionally, the presence of the COI has not been confirmed beneath the Osmose facility. However, it would appear that to some extent, LNAPL, and therefore adsorbed COI, may exist beneath the southeast corner of the Osmose facility. Once LNAPL recovery has been completed (including potential LNAPL from beneath the facility), the existing facility's concrete foundation will serve as an effective barrier (i.e., cap) to eliminate exposure to employees, workers, and residents to potential residual COI that may exist. As stated in the Feasibility Study, treatment of these potentially impacted soils beneath the southeast corner of the Osmose facility soils is neither feasible nor proposed.

2.2 Nature and Extent of Impacts

A summary of the nature and extent of impacts to soil and groundwater at the site is summarized in this section based on the results of the previous site investigations. An estimated 10,500 pounds (1,250 gallons) of fugitive hydrocarbons existed in the subsurface at the site during the investigation. This estimate did not include any hydrocarbons which may exist under the southeastern corner of the Osmose facility. The COIs were present at the site at varying concentrations as adsorbed, dissolved, and separate phases.

Wastes associated with the Osmose site have been determined to be classified as Code U051, per the Resource Conservation and Recovery Act (RCRA) 40 CFR Part 261.33, Identification and Listing of Hazardous Wastes. The listing basis for creosote is its toxicity characteristic. Residues or contaminated soil, water, or other debris resulting from the clean up of a spill of creosote into or on any land or water are also held by Part 261.33 to be U051-listed hazardous wastes.

2.2.1 LNAPL

The distribution of LNAPL (prior to initiation of LNAPL recovery), based on gauging data from existing monitoring wells, is presented on **Figure 2-1**. According to previous investigations, LNAPL accounted for the majority (75%) of the hydrocarbon mass present in the subsurface. Approximately 8,000 pounds (950 gallons) of LNAPL were estimated to exist on site prior to initiation of LNAPL recovery. These separate-phase hydrocarbons reside primarily in the silt/sand layer directly beneath the clay layer, from approximately 8 to 12 feet below grade. Operation of an LNAPL Recovery IRM system combined with manual bailing of LNAPL has improved the subsurface conditions to the point that no measurable thickness of LNAPL has been detected (or removed) since the October 1997 well gauging event. To date, approximately 700 gallons of the LNAPL has been recovered by a combination of manual bailing and the recovery system.

A bench scale ozone treatability test was conducted by Fluor Daniel GTI's Remediation Technology Testing Facility to determine if sufficient LNAPL had been recovered to initiate the ozone injection. The report concluded that sufficient LNAPL had been removed and recommended initiation of pulsed ozone injection.

2.2.2 Adsorbed Hydrocarbons

The areal extent of adsorbed hydrocarbons on soils above the RAOs is contiguous with the areal extent of LNAPL. The maximum adsorbed concentrations detected during the site investigations were 9.1 parts per million (ppm) VOCs and 640 ppm PAHs at locations MW-16 and MW-13, respectively. Adsorbed-phase hydrocarbons make up approximately 24 percent of the total hydrocarbons present at the site, with an estimated mass of approximately 2,500 pounds (300 gallons). Of these adsorbed hydrocarbons, approximately 88% exist in the saturated zone, while only 12% are believed to exist in the unsaturated zone.

An important factor controlling the movement of hydrocarbons on site is the presence of a clay layer approximately 3 to 8 feet below grade in the impacted area. The upper boundary of the clay layer is sharply defined, while the lower boundary consists of a gradational change with increasing depth to silt and eventually to fine sand. The clay itself is highly impermeable to both air and water, as observed during soil boring events and demonstrated by the results of permeability testing and soil vapor extraction testing performed as part of the ozone injection feasibility study (Section 2.4.1 below). As the silt content of the clay increases with depth, there is a corresponding increase in permeability. At approximately 7 feet below grade, the clay becomes silty enough that groundwater can penetrate from the aquifer beneath. This boundary at the 7-foot level provides an important constraint on the migration of hydrocarbon compounds. Almost no hydrocarbons were found in the clay layer between 3 feet and 6 feet; intermediate (below the RAO) concentrations were found between 6 feet and 7 feet.

Estimates of the distribution of adsorbed-phase hydrocarbons on, or within the clay layer indicate that approximately 1,000 pounds (120 gallons) of the total adsorbed hydrocarbons are adsorbed on, or immediately beneath the clay layer, representing about 9 percent of total hydrocarbons (or approximately 40% of the total adsorbed loading). Previous investigations indicate that these hydrocarbons are adsorbed on the bottom outer surface of the clay layer.

As stated above, the areal extent of VOCs and PAHs above the RAOs has been defined and closely resembles the areal extent of LNAPL. The vertical extent of hydrocarbons above the RAO (presented in Figures 2-9 and 2-10 of the Feasibility Study) ranges from approximately 7 to 11 feet below grade.

2.2.3 Dissolved-Phase

According to the Feasibility Study Report, the maximum dissolved concentrations detected during the site investigation were 2.4 ppm total volatiles (at MW-13) and 15.1 ppm total PAHs (at MW-12). Dissolved-phase hydrocarbons make up less than 1.0 percent of the total hydrocarbons present at the site, with an estimated mass of approximately 20 pounds (2.3 gallons). The dissolved plume appears to be centered in the area of the Ellicott Street personnel entrance gate, immediately downgradient from the former tank pit. Currently, groundwater capture via the pumping and treatment associated with the LNAPL Recovery IRM occurs at the site. The RAO for groundwater is compliance with NYS drinking water standards at three compliance wells (MW-11, MW-14, and MW-28). The most recent groundwater sampling event (June, 1997) indicated that these three wells are currently in compliance with the RAO.

2.3 Volume of Affected Soils

A total of approximately 1,400 cubic yards of soil exits on-site which requires treatment. Approximately 650 cubic yards of soil requiring treatment exist inside the soil treatment biocell. Additionally, approximately 750 cubic yards of soil exist within the study area, outside the biocell, with adsorbed PAH levels above 473 mg/kg. Most of these soils are between 7 to 11 feet below grade, in the vicinity of the Ellicott Street personnel entrance to the southern parking lot.

2.4 Feasibility and Pilot Tests

Described in the sections below are the field and bench studies that were conducted which are pertinent to the proposed ozone injection system and associated remedial design.

2.4.1 Soil Vapor Extraction

A soil vapor extraction (SVE) radius of influence (ROI) test was conducted in May/June 1993. Vapor recovery was unsuccessful in the shallow (2 to 3 feet below grade) unsaturated zone using a liquid ring high-vacuum pump capable of producing 40 inches of mercury ("Hg) vacuum. This shallow zone was above the clay layer which exists on site. Soils below the clay layer were dewatered and a helium injection test was conducted. A hand held helium detector was used to detect the travel patterns of the helium- no helium was detected outside the test area with the SVE operating. No specific ROI data was collected from this test; however, conservative estimates indicate that a 20-foot ROI was achieved in the field.

2.4.2 Ozone Pilot Test

An injection stream of 4% ozone (average), at pressures ranging from 7 to 9 psi, and at a flow rate of approximately 3 cfm was used during the ozone pilot test conducted in two areas (Area 1 and Area 2) of Osmose's southern parking lot. The Area 1 test was conducted on soils in the unsaturated zone. The COIs in soils in this study area were reduced to below the site RAOs during the pilot test and therefore are not considered for further action.

The Area 2 test was conducted on soils in the saturated zone. Daily operation and maintenance visits were performed to check equipment and collect data to track the progress of the pilot test. Based upon the measured flow rates and % ozone readings, a total of 789 pounds of ozone was injected into the subsurface during the pilot test in Area 2. The SVE system extracted approximately 115 pounds of unreacted ozone, leaving approximately 674 pounds of ozone which reacted in the subsurface. Vapor-phase granular activated carbon (VGAC) canisters were successful in destroying the ozone vapors in the SVE stream prior to discharge.

Prior to startup, the ozone dose required to treat the impacted soils in the saturated zone was conservatively estimated by assuming the ozone will mineralize both PAHs and humic acid in the soil. Ozone requirements were 2.96 lb/lb PAHs and 1.52 lb/lb humic acid, assuming empirical formulas for PAHs and humic acids of $CH_{0.7}$, and $CHO_{0.5}$ respectively. Soil concentrations of 0.1% PAHs, 0.5% humic acid, and a dry soil bulk density of 120 lb/ft^3 were assumed. The influx of LNAPL during the pilot test precluded calculation of the ozone efficiency since the mass of the ozone which entered the test area was unknown. In general, it was observed that areas which did not experience a large influx of LNAPL did exhibit a reduction in PAH concentrations.

2.4.3 Aquifer Pump Tests

An aquifer step test, a 24-hour drawdown test, and a recovery test were conducted at the site from June 24 through 26, 1993. The sustainable flow rate from a 4-inch, fiberglass reinforced epoxy (FRE) well (flow rate which could be maintained for 24-hours without dewatering the well) determined from the step test was 0.15 gpm. The average transmissivity was calculated to be 45 gallons/day/foot and the average storativity was 0.02.

The average required drawdown to ensure vapor collection during the ozone pilot test was determined to be 3.5 feet. The model CAPZONE was utilized for simulations of various well numbers, spacing, and flow rates. As described above, to vent excess, unreacted, ozone from beneath the clay layer present on site during the Area 2 pilot test, creation of a dewatered "pocket" beneath the clay layer was required. It was also important not to lower the groundwater table below the depth of the bottom of the combined sewer system lateral beneath Ellicott Street. Previous assessments had concluded that the sewer acts as a barrier to offsite migration of LNAPL.

Aquifer flow characteristics collected during the field test were used to model the most efficient layout of dewatering wells during the final Remedial Design (**Section 3.2.1**, below).

2.4.4 Ozone Bench Scale Test

An ozone bench scale treatability test was completed in July 1998 on soils collected from the Osmose site. The objective of the study was to determine if sufficient LNAPL had been removed from the subsurface to initiate ozone injection and to determine the optimal operational parameters for the proposed ozone treatment system. Specifically, the objectives were to compare the performance of direct, continuous ozonation to combined ozonation/biodegradation.

The following conclusions resulted from the study:

- sufficient LNAPL had been removed from the site to begin ozone injection
- the injection of ozone in a pulsed manner was advantageous over continuous injection of ozone
- the optimal injection rate should be approximately 3% ozone (in oxygen) at approximately 10 scfm added to each injection well for approximately 1 hour per day.

3.0 SYSTEM DESIGN

The following section provides a discussion of the final design of the ozone sparge system. The design incorporates two fundamental systems: (1) an expansion and upgrade to the existing groundwater and LNAPL recovery and treatment system; and (2) installation of an ozone injection and recovery system. An existing equipment compound currently houses the LNAPL and groundwater recovery and treatment system. The expanded and upgraded system will remain in this building. A new enclosure will be constructed to contain the ozone generation, recovery, and treatment system. This new enclosure will be located on the northern side of the existing Osmose Pilot Plant, as shown in **Drawing Y-2.**

Drawing Y-1: Site Plan is the base map produced from a survey conducted in January 1998 which provides a plan view of the Osmose site and surrounding areas. **Figure 2-1** and **Drawing Y-2** shows the areal view of the soils which require treatment. Soils within and below the soil treatment biocell require treatment.

A groundwater flow model was constructed to evaluate recovery well requirements (**Section 3.1.1**, below). The upgraded groundwater and LNAPL recovery system will consist of 11 recovery wells and the replacement of the existing settling tank with an oil–water separator, as described in **Section 3.1.2**.

The ozone injection and recovery system will consist of twenty (20) ozone injection wells and twenty-three (23) SVE wells strategically placed to provide full capture of potentially unreacted ozone as presented in **Section3.2. Drawing Y-2, Ozone Injection System Layout** provides a plan view indicating the locations of the ozone injection and SVE wells with the anticipated ROI of each well for soils both inside and outside the biocell requiring treatment. The design ROI for the injection wells is 15 feet, while the ROI for the SVE wells is either 20 feet for the wells along the east, west and southern portions of the impacted area, or 10 feet along the northern portion of the plume, nearest the Osmose main building. To address the impacted soils contained within the biocell, four (4) shallow ozone sparge points and four (4) shallow SVE points will be located inside the soil treatment biocell as also indicated on **Drawing Y-2.**

Both figures ("B" size: 11" x 17") and drawings ("D" size: 24" x 36") are used to illustrate the design. The "B" size figures are typically used to present geologic and hydrogeologic site conditions; "D" size drawings are associated with the treatment system design.

Individual components of the treatment system are presented below.

3.1 Upgrade of LNAPL/Groundwater Recovery System

Components of the expanded groundwater and LNAPL recovery/treatment system are presented below. These components include:

- Installation of ten new recovery wells
- Installation of down well total fluids recovery pumps
- Installation of an oil–water separator; removal of the existing settlement tank
- Installation of an in-line oil filter

3.1.1 Groundwater Flow Model

A groundwater flow model was constructed to evaluate the recovery well requirements to partially dewater a portion of the shallow aquifer beneath the Osmose property. The selected flow model, MODFLOW is a three-dimensional groundwater flow model developed by the United States Geological Survey (USGS). MODFLOW uses mathematical expressions to represent the groundwater flow system, including boundary conditions, hydrogeologic attributes of the aquifers, and simplifying assumptions to capture the heterogeneities of the subsurface. Visual MODFLOW (Guiguer & Franz, 1997) was used as a pre- and post-processor to MODFLOW to create input files and to view model results.

Groundwater flow parameters were developed based on the conceptual model. A numerical model requires simplifying assumptions when defining a model domain. Each volume element (a block defined by a row, a column and a layer in the grid) is assigned a unique set of hydraulic parameters influencing the calculations depicting flow of groundwater at the center of that particular block. Hydraulic properties incorporated into this model include hydraulic conductivity (horizontal and vertical), effective porosity, specific yield, and storativity. The input values to the model were based on the pump test and hydrologic evaluation completed during the feasibility study, and on the judgment of the project hydrogeologist .

To construct the model, general head boundaries were assigned on the west and east sides of the Osmose site, representative of nominal (static) groundwater conditions. A general head boundary (GHB) consists of a specified hydraulic head at the boundary and a specified hydraulic conductance value at that location in the model grid. This type of boundary accounts for both the hydraulic head within the model domain and the groundwater flux across a boundary. The model domain representing the vicinity of the Osmose site measures 470 feet approximately north to south (parallel to Ellicott Street) and 470 feet approximately east to west. General head boundaries were designated at the perimeter grid blocks to simulate regional flow. Groundwater elevations were set at 93 feet at the west boundary and 89 feet at the east boundary. The elevations were based on groundwater elevation data collected at the site during the last several years. These conditions were also calibrated using the pumping data collected at Osmose during the IRM. A single hydrostratigraphic unit corresponding to a silty, fine-grained sand was defined based on available aquifer test data and active pumping well information.

Several model simulations were run to evaluate well layouts needed for the desired dewatering, which was to produce an average of 3.5 feet of water table depression across the site, except in the vicinity of the sewer along Ellicott Street, at which point drawdown was limited to 2 feet.

With 10 pumping wells operating simultaneously, the desired result was achieved. An eleventh well was added to the array to provide a redundancy factor for such conditions as aquifer inhomogeneity, screen siltation, etc. The location of these wells are shown as **Figure 3-1**.The three westernmost wells will be pumped at 0.15 gpm, and the remaining eight wells at 0.1 gpm (total flow rate approximately 1.25 gpm).

3.1.2 Groundwater Control System

The groundwater extraction and treatment system installed for use during the original ozone injection pilot test, and upgraded for the LNAPL Recovery IRM, will be expanded, modified, and kept operational throughout this full-scale ozonation project. Currently, groundwater and LNAPL are being recovered using recovery wells RW-2, RW-4, RW-6, RW-8, and RW-9. Based on existing aquifer data collected during pump tests, it was determined that 10 new groundwater extraction wells, along with existing recovery well RW-6, are required to create a dewatered "pocket" below the clay layer within the treatment area. The locations of these new wells are presented on Figure 3-1, **Simulated Pumping Effect**. Specifications for recovery well installation are presented in **Appendix C**. The four existing total fluids pneumatically operated pumps in wells RW-2, RW-4, RW-8, and RW-9 will be removed from the current pumping wells and re-deployed in the new recovery wells. Six new down-well pumps will be purchased and installed in the six remaining new recovery wells. Pump specifications are included in **Appendix C**. High vacuum application at the wellhead to enhance LNAPL recovery will not be required as part of the final system design. Equipment located in the existing equipment enclosure associated with the application of vacuum at the existing recovery wells will be removed. Additionally, the two extraction stringers which currently exist will be removed and disconnected in the enclosure.

The only change anticipated for the water treatment system is the replacement of the existing influent equalization tank with a similarly sized oil-water separator (Specifications, **Appendix C**). Although the existing equalization tank has performed well to date, an oil-water separator will improve the system performance by increasing the amount of NAPL separated from the groundwater prior to treatment by LGAC. This modification also will improve the operating life of the LGAC. All groundwater treatment equipment will be kept in the existing SVE/water treatment enclosure. The location of the enclosure will not change.

3.1.3 Groundwater Treatment System

Based on an anticipated total flow rate of approximately 1.25 gpm, the existing configuration of LGAC canisters will be sufficient to treat the water prior to discharge.

3.2 Ozone Injection and Recovery System

The proposed ozone system will consist of five (5) primary components:

- ozone generation;
- ozone injection;
- vapor extraction and treatment;
- piping network; and
- instrumentation and controls.

In addition, construction of an equipment enclosure will be required.

The following provides a description of each of these components. **Drawing P-2, Piping and Instrumentation Diagram** provides a detailed schematic of the proposed ozone treatment system, while **Drawing S-1, Remediation Shed** indicates the arrangement of the ozone treatment equipment in it's enclosure.

3.2.1 Treatment System Enclosure

A treatment system enclosure will be constructed to house the ozone injection and recovery system. The enclosure will be located as shown on **Drawing Y-2**. The enclosure will be of woodframe construction with internal dimensions of approximately 8 feet tall, 22 feet long, and 8 feet wide and will be placed on a concrete slab foundation. A 7-foot wide double door will allow personnel and equipment access. The enclosure will be weatherized and will be insulated to minimize noise impacts to nearby residents and workers. A ventilation fan will be installed and continuously operated which will eliminate the requirement of Class 1, Div. 2 rated equipment. **Drawing S-1, Remediation Shed Layout** provides a plan and elevation view of the proposed equipment enclosure. Construction specifications are included in **Appendix C**. Construction details are provided on **Drawing D-1** through **D-3**.

Noise levels inside both equipment enclosures will be monitored according to **Section 3.2** of the HASP (included in **Appendix A**). Action levels included in the HASP will trigger upgrades in PPE to include appropriate hearing protectors, if required. Noise levels outside the enclosures will also be monitored for nuisance noise. If unacceptable levels exist outside the enclosures, engineering controls (e.g. sound deadening insulation around equipment) will be evaluated and implemented.

3.2.2 Ozone Generation

The ozone generation system will consist of a rotary screw air compressor, an oxygen separator, an oxygen holding tank, and an ozone generator.

The compressor will provide approximately 50 scfm (standard cubic feet per minute) of air to the oxygen separator at 100 pounds per square inch (psi). A 15 horsepower (hp) rotary screw compressor will be used to provide the high pressure/high flow required for this application. The compressor will be fitted with the standard accessories, including an automatic drain, inlet filter, pressure gauge, and inlet silencer. An oil filter and 0.1 micron particulate filter will be installed on the air discharge from the compressor to ensure that both the oxygen separator and the ozone generator do not become fouled.

The oxygen separator will provide 90% (or higher) pure gaseous oxygen for the ozone generator. The separator uses a molecular sieve to remove most of the impurities from ambient air, leaving only oxygen. The separator's two molecular sieve banks will cycle automatically, one purifying the influent pressurized air while the other purges in a cleaning cycle. Although these units may sometimes be called oxygen generators, the term "separator" is more accurate and should be used to avoid confusion with other types of oxygen producing units. The purified oxygen will be stored in a holding tank prior to discharge to the ozone generator.

After the oxygen holding tank, the ozone generator will convert the oxygen into ozone. It is anticipated that the generator will be sized to produce up to 26 pounds per day of ozone, or 4 cfm of injection gas with an ozone concentration of 10 percent ozone (by weight). The ozone generation rate and purity can be adjusted by varying several parameters, including oxygen feed rate, electrical input, and influent pressure. A booster blower will be required to increase injection flow to the desired 6-10 scfm. The ozone generator is a series of tubes through which oxygen and an electric current is passed, converting the oxygen (O_2) to ozone (O_3). The ozone generator requires approximately 5 to 6 kilowatt hours (kwh) of electricity per pound of ozone produced during normal operation. This operation results in the production of significant quantities of heat. Non-contact cooling water is used to remove the heat. For this system, it is estimated that approximately 5 gpm of cooling water will be required to cool the influent temperature to between 35-86°F. Even though readily available public water is present, an air cooled recirculating water chiller will be installed to reduce the water consumption and optimize the heat removal.

All piping between the ozone generator and the piping manifold will either be Type 316 stainless steel or Teflon tubing. Since the permissible exposure levels for ozone are low, it is critical that there be no leaks in any connections, especially those located inside the confines of the remediation enclosure. To minimize the possibility of such a leak, all threaded connections between the ozone generator and the piping manifold will be sealed during installation with Teflon tape and high grade silicon (GE-1000). Whenever practical, tubing will be used in place of threaded connections. On startup, all pressurized joints containing ozone will be leak tested with soapy water.

Specifications for the ozone generation equipment are presented in Appendix C.

3.2.3 Ozone Injection

A surge suppression unit will be installed following the ozone generator. This unit will absorb some of the pressure surges created when the ozone discharge manifold switches between sparge wells. This is required since the ozone generator is quite sensitive to pressure variations, and may even shut down if pressures are detected at the generation unit which are too high or low. Experience with similar units indicate that a one to two gallon capacity tank will provide the desired pressure buffering to avoid system shutdowns.

Following the surge tank, an in-line flowmeter and pressure gauge will indicate the flow rate of ozone entering the sparge manifold. After the flowmeter, the ozone will be distributed by a 20-leg piping manifold as depicted on **Drawing D-2 - Ozone Sparge/SVE Manifold Layouts.** Each leg will be fitted with an electrically actuated solenoid valve, pressure regulator and pressure gauge. The programmable logic controller (PLC) in the ozone generator will automatically control the solenoid valves to rotate ozone flow to each point, one point at a time. The PLC will open the solenoid valve to the next leg, five seconds before closing the previous leg in order to avoid a "dead-head" no flow condition. The PLC will be initially set for a 72-minute cycle time, meaning each well will be operated once per day. Sparge points nearest sensitive receptors (buildings, etc) will be set to operate during off-shift hours or when the presence of receptors is minimal.

Specifications are presented in **Appendix C.**

3.2.4 Vapor Extraction and Treatment

Although the total amount of ozone injected into the subsurface is relatively small (up to 26 pounds per day), a SVE system must be installed to ensure that unreacted ozone does not escape under the Osmose building or adjacent structures, or off-site. A network of SVE wells will be constructed along the perimeter of the remediation zone, as shown in **Drawing Y-2 - Ozone Injection System Layout.** Most of the existing SVE wells from previous pilot tests will not be used in the new SVE well network because they are located in areas where ozone vapors will be reacting with residual LNAPL and PAHs. These SVE wells will be abandoned during construction activities.

Additionally, it is anticipated that four (4) SVE wells will be installed within the soil treatment biocell to recover unreacted ozone from the sparge points located within the cell.

The ozone injection rate will be approximately 10 cfm. It is anticipated that a minimum of 600 cfm at 30" H_2O will be required to maintain the required area of influence by the SVE blower. The existing SVE blower's capacity of 250 cfm will not be sufficient and will require replacement. A 15 hp regenerative blower and motor will be rented for initial system startup to verify that sufficient area of influence can be maintained. Once performance data is collected, the appropriate blower and motor will be purchased for permanent installation.

Vapor-phase granular activated carbon (VGAC) will not be used for the removal and treatment of residual ozone for the full scale treatment system. Recent information indicates that activated carbon, when exposed to strong oxidizing agents such as ozone has been reported to undergo rapid oxidation which could create a fire hazard. Ozone will be removed from the effluent SVE air stream by an ozone-specific catalyst, such as that manufactured by Carus Chemical Corporation. The catalyst comes in the form of resin beads with a 3/8-inch diameter. Assuming a packed bed porosity of 0.34, two 55-gallon drums connected in parallel will provide the desired 2 fps velocity and 0.7 second residence time required for optimum efficiency. Catalyst performance is expected to be 99% removal efficiency, and will be verified during site visits.

3.2.5 Instrumentation and Controls

A PLC will serve as the "brains" of the ozone injection system. The ambient air ozone/oxygen monitor will be interlocked with the PLC to provide an emergency shutdown in the event of high ozone or low oxygen levels. The following interlocks will be incorporated into the system:

- If the vapor extraction blower shuts down or ambient air monitoring alarms are triggered, the ozone generator will shut down.
- If the ozone generator shuts down, the recirculating chiller and SVE blower will be shut down after a time delay of one hour.
- If high water level in the moisture separator is triggered, the SVE blower will shut down.
- If SVE blower shuts down, the rotary screw compressor will shut down.
- If oxygen concentration exceeds 22% or ozone concentrations exceed 0.1 ppm in the equipment enclosure ambient air, the ozone generator will shut down, the oxygen supply solenoid valve shuts down, and an autodialer notifies remote location by phone.

One externally mounted small light will be used to communicate internal alarm conditions. The light will be plainly visible above the entrance to the ozone treatment system enclosure. If the monitor detects a dangerous atmosphere inside the enclosure, the autodialer will activate, while the compressor, oxygen sieve, ozone generator, and the solenoid on the discharge of the oxygen tank will all be deactivated (closed). Equipment will not restart until manually reset. If the PLC detects any other error conditions that require a system shutdown (i.e., high discharge pressure) the autodialer will again activate.

The PLC will also coordinate operation of the sparge manifold, cycling flow to each sparge point, one at a time. The order, cycle time, and on/off status of each well will be adjustable in the field. The PLC will log the following data to a file: ambient ozone concentration, ambient oxygen concentration, ozone injection pressure, sparge point status (on/off) and system uptime. This data file will be copied to disk and provided to the site manager on a monthly basis.

The existing remediation equipment should not require any additional electrical connections. The new remediation equipment, located in the new equipment enclosure is expected to have the following electrical requirements:

15 Hp Rotary Screw Compressor:	230 V, 20A, 3 phase
Oxygen Separator:	120V, 15 A, 1 phase
Ozone Generator:	460V, 15 A, 3 phase
Misc. Lights, Outlets (4 circuits):	120V, 15 A, 1 phase

Specifications are included in Appendix C.

3.3 Piping

One-half-inch-diameter teflon tubing will be utilized to transport the ozone from the manifold inside the enclosure to each injection well. Only compression type fittings will be utilized, no worm style hose clamps or barbed fittings will be used for the ozone injection lines. An ABS plastic pipe will sheathe the tubing lines below grade, which will be located approximately 3 feet below grade to minimize any structural loads imposed by vehicles traveling overhead. A stainless steel compression fitting to NPT pipe thread adaptor will be used to transition the tubing to the sparge point.

Each of the 20 ozone injection points will be constructed of a 1-foot long, 1¼-inch-diameter stainless steel pre-packed injection well, as manufactured by Johnson Watermark, or equal. Injection wells will be installed to approximately 22 feet below grade. From each injection well, ½-inch I.D. Teflon tubing will be piped to the 15-inch round road box at the surface. Inside the road box, the tubing will be capped in order to allow disconnection for testing or maintenance. The lines from the sparge manifold will tee into the injection well at 2 feet below grade. The borehole will be filled from the sparge point to 2 feet below the road box with bentonite to provide a vapor tight seal. The last two feet of the borehole will be filled with Portland cement. **Drawing D-1 - Well and Trenching Detail** provides a typical well construction detail.

Air flow from each SVE well will be collected by below-grade 2-inch-diameter PVC Schedule 80 piping, as shown in **Drawing Y-3 - Piping & Utility Trench Layout**. A 2-inch-diameter PVC Schedule 80 ball valve and 1/4-inch monitoring point will be installed in each line to allow the flow from each point to be adjusted, monitored, and sampled.

The 23 SVE wells will be 2-inch-diameter wells, depending on their proximity to the area of soils above the RAOs. All wells will be screened from approximately 8 to 14 feet below grade. The top of the screen will be just at the bottom of the dense clay layer (as determined in the field during installation), extending into the more permeable silty clays and sands. The purpose of the SVE wells are not to draw large volumes of air through the subsurface soils, but rather to capture small quantities of ozone migrating through the silty clays and sands, and remove them from the site for treatment. Wells will be sealed with bentonite from the top of the screen to the top of the dense clay layer to eliminate any vapor pathways in the dense clay layer, which is currently separating the lower silty clays and sands from the upper silty sands with gravel. **Drawing D-1 - Well and Trenching Detail** provides a typical well construction detail.

3.4 Underground Utilities and Other Obstructions

The primary utilities of concern in the area of the Osmose remediation project are the underground gas mains, water lines, and telephone lines located beneath the sidewalk on the west side of Ellicott Street. The approximate location of these gas, water, and telephone lines are shown on **Drawing Y-1 - Site Map** and **Drawing Y-2 - Ozone Injection System Layout.** Conversations with Jim Bubige of National Fuel Gas (phone: 716-857-7000; fax: 716-857-7469) indicated that there are both medium-density polyethylene and rubber-gasketed steel gas lines servicing the Osmose facility and nearby buildings.

A contractor certified to perform work on natural gas pipelines will be utilized to replace both the cast iron pipe and the polyethylene pipe in the vicinity of the ozonation system. Pipe will be replaced with Halar pipe which is compatible with both ozone and natural gas. Prior to the point where the Halar pipe transitions back to the original material of construction, a bentonite "plug" will be created in the trench to prevent ozone from migrating through the bedding material to unprotected sections of pipe. The sections to be replaced are shown in **Drawing Y-3, Piping & Utility Trench Layout**.

The contractor will replace or shield the water line and phone lines in the vicinity of the ozonation system. The replacement pipe or shielding material will be ozone compatible. The sections to be replaced or shielded are shown in **Drawing Y-3, Piping & Utility Trench Layout**.

The existing water supply line, gas line, and compressed oxygen line from the Osmose pilot plant to the existing equipment enclosure will not be replaced or shielded as they are above the clay layer which will prohibit migration of the ozone upward towards these utilities. These lines are only temporary, and are used solely by Osmose.

Additionally, an underground storm sewer line which connects the sewer collectors/manways is located on-site. The storm sewer is oriented west to east and connects into the BSA combined sewer system which exists beneath Ellicott Street. Monitoring of the manways for vapors will be required.

3.5 Permits and Approvals

3.5.1 Air Discharge Permit

Two point source discharges are associated with the ozone injection and treatment system. These include:

- Off-gas from the SVE system after treatment
- Air from the oxygen concentrator (Sieve banks)

The NYSDEC Region 9 Division of Air was contacted to determine air discharge permit requirements. Per written correspondence from Ms. Connie Laport, P.E., Division of Air Resources, (dated September 23, 1998) and consistent with 6NYCRR part 201-3.3(29), the project is exempt from formal air permitting requirements.

The off-gas from the SVE will be treated with CARULITE 200 Catalyst, or similar, to destroy potentially unreacted ozone. A flow rate of approximately 600 cfm is anticipated from this discharge point. Monitoring for ozone will occur during startup and operation as detailed in the O&M manual. VOCs are not anticipated, however monitoring during startup will occur as detailed in the O&M manual. If detected, the Industrial Source Complex Short Term Air model will be used to ensure that the operation of this system will not violate the NYSDEC's annual or short-term guidance values for ozone or VOCs.

Off-gas from the oxygen concentrator will consist primarily of nitrogen, and small quantities of inert gases remaining in the ambient air stream after the oxygen has been removed. A flow rate of approximately 45 cfm is anticipated from this discharge point. Air monitoring of this discharge point is not anticipated during O&M.

3.5.2

Osmose currently possesses a Temporary Discharge Permit from the Buffalo Sewer Authority to discharge wastewater from the current recovery/treatment system after treatment through three LGAC vessels in series (Permit No. 98-02-TP002). The permit limit on rate of discharge is 3..0 gpm. The proposed system is anticipated to discharge less than 1.5 gpm.

The Buffalo Sewer Authority (BSA) has been contacted to inform them of the addition of non-contact cooling water discharge stream. Although a recirculating chiller will be used to eliminate most of the cooling water discharge, it is possible that this cooling water may occasionally have to be discharged. Any water discharged will be sent first to the proposed influent oil-water separator, and will be treated by the existing tertiary activated carbon units prior to discharge. No additional permitting or permit modification is required by the BSA.

3.6 Construction Quality Assurance

A Construction Quality Assurance (CQA) Plan has been prepared to address quality assurance/quality control (QA/QC) procedures to be undertaken during the construction and installation of the proposed ozone treatment system.

The CQA Plan is included in **Appendix D**.

3.7 Health and Safety

Fluor Daniel GTI is wholly committed to safety for its workers, its clients, and the public. Fluor Daniel GTI will take every precaution to minimize exposure of potentially hazardous substances through every phase of the project. As stated above in **Section 1.3**, the existing site HASP, prepared in accordance with the Occupational Safety and Health Administration (OSHA) regulations set forth in 29 CFR 1910.120, has been amended to include the specific work tasks associated with the RD/RA, and is included in **Appendix A**.

4.0 CONSTRUCTION SEQUENCING AND SCHEDULE

4.1 Construction Timeline

A detailed RD/RA Timeline and Procurement and Construction Schedule is included as **Figure 4-1**. Pending the department's review and approval of the RD by December 22, 1998, utility coordination and equipment procurement will begin in December 1998 and January 1999, respectively. Subsurface installation is projected to begin in March, with abovegrade installation beginning in April 1999.

Submittal of the O&M manual is anticipated within 30 days of the completion of the construction activities **(Section 5.0, below)**. Step I, Step II, and Step III of the treatment system start-up will occur in conjunction with the O&M manual construction and submittal. No ozone will be injected until the department has approved the manual, with cold-startup and shakedown after the O&M Plan is approved by the NYSDEC.

Figure 4-2, RD/RA Project Timeline, provides a summary of the major tasked associated with the RD/RA along with projected completion dates.

5.0 OPERATION AND MAINTENANCE

As required in Section II, D (page 6) of the Order, a detailed Operation and Maintenance (O&M) and Monitoring Plan will be submitted within 90 days after completion of the construction activities identified in the Department-approved Remedial Design. Osmose anticipates, however, that the O&M manual will be submitted to the Department within 30 days of the completion of construction activities.

Additionally, "as-built" drawings and a final engineering report certifying that the Remedial Design was implemented in accordance with the plan will be submitted.

Presented below is an outline of the anticipated operation, monitoring, and maintenance tasks.

5.1 Startup

Startup will consist of four stages. The first stage consisting of startup of the LNAPL/ groundwater recovery system. Gauging of monitoring wells will occur to verify that the design drawdown has been achieved. The second stage will consist of a SVE area of influence test. Once verification that the number and spacing of VEPs is adequate, the third stage of the test will be performed. This third stage consists of the injection of an inert gas into the subsurface (with the SVE operational) to verify all vapors can be recovered. The final stage consists of the injection of ozone startup procedures will be detailed in the O&M manual. Daily site visits are anticipated during this fourth stage.

5.2 Operation, Maintenance, and Monitoring

It is anticipated that after startup, weekly to bi-monthly operation and maintenance visits will ensure that the remediation system operates safely and efficiently. Specific O&M requirements will be determined once equipment has been installed and the product literature can be incorporated. It is anticipated that O&M and monitoring tasks will include:

Weekly/Bi-weekly Visits

- Water Treatment
    - — Clean probes in oil-water separator.
    - — Record effluent totalizer reading.
    - — Record thickness of LNAPL, DNAPL, and water in the oil-water separator.
    - — Verify operation of each pump.

- SVE
  - — Record blower vacuum levels, before and after the filter, and on the manifold header.
  - — Change oil in blower every two months.
  - — Record air flow, percent ozone, CO_2, and PID measurements both before and after the ozone catalyst.

- Ozone System
  - — Record ozone generator amperage, voltage, and temperature.
  - — Record ozone discharge flow rate, pressure, and percent ozone.
  - — Record ambient oxygen/ozone meter reading.
  - — Verify cooling water temperature, flow rate, and storage level.
  - — Change oil in compressor every two months.
  - — Verify compressor oil/dust filter quality.
  - — Record oxygen separator operating pressure.

- Monitoring
  - — Collect indoor ozone monitoring logs from Osmose personnel
  - — Perform work area atmospheric monitoring
  - — Perform ozone, PID, and CO_2 headspace measurements at "indicator" wells
  - — Collect vacuum/pressure measurements at "indicator" wells

Monthly Visit
- All tasks in weekly/bi-weekly visit, plus:
- Water Treatment
  - — Sample effluent, between each carbon, and influent water streams for EPA Method 602 and EPA Method 8270
  - — Gauge "indicator" wells to ensure proper drawdown of groundwater table is being maintained

- SVE System
  - — Sample effluent via PID for total VOCs

- Ozonation System
  - — Sample soil gas points for ozone via Dräger tube and for natural gas via PID.
  - — Service oxygen/ozone ambient air monitor.
  - — Copy PLC data log to disk.

Quarterly Visit
- All tasks in monthly visit plus:

- Gauge and sample MW-16, MW-13 for EPA 602, EPA 8270, and headspace ozone via Dräger tube.

- Collect ambient ozone reading via Dräger tube at the corner of Ellicott and Edna street.

- Collect flow and ozone readings via Dräger tube from each SVE extraction manifold.

Monitoring of the sewer system which is located beneath Ellicott Streeter will also be conducted. Additionally, soil borings will be installed to collect soil samples for laboratory analysis to document the remediation process. Both of these programs will be detailed in the O&M manual.

The monitoring plan will also include a detailed groundwater sampling plan which will be used to measure the effectiveness of the remedial activities at the site, and monitor compliance at the three point-of-compliance monitoring wells identified in the feasibility study.

The project Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) will be updated to include the proposed scope of work and sampling activities. These documents will be included within the O&M manual.

6.0 REFERENCES

Superfund Remedial Design and Remedial Action Guidance; United States Environmental Protection Agency, Office of Emergency and Remedial Response, OSWER Directive 9355.0-4A, June 1986.

Ozone Injection Feasibility Study Report. Groundwater Technology, Inc.; April 5, 1994.

Supplemental Investigation (Phase II) Report. Groundwater Technology, Inc.; August 31, 1993.

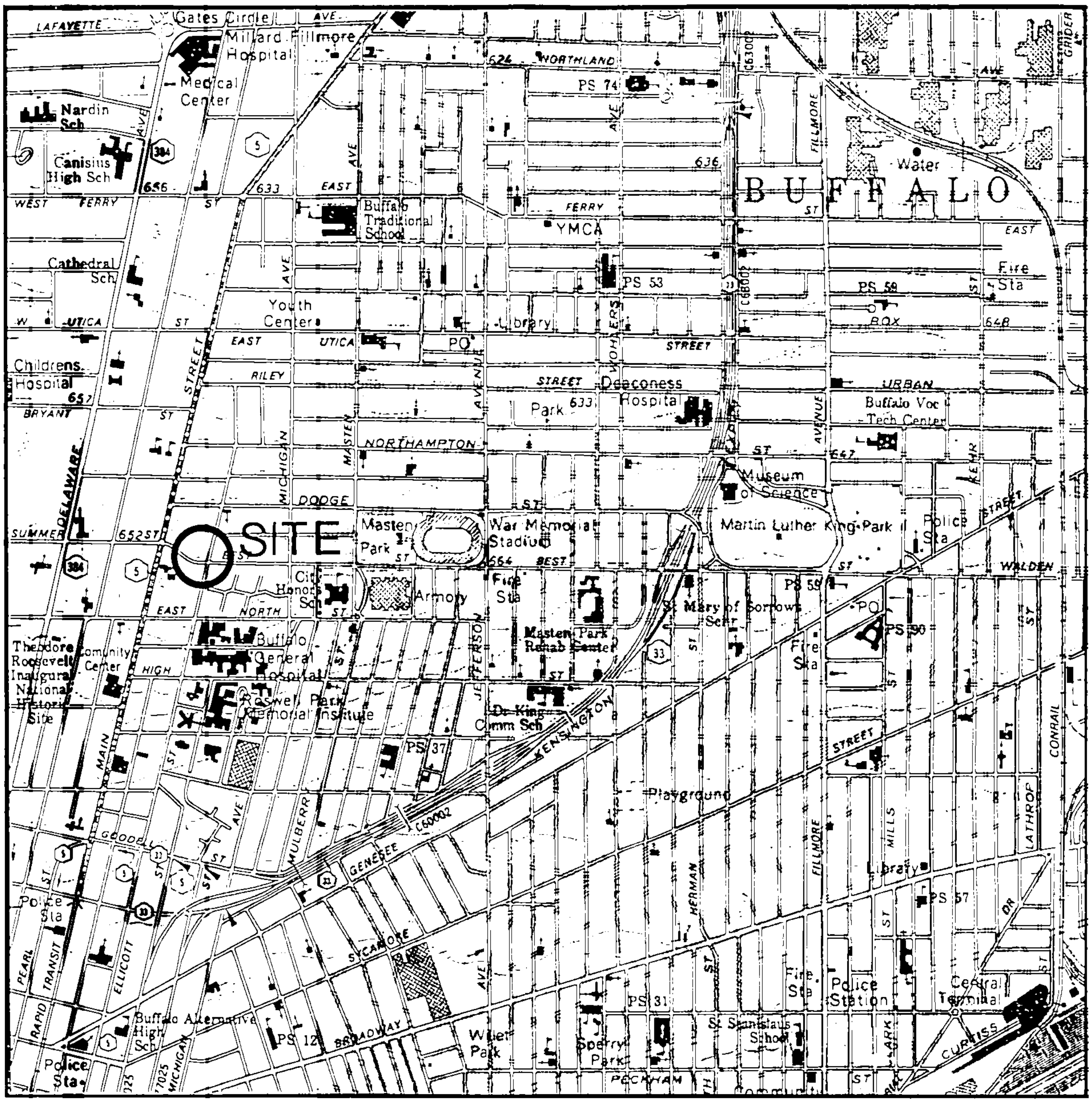
Record of Decision, Osmose Wood Preserving, Inc. Department of Environmental Conservation, Division of Environmental Remediation; January 1997.

Ozone Pilot Test Work Plan, Groundwater Technology, Inc.; September 25, 1992.

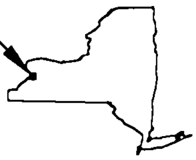
Proposed Remedial Action Plan, Osmose Wood Preserving, Inc., New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation; June 1996.

FIGURES

FIGURES



SOURCE: U.S.G.S. TOPOGRAPHIC QUADRANGLE
BUFFALO SE, NY QUADRANGLE
7.5 MINUTE SERIES
DATE: 1989



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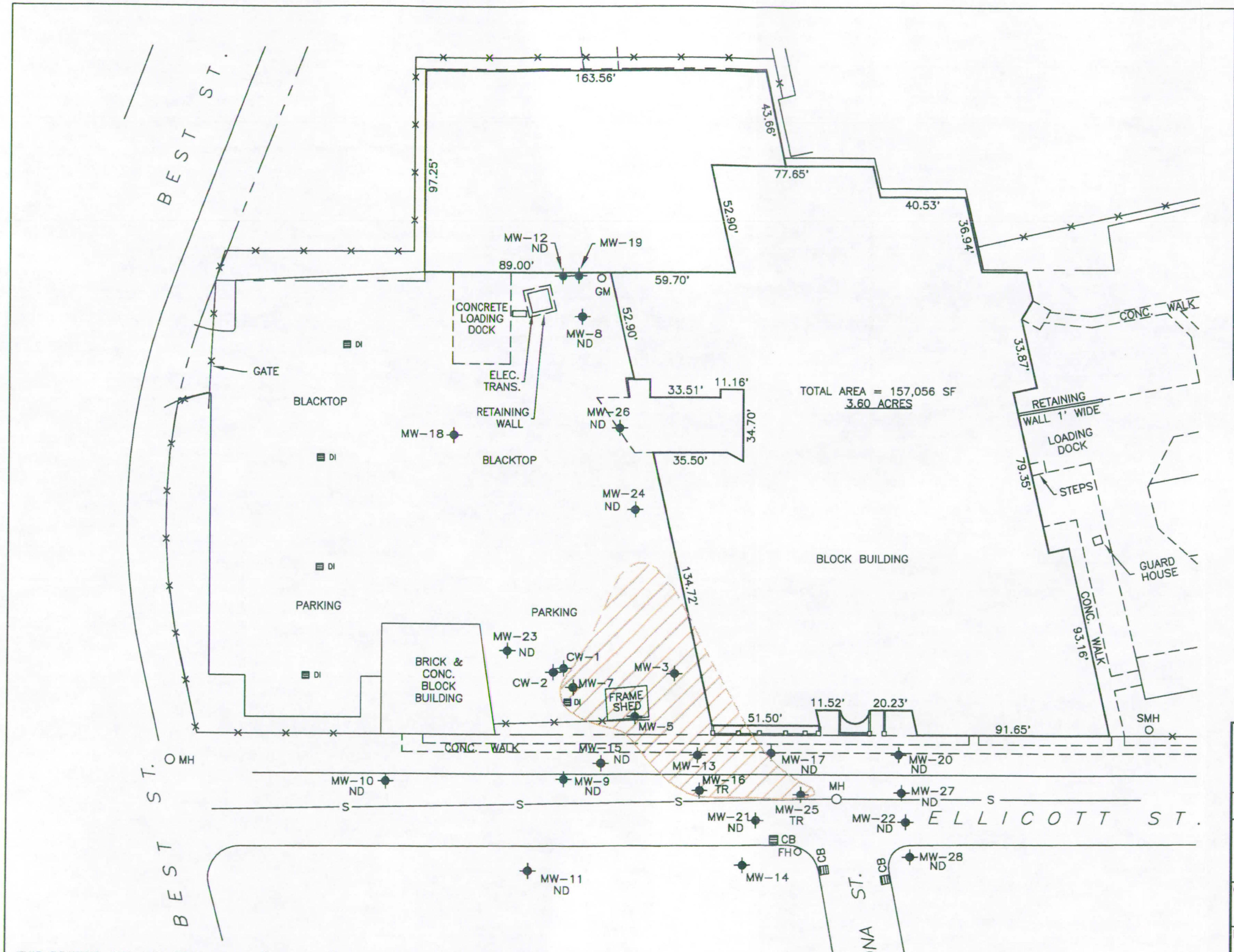
FLUOR DANIEL GTI

1245 KINGS ROAD
SCHENECTADY, NY 12303
(518) 370-5631

DESIGNED: GTK	**SITE LOCATION MAP**
DETAILED: SSH	CLIENT: OSMOSE WOOD PRESERVING, INC. — DRAWING DATE: 8/4/98
CHECKED:	LOCATION: 980 ELLICOTT STREET BUFFALO, NEW YORK — FIGURE: 1-1



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LEGEND

✦	MONITORING WELL
⊗	MONITORING POINT
⊙	SOIL BORING
O MH	MANHOLE
O FH	FIRE HYDRANT
—x—x—	FENCE
—S—	SEWER LINE
▨	APPROXIMATE EXTENT OF LNAPL
ND	NONE DETECTED

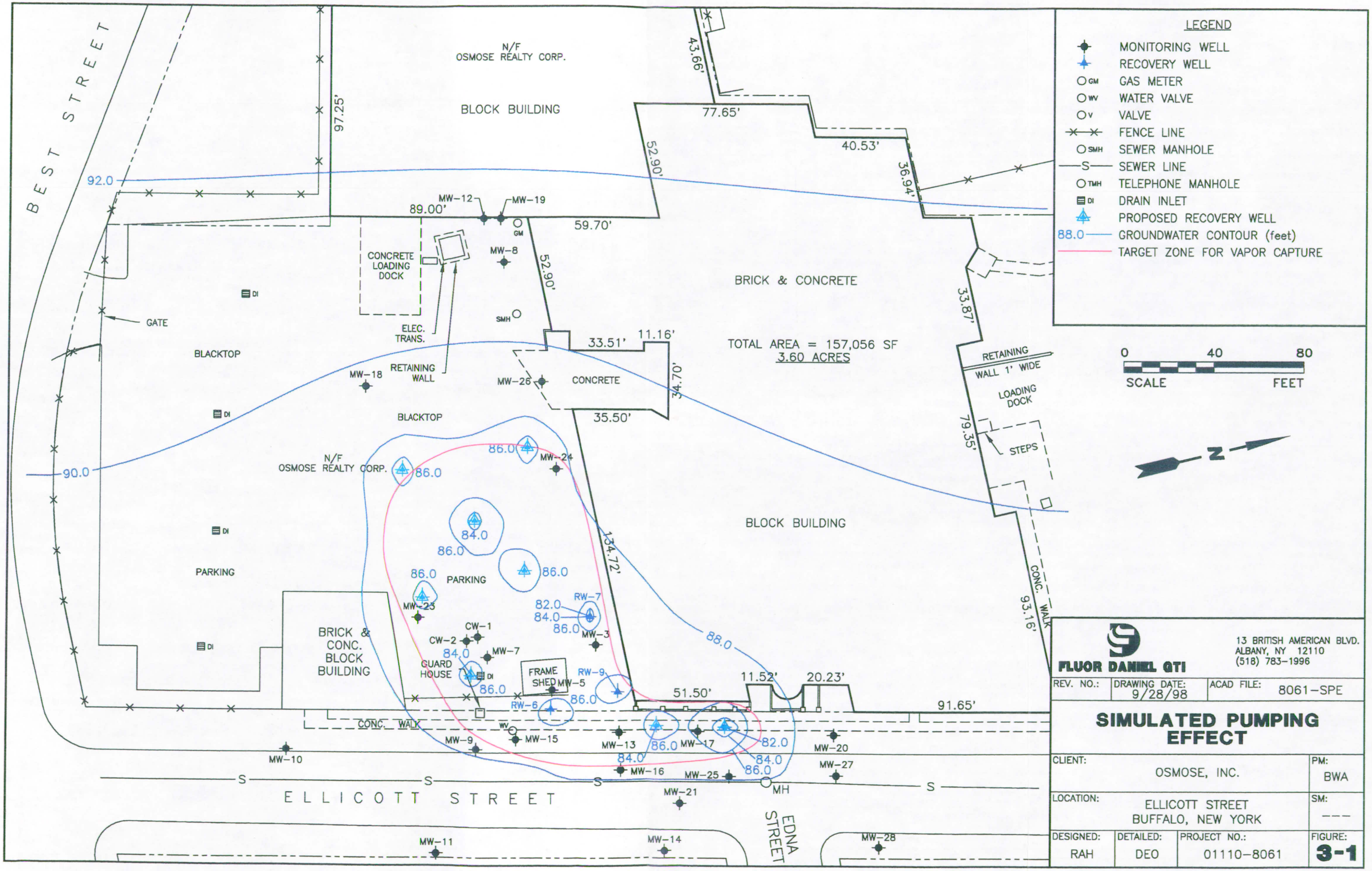
0 50 100
SCALE FEET

GT ENGINEERING
13 BRITISH AMERICAN BLVD.
ALBANY, NY 12110
(518) 783-1996

REV. NO.:
DRAWING DATE: 8/3/98
ACAD FILE: LNAPL

AREAL EXTENT OF LNAPL

CLIENT: OSMOSE, INC.
PM: BWA
LOCATION: ELLICOTT STREET BUFFALO, NEW YORK
SM: ---
DESIGNED: TPA
DETAILED: MET/DEO/SSH
PROJECT NO.: 01110-5307
FIGURE: **2-1**



FLUOR DANIEL GTI

13 BRITISH AMERICAN BLVD.
ALBANY, NY 12110
(518) 783-1996

REV. NO.:	DRAWING DATE: 9/28/98	ACAD FILE: 8061-SPE

SIMULATED PUMPING EFFECT

CLIENT:	OSMOSE, INC.	PM: BWA
LOCATION:	ELLICOTT STREET BUFFALO, NEW YORK	SM: ---

DESIGNED:	DETAILED:	PROJECT NO.:	FIGURE:
RAH	DEO	01110-8061	**3-1**

Figure 4-1

RD/RA PROCUREMENT &
CONSTRUCTION SCHEDULE

December 21, 1998
Rev R-1

Task Name	Start Date	Duration		End Date
FINAL (100%) DESIGN	5-Oct-98	53.0 d		21-Dec-98
DRAFT Design to NYSDEC	5-Oct-98	0.0		5-Oct-98
NYSDEC Review	6-Oct-98	22.0 d		5-Nov-98
Comments to Osmose	6-Nov-98	0.0		6-Nov-98
Incorporate NYSDEC Comments	9-Nov-98	9.0 d		20-Nov-98
FINAL Design to NYSDEC	23-Nov-98	0.0		23-Nov-98
NYSDEC Review of FINAL Design	23-Nov-98	20.0 d		21-Dec-98
NYSDEC Approval of Design	22-Dec-98	0.0		22-Dec-98
UTILITY COORDINATION	22-Dec-98	61.0 d		22-Mar-99
Off-Site Utilities Coordinatin	22-Dec-98	61.0 d		22-Mar-99
PROCUREMENT	11-Jan-99	49.0 d		22-Mar-99
Subcontractor Procurement	11-Jan-99	49.0 d		22-Mar-99
Develop Bidders List/Send RFPs	11-Jan-99	9.0 d		22-Jan-99
Pre-Bid Meeting	25-Jan-99	10.0 d		5-Feb-99
Bid Submittal	22-Jan-99	17.0 d		16-Feb-99
Review Bids/Select Contractors	16-Feb-99	10.0 d		1-Mar-99
Contract With Subs	2-Mar-99	15.0 d		22-Mar-99
Equipment Procurement	19-Jan-99	40.0 d		16-Mar-99
BSURFACE INSTALLATION	17-Mar-99	26.0 d		21-Apr-99
On-Site Utility Clearance	17-Mar-99	0.0		17-Mar-99
Install Air Sparge Wells	22-Mar-99	10.0 d		2-Apr-99
Install SVE Wells	22-Mar-99	10.0 d		2-Apr-99
Trenching/Piping Installation	5-Apr-99	13.0 d		21-Apr-99
Replace Off-site Gas Line	5-Apr-99	13.0 d		21-Apr-99
Replace On-site Gas Line	5-Apr-99	13.0 d		21-Apr-99
Shield Telephone Line	5-Apr-99	13.0 d		21-Apr-99
Iinstall System Piping	5-Apr-99	13.0 d		21-Apr-99
Construction QA/QC	5-Apr-99	13.0 d		21-Apr-99
ABOVEGRADE CONSTRCTON/INSTALL	22-Apr-99	24.0 d		25-May-99
Construct Equipment Enclosure	22-Apr-99	15.0 d		12-May-99
Equipment Installation	5-May-99	15.0 d		25-May-99
Construction QA/QC	5-May-99	15.0 d		25-May-99
Electrical Installation	12-May-99	10.0 d		25-May-99
O&M MANUAL	5-May-99	35.0 d		23-Jun-99
Preparation of Manual	5-May-99	35.0 d		23-Jun-99
Submittal to NYSDEC	23-Jun-99	0.0		23-Jun-99
START-UP	25-May-99	54.0 d		10-Aug-99
Step I- Dewatering	25-May-99	20.0 d		22-Jun-99
Step II- SVE Testing	23-Jun-99	10.0 d		7-Jul-99
Step III- Helium Injection	7-Jul-99	10.0 d		20-Jul-99
tep IV- Ozone Injection	21-Jul-99	15.0 d		10-Aug-99

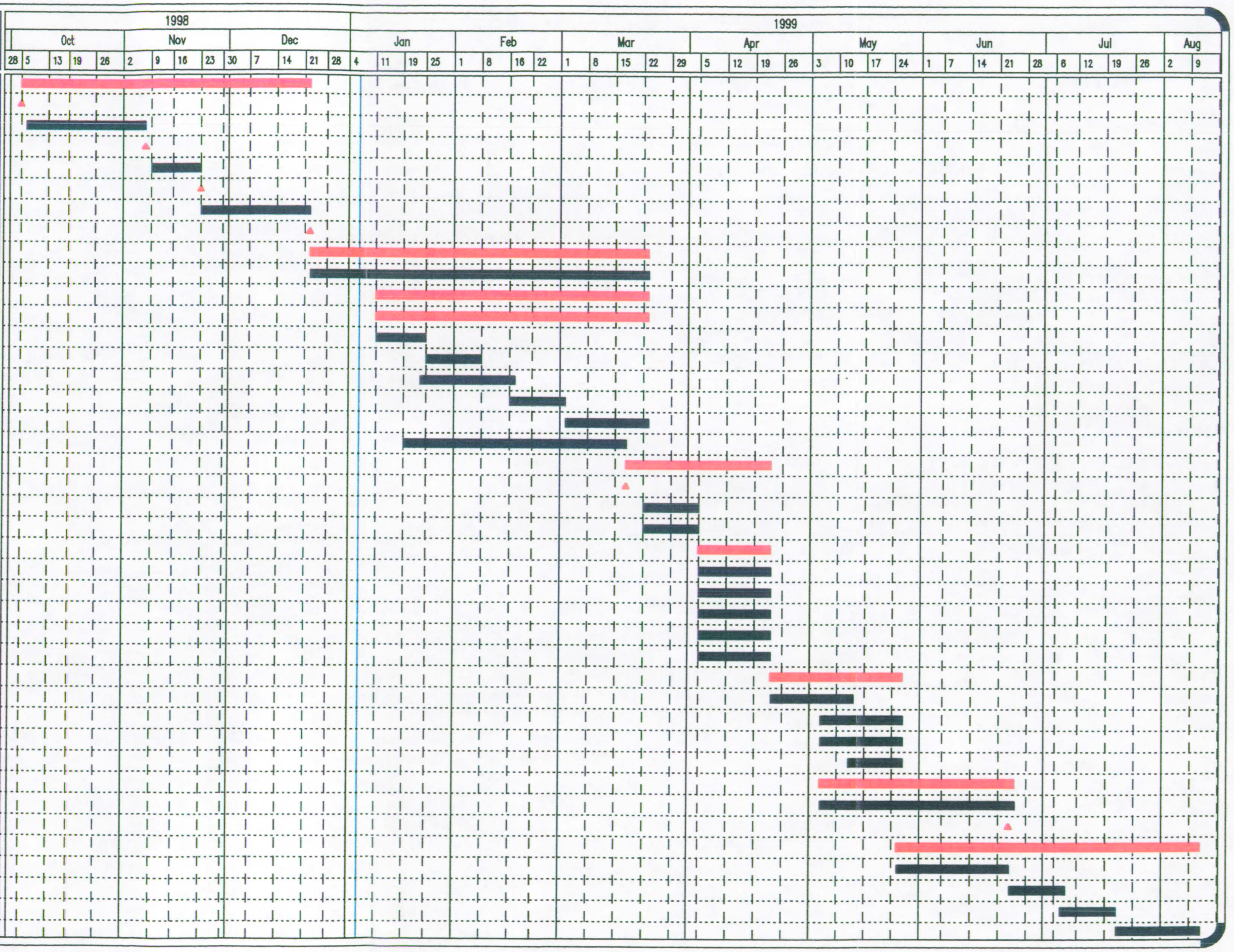
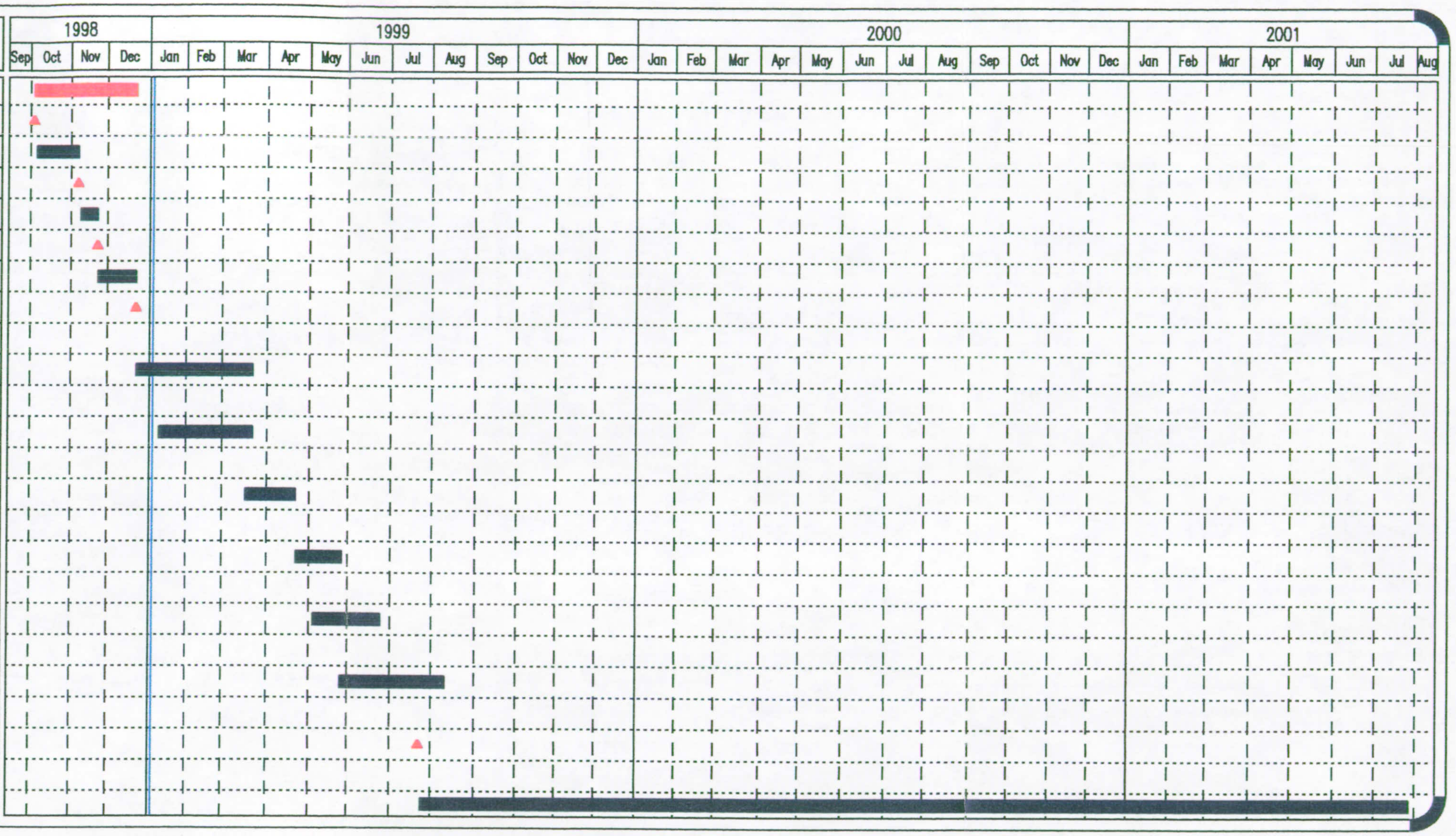


Figure 4–2

December 21, 1998
Rev R–0

RD/RA PROJECT TIMELINE

Task Name	Start Date	Duration		End Date
FINAL (100%) DESIGN	5–Oct–98	53.0 d		21–Dec–98
DRAFT Design to NYSDEC	5–Oct–98	0.0		5–Oct–98
NYSDEC Review	6–Oct–98	22.0 d		5–Nov–98
Comments to Osmose	6–Nov–98	0.0		6–Nov–98
Incorporate NYSDEC Comments	9–Nov–98	9.0 d		20–Nov–98
FINAL Design to NYSDEC	23–Nov–98	0.0		23–Nov–98
NYSDEC Review of FINAL Design	23–Nov–98	20.0 d		21–Dec–98
NYSDEC Approval of Design	22–Dec–98	0.0		22–Dec–98
UTILITY COORDINATION	22–Dec–98	61.0 d		22–Mar–99
PROCUREMENT	11–Jan–99	49.0 d		22–Mar–99
SUBSURFACE INSTALLATION	17–Mar–99	26.0 d		21–Apr–99
OVEGRADE CONSTRCTON/INSTALL	22–Apr–99	24.0 d		25–May–99
O&M MANUAL	5–May–99	35.0 d		23–Jun–99
START–UP	25–May–99	54.0 d		10–Aug–99
NYSDEC APPROVAL OF O&M PLAN	23–Jul–99	0.0		23–Jul–99
OPERATION AND MAINTENANCE	26–Jul–99	504.0 d		26–Jul–01



DRAWINGS

A

APPENDIX A

HEALTH AND SAFETY PLAN

SAFETY - FIRST AND ALWAYS

APPENDIX A
HEALTH AND SAFETY PLAN

FOR SITE ACTIVITIES AT

OSMOSE, INC.
980 ELLICOTT STREET
BUFFALO, NEW YORK 14209
NYSDEC SITE # 915143

PROJECT NO. 01110-8061

Bruce W Ahrens
BRUCE W. AHRENS
SENIOR PROJECT MANAGER

John R Reinemann
JOHN R. REINEMANN, CIH
HEALTH AND SAFETY REPRESENTATIVE

The information in this HASP is provided solely for the protection of the health and safety of Fluor Daniel, GTI employees and subcontractors working under the direct supervision and control of Fluor Daniel, GTI on this project. Fluor Daniel, GTI assumes no liability for, or responsibility to, any other parties for the accuracy or completeness of the information contained herein for any use or reliance upon this HASP by any other party.

FLUOR DANIEL GTI

TABLE OF CONTENTS

TABLES

EXHIBITS

LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
BP	Breath pipe
BT	Body temperature
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
BWL	Body water loss
BWT	Body water temperature
CET	Certified Environmental Trainer
CFR	Code of Federal Regulations
CGI	Combustible gas indicator
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
COHN	Certified Occupational Health Nurse
CNS	Central nervous system
CPR	Cardio-pulmonary resuscitation
CRZ	Contaminant reduction zone
CSE	Confined space entry
CSP	Certified Safety Professional
CZ	Clean zone
DM	Dust-particulate monitor
DOT	Department of Transportation
DT	Detector tube
DZ	Decontamination zone
EKG	Electrocardiogram
EMR	Environmental Medical Resources
EMS	Emergency Medical Services
EPA	Environmental Protection Agency
EZ	Exclusion zone
FID	Flame ionization detector
FP	Flashpoint
GFCI	Ground fault circuit interrupter
GM	Geiger-Mueller
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HBV	Hepatitis B-virus
HEPA	High efficiency particulate air-purifying
HR	Heart rate
HSM	Health and Safety Manager
HSR	Health and Safety Representative
HSS	Health and Safety Specialist

LIST OF ACRONYMS (continued)

HVDPE	High vacuum dual-phase extraction
HZ	Hot zone
IDLH	Immediately dangerous to life or health
ILO	International Labor Organization
IP	Ionization potential
JSA	Job safety analysis
LEL	Lower explosive limit
LO/TO	Lockout/tagout
mg/M_3	Milligrams per cubic meter
mg/L	Milligrams per liter
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
N	NIDA drug screen
NA	Not available
NBR	Nitrile butyl rubber
NEC	National Electrical Code
NIDA	National Institution on Drug Abuse
NIOSH	National Institute for Occupational Safety and Health
NFPA	National Fire Prevention Association
NL	NIDA-like drug screen
NRR	Noise reduction rating
O_2	Oxygen
O_3	Ozone
OM	Operations Manager
OJT	On the job training
OT	Oral temperature
OSHA	Occupational Safety and Health Administration
PEL	Permissible exposure limit
PID	Photoionization detector
PIR	Preliminary incident report
PM	Project Manager
ppb	Parts per billion
PPE	Personal protective equipment
ppm	Parts per million
RB	Random breathalyser
RBP	Random breath pipe
RCRA	Resource Conservation and Recovery Act of 1976
REL	Recommended exposure limit
RN	Registered Nurse

LIST OF ACRONYMS (continued)

RR	Relative responses
RT	Random ten panel drug screen
SHSO	Site Health and Safety Officer
SLM	Sound level meter
SOW	Scope of work
SPL	Sound pressure level
STEL	Short-term exposure limit
SZ	Support zone
TLV	Threshold limit value
TP	Fluor Daniel GTI ten panel drug screen
TSF	Tons per square foot
TWA	8-hour time-weighted average
UEL	Upper explosive limit
ug/L	Micrograms per liter
UST	Underground storage tank
VP	Vapor pressure
WBGT	Wet bulb globe temperature

SITE EMERGENCY FORM

Chemicals of Concern: Polynuclear aromatic hydrocarbons (PAH) from Brushing Grade Creosote, volatile organic compounds (VOC) from No.2 Fuel Oil and ozone from remediation system.

Minimum Level of Protection: Level D

Hazard Determination: Serious_____ Moderate XXXXX Low_____

Do not endanger your own life. Survey the situation before taking any action.

Fluor Daniel GTI Office Telephone	518-783-1996
Site Location Address	980 Ellicott St., Buffalo, NY 14209
Telephone Located at	Osmose Facility

EMERGENCY PHONE NUMBERS

IN THE EVENT OF ANY EMERGENCY CONTACT PROJECT MANAGER (PM) OR HEALTH AND SAFETY REPRESENTATIVE

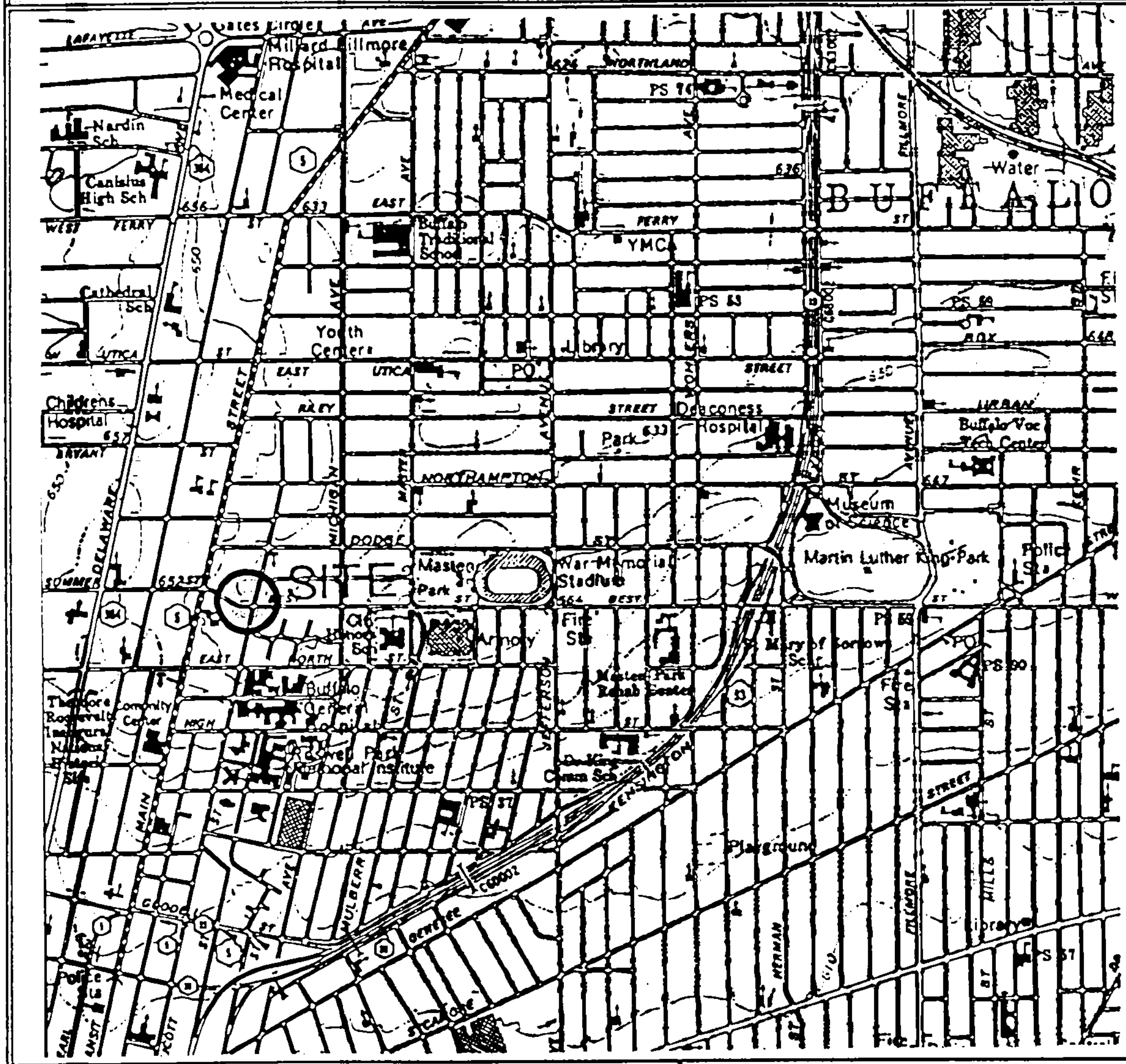
Ambulance	911
Fire	911
Police	911
Poison Control	716-878-7654
Hospital Name	Millard-Fillmore Hospital
Hospital Phone Number	716-887-4880
Project Manager	Bruce W. Ahrens, 518-783-1996
Site Safety Officer	To be announced
District Health and Safety Mgr.	John Reinemann, CIH, 518-783-1996
Client Contact	Michael E. Rider, 716-882-5905
NYSDEC	Region, 716-851-7220; 24 Hr Emergency, 800-457-7362

UTILITY MARKER EMERGENCY TELEPHONE NUMBERS

Utility	Color Code	Telephone Number
Water	Blue	800-962-7962 for all utilities
Gas	Yellow	
Electric	Red	
Telephone/Cable	Orange	
Sewer	Green	

Underground Facilities Protection Organization (UFPO) Telephone Number: 800-962-7962

HOSPITAL LOCATION MAP



HOSPITAL DIRECTIONS:
From the site, take Best St. west two blocks to the intersection of Delaware Avenue. Take a right (north) onto Delaware Avenue and go approximately five blocks to Gate Circle. The hospital is located on the right hand side at 3 Gate Circle.

HOSPITAL INFORMATION:

Name: Millard-Fillmore Hospital
Address: 3 Gate Circle
City, State Buffalo, NY

Phone: Emergency: 716-887-4880
General: 7165-887-4880

EMERGENCY FIRST AID

FIRST AID

Ingestion:	DO NOT INDUCE VOMITING. Call Poison Control - follow instructions. Administer cardiopulmonary resuscitation (CPR), if necessary. Seek medical attention.
Inhalation:	Remove person from contaminated environment. Administer CPR if necessary. Seek medical attention. DO NOT ENTER A CONFINED SPACE TO RESCUE SOMEONE WHO HAS BEEN OVERCOME UNLESS PROPERLY EQUIPPED AND A STANDBY PERSON IS PRESENT.
Skin Contact:	Brush off dry material, remove wet or contaminated clothing. Flush skin thoroughly with water. Seek medical attention if irritation persists.
Eye Contact:	Flush eyes with water for 15 minutes. Seek medical attention.
Exposure Symptoms:	Headache, dizziness, nausea, drowsiness, irritation of eyes, nose, throat, breathing difficulties.
Contingency Plan:	Report incident to PM and Health and Safety Specialist (HSS) after emergency procedures have been implemented.

RESPONDER MUST HAVE A CURRENT CERTIFICATE TO ADMINISTER FIRST AID OR CPR

1. Survey the situation. Do not endanger your own life. DO NOT ENTER A CONFINED SPACE TO RESCUE SOMEONE WHO HAS BEEN OVERCOME UNLESS PROPERLY EQUIPPED AND TRAINED. ENSURE ALL PROTOCOLS ARE FOLLOWED INCLUDING THAT A STANDBY PERSON IS PRESENT.

2. Call 911 (if available) or the fire department **IMMEDIATELY**. Explain the physical injury, chemical exposure, fire, or release.

3. Decontaminate the victim without delaying life-saving procedures.

4. If the victim's condition appears to be noncritical, but seems to be more severe than minor cuts, he/she should be transported to the nearest hospital by trained Emergency Medical Services (EMS) personnel: let the doctor assume the responsibility for determining the severity of the injury. If the condition is obviously serious, EMS must transport the victim.

5. Notify the PM and the HSS. Complete the Fluor Daniel GTI Preliminary Incident Report (PIR) within 24 hours.

EMERGENCY FIRST AID PROCEDURES

To Stop Bleeding		CPR	
1.	Give medical statement.	1.	Give medical statement.
2.	Assure airway, breathing, circulation.	2.	Arousal: Check for consciousness.
3.	Use **DIRECT PRESSURE** over the wound with clean dressing or your hand (use nonpermeable gloves). Direct pressure will control most bleeding.	3.	Open airway with chin-lift.
4.	Bleeding from an artery or several injury sites may require **DIRECT PRESSURE** on a **PRESSURE POINT.** Use pressure points for 30 - 60 seconds to help control severe bleeding.	4.	Look. listen, and feel for breathing.
5.	Continue primary care and seek medical aid as needed.	5.	If breathing is absent, give 2 slow, full rescue breaths.
		6.	Check the pulse for 5 to 10 seconds.
		7.	If pulse is present, continue rescue breathing: **1 breath every 5 seconds**.
		8.	If pulse is absent, initiate CPR; 15 compressions for each two breaths.

1.0 INTRODUCTION

Osmose, Inc. (Osmose) has retained Fluor Daniel GTI, Inc. (Fluor Daniel GTI) to perform environmental services at the Osmose facility located at 980 Ellicott Street in Buffalo, New York. The Ellicott Street facility serves as the executive and accounting headquarters and also includes research and product production at the site. This facility manufactures a variety of preservatives used in the treatment of lumber and wood products.

This Health and Safety Plan (HASP) is a revision of the plan written October 9, 1992. This plan includes the same general information as the previous plan but format has been updated since the original version.

The Health and Safety Plan (HASP) is written to ensure the well-being of all field personnel and the community surrounding the site. Accordingly, project staff and approved Fluor Daniel GTI subcontractors must follow the policies and procedures established in the HASP. All Fluor Daniel GTI personnel and subcontractors assigned to this project must sign the Agreement and Acknowledgment Sheet (Exhibit B) to confirm that they understand and agree to abide by the provisions of the plan.

All work will comply with Fluor Daniel GTI health and safety guidelines in concurrence with all applicable sections of the Occupational Safety and Health Act (OSHA), 29 Code of Federal Regulations (CFR) 1910 and 1926; specifically 29 CFR 1910.120 and 1926.65 Standards, "Hazardous Waste Operations and Emergency Response," (29 CFR 1910.120) as well as other federal, state, and local regulations that require the development and implementation of a HASP. Generation of this document certifies that the workplace has been evaluated for the hazards as described. A hazard assessment has been performed and the adequacy of the personal protective equipment (PPE) selected is hereby certified per 29 CFR 1910.132(d) and is duly noted by the signature(s) and date appearing on the cover page of this document.

This HASP addresses the safety issues associated with the construction and operation of an ozone sparge, soil vapor extraction (SVE), and ground water recovery/treatment systems. The HASP addresses safety issues that may be associated with performing installation operation and maintenance on the remediation system over a projected one to two year period. The HASP addresses site and surrounding property safety. Preliminary design on remediation systems has been completed. This HASP has been prepared in conjunction with and submitted as part of, the final remedial design. The remediation systems are expected tol be procured and installed in a November 1998 through January, 1999 time frame. In general, the work to be performed involves the following site tasks:

- Excavation and trenching;
- Upgrading of an existing LNAPL recovery system;
- Installation of a soil vapor extraction system;
- Installation of a vapor treatment system;

- Installation of ozone generating equipment;
- Installation of an ozone sparging system;
- Performing equipment operation and maintenance including lockout/tagout;
- Gauging existing monitoring wells;
- Sampling existing monitoring wells; and,
- Abandonment of wells.

The minimum level of protection for this site is Level D. For each task, the potential hazards for employee exposure to site chemicals and/or air monitoring results, will determine the level of protection. Modified Level D will be worn during tasks that may have the potential for skin contact with impacted media (soil or water). Upgrade to Level C and/or B will occur when the possibility of exposure exists from the onset of site-specific tasks or results of real-time monitoring exceed established action levels listed in Table 7, Air Monitoring Action Levels. This HASP must be modified or amended when circumstances or conditions develop that are beyond the scope of this plan.

Any changes in project work scope and/or site conditions as described must be amended in writing by the Health and Safety Representative (HSR) on the HASP Amendment Sheet (Exhibit A).

Table 1, Responsibilities of On-Site Personnel, lists those accountable and responsible for the implementation of the HASP. Table 2, Hazard Analysis Matrix, presents an overview of site-specific job tasks and the associated hazards. Table 3, Chemicals of Concern Profile presents an overview of the hazards and control measures associated with the site chemicals of concern. Lastly, Table 4, presents an overview of the Fluor Daniel GTI health and safety programs in which all field personnel are required to participate. These include the medical surveillance and comprehensive training programs in accordance with OSHA Hazardous Waste Operations and Emergency Response standard, 29 CFR 1910.120.

1.1 Site Description/Background Information

The Osmose site is located on the corner of Best Street and Ellicott Street. Soil in one area of the site possesses elevated concentrations of PAHs from historic releases of brushing grade creosote and VOCs associated with No. 2 fuel oil. PAHs have been detected in soils at levels up to 650 mg/kg (ppm). VOCs in soil have ranged from non-detectable to 9.1 mg/kg. The maximum level of dissolved VOCs in groundwater was 2.2 milligram/liter (mg/l) and the maximum level of PAHs in groundwater was 12 mg/l (or ppm).

Laboratory and field treatability studies have indicated that PAHs may be degraded in situ through injection of ozone into the subsurface. Fluor Daniel GTI or its subcontractors will conduct installation and operation of an ozone injection/SVE treatment system as required by the New York State

Department of Environmental Conservation's (NYSDEC) Record of Decision (ROD) and as specified in the final design.

1.2 Project Personnel and Responsibilities

Fluor Daniel GTI will oversee and act accordingly during all phases of the project. The following management structure will be instituted for the purpose of successfully and safely completing this project.

Technical Advisors

John Reinemann, CIH District Health and Safety Manager	Fluor Daniel GTI, Albany, NY	(518) 783-1996
David Crowley, CSP, CET, CHMM Fluor Daniel GTI, Norwood, MA		(781) 769-7600

The specific duties of the technical advisors include:

- providing technical input into the design and implementation of the site HASP,
- advising on potential for worker exposure to project hazards along with appropriate methods and/or controls to eliminate site hazards.

A site health and safety officer (SHSO) will be assigned on a full time basis during site activities and shall assist and represent the Health and Safety Manager (HSM). The SHSO shall have the responsibility and authority to implement and enforce the approved HASP; this includes modifying/halting work, and removal of personnel from the site if work conditions change and effect on-site/off-site health and safety matters. The SHSO will serve as the main contact for any on-site emergency situation.

Table 1. Responsibilities of On-Site Personnel

Table 1. Responsibilities of On-Site Personnel (continued)

Title	General Description	Responsibilities
Project Manager (PM) Bruce Ahrens	Reports to upper-level management. Has authority to direct response operations. Assume total control over site activities.	■ Prepares and organizes background review of the project, the work plan, the HASP, and the field team. ■ Obtains permission for site access and coordinates activities with appropriate officials. ■ Sees that the work plan is properly carried out and on schedule. ■ Briefs the field personnel on specific assignments. ■ Together with the SHSO sees that health and safety requirements are met. ■ Prepares final report and follow up on Preliminary Incident Report (PIR) events.
SHSO To be assigned	Advises the PM on all aspects of health and safety on site. Stops work if site operations threaten worker or public health and safety. Informs health and safety specialist of any changes in site conditions or project status.	■ Periodically inspects protective clothing and equipment. ■ Sees that protective clothing and equipment are properly stored and maintained. ■ Controls entry and exit at the access control points. ■ Monitors the workers for signs of stress, including heat stress, cold exposure, and fatigue. ■ Implements the HASP. ■ Conducts periodic inspections to assess whether the HASP is being followed. ■ Enforces the "buddy" system. ■ Informed of emergency procedures, evacuation routes, and telephone number of local hospital, poison control center, fire department, and police department. ■ Notifies, when necessary, local public emergency officials. ■ Submits PIRs promptly to site supervisor and PM. ■ Maintains communication with health and safety representative on site activities.

Table 1. Responsibilities of On-Site Personnel (continued)

Title	General Description	Responsibilities
SHSO (continued)		■ Coordinates emergency medical care. ■ Sets up decontamination lines and decontamination solutions appropriate for the chemical contaminants encountered. ■ Controls the decontamination of equipment, personnel, and samples from contaminated areas. ■ Facilitates the proper disposal of contaminated clothing and materials. ■ Maintains the availability of required equipment. ■ Advises Fluor Daniel GTI Technology health services and medical personnel of potential exposures. ■ Notifies emergency response personnel in the event of an emergency. ■ Maintains and oversees operation of monitoring equipment and interpretation of data from the monitoring equipment.
Project Supervisor To be assigned	Reports to PM. Has authority to direct response operations. Assumes total control over site activities.	■ Conducts Daily Safety Tailgate Meeting and documents attendance (Exhibit M). ■ Conducts periodic field health and safety inspections (Exhibit L). ■ Manages field operations. ■ Executes the work plan and schedule. ■ Enforces safety procedures. ■ Coordinates with the SHSO in enforcing worker protection levels. ■ Enforces site control. ■ Documents field activities and sample collection. ■ Notifies when necessary, local public emergency officials. ■ Submits PIRS and initiates follow up with PM and SHSO.
Work Team	Reports to project supervisor for on-site activities. Work parties must comprise at least two people for high hazard operations.	■ Safely completes on-site tasks required to fulfill the work plan. ■ Complies with the HASP. ■ Attends and participates in Daily Safety Tailgate Meetings. ■ Notifies SHSO or supervisor of suspected unsafe conditions. ■ Submits PIRs to SHSO and Project Supervisor.

1.3 Hazard Analysis and Site-Specific Health and Safety Program Requirements

Site-specific job tasks and the associated hazards are identified in Table 2, Hazard Analysis Matrix. For each task involved with the project are the type of hazards that may be encountered. Utilize the hazard analysis table as a guide for implementing specific health and safety programs. Table 5, Potential Hazards and Controls provide guidelines to follow when conducting the tasks involved with this project.

Table 2. Hazard Analysis Matrix

Hazards	Tasks						
	Excavate and Trench Work	Upgrade LNAPL Recov. System	Install Vapor Treat. And Extr. Systems	Coll. Envir. Samples	Air Sparging	Gauge/ Aband. Wells	System O & M/ LOTO
Chemicals of Concern Exposure	X		X	X	X	X	X
OSHA Chemicals Exposure	X	X	X	X	X	X	X
Mechanical Equipment/ Construction	X	X	X		X		X
Electrical	X	X	X		X		X
Fire and Explosion	X	X	X	X	X		X
Heat/Cold Stress	X	X	X	X	X	X	X
Vehicular Traffic	X		X	X		X	X
Pedestrian Traffic	X					X	
Overhead Utilities	X		X	X			
Underground Utilities	X	X	X			X	
Noise	X	X	X		X		X
Confined Space Entry (CSE)			X	X			
Poisonous Plants							
Snakes/Spiders/ Insects	X	X	X	X		X	X

Site-Specific Health and Safety Program Requirements

Based upon the site-specific hazard analysis, the following programs must be implemented and the accompanying forms, found in the Exhibits section of the HASP, completed. The completed forms can then be attached to this document.

SITE-SPECIFIC PROGRAM	HASP EXHIBIT
Air Monitoring Program	E
Noise Monitoring Program	E
Site-Specific Lockout/Tagout (LO/TO) Procedures	C
Excavation/Trenching	F
Underground Utility Contact Prevention and Management Plan	F
Heat/Cold Stress Procedure	I
Hot Work Permit	H
Daily Safety Tailgate Meeting	M

1.4 Chemicals of Concern Profile

Based upon data obtained from the background information, site history, and site characterization a summary profile of the hazards and control measures to follow for the chemicals of concern is presented. Summarized in Table 3, the profile provides an overview of the hazards associated with potential exposure to the chemicals of concern and the preventative measures. For more detailed and specific information, always refer to the Material Safety Data Sheet (MSDS) or equivalent information for the compound located in Exhibit D.

Table 3. Chemicals of Concern Profile

Chemical of Concern	Profile of Hazards and Control Measures to Follow
No. 2 Fuel Oil	Contains a mixture of petroleum hydrocarbons including paraffinic, olefinic, naphthenic and aromatic hydrocarbons including less than 100 ppm benzene, a human carcinogen. A flammable liquid. A skin irritant and central nervous system (CNS) depressant. Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness. Primary target organs include the CNS, skin and mucous membranes. Excessive contact with skin may cause dermatitis. Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety. Wear protective eyeglasses and gloves when handling. No OSHA permissible exposure limit (PEL) has been established. However, benzene, a minor contaminant, has a PEL of 1.0 ppm. See generic MSDS in Exhibit D for additional hazards and control measures.

Chemical of Concern	Profile of Hazards and Control Measures to Follow
Brushing Grade Creosote	Contains coal tar pitch volatiles, a human carcinogen. Combustible liquid. Toxic by inhalation, ingestion, and skin contact. OSHA PEL is 0.2 mg/M3. Photosensitization from skin contact can occur. Coal tars contain a variety of polynuclear aromatic hydrocarbons such as benzo[a]pyrene, benzanthracene, and other polycyclic compound derivatives. Effects of overexposure includes skin irritation, dermatitis, skin cancer. Target organs include eyes, skin, bladder, kidneys and respiratory system. Avoid ingestion. Systemic absorption by any route may cause trouble breathing, thready pulse, dizziness, headache, nausea, vomiting, salivation and convulsions. Exposure to large doses may be fatal. Wear chemical impervious gloves and coveralls when handling in addition to other PPE specified in the HASP or on the MSDS. See the attached MSDSs for brushing grade creosote, coal tar, and other polycyclic aromatic hydrocarbons located in Exhibit D for additional information on hazards and control measures to follow.
Ozone (Treatment Chemical)	Powerful oxidizing agent. Highly chemically reactive and extremely shock sensitive as a liquid or solid. Inhalation produces various degrees of respiratory effects from irritation to pulmonary edema as well as affecting the eyes, blood, and CNS. Ozone accelerates decomposition of rubber and reacts with non-saturated organic compounds to produce ozonides which are unstable and may decompose with explosive violence. Not readily water soluble so inhalation of gas will irritate the bronchioles and alveoli of the lungs. Inhalation can cause nose, throat, and respiratory tract irritation, cough, difficulty breathing, visual disturbances, watering eyes, headache, decreased pulse rate with a fall in blood pressure, incoordination, chest pain, substernal soreness, and fatigue. Acute inhalation exposure has resulted in reproductive effects, blood changes and chromosomal changes. Inhalation of around 2 ppm caused watering eyes, decreased pulse rate, drop in blood pressure and coughing. Exposure to 1 ppm has resulted in coughing and difficulty breathing. (see attached MSDS). Repeated exposure may cause breathing disorders though respiratory tract scarring or premature aging. OSHA PEL is 0.1 ppm; IDLH is 10 ppm. NIOSH and ACGIH recommend a ceiling concentration of 0.1 ppm. Odor threshold ranges between 0.0076 and 0.25 ppm. A bluish gas with a pungent, bleach-like odor. See attached MSDS in Exhibit D for additional hazards information and special protection data and special precautions to follow.

Table 4. Fluor Daniel GTI Health and Safety Training Programs

Training Program	Requirement/Action
■ Specific training program requirements are described in Fluor Daniel GTI's Health and Safety Procedure Manual, Policy and Procedure #8, "Safety Training." ■ Training requirements and programs comply with the OSHA Hazardous Waste Operations and Emergency Response standard, 29 CFR 1910.120.	■ Field personnel must complete a minimum of 40 hours of hazardous waste activity instruction. ■ Field personnel must complete a minimum of 3 days supervised field instruction. ■ Field personnel assigned to the site will also receive 8 hours of refresher training each year. ■ On-site managers and supervisors directly responsible for employees engaged in hazardous waste operations receive an additional 8 hours of supervisory training. ■ Field personnel assigned to site also receive first aid/Cardio-pulmonary resuscitation (CPR) and blood borne pathogen training. ■ Field personnel and subcontractors assigned to site must participate in "Daily Safety Tailgate Meeting" and document their attendance.
■ Regulatory compliance training for excavation/trenching operations meet requirements outlined in 29 CFR 1926, Subpart P.	■ On-site managers and supervisors directly responsible for employees engaged in excavation/trenching operations receive the Fluor Daniel GTI 4-hour " Regulatory Compliance Training Seminar."
■ Authorized supervisor, attendant, and entrant training for permit required confined space entry meet requirements outlined in 29 CFR 1910.146.	■ Field personnel assigned to site who must supervise, watch over and/or enter permit required confined spaces receive the Fluor Daniel GTI 8-hour (or equivalent) "Confined Space Entry" course.
■ Fall protection training that meets requirements in 29 CFR 1926.503	■ Field personnel assigned to site who must work in areas with fall hazards six feet or greater must receive the Fluor Daniel GTI 2-hour "Fall Protection" course.
■ Fluor Daniel GTI requirement for removing underground storage tanks (UST).	■ Field personnel assigned to site who are tasked with the assessment and removal of USTs must complete the 4-hour Fluor Daniel GTI "Underground Storage Tank Removal" course.

Training Program	Requirement/Action
■ Orientation of plant operations, hazards, safe work practices, and emergency procedures to follow that meets the requirements of the OSHA Process Safety Standard, 29 CFR 1910.119.	■ Project personnel who are on the project site that falls under the Process Safety Standard will receive orientation by a company representative.

2.0 HAZARD IDENTIFICATION AND CONTROL

Based upon the hazard analysis of the tasks that will be conducted for the project, Table 5 lists the general procedures and practices to follow to prevent injury or illness. Appropriate training for specific hazards must be completed by field personnel prior to initiating work activities. Precautions must be taken to prevent injuries and exposures to the following potential hazards. For additional information, refer to the Fluor Daniel Health and Safety Policies and Procedures, or consult with your health and safety professional.

Table 5. Potential Hazards and Control

Potential Hazard	Control
Exposure to Chemical Products (See Exhibit D: MSDS Definitions and MSDSs)	1. Stand up-wind of chemical products whenever possible. 2. Minimize direct contact and contact time with contaminated media to prevent exposure. 3. Avoid walking through discolored areas, puddles, leaning on drums, or contacting anything that is likely to be contaminated, unless wearing the appropriate PPE. 4. Do not eat, drink, smoke and/or apply cosmetics in the hot or warm zones. 5. Wear appropriate PPE when it is required to come in contact with contaminated media or surfaces. 6. Level D PPE must be worn as a minimum when on project site. 7. > 2 parts per million (ppm) organic vapors, sustained for 5 minutes, in breathing zone requires monitoring for benzene using colorimetric indicator tubes; Benzene concentrations above 0.5 ppm requires an upgrade to Level C. 8. 20 ppm to 100 ppm organic vapors, sustained for 5 minutes, in breathing zone requires upgrade from Level D to Level C. 9. > 100 ppm organic vapors, or if unknown materials are encountered, call the HSR.

Table 5. Potential Hazards and Control (continued)

Potential Hazard	Control
Exposure to OSHA Defined Hazardous Materials (See Exhibit D: MSDS Definitions and MSDSs)	1. All chemicals brought on-site by Fluor Daniel GTI personnel or their subcontractors, such as pipe glues, solvents, reagents, decontamination solutions, or any other OSHA defined hazardous material must be adequately labeled and the MSDSs available on-site. 2. MSDSs brought on-site can be attached in Appendix D or in the MSDS binder that is kept in the company vehicle. 3. Training on OSHA defined hazardous materials must be completed and documented. Use the Daily Safety Tailgate Meeting Form in Exhibit M to record training attendance.
Erecting Temporary Structure or Working From Aerial Lift	1. Wear leather gloves while attaching support members to protect against pinching injuries. 2. While working from elevated levels greater than 6 feet, ensure that all employees have 100% fall protection with full body harnesses and guardrails. 3. Do not stand under loads that are being raised or lowered with cranes or aerial lifts. 4. Conduct pre-operational inspection of aerial lifts to include: tire air pressure, hydraulic fuel level and pressure check, make sure pivot pins are secured, check hoses for worn areas, check for cracks or deviations in welded parts, the safety limit switch should work freely, security of the guardrail system on the platform, check both ground and platform control functions, raise and lower each boom system separately, listen for any unusual noises, vibrations, or uneven operations. 5. Maintain a safe distance of 20 feet from unguarded overhead power lines. 6. Conduct site evaluation to determine proper positioning for the unit. Make sure surface is level. Cordon off holes, drop-offs, bumps or weak ground surfaces. 7. Never climb a raised platform or stand on the mid-rail or top-rail. 8. Tools should always be hung or put into a belt whenever possible.
Exposure to Surface/ Subsurface Airborne Dust in the Work Zone	1. Stand up-wind whenever intrusive activities occur and generate visible signs of airborne dust. 2. Monitor air for airborne soil dust (surface or subsurface soil) with portable aerosol dust-direct reading instrument. 3. >0.15 mg/M^3 above background in the breathing zone, sustained for 5 minutes, requires upgrade to Level C and use of dust suppression. 4. > 50 mg/M^3 in breathing zone requires upgrade to Level B. Approval for Level B must first be approved by HSR. 5. Utilize wet methods (spraying ground, wet drilling, etc.) when visible signs of airborne dust are generated. Reference NYSDEC TAGM-4031.

Table 5. Potential Hazards and Control (continued)

Potential Hazard	Control
Exposure to OSHA Defined Hazardous Materials (See Exhibit D: MSDS Definitions and MSDSs)	1. All chemicals brought on-site by Fluor Daniel GTI personnel or their subcontractors, such as pipe glues, solvents, reagents, decontamination solutions, or any other OSHA defined hazardous material must be adequately labeled and the MSDSs available on-site. 2. MSDSs brought on-site can be attached in Appendix D or in the MSDS binder that is kept in the company vehicle. 3. Training on OSHA defined hazardous materials must be completed and documented. Use the Daily Safety Tailgate Meeting Form in Exhibit M to record training attendance.
Erecting Temporary Structure or Working From Aerial Lift	1. Wear leather gloves while attaching support members to protect against pinching injuries. 2. While working from elevated levels greater than 6 feet, ensure that all employees have 100% fall protection with full body harnesses and guardrails. 3. Do not stand under loads that are being raised or lowered with cranes or aerial lifts. 4. Conduct pre-operational inspection of aerial lifts to include: tire air pressure, hydraulic fuel level and pressure check, make sure pivot pins are secured, check hoses for worn areas, check for cracks or deviations in welded parts, the safety limit switch should work freely, security of the guardrail system on the platform, check both ground and platform control functions, raise and lower each boom system separately, listen for any unusual noises, vibrations, or uneven operations. 5. Maintain a safe distance of 20 feet from unguarded overhead power lines. 6. Conduct site evaluation to determine proper positioning for the unit. Make sure surface is level. Cordon off holes, drop-offs, bumps or weak ground surfaces. 7. Never climb a raised platform or stand on the mid-rail or top-rail. 8. Tools should always be hung or put into a belt whenever possible.
Exposure to Surface/ Subsurface Airborne Dust in the Work Zone	1. Stand up-wind whenever intrusive activities occur and generate visible signs of airborne dust. 2. Monitor air for airborne soil dust (surface or subsurface soil) with portable aerosol dust-direct reading instrument. 3. >0.15 mg/M^3 above background in the breathing zone, sustained for 5 minutes, requires upgrade to Level C and use of dust suppression. 4. > 50 mg/M^3 in breathing zone requires upgrade to Level B. Approval for Level B must first be approved by HSR. 5. Utilize wet methods (spraying ground, wet drilling, etc.) when visible signs of airborne dust are generated. Reference NYSDEC TAGM-4031.

Table 5. Potential Hazards and Control (continued)

Potential Hazard	Control
Vehicular Traffic	1. Wear traffic safety vest when vehicle hazard exists. 2. Use cones, flags, barricades, and caution tape to define work area. 3. Use vehicle to block work area. 4. Engage police detail for high-traffic situations. 5. Refer to section 5.3 for specific details and guidance.
Fall Protection	1. Assess the work to determine if there is a potential for falling. 2. Make a determination of the distance of the potential fall. 3. A fall protection system must be used for potential falls greater than 6 feet. 4. Consult a competent person, such as the HSR, regarding the applicability requiring fall protection and what type of protection systems should be used. 5. Inspect all fall protection equipment and anchoring points prior to their use. 6. Ensure Fall Protection training for applicable employees is completed prior to initiating work activities.
CSE (Note: not anticipated for this work. However, these control measures must be used should confined space entry situations develop)	1. Ensure personnel assigned meet CSE training requirements. 2. Complete CSE Hazard Analysis Form in Exhibit G. 3. Complete CSE permit. Post sign. 4. Ensure pre-entry CSE safety meeting is conducted. 5. Remove vault cover using proper lifting techniques. 6. Promote natural ventilation by opening the space to fresh air, if needed utilize mechanical purge ventilation. 7. Conduct remote air monitoring prior to entry. 8. Attendant can act as CSE Supervisor and must be present at CSE entry point all times when entrant is in CSE. 9. Access work for fall hazards and ensure provisions for non-entry rescue have been met. 10. Enter only when safe; conduct continuous air monitoring.
Installation and Operation of Soil Vapor Extraction (SVE) System	1. Competent person must be present during excavation/trenching activities; follow procedures in Exhibit F. 2. SVE effluent pipe and galvanized steel SVE pipes from thermal SVE wells are "HOT" and must be labeled to prevent skin burns. 3. LO/TO points must be identified for blower motors and specific LO/TO procedures followed as listed in Exhibit C. 4. Monitor for benzene, phenol and ozone using colorimetric indicator tubes (low level) when possibility of exposure occurs such as during emission monitoring activities or system maintenance. Follow air monitoring schedule and action levels in Table 7 of this HASP.

Table 5. Potential Hazards and Control (continued)

Potential Hazard	Control
Upgrade, Operation, and Maintenance of High Vacuum Dual Phase Extraction (HVDPE) System	1. Competent person must be present during excavation/trenching activities. Follow procedures in Exhibit F. 2. Fall protection equipment (harness and lifeline) must be used during construction of remediation shed which will requires work above 6 feet in height. 3. LOTO points must be identified for vacuum motors and specific LOTO procedures followed as listed in Exhibit G. 4. Monitor for aromatic and chlorinated organic compounds with a photoiionization detector (PID) (10.2 and 11.7 eV lamp, respectively)/flame ionization detector (FID) when possibility of exposure occurs such as during emission monitoring or system maintenance activities. Follow air monitoring schedule and action levels listed in Table 7. 5. Conduct noise monitoring during HVDPE operation to determine hearing conservation program requirements. 6. Ensure product recovery vessels are labeled for hazard communication requirements..
Inclement Weather	1. Stop outdoor work during electrical storms and other extreme weather conditions such as extreme heat or cold temperatures. 2. Take cover indoors or in vehicle. 3. Listen to local forecasts for warnings about specific weather hazards such as tornados, hurricanes, and flash floods.
Utility Lines Contact	1. Contact Dig Safe to have utility lines marked prior to excavation/trenching 2. Refer to site drawings or customer interviews if on private property for utility locations. 3. Hand dig 3 to 5 feet down to avoid breaking utility lines. 4. Refer to Exhibit F for Underground Utility Contact Prevention Management Plan.
Noise	1. Wear hearing protection when equipment such as a drill rig, jackhammer, cut saw, air compressor, blower or other heavy equipment is operating on the site. 2. Wear hearing protection whenever you need to raise your voice above normal conversational speech due to a loud noise source; this much noise indicates the need for protection. 3. Hearing protection is required when measured sound pressure levels (SPL) exceed 85 dB(A) where employees stand or conduct work. 4. Conduct noise monitoring of suspected high noise operations at the beginning of the workday or start up of new operations to verify noise control/hearing protection requirements. 5. Refer to Section 3.2, Noise Monitoring for guidance.

Table 5. Potential Hazards and Control (continued)

Potential Hazard	Control
Electric Shock	1. Maintain appropriate distance from overhead utilities; **20-foot minimum clearance from power lines required; 10-foot minimum clearance from shielded power lines.** 2. Use ground-fault circuit interrupters as required. 3. Perform LO/TO procedures (Exhibit C). 4. Use three-pronged plugs and extension cords. 5. Contact your local underground utility-locating service. 6. Follow code requirements for electrical installations in hazardous locations.
Physical Injury	1. Wear hard hats and safety glasses when on-site. 2. Maintain visual contact with the equipment operator and wear orange safety vest when heavy equipment is used on-site. 3. Avoid loose-fitting clothing (driller and driller's helper). 4. Prevent slips, trips, and falls; keep work area uncluttered. 5. Keep your hands away from moving parts (i.e., augers). 6. Test the emergency shut-off switch on the drill rig daily.
Back Injury	1. Use a mechanical lifting device or a lifting aid where appropriate. 2. If you must lift, plan the lift before doing it. 3. Check your route for clearance. 4. Bend at the knees and use leg muscles when lifting. 5. Use the buddy system when lifting heavy or awkward objects. 6. Do not twist or jerk your body while lifting.
Heat Stress	1. Increase water intake while working. 2. Minimize and/or avoid alcohol intake the night before working in heat stress situations. 3. Increase number of rest breaks and/or rotate workers in shorter work shifts; take breaks in shaded areas. 4. Watch for signs and symptoms of heat exhaustion and fatigue. 5. Plan work for early morning or evening during hot months. 6. Use ice vests when necessary. 7. Rest in cool, dry areas. 8. In the event of heat stroke, bring the victim to a cool environment and initiate first aid procedures. Refer to Appendix I.
Cold Stress (For winter operations)	1. Take breaks in heated shelters when working in extremely cold temperatures. 2. Remove the outer layer of clothing and loosen other layers to promote evaporation of perspiration, upon entering the shelter. 3 Be aware of cold stress symptoms such as shivering, numbness in the extremities, and sluggishness. 4. Drink warm liquids to reduce the susceptibility to cold stress. Refer to Appendix I.

Table 5. Potential Hazards and Control (continued)

Potential Hazard	Control
High Crime Areas	1. Be aware of surroundings. 2. Use the buddy system. 3. Request police detail when appropriate.
Insects	1. Tuck pants into socks. 2. Wear long sleeves. 3. Use insect repellent. 4. Avoid contact by always looking ahead to where walking, standing, sitting, leaning, grabbing, lifting or reaching-in-to. 5. Check for signs of insect/spider bites, such as redness, swelling, and flu-like symptoms. 6. Use buddy system to check each other for signs of insect/spider bites. 7. Remove ticks immediately with fine tipped tweezers by grasping the tick as close to your skin as possible and gently pulling straight out. Do not squeeze the tick's body as this may inject fluids into you. Wash the bite area of skin and apply antiseptic.
Poisonous Plants (Such as Poison Ivy, Oak or Sumac)	1. Don't enter areas infested with poisonous plants. 2. Immediately wash any areas that come into contact with poisonous plants. 3. Protect exposed skin area with gloves and Tyvek® suits. 4. Be aware that the oil from the plant can be carried on boots, clothes and equipment. Always protect skin from contact. 5. If you have known or suspected allergies, carry an Epi-Pen at all times and notify co-workers that you are allergic.
Poisonous Snakes (If in areas of known habitat)	1. Avoid walking in areas where snake may nest or hide. Always look ahead to where walking for signs of snakes. 2. Use extreme caution when moving or lifting objects which could be used by snakes as cover. 3. Never reach under or behind objects or into other areas where snakes may hide. 4. Wear sturdy leather boots.
Ladders	1. Assess work areas for fall hazards. 2. Make sure ladder rungs are sturdy and free of cracks. 3. Use ladders with secure safety feet. 4. Pitch ladders at a 4:1 ratio. 5. Secure ladder at the top or have another person at the bottom to help stabilize it. 6. Do not use ladders for access to air stripper towers. 7. Use non-conductive ladders near electrical wires.

Table 5. Potential Hazards and Control (continued)

Potential Hazard	Control
Fire Control	1. Smoke only in designated areas. 2. Keep flammable liquids in closed containers. 3. Keep site clean; avoid accumulating combustible debris such as paper. 4. Follow Hot Work Safety Procedures when welding or performing other activities requiring an open flame. 5. Isolate flammable and combustible materials from ignition sources. 6. Ensure fire safety integrity of equipment installations.
Static Electricity	1. Do not create static discharge in flammable atmospheres. 2. Electrically bond and ground pumps transfer vessels, tanks, drums, bailers and probes, when moving liquids. 3. Electrically bond and ground vacuum trucks and the tanks they are emptying. 4. Do not splash fill containers with flammable liquids.
Rapid Response	1. Ensure emergency response activities have been completed prior to beginning rapid response field activities. 2. Conduct hazard assessment of project site and communicate findings through a "Daily Tailgate Safety Meeting" to all Fluor Daniel GTI employees and subcontractors prior to beginning rapid response field activities. 3. Communicate applicable Fluor Daniel GTI health and safety programs to other contractors on site that may be impacted and coordinate field activities with them.
Welding, Cutting, Brazing	1. Conduct fire safety evaluation. 2. Complete Hot Work Permit (Exhibit H). 3. Ensure flammable materials are protected from hot work, sources of ignition. 4. Ensure fire watch/fire extinguisher is on standby by hot work location.
Cleaning Equipment	1. Wear appropriate PPE to avoid skin and eye contact with isopropyl alcohol, alconox, or other cleaning materials. 2. Stand upwind to minimize any potential inhalation exposure. 3. Dispose of spent cleaning solutions and rinses accordingly.
Installation and Operation of Ozone Sparge System	1. Competent person must be persent during excavation/trenching actities. Follow procedures in Exhibit F. 2. Use hot work permit and procedures in Exhibit H when welding, cutting or torching. 3. Ensure ozone delivery piping system has been leak tested with helium prior to generationg ozone. 4. Conduct real time air monitoring for ozone during activites where employees are in close proximity to ozone generator or discharge points. Follow air monitoring guidelines and action levels in Table 7. 5. Review job safety analysis (JSA) listed in Exhibit J.

Potential Hazard	Control
First aid kit, blood borne pathogen kit, emergency eye wash/shower station, fire extinguisher and absorbent pads will be located on-site, either in the decontamination zone, or in the Fluor Daniel GTI company vehicle.	

3.0 AIR MONITORING AND NOISE MONITORING

3.1 Air Monitoring

Air monitoring must be performed on all sites in accordance with Fluor Daniel GTI practices. Organic vapor and/or concentrations are monitored in the field with a FID or PID with an 10.2 eV or 11.7 eV lamp. Flammable vapor and/or gas are monitored with an oxygen/combustimeter (O_2/LEL) real-time instrument. Airborne dust/particulate concentrations are measured with a real-time aerosol monitor (using a scattered light photometric sensing cell) when there are visible signs of airborne dust. Specific real-time air monitors, or colorimetric indicator tubes can be used for ozone and carbon monoxide monitoring during O_3 sparging or checking levels of excessive combustion engine exhaust, if a problem. Detector tube grab sampling is conducted for benzene and ozone, when results of non-specific real-time monitor action levels are reached or when their presence is suspected. Note that ozone has a relatively low odor threshold value (good warning properties). Both area and personal air monitoring readings are to be taken to characterize site activities. Air monitoring results must be documented on the Air Monitoring Form (Exhibit E).

ATTENTION:

SITE PERSONNEL ASSIGNED RESPONSIBILITY TO CONDUCT AIR MONITORING MUST HAVE BEEN TRAINED IN AIR MONITORING EQUIPMENT OPERATION AND CALIBRATION PRIOR TO ITS USE.

Calibration and maintenance of air monitoring equipment must follow manufacture specifications and be documented. Recalibration and adjustment of air monitoring equipment must be completed when site conditions and equipment operation reveal the need. Record all air monitoring equipment calibration and adjustment information on form in Exhibit E.

Air monitoring action levels (Table 7) have been developed by the Fluor Daniel GTI HSM, to indicate the chemical concentrations in the breathing zone that require an upgrade in level of PPE. Action levels are typically set at either one-half the OSHA Permissible Exposure Limit (PEL), National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL), or the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV). Rationale for establishing action levels is based upon the data available that characterizes contaminants of concern in soil or water. Calculation for estimating action levels is then completed using the principles of Henry's Law (volatiles in water), fugacity (volatiles in soil), and proportionality (particulates in soil). When analytical data is not available, a qualitative assessment is conducted based on knowing the contaminants of concern and then setting action levels based on the compound(s) with the lowest OSHA PEL, NIOSH REL or ACGIH TLV, and following an air monitoring schedule that will minimize any potential for over exposure.

All workers on-site must have been properly fitted with PPE (i.e., respirators) and have been trained in their use (i.e., donning and doffing). Air monitoring measurements will be taken in the breathing zone of the worker most likely to have the highest exposure. Transient peaks will not automatically trigger action. Action will be taken when levels are consistently exceeded in a 5-minute period. Similarly, if chemical odors are detected that are a nuisance, bothersome, or irritating, an upgrade in respiratory protection can provide an extra level of comfort or protection when conducting site activities. Guidelines for frequency of air monitoring are presented in Table 6. Job tasks that require air monitoring, the applicable action levels that apply for those tasks, and the frequency of air monitoring are described in Table 6 and Table 7 respectively.

Engineering controls such as the venturi air mover (supplied by compressed air) to exhaust or dilute solvent vapors emanating from monitoring wells or when conducting intrusive activities can be utilized as a means to downgrade PPE requirements (Level B to C, Level C to D).

Table 6. Air Monitoring Frequency Guidelines

Conduct periodic monitoring when:

1. It is possible that an immediately dangerous to life or health (IDLH) condition or a flammable atmosphere has developed, or

2. There is an indication that exposures may have risen over established action levels, permissible exposure limits or published exposure levels since the last monitoring. Look for a possible rise in exposures associated with these situations:

   - **Change in site area** - work begins on a different section of the site.
   - **Change in contaminants** - handling contaminants other than those first identified.
   - **Visible signs of particulate exposure from intrusive activities such as drilling/boring and excavation.**
   - **Perceptible chemical odors or symptoms of exposure.**
   - **Change in on-site activity** - one operation ends and another begins.
   - **Handling leaking drums or containers.**
   - **Working with obvious liquid contamination** (e.g., a spill or lagoon).

Conduct air monitoring when the possibility of volatilization exists (such as with a new monitoring well or a well containing known product).

Table 7. Air Monitoring Action Levels

Instrument*	Function	Measurement	Action
FID or PID (10.2/11.7eV lamp) - Measures Total Organic Vapors			
	Conduct air monitoring for volatile organic compounds during activities where impacted media are present.	0 - 2 ppm	Level D/Modified Level D required. Check for benzene with detector tubes.
		>2 - 50 ppm	Upgrade to Level C.
		>50 - 1,000 ppm	Upgrade to Level B. Coordinate with PM and HSR for guidance.
		>1,000 ppm	Stop work required. Leave work area, contact PM and HSR for guidance.
Benzene Detector Tubes			
	Conduct grab sampling for benzene when sustained PID/FID readings are detected in the breathing zone.	0 - 0.5 ppm	Level D/Modified Level D required.
		>0.5 - 50 ppm	Upgrade to Level C required.
		>50 - 1,000 ppm	Upgrade to Level B required.
		>1,000 ppm	Stop work required. Contact PM and HSR for guidance.
Ozone Real-Time Monitor/Detector Tubes			
	Conduct air monitoring when performing O & M on remediation equipment, or whenever exposure to ozone is suspected. Upgrade will be required whenever readings are sustained for > 5 minutes in breathing zone.	0 - 0.05 ppm	Level D/Modified Level D required
		>0.05 to 5 ppm	Upgrade to Level C required.
		>5.0 ppm	Upgrade to Level B required with approval from HSR.
Dust/Particulate Monitor			
	Conduct air monitoring for dust particulate when sustained (> 5 minute) levels of visible dust are generated and engineering controls such as wet methods are ineffective.	0 - 0.15 mg/M^3	Level D/Modified Level D required.
		>0.15 - 50 mg/M^3	Upgrade to Level C. Use dust supression measures to mitigate. If levels remain above 0.15 mg/M3 stop work until levels drop below 0.15 mg/M3. Follow guidance in NYSDEC TAGM # 4031," Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites."

Table 7. Air Monitoring Action Levels (continued)

Instrument*	Function	Measurement	Action
Oxygen/Combustimeter (O_2/LEL)	Measures oxygen level (O_2) and lower explosive limit (LEL)		
Conduct air monitoring for O_2/LEL when conditions exist where flammable vapors/gases and/or oxygen deficiency or enrichment can occur. A decreased O_2 reading of 0.1% (e.g., 20.9% to 20.8%) actually represents a change in the total air envelope of approximately 0.5% or 5,000 ppm. This represents little hazard if the displacing gas is inert; if the displacing gas is toxic/flammable/reactive, such a concentration represents a real hazard. Verify reasons for O_2 depletion by conducting air monitoring with instruments that can measure suspected contaminants (PID/FID) or that can confirm presence of contaminants (detector tubes or chemical specific real-time air monitors).		O_2 = 20.9 %	Acceptable
		O_2 >19.5 - 20.8%	Verify reasons for O_2 depletion with appropriate air monitoring instrumentation before work continues. Utilize appropriate engineering controls/PPE once atmospheric contaminants have been verified.
		O_2 >20.9 % - 22 %	Verify reasons for O_2 enrichment before entering area. Utilize appropriate engineering controls/PPE to control O_2 enriched atmosphere.
		O_2 >22 %	Leave area immediately; this atmosphere is extremely flammable. Notify PM or HSR for guidance.
		O_2 <19.5%	Leave area immediately; this atmosphere is oxygen deficient. Verify reasons for O_2 depletion with appropriate air monitoring instrumentation before work continues. Utilize appropriate engineering controls/PPE once atmospheric contaminants have been verified.
		LEL <10%	Acceptable conditions. Continue normal activity.
		LEL >10%	Leave area immediately. Contact PM or HSR for guidance on venting and other safety measures.

*Note: Instruments must be calibrated according to manufacturer's recommendations.

Table 8. Hazard Summary

AIR MONITORING SUMMARY

Job Task	Level PPE	Instrument	Frequency
Excavation and trenching activities	Modified Level D (See Table 11)	PID[1] or FID[2], O_2/LEL[3], DT[4], DM[5]	Start up of work, then 30 minutes to continuously based on sampling results and sample location. Continuously if action level is exceeded. May be reduced to once per hour based on previous data collected.
Installation of remediation systems	Modified Level D (See Table 11)	PID or FID, O_2/LEL, DT, DM	For below ground installations: Start up of work, then 30 minutes to continuously based on sampling results and sample location. Continuously if action level is exceeded. For above ground installations: Start up of work only; however, if work activities expose workers to chemicals, monitor every 30 minutes or more frequently, if action level is exceeded. May be reduced to once per hour based on previous data collected.
Perform O&M and LOTO	Modified Level D (See Table 11)	PID or FID, O_2/LEL, DT	Start up of work, then 30 minutes to continuously based on sampling results and sample location. Continuously if action level is exceeded. May be reduced to once per hour based on previous data collected.
Air sparging	Modified Level D (See Table 11)	PID or FID, O_2/LEL, DT	Start up of work, then 30 minutes to continuously based on sampling results and sample location. Continuously if action level is exceeded. May be reduced to once per hour based on previous data collected.
Gauging wells	Modified Level D (See Table 11)	PID or FID, O_2/LEL, DT	Start up of work. Continuously if action level is exceeded. May be reduced to once per hour based on previous data collected.
Sampling wells, soils	Modified Level D (See Table 11)	PID or FID, O_2/LEL, DT, DM	Start up of work. Continuously if action level is exceeded. May be reduced to once per hour based on previous data collected.
Abandon wells	Modified Level D (See Table 11)	PID or FID, O_2/LEL, DT, DM	Start up of work, then 15 minutes to continuously based on sampling results and sample location. Continuously if action level is exceeded.

[1] PID, Photoionization Detector
[2] FID, Flame Ionization Detector
[3] O_2/LEL, Oxygen Level and Combustible Gas Meter
[4] DT, Benzene Detector Tube
[5] DM, Dust/ Particulate Monitor

Note: "Start up of work at each new task location" means to monitor the air quality at each new operation on the site. The breathing zone is the area inside a 1-foot radius around the head.

3.2 Noise Monitoring

Noise monitoring must be performed in accordance with Fluor Daniel GTI practices. Noise levels are monitored in the field with either a Type I or Type II Sound Level Meter (SLM). Noise dosemeter readings can also be obtained to determine the percent (%) noise dose. Noise levels and % dose measured are then compared to limits listed in OSHA standard 29 CFR 1910.95, Hearing Conservation.

Action levels listed in Table 9 will trigger upgrade in PPE to include appropriate hearing protectors (muffs or plugs) or initiate possible noise control engineering. Noise monitoring equipment must be calibrated prior to use each shift and checked at the end of the shift to determine accuracy. Noise readings must be recorded on data form in Exhibit E, Noise Monitoring Form.

Selection of hearing protection must match the employees needs and the ability to attenuate noise below 90 dB(A). Each hearing protection device (muff or plugs) has a Noise Reduction Rating (NRR) assigned by the U.S. Environmental Protection Agency (EPA). To calculate the hearing protector's effectiveness use the following formula:

$$\text{Noise Reading dB(A)} - (\text{NRR} - 7\text{dB}) < 90\ \text{dB(A)}$$

Table 9. Noise Monitoring

Instrument	Measurement	Action
Type I or Type II SLM - Calibrate Before Use		
	>80 dB(A) → 85 dB(A)	Hearing protection recommended. Limit work duration to 8-hour shifts.
	>85 dB(A) → 90 dB(A)	Hearing protection required. Limit work duration to 8-hour shifts.
	>90 dB(A) → 115 dB(A)	Hearing protection required. Investigate use of engineering controls. Limit work duration to 8-hour shifts.
	> 115 dB(A)	Stop work. Contact HSR and PM.

4.0 CSE PROCEDURES

Although not currently anticipated, in the event site work may require personnel to enter confined spaces, **No Fluor Daniel GTI employee or subcontractor shall enter an area identified as a confined space without using the CSE procedures described in Exhibit G and the site-specific entry procedures presented in this Exhibit.** The purpose of the CSE procedure is to protect employees from potentially hazardous environments and to facilitate immediate rescue in an emergency situation. A CSE Permit must be posted at the entrance to each confined space. Permit required confined spaces identified for this project may include vaults associated with remediation systems at this site.

5.0 CHEMICAL HAZARD CONTROL

5.1 Chemical Handling Procedures

Personnel must practice the chemical-specific handling procedures outlined below.

Table 10. Chemical Handling Procedures

Chemical	Description	Procedures
Acids and Bases Acids: including hydrochloric, nitric, and sulfuric acids Bases: including sodium hydroxide	Extremely corrosive materials with a variety of uses.	■ Wear gloves and eye-splash protection while using acid dispensed from a small dropper bottle during water sampling. ■ Wear a full-face, air-purifying respirator equipped with combination cartridges (organic vapor/acid gas) as well as Tyvek® coveralls and nitrile and/or nitrile butyl rubber (NBR) gloves for large volume applications. ■ Have an eye wash bottle or portable eye wash station on-site. ■ Cap all drums after dispensing chemicals. ■ Do not add anything into a virgin chemical drum, including unused product. ■ Avoid mixing strong acids and bases. Consult HSR for task-specific evaluation. If mixing is absolutely necessary, do it slowly. Avoid vapors or fumes that are generated. ■ When diluting acids, add the acid to water in small quantities and mix cautiously. ■ When diluting bases, add water to the base in small quantities and mix cautiously.
Activated Carbon	Granular adsorbent medium used to remove residual hydrocarbons from water and/or air.	■ Use respiratory protection when activated carbon creates a dusty environment. ■ Avoid using Activated Carbon Filter Beds for Ketone Solvents - an exothermic reaction can develop over time and result in possible explosion. ■ Contact HSR for task-specific evaluation.

5.2 PPE

Based upon the hazards that may be encountered during site activities, PPE as follows was selected. Only PPE that meets the following American National Standards Institute (ANSI) standards are to be worn.

- Eye protection - ANSI Z87.1-1989
- Head protection - ANSI Z89.1-1986
- Foot protection - ANSI Z41-1991

Employees must maintain proficiency in the use and care of PPE that is to be worn. Typically this is covered during formal and informal refresher training sessions presented by Fluor Daniel GTI.

Level D is the minimum acceptable level of protection for this project site. Upgrade to Modified Level D occurs when the possibility of contact to the skin or work uniform can occur from contaminated media. Upgrade to Level C will occur when results of air monitoring reveals action levels have been exceeded. Upgrade to Level B occurs when results of air monitoring reveals action levels have been exceeded, and site personnel meet training requirements. Wear hearing protection when in areas where high noise levels are generated.

Table 11. PPE

Level	Requirements
Level D	■ Work uniform ■ Steel-toed boots ■ Approved safety glasses or goggles ■ Hard hat ■ Fluorescent vest, when vehicular traffic is on or adjacent to the site ■ Nitrile gloves for water sampling handling
Modified Level D	**One or more of the following:** ■ Chemical resistance (acid or solvent) boot covers ■ PE-coated Tyvek® suit, NBR outer and nitrile inner gloves if skin contact with contaminants is possible. ■ Hearing protection (muffs and/or plugs).
Level C	■ Level D and Modified Level D ■ Cooling vests and thermal protection, if needed ■ NIOSH/MSHA-approved full-face respirator with organic vapor/acid gas high efficiency particulate air-purifying (HEPA) cartridges.
Level B	■ Level D and Modified Level D ■ Cooling vests, and thermal protection, if needed ■ NIOSH/MSHA approved full face positive pressure demand supplied air respirator, either airline or self contained.
Prior to use, all equipment must be inspected to ensure proper working condition.	

5.3 Site Control: Work Zones

Work zones will be established in order to:

- Delineate high-traffic locations,
- Identify hazardous locations, and
- Contain contamination within the smallest area possible.

Employees entering the work zone must wear the proper PPE for that area. Work and support zones will be established based on ambient air monitoring data, necessary security measures, and site-specific conditions. Work zones will be identified as either Hot Zone (HZ)/Exclusion Zone (EZ); Decontamination Zone (DZ)/Contamination Reduction Zone (CRZ); or Clean Zone (CZ)/Support Zone (SZ).

The following PPE requirements apply for Work Zones:

- HZs/EZs requires Level Modified Level D or Level C PPE
- DZs/CRZs require Modified Level D PPE
- SZs/CZs require Level D PPE

Specific work zones for this project have been identified and shown on the site map in Appendix I.

Listed are general guidelines for delineation of work zones. CRZs will be developed for decontamination procedures listed in Section 4.5.

1. The HZ/EZ is identified to contain areas where excavation is occurring that exposes workers to contaminated soils. A minimum ten-foot distance surrounding this area will be demarcated with cones, barricades and/or caution tape depending on location to employees, general public, and high traffic areas. The area inside the ozone remediation shed may also be considered a hot zone since workers may be exposed to substantial levels of ozone if leaks in the system occur. Monitoring should always be done in the HZ/EZ to determine employee exposure.

2. The DZ/CRZ will be a corridor connecting the HZ/EZ and the support zone and can include the back-end of the company pick-up truck. The DZ/CRZ will be demarcated at its boundaries with barricades, cones, and/or caution tape depending on location to employees, general public, and high traffic areas.

3. Support areas are all areas outside the hot zone or contamination reduction zones which do not pose chemical exposure potential to workers.

Table 12. Site Security and Work Zone Definition

WORKING IN STREET OR ROADWAY

- Wear traffic vest and hardhat when vehicle hazard exists.
- Use cones, flag-mounted cones, caution tape and/or barricades.
- Use vehicle strobe light and block area with truck.
- Develop traffic patternization plan for high traffic situations:
    - use flag person,
    - use flashing arrow sign,
    - use "MEN WORKING" signs liberally,
    - obtain lane closing permits, and
    - engage police details.

WORKING AT EXCAVATION/TRENCHING SITES

- "Competent person" is required per OSHA 29 CFR 1926 Subpart P.
- Safety guard open excavations by restricting unauthorized access.
- Highlight work area using prominent warning signs (cones, saw horses/barricades and signage) placed a minimum of 10' back from excavation opening.
- Maintain zone definition along perimeter with **continuous string** of yellow orange caution tape.

EXCAVATIONS LEFT UNATTENDED OR OVERNIGHT

Use one of the following methods to address these situations:

- Surround entire perimeter with plastic or cloth construction net fencing. Anchor fence to ground using steel posts driven into ground. Space out posts no greater than 8 feet apart. Fence height minimum 4-feet high. Fence material must be of a quality capable of withstanding a pressure of 200 pounds. Place fence a minimum of 10 feet back from excavation opening.
- Place 8-foot long barricades affixed with flashing lights end to end with 4-foot high construction net fence attached to barricades.
- Utilize temporary curbing or concrete "jersey" barriers affixed with flashing signal lights or other effective warning signs.

5.4 Decontamination Procedures

Operations conducted at this site have the potential to contaminate field equipment and PPE. To prevent the transfer of contamination to vehicles, administrative offices and personnel, the procedures presented in Table 13 must be followed. Specific decontamination requirements will be followed by utilizing the equipment for that purpose. Work uniforms and Level D PPE must not be brought to employee residences and left either on-site, at the office location, or in the company vehicle. Laundering of company uniforms must be by Fluor Daniel GTI approved laundering services and not done at employees residence.

Table 13. Decontamination Procedures

Item	Examples	Procedure
Field equipment	Bailers, interface probes, hand tools, drill augers, and miscellaneous sampling equipment	■ Decontaminate with a solution of detergent and water; rinse with water prior to leaving the site. ■ Protect from exposure by covering with disposable covers such as plastic to minimize required decontamination activities.
Disposable PPE	Tyvek® suits, inner latex gloves, respirator cartridges	■ Dispose of according to the requirements of the client and state and federal agencies. ■ Change out respirator cartridges on a daily basis and dispose accordingly.
Nondisposable PPE	Respirators	■ Wipe out respirator with disinfecting pad prior to donning. ■ Decontaminate respirator on-site at the close of each day based upon extent of contamination. This procedure could include disassembling the respirator and cleaning, rinsing, sanitizing, and drying all parts with approved powders and solutions.
	Boots and gloves	■ Decontaminate outside with a solution of detergent and water; rinse with water prior to leaving the site. ■ Protect from exposure by covering with disposable covers such as plastic to minimize required decontamination activities.

All water used in decontamination procedures should be stored in portable storage tanks until sufficient amount are stockpiled to facilitate disposal treatment. Disposable sampling and PPE will be place in plastic bags and temporarily stored in designated drums. These drums shall be disposed of according to regulatory guidelines, if necessary.

5.5 Example Decontamination Diagram

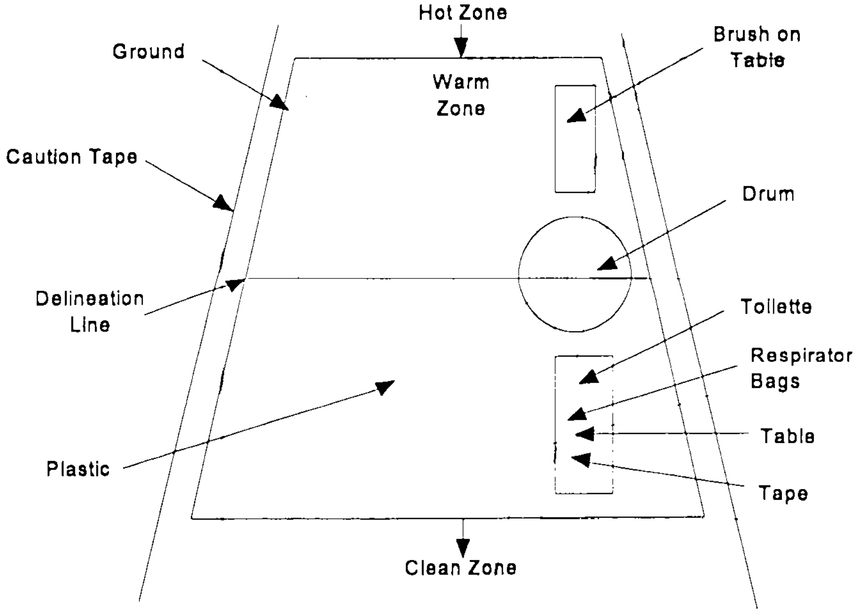
If Level C or Level B PPE is required, a CRZ will be constructed in a centralized common area with a travel path from the EZ demarcated with caution tape, or four-foot high cones. The decontamination procedure for this project site is a two stage process.

STAGE 1 ■ Gross contamination removal with a brush.

- Remove outer boots and dispose in a drum.
- Remove Tyvek® suit and dispose in a drum.
- Remove outer gloves and dispose in a drum.
- Walk to Stage 2.

STAGE 2

- Remove respirator.
- Remove cartridge and dispose in a drum.
- Clean respirator and insert into a bag.
- Remove inner gloves and dispose.
- Wipe hands with a toilette and dispose.
- Walk out of decontamination area.



6.0 CONTINGENCY PLANS

Table 14 presents contingency plans for potential emergency situations. Ensure that the information in the contingency plans have been clearly communicated to all project personnel and those within the vicinity that may be affected, such as plant personnel and other contractors on site.

Table 14. Contingency Plans for Site Emergencies

Situation	Action
Evacuation	1. Immediately notify all on-site personnel of an emergency requiring evacuation. 2. Leave the dangerous area and report to a designated rally point. 3. Notify emergency medical service (EMS), as appropriate. 4. Account for all personnel. 5. Contact the PM and the HSR as soon as possible. 6. Maintain site security and control measures for community safety until emergency responders arrive.
Medical Emergency	1. Survey the situation: **Do not enter an area that may jeopardize your safety.** ■ Establish the patient's level of consciousness. ■ Call for help. ■ Contact EMS and inform them of patient's condition. 2. Primary assessment (patient unconscious) ■ Arousal ■ Airway ■ Breathing ■ Circulation **Only trained personnel should perform CPR or First Aid - State you are medically trained** 3. Secondary assessment (patient conscious) ■ Check for bleeding: Control with direct pressure. ■ Do not move patient (unless location is not secure). ■ Monitor vital signs. ■ Provide First Aid to the level of your training. ■ Contact the PM and HSR as soon as possible. ■ Document the incident on Fluor Daniel GTI's PIR form.
Fire Emergency	1. **Evacuate the area.** 2. Notify the EMS. 3. Extinguish small fires with an all-purpose extinguisher. 4. Contact the PM and HSR. 5. Document the incident using the PIR form.

<table>
<tr><th>Situation</th><th>Action</th></tr>
<tr><td>Spill/ Release</td><td>Prevent problems by documenting the location of underground lines (e.g., product, sewer, telephone) before starting site work. If you drill through a line or tank or another leak occurs, document the spill/release in writing. Include dates, times, actions taken, agreements reached and names of people involved. In the event of a spill/release, follow this plan.
1. Wear appropriate PPE; stay upwind of the spill/release.
2. Turn off equipment and other sources of ignition.
3. Turn off pumps and shut valves to stop the flow/leak.
4. Plug the leak or collect drippings in a bucket, when possible.
5. Place sorbent pads to collect product, if possible.
6. Call Fire Department immediately if fire emergency develops.
7. Inform Fluor Daniel GTI PM about the situation.
8. Determine if the client wants to repair the damage of if the client will use an emergency repair contractor.
9. Based on agreements, contact emergency spill contractor for containment of free product.
10. Advise the client of spill discharge notification requirements and determine who will complete and submit forms. Do not submit or report to agencies without the client's consent. Document each interaction with the client and regulators and note, in writing; name, title authorizations, refusals, decisions, and commitments to actions.
11. Do not transport or approve transportation of contaminated soils or product until proper manifests have been completed and approve. Be aware that soils/product may meet criteria for hazardous waste.
12. Do not sign manifests as generator of wastes; contact the regional compliance manager to discuss waste transportation.</td></tr>
<tr><td colspan="2">*Notifications - **a spill/release requires completion of a PIR and Class III notification.***
The PM must contact the client or generator. The generator is under obligation to report to the proper government agencies. If the spill extends into waterways, the Coast Guard and the National Response Center ([800] 424-8802) must be notified immediately by the client or with their permission.</td></tr>
</table>

6.1 Field Communications

Communications at the work site can be accomplished by verbal and/or non-verbal means to ensure contact with all Fluor Daniel GTI and subcontractors. Verbal communication can be impacted by the on-site background noise and while wearing respiratory protection. Table 15 lists the type of communication methods and equipment to use, depending on site conditions. Communication equipment must be checked daily to ensure proper operation and all project personnel must be initially briefed on the communication methods prior to starting work and reviewed in Daily Safety Tailgate Meetings as a reminder.

Table 15. Field Communication Methods

COMMUNICATION DEVICE	TYPE OF COMMUNICATIONS	SIGNAL
Telephone On-Site or Cellular Telephone	Emergency notification	Initiate phone call using applicable emergency numbers
Two-Way Radio	Emergency notification among site personnel	Initiate radio communication with Code Red message
Compressed Air Horn	Hailing site personnel for non-emergency	One long blast, one short blast
Compressed Air Horn	Hailing site personnel for emergency evacuation	Three long continuous blasts
Visual	Hailing site personnel for distress, need help	Arms waved in circle overhead
Visual	Hailing site personnel for emergency evacuation	Arms waved in cris-cross over head
Visual	Contaminated air/strong odor	Hands clutching throat
Visual	Break, lunch, end of day	Two hands together, break apart

7.0 MEDICAL MONITORING PROGRAM

Fluor Daniel GTI, under the oversight of the company's consulting physician, has developed a medical monitoring program to track the physical conditions of it's employees on a routine basis; starting with a baseline assessment, then periodic follow-up (annual or biennial) or specific project requirements based upon site contaminants or as assessment tool to aid in determining possible exposure.

7.1 Medical/Technical Advisors

Elayne Theriault, MD
Fluor Daniel GTI, CONSULTING PHYSICIAN (800) 229-3674 x 326

John Reinemann, CIH
Fluor Daniel GTI, District Health & Safety Manager
Schenectady, NY (518) 783-1996

David Crowley, CSP, CET, CHMM
Fluor Daniel GTI, Corporate Health and Safety Director

Norwood, MA (781) 769-7600

The specific duties of the medical/technical advisors include:

- recommending a suitable medical monitoring program for the site workers by the occupational health physician in conjunction with consultation of the above listed personnel,
- providing interpretation of medical monitoring requirements and technical guidance for developing project specific medical monitoring requirements, and
- advising worker exposure potential along with appropriate hazard reduction methods.

Table 16. Medical Monitoring Program

Module	Hst. Phys. W/Dipstick UA, Vision, Vital Signs	Spiro	Audio	EKG	Chest X-Ray	Bio Chem W/Diff	Shipping Fee	Substance Abuse Screen	Random Substance Abuse	Tetanus Diphtheria
BASELINE										
Regular	●	●	●		●	●	●	NL/BP		(10Y)
Regular/DOT	●	●	●		●	●	●	N/BP		(10Y)
ANNUAL/PERIODIC										
Regular	●	●	●		5Y	●	●	NL/BP	RT/RBP	(10Y)
Regular/DOT	●	●	●		5Y	●	●	N/BP	RT/RN/RB	(10Y)
BIENNIAL										
Regular	●	●	●		5Y	●	●	NL/BP	RT/RBP	(10Y)

	>40 years of age or for medial indications (pre-approved by EMR)
#	X-ray film sent to EMR for International Labor Organization (ILO) reading
1Y - 5Y	Yearly frequency
( )	If not done within
TP	Fluor Daniel GTI ten panel drug screen
BP	Breath pipe
N	National Institution of Drug Abuse (NIDA) drug screen
NL	NIDA-like drug screen
RT	Random ten panel drug screen
RBP	Random breath pipe
RB	Random breathalyser

An EKG is required on a baseline exam. Thereafter, an EKG is performed annually for anyone over 40 years of age or for medical indications. A chest x-ray is required on a baseline exam, and then once every 5 years thereafter. A chest x-ray is also required upon termination (if it has been more than 1 year since the previous x-ray). Random drug screens and tetanus are variable components; therefore, they are not included in the total examination price. These variable components will only be billed at the time they are included in the exam.

Examination price is based on the utilization of the EMR medical facility network. Should Fluor Daniel GTI wish to choose the facilities at which some or all of the services are provided, it is agreed that Fluor Daniel GTI will pay any difference between these component prices and those charged by those facilities designated by the client. In the event an EMR medical facility increases fees substantially over those component prices, Fluor Daniel GTI has agreed to pay any reasonable difference or to change to an alternative EMR-qualified facility.

EXHIBIT A-A

AGREEMENT AND ACKNOWLEDGEMENT FORM
HASP AMENDMENT SHEET
VISITOR/TRAINEE GUIDELINES
TRAINEE/OBSERVER AGREEMENT FORM

AGREEMENT AND ACKNOWLEDGEMENT SHEET

Fluor Daniel GTI personnel have the authority to stop field activities at this site if any activity is not performed in accordance with the requirements of the HASP. All Fluor Daniel GTI project personnel, subcontractor personnel, and visitors are required to sign the Agreement and Acknowledgement Sheet **prior** to conducting field activities at this site.

FLUOR DANIEL GTI
AGREEMENT AND ACKNOWLEDGEMENT STATEMENT

1. **I have read and fully understand the HASP and my responsibilities.**
2. **I agree to abide by the provisions of the HASP.**

Name	Signature
Company	Date
Name	Signature
Company	Date
Name	Signature
Company	Date
Name	Signature
Company	Date
Name	Signature
Company	Date
Name	Signature
Company	Date
Name	Signature
Company	Date

FLUOR DANIEL GTI, INC.

Project Name:

Project Number:

PM:

Location:

Changes in field activities or hazards:

Approved by:______________________________________
Project Manager

____
Date

FLUOR DANIEL GTI

VISITOR/TRAINEE GUIDELINES

Fluor Daniel GTI is committed to providing a safe environment on all work sites for visitors, trainees, employees and/or passersby. In order to accomplish this, the following guidelines must be followed. **Infractions of the listed requirements agreement will be viewed as extremely serious and will be subject to discipline up to and including termination for either the trainee and/or supervisor.**

1. VISITORS

Any person not actively participating in the work at the site is regarded as a "visitor" and must follow Fluor Daniel GTI's visitor/trainee guidelines while on-site. Visitors must be accompanied by a representative at all times.

Visitors will attend and sign-off on a site orientation. The orientation will cover specific areas that visitors will not be allowed to access during certain work activity. Visitors are required to wear appropriate PPE on-site. Required PPE for visitors include:

closed toed shoes,
hard hat,
safety glasses with side shields, and
other as required by SHSO (i.e., gloves, hearing protection, Tyvek® suit, etc.)

2. TRAINEES

Trainees are employees of Fluor Daniel GTI who have not yet completed Fluor Daniel GTI's required safety training program. New hires and in-house company transfers will be considered trainees until safety training requirements are met.

Trainees will be informed of restrictions by their supervisor and must abide by them on-site.

Trainees will be permitted to visit Fluor Daniel GTI sites to obtain three days on the job (OJT) training as observers as long as the following conditions are met:

Trainees are supervised at all times while on-site.
Trainees do not perform work functions of any type while on-site unless under direct supervision.
Trainees do not handle any equipment, tools and/or supplies while on-site unless under direct supervision.
Trainees do not enter any hazardous or HZ or confined space areas while on-site unless under direct supervision.

Supervisors will be responsible for informing trainees of the above conditions and for ensuring that the conditions are met. Supervisors will also ensure that trainees will not be asked to violate the conditions listed above.

A Trainee/Observer Agreement Form must be signed by both the trainee and the supervisor and placed on file in the Regional Human Resources department.

TRAINEE/OBSERVER AGREEMENT FORM

The following section is to be filled out by trainee.

Agreement between:

____________________________ ________________ and Fluor Daniel GTI.

Name (print/type) SS#

Because we have your safety in mind, you will be considered a trainee until all training criteria are met. This means you must complete all training requirements prior to performing work activities on-site.

Training requirements include:

> Up to date medical clearance documentation, successful completion and documentation or 40-hour HAZWOPER.
>
> Trainees also must attend an orientation of the HASP including specific training on hazards that there is a likelihood the worker would be exposed to.
>
> Prior to a trainee becoming a worker, the trainee must successfully complete three days of OJT. This three day OJT must be performed under direct supervision of a qualified supervisor.

I agree to adhere to the above conditions in all instances while on-site as a trainee/observer.

____________________________ ____________________

Signature Date

- -

This section is to be filled out by supervisor.
As supervisor to the above trainee, I agree to the above restrictions and agree not to request him/her to perform activities contrary to those restrictions.

____________________________ ____________________

Signature Date

AGREEMENT AND ACKNOWLEDGEMENT SHEET

Fluor Daniel GTI personnel have the authority to stop field activities at this site if any activity is not performed in accordance with the requirements of the HASP. All Fluor Daniel GTI project personnel, subcontractor personnel, and visitors are required to sign the Agreement and Acknowledgement Sheet **prior** to conducting field activities at this site.

FLUOR DANIEL GTI
AGREEMENT AND ACKNOWLEDGEMENT STATEMENT

1. **I have read and fully understand the HASP and my responsibilities.**
2. **I agree to abide by the provisions of the HASP.**

Name ______________________ Signature ______________________
Company ______________________ Date ______________________

Name ______________________ Signature ______________________
Company ______________________ Date ______________________

Name ______________________ Signature ______________________
Company ______________________ Date ______________________

Name ______________________ Signature ______________________
Company ______________________ Date ______________________

Name ______________________ Signature ______________________
Company ______________________ Date ______________________

Name ______________________ Signature ______________________
Company ______________________ Date ______________________

Name ______________________ Signature ______________________
Company ______________________ Date ______________________

FLUOR DANIEL GTI, INC.

Project Name:

Project Number:

PM:

Location:

Changes in field activities or hazards:

Approved by:______________________________________ ______________________
Project Manager Date

VISITOR/TRAINEE GUIDELINES

Fluor Daniel GTI is committed to providing a safe environment on all work sites for visitors, trainees, employees and/or passersby. In order to accomplish this, the following guidelines must be followed. **Infractions of the listed requirements agreement will be viewed as extremely serious and will be subject to discipline up to and including termination for either the trainee and/or supervisor.**

1. VISITORS

Any person not actively participating in the work at the site is regarded as a "visitor" and must follow Fluor Daniel GTI's visitor/trainee guidelines while on-site. Visitors must be accompanied by a representative at all times.

Visitors will attend and sign-off on a site orientation. The orientation will cover specific areas that visitors will not be allowed to access during certain work activity. Visitors are required to wear appropriate PPE on-site. Required PPE for visitors include:

closed toed shoes,
hard hat,
safety glasses with side shields, and
other as required by SHSO (i.e., gloves, hearing protection, Tyvek® suit, etc.)

2. TRAINEES

Trainees are employees of Fluor Daniel GTI who have not yet completed Fluor Daniel GTI's required safety training program. New hires and in-house company transfers will be considered trainees until safety training requirements are met.

Trainees will be informed of restrictions by their supervisor and must abide by them on-site.

Trainees will be permitted to visit Fluor Daniel GTI sites to obtain three days on the job (OJT) training as observers as long as the following conditions are met:

Trainees are supervised at all times while on-site.
Trainees do not perform work functions of any type while on-site unless under direct supervision.
Trainees do not handle any equipment, tools and/or supplies while on-site unless under direct supervision.
Trainees do not enter any hazardous or HZ or confined space areas while on-site unless under direct supervision.

Supervisors will be responsible for informing trainees of the above conditions and for ensuring that the conditions are met. Supervisors will also ensure that trainees will not be asked to violate the conditions listed above.

A Trainee/Observer Agreement Form must be signed by both the trainee and the supervisor and placed on file in the Regional Human Resources department.

TRAINEE/OBSERVER AGREEMENT FORM

The following section is to be filled out by trainee.

Agreement between:

______________________________ ______________ and Fluor Daniel GTI.
Name (print/type) SS#

Because we have your safety in mind, you will be considered a trainee until all training criteria are met. This means you must complete all training requirements prior to performing work activities on-site.

Training requirements include:

> Up to date medical clearance documentation, successful completion and documentation or 40-hour HAZWOPER.
>
> Trainees also must attend an orientation of the HASP including specific training on hazards that there is a likelihood the worker would be exposed to.
>
> Prior to a trainee becoming a worker, the trainee must successfully complete three days of OJT. This three day OJT must be performed under direct supervision of a qualified supervisor.

I agree to adhere to the above conditions in all instances while on-site as a trainee/observer.

______________________________ ______________
Signature Date

This section is to be filled out by supervisor.
As supervisor to the above trainee, I agree to the above restrictions and agree not to request him/her to perform activities contrary to those restrictions.

______________________________ ______________
Signature Date

EXHIBIT A-B

PIR
INCIDENT REPORTING GUIDE

Line Manager must check incident type:

Class I ________

Class II ________

Class III ________

PRELIMINARY INCIDENT REPORT

Person Completing Report ________________ Office ________ Date ______ Incident Date ______

Incident Time: ______ Location ________ Home Dept. # _ _ _ _ _ _ Visiting Dept. # _ _ _ _ _ _

Person Involved in Incident ____________________ Telephone _ _ _ - _ _ _ - _ _ _ _

Driver Name (if motor vehicle accident) ____________________ Telephone _ _ _ - _ _ _ - _ _ _ _

Type of Incident:

Personal Injury/Illness
Chemical Exposure
Equipment Damage
Theft
Property Damage
Permit/Code Compliance

Near Miss Event
Unsafe Condition/Action
Fire/Explosion
Spill/Release
Customer Incident
Newspaper/Radio/TV

Other
Motor Vehicle Accident
Assoc. Leasing Vehicle #: _ _ _ _ _ _ _ _ - _ _
VIN # ____________________
If FDGTI vehicle, call Associates Leasing at 800-255-2607.
Circle one based on initial findings: Preventable/Non-preventable

---

Personal Injury Yes No (If no, go to next section)

First Aid Only
Hospitalization
Medical Treatment
Possible Injury, Not Confirmed

Person Injured:
Fluor Daniel GTI Employee (If so, complete First Report of Injury)
Subcontractor
Customer/Public/Other

Nature of Injury, Illness or Exposure: ____________________

Describe nature of incident, how it occurred, who was involved, witnesses and possible causal factors: (Attach additional sheets if necessary)

First Report of Injury Attached Police Report Attached

Describe immediate actions taken and persons notified: (Attach additional sheets if necessary)

Line Manager (responsible for follow-up) ____________________ Office __________

DISTRIBUTION

Provide this report to the line manager immediately. The line manager is responsible for the proper distribution of the PIR form per the Incident Reporting Guide (see reverse side). Notify the Norwood Health and Safety Department of all Class II and III incidents immediately by phone at (800) 876-0647, Mailbox *11911, and fax a copy of the PIR to (617) 769-9861 .

Rev. 9/96

Line Manager must check incident type:

Class I ________

Class II ________

Class III ________

PRELIMINARY INCIDENT REPORT

Person Completing Report ______________________ Office __________ Date ________ Incident Date ________ ______________

Incident Time: ________ Location ____________ Home Dept. # _ _ _ _ _ _ Visiting Dept. # _ _ _ _ _ _

Person Involved in Incident ______________________________ Telephone _ _ _ - _ _ _ - _ _ _ _

Driver Name (if motor vehicle accident) ______________________________ Telephone _ _ _ - _ _ _ - _ _ _ _

Type of Incident:

Personal Injury/Illness
Chemical Exposure
Equipment Damage
Theft
Property Damage
Permit/Code Compliance

Near Miss Event
Unsafe Condition/Action
Fire/Explosion
Spill/Release
Customer Incident
Newspaper/Radio/TV

Other
Motor Vehicle Accident
Assoc. Leasing Vehicle #: _ _ _ _ _ _ _ _ - _ _
VIN # ______________________________
If FDGTI vehicle, call Associates Leasing at 800-255-2607.
Circle one based on initial findings: Preventable/Non-preventable

---

Personal Injury Yes No (If no, go to next section)

First Aid Only
Hospitalization
Medical Treatment
Possible Injury, Not Confirmed

Person Injured:
Fluor Daniel GTI Employee (If so, complete First Report of Injury)
Subcontractor
Customer/Public/Other

Nature of Injury, Illness or Exposure: ______________________________

Describe nature of incident, how it occurred, who was involved, witnesses and possible causal factors: (Attach additional sheets if necessary)

First Report of Injury Attached Police Report Attached

Describe immediate actions taken and persons notified: (Attach additional sheets if necessary)

Line Manager (responsible for follow-up) ______________________________ Office ____________

DISTRIBUTION

Provide this report to the line manager immediately. The line manager is responsible for the proper distribution of the PIR form per the Incident Reporting Guide (see reverse side). Notify the Norwood Health and Safety Department of all Class II and III incidents immediately by phone at (800) 876-0647, Mailbox *11911, and fax a copy of the PIR to (617) 769-9861 .

Rev. 9/96

INCIDENT REPORTING GUIDE

Incident Class	Class I: A minor incident that is dealt with at the local level	Class II: A serious incident requiring immediate distribution and notification as described below and on the first page.	Class III: A highly significant incident requiring immediate notification and assistance from Regional Manager and Corporate
Examples of Incidents	First Aid injury Minor damage <$200 Non-reportable quantity spill Near miss event Unsafe condition or action	Personal injury (more than first aid to employee, subcontractor or public) Any motor vehicle accident Damage to property greater than $200 but less than $10,000 Near miss incident that could have been very serious Fire/Explosion Non-emergency notification of regulatory agency is required Served with subpoena (DO NOT ACCEPT; have subpoena delivered to CT Corporation System, our Registered Agent at 800-336-3376 or contact Legal Dept. in Norwood for additional assistance; no written investigation report is required for a subpoena.)	Possible Lost Work Day injury Hospitalization (of one or more persons) Multiple injury of employees, subcontractors or public Unprotected chemical exposure Death Damage to property greater than $10,000 Reportable quantity spill release Emergency notification of regulatory agency Regulatory agency response to incident site (inspection) Contact or appearance of news or public media
Notification Actions	1. On-scene person notifies Line Manager* immediately by phone. 2. Provide PIR form to Line Manager and H&S Representative(s)** immediately following the incident. 3. Line Manager investigates and follows up within 48 hours.	1. On-scene person notifies Line Manager* immediately by phone. 2. Line Manager notifies the District Manager; Regional Manager, H&S Representative(s)**, Human Resources Representative, Corporate H&S Director and CEO with PIR form immediately following the incident. 3. Line Manager provides a detailed final investigation report within 48 hours after the original PIR is submitted. The final report must be submitted to District Manager, Regional Manager, H&S Representative(s), Human Resources Representative, Corporate Director H&S and CEO.	1. On-scene person notifies Line Manager* immediately by phone. 2. Line Manager immediately notifies District Manager, Regional Manager, H&S Representative(s)**, Human Resources and Corporate Director H&S. PIR form is provided by fax immediately to (617-769-9861) addressed to Corporate Director H&S. 3. Incident management team conferences by phone and formulates an action plan.

Notes: If there is a question as to Class I or II, follow Class II notification actions. Rev. 9/96

All Class II and III incidents must be communicated to the Norwood Health and Safety Department immediately by phone at (800) 876-0647, Mailbox *11911; leave a voice message. This will activate a digital pager which is carried by a company health and safety professional 24 hours a day.

All lost-time injury events will be investigated by the respective Regional Manager with a final report to the CEO.

*Line management = reporting manager, project manager, or operations/office manager.
**H&S representative = includes District H&S representatives and Regional H&S manager

INCIDENT REPORTING GUIDE

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Examples of Incidents	First Aid injury Minor damage <$200 Non-reportable quantity spill Near miss event Unsafe condition or action	Personal injury (more than first aid to employee, subcontractor or public) Any motor vehicle accident Damage to property greater than $200 but less than $10,000 Near miss incident that could have been very serious Fire/Explosion Non-emergency notification of regulatory agency is required Served with subpoena (DO NOT ACCEPT; have subpoena delivered to CT Corporation System, our Registered Agent at 800-336-3376 or contact Legal Dept. in Norwood for additional assistance; no written investigation report is required for a subpoena.)	Possible Lost Work Day Injury Hospitalization (of one or more persons) Multiple injury of employees, subcontractors or public Unprotected chemical exposure Death Damage to property greater than $10,000 Reportable quantity spill release Emergency notification of regulatory agency Regulatory agency response to incident site (inspection) Contact or appearance of news or public media
Notification Actions	1. On-scene person notifies Line Manager* immediately by phone. 2. Provide PIR form to Line Manager and H&S Representative(s)** immediately following the incident. 3. Line Manager investigates and follows up within 48 hours.	1. On-scene person notifies Line Manager* immediately by phone. 2. Line Manager notifies the District Manager; Regional Manager, H&S Representative(s)**, Human Resources Representative, Corporate H&S Director and CEO with PIR form immediately following the incident. 3. Line Manager provides a detailed final investigation report within 48 hours after the original PIR is submitted. The final report must be submitted to District Manager, Regional Manager, H&S Representative(s), Human Resources Representative, Corporate Director H&S and CEO.	1. On-scene person notifies Line Manager* immediately by phone. 2. Line Manager immediately notifies District Manager, Regional Manager, H&S Representative(s)**, Human Resources and Corporate Director H&S. PIR form is provided by fax immediately to (617-769-9861) addressed to Corporate Director H&S. 3. Incident management team conferences by phone and formulates an action plan.

Notes: If there is a question as to Class I or II, follow Class II notification actions. Rev. 9/96

All Class II and III incidents must be communicated to the Norwood Health and Safety Department immediately by phone at (800) 876-0647, Mailbox *11911; leave a voice message. This will activate a digital pager which is carried by a company health and safety professional 24 hours a day.

All lost-time injury events will be investigated by the respective Regional Manager with a final report to the CEO.

*Line management = reporting manager, project manager, or operations/office manager.
**H&S representative = includes District H&S representatives and Regional H&S manager

EXHIBIT A-C

LO/TO PROCEDURES

This form is required to be completed when equipment (i.e. electrical, mechanical, pneumatic, chemical, thermal) that requires maintenance, which has stored energy, could be set in motion, thereby causing an injury. To complete the form:

Identify all equipment (i.e. blower motor, recovery pump, etc);
Describe the operation to be conducted (i.e. change fuse, change motor brushes, etc.)
Describe the lockout method/location (i.e. circuit breaker panel outside remediation compound shed, using a single-pole, red plastic lockout clip)

SITE-SPECIFIC LO/TO PROCEDURES

Equipment	Operation	Lockout Method/Location

This form is required to be completed when equipment (i.e. electrical, mechanical, pneumatic, chemical, thermal) that requires maintenance, which has stored energy, could be set in motion, thereby causing an injury. To complete the form:

Identify all equipment (i.e. blower motor, recovery pump, etc);
Describe the operation to be conducted (i.e. change fuse, change motor brushes, etc.)
Describe the lockout method/location (i.e. circuit breaker panel outside remediation compound shed, using a single-pole, red plastic lockout clip)

SITE-SPECIFIC LO/TO PROCEDURES		
Equipment	Operation	Lockout Method/Location

EXHIBIT A-D

MSDS DEFINITIONS
MSDS

EXHIBIT A-F

EXCAVATION/TRENCHING SAFETY PROCEDURES
TRENCH SAFETY DAILY FIELD REPORT
SOILS CLASSIFICATION CHECKLIST
SOILS ANALYSIS CHECKLIST
EXCAVATION/TRENCHING - UNDERGROUND UTILITIES
UNDERGROUND UTILITY CONTACT PREVENTION AND MANAGEMENT PLAN
EXCAVATION/TRENCHING - USTs
UST REMOVALS

ATTENTION:

THE TRENCH SAFETY DAILY FIELD REPORT FORM
MUST BE COMPLETED AT LEAST DAILY DURING EXCAVATION/TRENCHING
OPERATIONS
AND MORE FREQUENTLY IF CONDITIONS CHANGE.

EXCAVATION/TRENCHING SAFETY PROCEDURES

Evaluation: Conducted by Competent Person 29 CFR 1926.

Two soil classifications must be completed to determine sloping/shoring requirements.
Conduct daily inspections of all open excavations prior to entry.

Egress: Excavation areas 4 feet (1.22 meters) or more deep

Ladders must be spaced no more than 25 feet (7.62 meters) apart so that a person in the trench is always within 25 feet (7.62 meters) of a ladder for egress.

Shoring: Excavation areas 5 feet (1.52 meters) or more deep

Excavations must be sloped or shored if personnel will be entering the excavation.
Soil classification may be done only by a competent person using both a visual and manual test.

WARNING: One soil classification may not be enough. Outside disturbances during excavation may change even the best classification.
Inspect the soil after any condition change.

Storage: All excavations.

Spoils and heavy equipment must be stored a minimum of 2 feet (0.61 meters) from the edge of the excavation.
Store spoils on the downhill side.

Maximum Allowable Slopes

Soil or Rock Type	Maximum allowable slopes (H:V)[1] for excavations less than 20 feet (6.10 meters) deep[2]	
Stable Rock[3]	Vertical	(90°)
Type **A** - highly cohesive soil	3/4:1	(53°)
Type **B** - cohesive soil with some sand	1:1	(45°)
Type **C** - loose, wet, or sandy soil	1½:1	(34°)

Notes:

[1] Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

[2] Sloping or benching for excavations greater than 20 feet (6.10 meters) deep shall be designed by a registered professional engineer.

[3] A short-term maximum allowable slope of ½ H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 meters) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 meters) in depth shall be 3/4 H:1V (53°)

TRENCH SAFETY DAILY FIELD REPORT

DATE:____________________

Project Name:____
Project Manager:______________________________________
Weather Conditions:

I hereby attest that the following conditions existed and that the following items were checked or reviewed during this inspection.

INSPECTION ITEM	YES	NO	NA
All open trenches were inspected.			
Were any tension cracks observed along top of any slopes?			
Was any water seepage noted on trench walls or trench bottom?			
Was bracing system installed in accordance with design?			
Type shoring being used__________________.			
Is shoring secure?			
Was there evidence of shrinkage cracks in trench walls?			
Was there any evidence of caving since the last field inspection?			
Trench box(s) certified with tabulated data?			
Traffic in area adequately away from trenching operations with barricades			
Surface encumbrances and other hazards in area accounted for?			
Protective measures taken for standing water in trench.			
All site personnel wearing reflective vest.			
Atmospheric testing conducted in trenched < 4 feet deep.			
Vibrations from equipment or traffic too close to trenching operation?			

Observations:____

Competent Person signature________________________________

Soils Analysis Checklist

This checklist must be completed when soil analysis is conducted to determine the excavation soil type. A separate analysis must be performed on each layer of soil excavation walls. Additional soil analysis must also be performed for the excavation (trench) when it stretches over a distance where soil type may change.

Name:________________________ Date:______________ Time:__________
Competent person:____
Where was the sample taken from?___________________________________
Excavation: Depth________________________ Width______________ Length________

SOIL CLASSIFICATION - VISUAL TEST

ITEM	TEST PROTOCOL	YES	NO	COMMENTS/ACTIONS
1	**Soil Particle Type** Fine Grained/Cohesive Course Grained(Sand or Gravel)			
2	**Excavation Water Conditions** Dry Surface Water Present Submerged Water Present			
3	**Soil Condition** Undisturbed Disturbed Layered Soil Dipping into Excavation Excavation Exposed to Vibrations Cracked/Fissures/Spalling Observed			
4	**Additional Excavation Hazards** Surface Encumbrances(If YES - What Type) Hazardous Atmosphere in Excavation (If YES - List Source and Conditions)			

SOIL ANALYSIS - MANUAL TEST

RESULTS	THUMB TEST	Check here if conducted
	Type A - Soil identified by thumb with great degree of effort	
	Type B - Soil identified by thumb with some degree of effort	
	Type C - Soil identified by thumb with little degree or no effort	

RESULTS	PENETROMETER OR SHEARVANE Circle which used	Write in brand/model
	Type A - Soil with unconfined compressive strength of 1.5 tons per square foot (tsf) or greater	
	Type B - Soil with unconfined compressive strength > 0.5 to 1.5 tsf	
	Type C - Soil with unconfined compressive strength < 0.5 tsf or soil that is submerged or exposed to water	

Soil Classification

Type A	Type B	Type C

Selection of Protective System (Appendix F)

PROTECTIVE SYSTEM	Sloping Specify angle______________________ ______________ Timber shoring ______________ Aluminum hydraulic shoring ______________ Trench Shield Max Depth in this soil ______________

Note: Although OSHA will accept the above tests in most cases, some states do not - check your state safety requirements for trenching regulations.

REFERENCES

Agency for Toxic Substance and Disease Registry (ATSDR) (1990) Toxicological profile for benzo(b)fluoranthene. U.S. Public Health Service.

Amin, S., LaVoie, E.J. and Hecht, S.S. (1982) *Identification of metabolites of benzo(a)fluoranthene*. Carcinogenesis 3:171-174.

Amin, S., Huie, K., Hussaur, N., Geddie, J.E. and Hecht, S.S. (1985) *Mutagenicity and tumor initiating activity of methylated benzo(b)fluoranthenes*. Carcinogenesis 6:1023-1025.

Cooper, C.S., Grover, P.L. and Sims, P. (1983) *The metabolism and activation of benzo(a)pyrene*. In: Bridges, J.W., Chase, L.F. eds. Progress in drug metabolism, Vol.7. John Wiley and Sons, New York, pps. 295-395.

Deutsch-Wenzel, R.P., Brune, H., Grimmer, O., Dettbarn, G. and Misfield, J. (1983) *Experimental studies in rat lungs on the carcinogenicity and dose-response relationships of eight frequently occurring environmental polycyclic aromatic hydrocarbons*. J. Natl.Cancer Inst. 71:539-544.

Grover, P.L. (1986) *Pathways involved in the metabolism and activation of polycyclic aromatic hydrocarbons*. Xenobiotica. 16:915-931.

Hermann, M. (1981) *Synergistic effects of individual polycyclic aromatic hydrocarbons and the mutagenicity of their mixtures*. Mutat. Res. 90:399-409.

LaVoie, E.J., Amin, S., Hecht, S.S., Furuya, K. and Hoffmann, D. (1979) *On the metabolic activation of the environmental carcinogens benzo(j)fluoranthene and benzo(b)fluranthene*. Proc. Am. Assoc. Ca. 20:81.

LaVoie, E.J., Amin, S., Hecht, S.S., Furuya, K. and Hoffmann, D. (1982) *Tumour initiating activity of dihydrodiols of benzo(b)fluoranthene, benzo(j)fluoranthene, and benzo(k)fluoranthene*. Carcinogenesis 3:49-52.

Levin, W., Wood, A., Chang, R.L. et al. (1982) *Oxidative metabolism of polycyclic aromatic hydrocarbons to ultimate carcinogens*. Drug Metab. Rev. 13:555-580.

Mossanda, K., Poncelet, F., Fouassin, A. and Mercier, M. (1979) *Detection of mutagenic polycyclic aromatic hydrocarbons in African smoked fish*. Food Cosmet. Toxicol. 17:141-143.

Wynder, E.L. and Hoffmann, D. (1959) *The carcinogenicity of benzofluoranthenes*. Cancer 12:1194-1199.

BENZO[k]FLUORANTHENE

GENERAL BACKGROUND INFORMATION

Benzo[k]fluoranthene (BkF) is a member of the class of compounds referred to as polycyclic aromatic hydrocarbons (PAHs). PAHs contain two or more aromatic rings. PAHs are ubiquitous in nature and are both naturally occurring and man-made. Exposure to BkF can come from air, water, or soil. As a PAH, BkF is present in the emissions from industrial plants that produce coal tar, cooking plants, asphalt production plants, and home heating with wood and coal. BkF is also present in charcoal-broiled foods and cigarette smoke (ATSDR, 1990).

PHARMACOKINETICS

No data on the absorption, distribution or excretion of BkF were identified. BkF is believed to be metabolized to phenol and dihydrodiol metabolites (ATSDR, 1990). The general metabolic pathways elucidated for benzo[a]pyrene are believed to be active on BkF. As for the other PAHs, the material excreted is expected to consist primarily of dihydrodiol and phenol conjugates (Levin et al., 1982; Cooper et al., 1983; Grover et al., 1986).

HUMAN TOXICOLOGICAL PROFILE

The database for human toxicity is very limited. There are no studies correlating exposure to BkF and cancer or systemic toxicity. The only data implicating BkF as a carcinogen come from carcinogenicity studies using a mixture of PAHs.

MAMMALIAN TOXICOLOGICAL PROFILE

The database on the toxicity of BkF is limited. The skin tumor initiating ability of BkF has been demonstrated in mice using a standard initiation/promotion protocol with either croton resin or phorbol myristate acetate as tumor promotors (Van Duuren et al., 1966; LaVoie et al., 1982). Chronic dermal application of benzo[k]fluoranthene to mice resulted in no skin tumors, suggesting that BkF alone is not a complete carcinogen (Wynder and Hoffman, 1959).

GENOTOXICITY

The genotoxicity of BkF has not been documented in *in vitro* studies. In vivo, a single topical application of BkF was reported to bind to DNA in CD-1 mouse skin (Weyland et al., 1987). Covalent binding of chemicals to DNA can result in strand breaks and DNA damage, ultimately leading to mutations (ATSDR, 1990).

CHRYSENE

GENERAL BACKGROUND INFORMATION

Chrysene is one of the polycyclic aromatic hydrocarbon (PAH) compounds which are formed during the combustion of organic material. Chrysene often exists in particulate form, adsorbing to existing particulate material in air. Human exposure can occur in the workplace (coal and asphalt production plants, cooking plants, smoke houses) or in the environment due to chrysene contamination of air, food, soil and water (ATSDR, 1990).

PHARMACOKINETICS

Chrysene can be absorbed by all routes of exposure (see section on Relative Absorption Factors). Its absorption is believed to be qualitatively similar to benzo[a]pyrene (ATSDR, 1990). Following absorption, chrysene distributes to all organs, reaching the highest concentration in tissues with large fat content (adipose tissue, mammary tissue, brain) (Modica et al., 1983). Chrysene undergoes metabolic biotransformation mediated by the mixed function oxidase enzyme system to form reactive intermediates hypothesized to be responsible for its toxicity. The major metabolites include trans-dihydrodiols, phenols, diol epoxides and triol epoxides (Thakker et al., 1985). The reactive metabolites are conjugated and excreted primarily in feces (Schlede et al., 1970).

HUMAN TOXICOLOGICAL PROFILE

There is no information available on threshold toxic effects of chrysene in humans. Since it is structurally similar to benzo[a]pyrene, it would be expected to produce effects similar to B[a]P following acute or chronic exposure (see Toxicity Profile on Benzo[a]pyrene).

MAMMALIAN TOXICOLOGICAL PROFILE

There is no information available on threshold toxic effects of chrysene in animals. Since it is structurally similar to benzo[a]pyrene, it would be expected to produce effects similar to B[a]P following acute or chronic exposure (see Toxicity Profile for Benzo[a]pyrene).

GENOTOXICITY

The genotoxicity of chrysene has been evaluated in in vivo and in vitro cytogenetic tests. Chrysene produced weak positive results in bacterial mutation assays, human epithelial mutation studies, cell transformation assays and in vivo cytogenetic studies (Waters et al., 1987). Metabolism of chrysene is essential to produce the observed positive responses. Chrysene is not genotoxic in all test systems, however, it is believed to be a weak mutagen (ATSDR, 1990). The carcinogenicity of chrysene has not been adequately studied. There are no reports directly correlating human chrysene exposure and tumor development. There is limited evidence that chryesene is a skin carcinogen in animals following long-term dermal application (Wynder and Hoffmann, 1959; Hecht et al., 1974).

DIBENZO[a,h]ANTHRACENE

GENERAL BACKGROUND INFORMATION

Dibenzo[a,h]anthracene is a member of the polycyclic aromatic hydrocarbons (PAH). PAHs are a class of compounds which are non-polar and contain two or more aromatic rings. They are ubiquitous in nature and are both naturally occurring and man-made. The data regarding dibenzo[a,h]anthracene are very limited. As a PAH, it is found in tobacco smoke, food, and the emissions from industrial or natural burning.

PHARMACOKINETICS

Dibenzo[a,h]anthracene is metabolized similarly to benzo(a)pyrene (ATSDR, 1990). However, while the metabolic profiles of these two compounds (and other alternant PAHs) are qualitatively similar, there are differences in the levels and rates of formation of specific metabolites among tissues and cell preparations used. Sanders et al (1986) applied ^{14}C - dibenzo[a,h]anthracene to the shaved backs of mice. After 24 hours, the majority of activity was recovered from the application site, with the remainder from body tissues and excreta. In comparison, benzo(a)pyrene similarly applied was found predominantly in the excreta and body tissues, with the remainder at the application site.

HUMAN TOXICOLOGICAL PROFILE

The database for the toxicological effects of dibenzo[a,h]anthracene on humans, separate from other PAHs, is limited. Toxic effects attributable to mixtures of PAHs include a variety of skin lesions and non-cancer lung diseases such as bronchitis (IARC, 1973).

MAMMALIAN TOXICOLOGICAL PROFILE

Dibenzo[a,h]anthracene has been shown to induce skin tumors in lab animals (i.e. it is a complete carcinogen) following dermal exposure (Wyndner and Hoffman, 1959; Van Duuren et al, 1967; and Lijinsky et al, 1965). Dibenzo[a,h]anthracene ahs also demonstrated tumor initiation activity (Slaga et al. 1980).

Carcinogenic PAHs as a group has immunosupprssive effects, with the degree of immunosuppression correlated with carcinogenic potency (ATSDR, 1990). Dibenzo[a,h]anthracene was also tested for developmental effects via parenteral routes and was found to produce fetolethal effects in rats (Wolfe and Bryan, 1939).

GENOTOXICITY

Dibenzo[a,h]anthracene is mutagenic (Barfknecht et al, 1982; Rocchi et al, 1980) and produces DNA damage (Martin et al, 1978) in cultured human cells. Test results in nonhuman systems were also positve (ATSDR, 1990).

FLUORANTHENE

GENERAL BACKGROUND INFORMATION

Fluoranthene is a member of the polyaromatic hydrocarbons (PAH). PAHs constitute a class of non-polar compounds that contain two or more aromatic rings. They are ubiquitous in nature and are both naturally occurring and man-made. Fluoranthene has been detected in food, cigarette smoke, and smoke from industrial and natural burning.

PHARMACOKINETICS

No data were found regarding the pharmacokinetics of fluoranthene.

HUMAN TOXICOLOGICAL PROFILE

The database for the toxicological effects of fluoranthene on humans, separate from other PAHs, is limited. Toxic effects attributable to mixtures of PAHs include a variety of skin lesions and non-cancer lung diseases such as bronchitis (IARC, 1973).

MAMMALIAN TOXICOLOGICAL PROFILE

The database on the toxicity of fluoranthene is limited. A 13 week subchronic study where CD-1 mice were gavaged with up to 500 mg/kg-day of fluoranthene indicated nephropathy, increased liver weights, hematological alterations and clinical effects (EPA, 1988). A developmental study in which fluoranthene was administered once via intraperitoneal injection to pregnant mice reported only an increased rate of embryo resorption (Irvin and Martin, 1987).

Chronic dermal application of up to 1 percent fluoranthene to the backs of mice did not induce skin tumors following lifetime application (Hoffman et al, 1972; Horton and Christian, 1974; and Wydner and Hoffman, 1959a). Fluoranthene is not a complete carcinogen (ATSDR, 1990) and does not exhibit iniation activity (Hoffman et al, 1972).

GENOTOXICITY

There is some evidence that fluoranthene is genotoxic (ATSDR, 1990). Genotoxic effects have been reported in human cells with exogenous metabolic activation, but negative results were recorded without metabolic activation.

FLUORENE

GENERAL BACKGROUND INFORMATION

Fluorene is a member of the polyaromatic hydrocarbons (PAH). PAHs constitute a class of non-polar compounds that contain two or more aromatic rings. They are ubiquitous in nature and are both naturally occurring and man-made. The data on fluorene are very limited. Low levels of (5 to 67 ug/kg) have been detected in smoked meats (U.S. EPA, 1982).

PHARMACOKINETICS

No data were found regarding the pharmacokinetics of fluorene.

HUMAN TOXICOLOGICAL PROFILE

The database for the toxicological effects of fluoranthene on humans, separate from other PAHs, is limited. Toxic effects attributable to mixtures of PAHs include a variety of skin lesions and non-cancer lung diseases such as bronchitis (IARC, 1973).

MAMMALIAN TOXICOLOGICAL PROFILE

Limited information is available on the threshold effects of fluorene. An EPA study (EPA,1989) indicated that CD-1 mice exposed by gavage to up to 500 mg/kg-day of fluorene showed hypoactivity as well as a decrease in red blood cell count and packed cell volume and hemoglobin. Increases in absolute and relative liver, spleen and kidney weights was also observed. Gershbein (1975) reported that partially hepatectomized rats fed a diet of 180 mg/kg-day of fluorene for 10 days showed a statistically significant increase in liver regeneration, which is indicative of the ability to induce a proliferative response.

Fluorene is not reported to be a complete skin carcinogen (ATSDR, 1990). It was inactive as a tumor initiator when an estimated total dose of 1.0 mg was applied prior to the application of tetradecanoyl phorbol acetate (LaVoie et al, 1980).

GENOTOXICITY

There is no evidence that fluorene is genotoxic, but genotoxicity has been studied only in a few in vitro assays (ATSDR, 1990).

INDENO[1,2,3-cd]PYRENE

GENERAL BACKGROUND INFORMATION

Indeno[1,2,3,-cd]pyrene is a member of the polyaromatic hydrocarbons (PAH). PAHs constitute a class of non-polar compounds that contain two or more aromatic rings. They are ubiquitous in nature and are both naturally occurring and man-made. Indeno[1,2,3-cd]pyrene is present in cigarette smoke (IARC, 1983) as well as emissions from industrial stacks.

PHARMACOKINETICS

No data were found regarding the pharmacokinetics of indeno[1,2,3-cd]pyrene. However, its metabolism should be similar to another non-alternant PAH, benzo(b)fluoranthene (ATSDR, 1990).

HUMAN TOXICOLOGICAL PROFILE

The database for the toxicological effects of indeno[1,2,3-cd]pyrene on humans, separate from other PAHs, is limited. Toxic effects attributable to mixtures of PAHs include a variety of skin lesions and non-cancer lung diseases such as bronchitis (IARC, 1973).

MAMMALIAN TOXICOLOGICAL PROFILE

Studies on laboratoyr animals have demonstrated that indeno[1,2,3-cd]pyrene can induce skin tumors (i.e. it is a complete carcinogen) following dermal exposure (ATSDR, 1990).
It has tumor initiating activity, but is not as potent as benzo(b)fluoranthene (Rice et al, 1985).

Carcinogenic PAHs as a group are immunosuppressant, with the degree of suppression correlated with the degree of potency (ATSDR, 1990)

GENOTOXICITY

In test systems using non-human cells, indeno[1,2,3-cd]pyrene was found to be genotoxic (ATSDR, 1990).

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR) (1990) Toxicological profile for polycyclic aromatic hydrocarbons. U. S. Public Health Service.

International Agency for Research on Cancer (IARC) (1983) *Monograph on the evaluation of carcinogenic risk of chemicals to man, Indeno(1,2,3-cd)pyrene*. 32:419-430.

Rice, J.E. et al. (1985) *On the metabolism, mutagenicity and tumor-initiating activity of ideno(123cd)pyrene*. In: Cooke, M. Dennis, A.J. eds. Polynuclear aromatic hydrocarbons: metabolisms, methods and metabolism. Proceedings of the Eighth International Symposium. Columbus, Ohio: Battelle Press, 10970-1109.

NAPHTHALENE

GENERAL BACKGROUND INFORMATION

Naphthalene is a white solid substance at room temperature. It has a distinct odor of mothballs or tar. Humidity and sunshine cause evaporation into the air within a few hours. When placed in water or soil, bacteria will destroy naphthalene, or will render it airborne within a few hours (ATSDR, 1990). Tobacco smoke is known to release 3 ug of naphthalene per cigarette (U.S. EPA, 1982). The compound is used in the production of dyes, solvents, lubricants, motor fuels (U.S. EPA, 1980) and is a major component of many moth ball preparations.

PHARMACOKINETICS

Humans can absorb naphthalene by dermal, inhalation and oral routes (see section on Relative Absorption Factors). Metabolism occurs via the P450 mixed function oxidase enzyme system to yield multiple intermediates which are then conjugated. Key metabolites are responsible for each toxicity endpoint following intraperitoneal administration: 2-naphthoquinones --> hemolysis; 1,2-naphthoquinones --> cataracts; 3-GSH adducts --> pulmonary toxicity (Buckpitt et al., 1984). Excretion of metabolites occurs via urine and feces (ATSDR, 1990).

HUMAN TOXICOLOGICAL PROFILE

Adults and children exposed to airborne naphthalene experience vomiting, abdominal pain and anemia (ATSDR, 1990). Most of the data is for inhalation of naphthalene from mothballs. The primary site of toxicity is the erythrocyte resulting in hemolytic crisis (hemolytic anemia). Jaundice is seen upon dermal, inhalation, and oral exposures, as are kidney effects (ATSDR, 1990). Near-blindness resulted in male and female subjects with 5 gram ingestion (ATSDR, 1990).

MAMMALIAN TOXICOLOGY PROFILE

Oral doses in rats have hepatic effects. Dogs (1800 mg/kg) for 5 days of exposure showed signs of lethargy and ataxia, and decreased hemoglobin levels (ATSDR, 1990)

GENOTOXICITY

No studies of genotoxic effects in humans or laboratory animals were located. No human epidemiological evidence for cancer.
Inconclusive evidence for cancer in rats and mice were found (ATSDR, 1990).

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR) (1990) Toxicological profile for naphthalene 2-methylnapthalene. U.S. Public Health Service.

Buckpitt, A. and Richieri, P. (1984) Comparative biochemistry and metabolism: Part 2. Naphthalene lung toxicity. Wright-Patterson Air Force Base, OH: Air Force Systems Command, Aerospace Medical Division. Air Force Aerospace Medical Research Laboratory. AFAMRL-TR-84-058.

U.S. Environmental Protection Agency (U.S. EPA) (1980) Ambient water quality criteria for polycyclic aromatic hydrocarbons. Office of Emergency and Remedial Response. Washington, DC.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR) (1990) Toxicological profile for polycyclic aromatic hydrocarbons. U. S. Public Health Service.

Higgins, L. and Yang, Y. (1962) *Induction and extinction of mammary cancer.* Science 137:257-262.

International Agency for Research on Cancer (IARC) (1983) *Monograph on the evaluation of carcinogenic risk of chemicals to man, Phenanthrene.* 32:419-430.

LaVoie, K. et al. (1981) *Mutagenicity and tumor initiating activity and metabolism of phenanthrenes.* Cancer Res. 41:3441-3447.

Rahman, A., Barrowman, J.A., Rahimtula, A. (1986) *The influence of bile on the bioavailability of polynuclear aromatic hydrocarbons from the rat intestine.* Can J Physio Pharmacol 64:1214-1218.

Roe, F.J.C. (1962) *Effect of phenanthrene on tumour-initiation by 3,4-benzpyrene.* Br J Cancer 16:503-506.

Sax, N.I. (1984) Dangerous Properties of Industrial Materials. 6th edition. Van Nostrand Reinhold Company. N.Y.

Simmon, P. et al. (1979) *Mutagenic activity of chemicals carcinogens and related compounds in the intraperitoneal host-mediated assay.* J. Natl. Cancer Inst. 62:911-918.

Wood, R. et al. (1979) *Mutagenicity and tumorigenicity of phenanthrene and chrysene epoxides and diol epoxides.* Cancer Res. 39:4069-4077.

Yoshikawa, T. et al. (1987) *Toxicity of polycyclic aromatic hydrocarbons III. Effects of beta-naphtoflavone pretreatment on hepatotoxicity of compounds produced in the ozonation or NO2-nitration of phenanthrene and pyrene by rats.* Vetern Human Toxicol. 29:113-117.

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Material Safety Data Sheets Collection

Benzo(a)pyrene **MSDS No. 164**

Date of Preparation: 2/94

Section 1 - Chemical Product and Company Identification 43

Product/Chemical Name: Benzo(a)pyrene
Chemical Formula: $C_{20}H_{12}$; a polynuclear aromatic hydrocarbon
CAS No.: 50-32-8
Synonyms: BaP; 3,4-benz(a)pyrene; BP; 3,4-benzopyrene; 3,4-benzpyrene. Formerly called 1,2-benzpyrene.
Derivation: Synthesized from pyrene and succinic anhydride.
General Use: Benzo(a)pyrene is no longer used or produced commercially in the US. In its pure form, benzo(a)pyrene may be used as a research laboratory reagent. It also occurs in combustion products of coal, oil, petroleum, wood and other biological matter; in motor vehicle and other gasoline and diesel engine exhaust; in charcoal-broiled foods; in cigarette smoke and general soot and smoke of industrial, municipal, and domestic origin. It occurs naturally in crude oils, shale oils, coal tars, gases and fly ash from active volcanoes and forest fires. **Vendors:** Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Benzo(a)pyrene, ca 100 %wt; except in laboratories, benzo(a)pyrene is usually mixed with other coal tar pitch chemicals. Consider exposure limits for coal tar pitch volatiles as a guideline. However, because benzo(a)pyrene is considered a probable carcinogen to humans, it is recommended that exposures to carcinogens be limited to the lowest feasible concentration.

OSHA PELs
Coal tar pitch volatiles
8-hr TWA: 0.2 mg/m^3

ACGIH TLVs
A2: Suspected Human Carcinogen

NIOSH REL
10-hr TWA: 0.1 mg/m^3
Carcinogen; coal tar pitch volatile, cyclohexane extractable fraction.

DFG (Germany) MAK
None established

IDLH Level
700 mg/m^3
Coal tar pitch volatiles (benzene soluble fraction)

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Benzo(a)pyrene is a pale yellow, crystalline solid or powder that is irritating to the skin, eyes, and respiratory tract. It is a carcinogen and mutagen. Handle with extreme caution!

Wilson Risk Scale

R	1
I	4
S	4
K	1

HMIS

H	2*
F	1
R	0

* Chronic Effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion. **Target Organs:** Respiratory system, bladder, kidneys, skin.
Acute Effects: Inhalation: Respiratory tract irritation. **Eye:** Irritation and/or burns on contact. **Skin:** Irritation with burning sensation, rash, and redness; dermatitis on prolonged exposure. Sunlight enhances effects (photosensitization). **Ingestion:** None reported.
Carcinogenicity: IARC, NTP, NIOSH, ACGIH, EPA, and MAK list benzo(a)pyrene as: an IARC 2A (probably carcinogenic to humans: limited human evidence, sufficient evidence in experimental animals), an NTP-2 (reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals), a NIOSH-X (carcinogen defined with no further categorization); an ACGIH TLV-A2 (suspected human carcinogen: carcinogenic in experimental animals, but available epidemiological studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans); an EPA-B2 (sufficient evidence from animal studies, inadequate evidence or no data from epidemiological studies); and an MAK-A1 (capable of inducing malignant tumors as shown by experience with humans) carcinogen, respectively.
Medical Conditions Aggravated by Long-Term Exposure: Respiratory system, bladder, kidney, and skin disorders.
Chronic Effects: Inhalation: Cough and bronchitis. **Eye:** Photosensitivity and irritation. **Skin:** Skin changes such as thickening, darkening, pimples, loss of color, reddish areas, thinning of the skin, and warts. Sunlight enhances effects (photosensitization). **Other:** Gastrointestinal (GI) effects include leukoplakia (a pre-cancerous condition characterized by thickened white patches of epithelium on mucous membranes, especially of the mouth). Cancer of the lung, skin, kidneys, bladder, or GI tract is also possible. Smoking in combination with exposure to benzo(a)pyrene increases the chances of developing lung cancer. Persons with a high degree of inducibility of the enzyme aryl hydrocarbon hydroxylase may be a high risk population.
Comments: Pregnant women may be especially susceptible to exposure effects of benzo(a)pyrene; exposure may damage the fetus. In general, polyaromatic hydrocarbons such as benzo(a)pyrene tend to localize primarily in body fat and fatty tissues (for ex. breasts) and are excreted in breast milk. Benzo(a)pyrene may also affect the male reproductive system (testes and sperm).

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

annual basis for employees 45 yr of age or older or with 10 or more years of exposure to coal tar pitch volatiles. Train workers about the hazards of benzo(a)pyrene and the necessary protective measures to prevent exposure. Periodically inspect lab atmospheres, surfaces such as walls, floors, and benches, and interior of fume hoods and air ducts for contamination. Post appropriate signs and labels on doors leading into areas where benzo(a)pyrene is used.

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. The following respirator recommendations are for coal tar pitch volatiles. For any unknown concentration, wear any SCBA with a full facepiece and operated in a pressure-demand or other positive pressure mode, or any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive pressure mode. For escape, wear any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter, or any appropriate escape-type SCBA. 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), wear 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 to prevent prolonged or repeated skin contact. In animal laboratories, wear protective suits (disposable, one-piece and close-fitting at ankles and wrists), gloves, hair covering, and overshoes. In chemical laboratories, wear gloves and gowns. Wear protective eyeglasses or chemical safety, gas-proof goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

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

Contaminated Equipment: Shower and change clothes after exposure or at the end of the workshift. Separate contaminated work clothes from street clothes. Launder before reuse. Remove benzo(a)pyrene from your shoes and clean personal protective equipment. Use procedures to ensure laundry personnel are not exposed.

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: Solid

Appearance and Odor: Pale yellow monoclinic needles with a faint, aromatic odor.

Vapor Pressure: >1 mm Hg at 68 °F (20 °C)

Formula Weight: 252.30

Specific Gravity (H_2O=1, at 4 °C): 1.351

Water Solubility: Insoluble; 0.0038 mg (+/- 0.00031 mg) in 1 L at 77 °F (25 °C)

Other Solubilities: Ether, benzene, toluene, xylene, concentrated hydrosulfuric acid; sparingly soluble in alcohol, methanol.

Boiling Point: >680 °F (>360 °C); 540 °F (310 °C) at 10 mm Hg

Melting Point: 354 °F (179 °C)

Octanol/Water Partition Coefficient: log Kow= 6.04

Section 10 - Stability and Reactivity

Stability: Benzo(a)pyrene is stable at room temperature in closed containers under normal storage and handling conditions. It undergoes photo-oxidation when exposed to sunlight or light in organic solvents and is also oxidized by chromic acid and ozone.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Strong oxidizers (chlorine, bromine, fluorine) and oxidizing chemicals (chlorates, perchlorates, permanganates, and nitrates).

Conditions to Avoid: Avoid heat and ignition sources and incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo(a)pyrene can produce carbon monoxide and carbon dioxide.

Section 11- Toxicological Information

Toxicity Data:*

Tumorigenic Effects:

Rat, oral: 15 mg/kg produced gastrointestinal and musculoskeletal tumors.

Mouse, inhalation: 200 ng/m^3/6 hr administered intermittently over 13 weeks produced tumors of the lungs.

Rabbit, skin: 17 mg/kg administered intermittently over 57 weeks produced tumors of the skin and appendages.

Teratogenicity:

Rat, oral: 2 g/kg administered 28 days prior to mating and 1-22 days of pregnancy produced a stillbirth.

Rat, oral: 40 mg/kg on the 14th day of pregnancy caused changes in the extra embryonic structures.

Mouse, oral: 75 mg/kg administered to the female during the 12-14 day of pregnancy produced biochemical and metabolic effects on the newborn.

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Material Safety Data Sheets Collection:

Sheet No. 757
Coal Tar Creosote

Issued: 7/91

Section 1. Material Identification

34

Coal Tar Creosote (molecular formula varies with purity) Description: Three main derivations: by distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking. It typically contains up to 160 chemicals, mainly aromatic compounds such as phenol, pyrol and pyridine. Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, hop defoliant, and lubricant for die molds; in manufacturing chemicals; and in medicine as an antiseptic, disinfectant, antipyretic, astringent, germicide, and styptic.

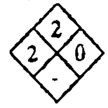
Other Designations: CAS No. 8001-58-9, Awpa,® brick oil, Caswell No. 225,® coal tar oil, creosote, creosote oil, creosotum, cresylic creosote, heavy oil, liquid pitch oil, naphthalene oil, Preserv-o-sote,® Sakresote,® tar oil, wash oil.

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

Cautions: Flammable, liquid coal tar creosote is toxic by inhalation, ingestion, and skin contact. The IARC and NTP classify it as *a human carcinogen.*

R 1
I 4
S 4*
K 2
* Skin absorption

NFPA



HMIS
H 2
F 2
R 0
PPG†
† Sec. 8

* Skin absorption can occur with phenol, a major component of coal tar creosote.

Section 2. Ingredients and Occupational Exposure Limits

Coal tar creosote, ca 100%

1990 OSHA PEL
8-hr TWA: 0.2 mg/m³*

1987 IDLH Level
700 mg/m³

1990-91 ACGIH TLV
TWA: 0.2 mg/m³*

1990 NIOSH REL
0.1 mg/m³ (cyclohexane extractable portion)

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 725 mg/kg; toxic effects not yet reviewed
Dog, oral, LD_{Lo}: 600 mg/kg; toxic effects not yet reviewed
Rat, TD_{Lo}: 52,416 mg/kg administered during 91 days prior to mating produces reproductive effects on fallopian tubes and ovaries
Mouse, skin, TD_{Lo}: 99 g/kg produces tumors in skin and appendages

* As coal tar pitch volatiles.
† See NIOSH, *RTECS* (GF8615000), for additional mutation, reproductive, tumorigenic, and other toxicity data.

Section 3. Physical Data

Boiling Point: 381 to 752 °F (194 to 400 °C)
Distillation Range: 446 to 554 °F (230 to 290 °C)
Heat of Combustion: -12,500 Btu/lb
Heat of Vaporization: 107 Btu/lb

Molecular Weight: Varies with purity
Density/Specific Gravity: 1.07 to 1.08 at 68 °F (20 °C)
Water Solubility: Slightly soluble

Appearance and Odor: Pure coal tar creosote is colorless, but the industrial product is a yellow to black oily liquid with an aromatic smoky smell and a burning caustic taste.

Section 4. Fire and Explosion Data

Flash Point: 165.2 °F (74 °C), CC	**Autoignition Temperature:** 637 °F (336 °C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog or regular foam. Since water is least effective, use it as an extinguishing agent only when the preferred measures are unavailable. However, use water spray to cool fire-exposed containers.

Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Containers may explode in heat of fire. Coal tar creosote presents a vapor explosion hazard indoors, outdoors, and in sewers.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Fully decontaminate or properly dispose of personal protective clothing.

Section 5. Reactivity Data

Stability/Polymerization: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.

Conditions to Avoid: Avoid excessive heat and contact with chlorosulfonic acid.

Hazardous Products of Decomposition: Thermal oxidative decomposition of coal tar creosote can produce oxides of carbon and thick, black, acrid smoke.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA list coal tar creosote as a carcinogen.
Summary of Risks: Coal tar creosote is toxic by inhalation, ingestion, and skin contact. It contains a variety of hydrocarbons such as phenol and polycyclic aromatic hydrocarbons such as benzo[a]pyrene, benzanthracene, and phenol derivatives. The range of toxicity depends on the exposure concentration, amount, and duration. Effects may include irritation, burns, and several forms of cancer.
dical Conditions Aggravated by Long-Term Exposure: Chronic respiratory or skin diseases.
get Organs: Eyes, skin, bladder, kidneys, and respiratory system.
imary Entry Routes: Inhalation, ingestion, and skin contact.
Acute Effects: Skin contact may cause irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and small bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur. Inhalation may be irritating to the respiratory tract. Eye contact may cause conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. Ingestion may result in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress, and shock. Systemic absorption by any route (including skin absorption) may cause trouble breathing, thready (continuous or drawn out) pulse, dizziness, headache, nausea, vomiting, salivation, and convulsions. Exposure to large doses (particularly by ingestion) may be fatal.
Chronic Effects: Dermatitis, skin cancer, and lung cancer.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* let victim rub eyes or keep them tightly closed. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Wash affected area with soap and flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of milk or water. *Do not induce vomiting!*
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Cresol may be detected in urine.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources–no flares, smoking, or flames in hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If possible with no risk, stop leak. Water spray may be used to reduce vapor but it may not prevent ignition in closed spaces. 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 liquid spill for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: Coal tar creosote is fouling to shoreline. Ecotoxicity values are: TL_{50}, goldfish (*Carassius auratus*), 3.51 ppm/24 hr (60:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
Disposal: 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), Hazardous Material No. U051
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
isted as a SARA Toxic Chemical (40 CFR 372.65)

IA Designations

d (as coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since 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 NIOSH-approved respirator. 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.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact. Applying a layer of petroleum jelly or lanolin castor oil ointment to the face reduces vapor contact and penetration through skin. Frequent change of protective garments is an additional protective measure.
Ventilation: Provide general and local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since 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: Take particular care to avoid any contamination of drains or ventilation ducts. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
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: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area. Store coal tar creosote as close to area of use as possible to minimize transporting distance.
Engineering Controls: Use engineering controls to keep airborne concentrations below the OSHA PEL. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Always perform synthesis and purification procedures under a vertical ventilation hood and make regular operational safety checks. Label doors to rooms where coal tar creosote is produced, used, or stored as containing a carcinogen. Locate emergency equipment at well-marked and clearly identified stations in case emergency escape is necessary.
Other Precautions: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about coal tar creosote's carcinogenicity and proper handling procedures to avoid exposure.
Other Comments: Caution is in order when handling or sawing old creosote-treated lumber since it retains a considerable portion of creosote for up to 25 to 30 years.

Transportation Data (49 CFR 172.101)

T Shipping Name: Creosote
T Hazard Class: Flammable liquid
No.: UN1136
DOT Label: Flammable liquid

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 142, 143, 146, 148, 153, 159

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Mark Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 469
Fuel Oil No. 2

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification

33

Fuel Oil No. 2 Description: A mixture of petroleum hydrocarbons; a distillate of low sulfur content. Fuel oil no. 2 resembles kerosine. Used as a general-purpose domestic or commercial fuel in atomizing-type burners; as a fuel for trucks, ships and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.
Other Designations: CAS No. 68476-30-2, diesel oil.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*$^{(73)}$ for a suppliers list.

Cautions: Fuel oil No. 2 is a skin irritant and central nervous system depressant with high mist concentrations. It is an environmental hazard and a dangerous fire hazard when exposed to heat, flame, or oxidizers.

R 1
I -
S 2
K 2

NFPA
2
0 0
-

HMIS
H 0
F 2
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 2*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data†
None established	None established	None established	Rat, oral, LD_{50}: 9 g/kg; produces gastrointestinal effects (hypermotility, diarrhea)

* A complex mixture (<95%) of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons; sulfur content (<0.5%); and benzene (<100 ppm). {A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)}.
† Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 363 to 634 °F (184 to 334 °C)
Water Solubility: Insoluble
Viscosity: 268 centistoke at 100 °F (37.8 °C)
Pour Point:* <21 °F (-6 °C)
Specific Gravity: 0.8654 at 59 °F (15 °C)
Appearance and Odor: Brown, slightly viscous liquid.

*Pour point is the lowest temperature at which a liquid flows from an inverted test container.

Section 4. Fire and Explosion Data

Flash Point: 100 °F (38 °C) min.
Autoignition Temperature: 494 °F (257 °C)
LEL: 0.6% v/v
UEL: 7.5% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, foam, water fog or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire.
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. This fuel oil's volatility is similar to gasoline's.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to health and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Fuel oil no. 2 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of fuel oil no. 2 yields various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon dioxide, carbon monoxide, and sulfur dioxide.

Section 6. Health Hazard Data

Carcinogenicity: Although it has not assigned an overall evaluation to fuel oil No. 2, the IARC has evaluated distillate (light) fuel oils as not classifiable as human carcinogen (Group 3; animal evidence limited).

Summary of Risks: Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and time of exposure. Since intestinal absorption of longer chain hydrocarbons is lower than bsorption from lighter fuels, a lesser degree of systemic effects and more diarrhea may result. When removed from exposed area, affected rsons usually experience complete recovery. Hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, ay result if oil is aspirated into the lungs. These results are more likely when vomiting after ingestion rather than upon ingestion, as is often the case with lower viscosity fuels. A comparative ratio of oral-to-aspirated lethal doses may be 1 pt vs. 5 ml. Prolonged or repeated skin contact may cause irritation of the hair follicles and may block the sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Central nervous system (CNS), skin, and mucous membranes.

Primary Entry Routes: Inhalation, ingestion.

Acute Effects: Systemic effects from ingestion include gastrointestinal (GI) irritation, vomiting, diarrhea, and, in severe cases, CNS depression, progressing to coma and death. Inhalation of aerosol or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish coloration of the skin and mucous membranes caused by deficient blood oxygenation).

Chronic Effects: Repeated contact with the skin causes dermatitis.

FIRST AID

Eyes: Gently lift the 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. If large areas of the body are exposed or if irritation persists, get medical help immediately. Wash affected 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. If ingested, *do not induce vomiting* due to aspiration hazard. Contact a physician immediately.

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

Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Fuel oil no. 2 is an environmental hazard. Report large spills.

Disposal: 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 261.21): Ignitable waste
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
ARA Toxic Chemical (40 CFR 372.65): Not listed

HA Designations

r Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with mist filter and organic vapor cartridge. 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.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since 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: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

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: Use and storage conditions should be suitable for an OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in areas of storage or use.

Engineering Controls: Avoid prolonged skin contact and vapor or mist inhalation. Use only in a well-ventilated area with personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Fuel oil

DOT Hazard Class: Combustible liquid

ID No.: NA1993

DOT Label: None

T Packaging Exceptions: 173.118a

T Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 103, 126, 127, 132, 133, 136, 143

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Material Safety Data Sheets Collection:
Sheet No. 34
Ozone

Issued: 8/78 Revision: C, 9/92

Section 1. Material Identification

Ozone (O_3) Description: Occurs in the atmosphere from UV light action on oxygen at high altitudes where it acts as an atmospheric shield against UV light penetration. Derived by passage of air or oxygen between electrodes across which is maintained an alternating high voltage potential, or by heating silver difluoride in a dilute aqueous acid. It may also be found as a by-product in welding arcs, in corona discharges by ultraviolet radiation and around high voltage equipment. Ozone's largest use is as an oxidizing agent in azelaic acid production. Also used as a disinfectant for air and water; in bleaching textiles, paper pulp, waxes, starch, and sugar; organic synthesis, processing certain perfumes, vanillin, camphor, peroxide production, rapid drying of varnish and printing inks; for mold and bacteria control in cold storage rooms, and refining mineral oils and their derivatives. Considered for deodorizing and disinfecting certain premises and purifying air with a high carbon monoxide concentration such as found in garages. However this use is controversial because of the high levels of ozone needed and the inherent hazards.

Other Designations: CAS No. 10028-15-6, triatomic oxygen

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

Cautions: A powerful oxidizing agent, ozone is highly chemically reactive and extremely shock sensitive as a liquid or solid. Inhalation produces various degrees of respiratory effects from irritation to pulmonary edema (fluid in lungs) as well as affecting the eyes, blood, and central nervous system. Liquid ozone on contact with skin or mucous membranes produces severe burns.

Gas

Genium		HMIS	
R	1	H	3*
I	4	F	0
S	-	R	1
K	0	PPE†	

Genium: 0, 3, 1, OX

* Chronic effects
† Sec. 8

Liquid

Genium		HMIS	
R	3	H	1*
I	4	F	0
S	4	R	3
K	0	PPE†	

Genium: 0, 2, 3, OX

* Chronic effects
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Ozone, ca 100%

1991 OSHA PELs
8-hr TWA: 0.1 ppm (0.2 mg/m^3)
15-min STEL: 0.3 ppm (0.6 mg/m^3)

1990 IDLH Level
10 ppm

1990 NIOSH REL
Ceiling: 0.1 ppm (0.2 mg/m^3)

1992-93 ACGIH TLV
Ceiling: 0.1 ppm (0.2 mg/m^3)

1990 DFG (Germany) MAK
TWA: 0.1 ppm (0.2 mg/m^3)
Category 1: local irritant
Peak Exposure Limit: 0.2 ppm, 5 min momentary value, 8 per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 1860 ppb/75 min caused watering eyes, decreased pulse rate with a fall in blood pressure, and cough.
Human, inhalation, TC_{Lo}: 1 ppm caused cough, difficulty breathing, and other changes.
Rat, inhalation, TC_{Lo}: 1500 ppb/24 hr (17 to 20 days of pregnancy) produced behavioral disorders in newborn.
Rat, inhalation, TC_{Lo}: 1040 ppt/24 hr (6 to 9 days of pregnancy) caused developmental abnormalities of the musculoskeletal system.

* See NIOSH, *RTECS* (RS8225000), for additional irritation, mutation, reproductive and toxicity data.

Section 3. Physical Data

Boiling Point: -169 °F (-111 °C)
Melting Point: -315 °F (-193 °C)
Vapor Pressure: > 1 atm
Vapor Density (Air = 1): 1.655
Refraction Index: 1.2226 (liquid)
Odor Threshold: 0.0076 to 0.25 ppm
Molecular Weight: 48
Density: 1.614 g/mL (*liquid*) at -319 °F (-195.4 °C), 2.144 g/L (*gas*) at 32 °F (0 °C)
Water Solubility: Very slightly soluble, 0.49 mL/100 mL at 32 °F (0 °C)
Other Solubilities: Soluble in alkaline solvents.
Ionization Potential: 12.52 eV

Appearance and Odor: Unstable bluish gas [> -169 °F (-112°C)], dark blue liquid [-169 to -315 °F (-112 to 192.5°)], or blue-black crystals [< 315 °F (-192.5°C)], with a pungent odor.

Section 4. Fire and Explosion Data

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

Extinguishing Media: Use extinguishing agents suitable for surrounding fire.

Unusual Fire or Explosion Hazards: Container may explode in heat of fire. Decomposition of ozone into oxygen can increase strength 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. If possible without risk, remove container from fire area. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ozone is unstable at normal temperatures and readily decomposes to biatomic oxygen. In its liquid and solid forms, ozone exploded violently when shocked, exposed to heat or flame, or by chemical reaction with reducing agents. Hazardous polymerization cannot occur. Ozones' stability in aqueous solutions decreases as alkalinity increases but this is reversed at high alkaline concentrations. For example, ozones' half-life is 2 min at 1 N sodium hydroxide but 83 hr at 20 N sodium hydroxide.

Chemical Incompatibilities: Ozone accelerates decomposition of rubber and reacts with non-saturated organic compounds to produce ozonides which are unstable and may decompose with explosive violence. It is incompatible with acetylene, alkenes, alkyl metals, benzene, aniline, bromine, charcoal + potassium iodide + friction, isopropylidene compounds, dicyanogen, diethyl ether, *t*-2,3-dichloro-2-butene; 1,1-difluoroethylene; hydrogen bromide; 2-methyl-1,3-butadiene; nitrogen, nitrogen oxide, nitrogen trichloride, fluoroethylene, liquid hydrogen (with solid O_3), ethylene (at -238 °F/- 150 °C), (carbon monoxide, ammonia, or phosphine at 32 or -108 °F/0 or -78 °C), liquid oxygen difluoride + gaseous hydrogen, silica gel, stibine (at -130 °F/-90 °C), tetrafluorohydrazine, and all other reducing materials, organic or inorganic.

Conditions to Avoid: Shock, exposure to heat or flame and contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of ozone can produce oxygen.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list ozone as a carcinogen.

Summary of Risks: Ozones' toxic effects are largely due to its strong oxidative ability. It has a radiomimetic structure (like ionizing radiation) and therefore has no true threshold limit and no exposure (no matter how small) is 'theoretically' without effect. Since it is only slightly water soluble it does not solubilize in the mucous membranes along the respiratory tract but rather passes straight to the smallest......

Continue on next page

Section 6. Health Hazard Data, *continued*

brochioles and alveoli. Exercise increases inhaled ozones' toxicity. Initial small exposures may reduce cell sensitivity and/or increase mucous thickness producing an adaptation to low levels of ozone. This is shown by the greater reaction of newly exposed individuals as compared with those previously exposed to similar levels. Industrial exposures are most likely due to leakage from ozone-using processes and from exposure to high-voltage electrical equipment and electric-arc welding.

dical Conditions Aggravated by Long-Term Exposure: Respiratory disorders.

get Organs: Blood, respiratory and central nervous systems.

rimary Entry Routes: Inhalation and skin contact (with liquid ozone).

Acute Effects: Inhalation can cause nose, throat, and respiratory tract irritation, cough, difficulty breathing, visual disturbances, watering eyes, headache, decreased pulse rate with a fall in blood pressure, incoordination, chest pain, substernal soreness, and fatigue. By analogy to animals, severe exposures cause hemorrhage, pulmonary edema (fluid in lungs), and death. Human tissue and animal studies have shown blood changes (disk to spherical RBC shape, thus allowing easier hemolysis), chromosomal changes and reproductive effects. Cell membrane damage has been shown in heavily exposed animals where eventual tissue death can form a characteristic lesion at the junction of the conductive airways and gas exchange lung region, a site expected to be similarly affected in humans. Skin contact with liquid ozone can cause frostbite.

Chronic Effects: Repeated exposure may cause breathing disorders through respiratory tract scarring or premature aging as seen in continued exposure to ionizing radiation.

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: If frostbite occurs, rapidly rewarm in 107.6 °F (42°C) until completely recovered.

Inhalation: Remove exposed person to fresh air, support breathing, and administer 100% humidified oxygen as needed.

Ingestion: Highly unlikely since ozone is a gas until -169 °F.

Note to Physicians: Detection of lactate dehydrogenase in the blood may indicate increased lung permeability due to ozone damage. Administration of 100% oxygen may be all that is needed to relieve symptoms. Persistent hypoxia may require endotracheal intubation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. If leak can not be repaired in place, remove cylinder to safe, open area and repair or allow to empty. Cleanup personnel need to protect against gas inhalation or skin contact with the liquid (extremely cold). Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Environmental Data: Ozone contributes to photochemical smog formation. By limiting the emission of air pollutants converted to ozone, such as reactive hydrocarbons and nitrogen oxides, atmospheric ozone concentrations would decrease.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.23): No. D003,
Characteristic of reactivity *(as liquid or solid ozone)*
Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 100 lb
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant
(29 CFR 1910.1000, Table Z-1-A)
Listed as a Process Safety Hazardous Chemical
(29 CFR 1910.119), RQ: 100 lb

sted "Unlisted Hazardous Waste, Characteristic of reactivity" as a CERCLA zardous Substance* (40 CFR 302.4, *as liquid or solid ozone*): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001]

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, 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 < 1 ppm, use a supplied-air respirator (SAR) or SCBA. For < 2.5 ppm, use a SAR operated in continuous-flow mode or powered air-purifying respirator with suitable chemical cartridges. For < 5 ppm, use a SAR or SCBA with a full facepiece. For < 10 ppm, use a SAR operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. Seals and tubing used in respirator gear should be oxidation resistant. *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 cryogenically (severe cold) protective gloves, boots, aprons, and gauntlets to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the 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 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 containers in refrigerated areas away from reducing agents and flammable materials such as iron, copper, or chromium that may catalyze decomposition. Suitably insulate all electrical equipment and electrically ground and bond all equipment used in ozone manufacture, use, storage, transfer, and shipping. **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. Enclose or equip with exhaust ventilation, processes employing ozone to capture any escaping gas at the source. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on the respiratory tract. Chest x-rays and pulmonary function tests (FEV& FVC) are advisable. Workers handling liquid O_3 should protect against severe cold (cryogenic materials).

Transportation Data (49 CFR 172.101)

DOT Name: Compressed liquefied gas, n.o.s.; zone A
DOT Hazard Class: 2.3
ID No.: UN1955
T Packaging Group: ---
T Label: Poison Gas
pecial Provisions: (172.102): 1

Packaging Authorizations
a) Exceptions: None
b) Nonbulk Packaging: 173.192
c) Bulk Packaging: 173.245

Quantity Limitations
a) **Passenger, Aircraft, or Railcar:** Forbidden
b) **Cargo Aircraft Only:** Forbidden

Vessel Stowage Requirements
Vessel Stowage: D
Other: 40

MSDS Collection References: 26, 73, 89, 100, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 163, 164, 167, 171, 174, 175, 180

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD

PERFORMANCE ▲ COMMITMENT ▲ INTEGRITY

PCI OZONE & CONTROL SYSTEMS, INC
A Subsidiary of PCI, Inc.

ONE FAIRFIELD CRESCENT
WEST CALDWELL, N.J. 07006 USA
(201) 575-7052
FAX: (201) 575-8941

MATERIAL SAFETY DATA SHEET

OZONE

SECTION I

Manufacturer Name: PCI OZONE & CONTROL SYSTEMS, INC.
Manufacturer of Ozone Generator Systems.
Emergency phone number: 201-575-7052
Address: 1 Fairfield Crescent, West Caldwell, New Jersey 07006

Chemical Family: Gaseous Oxident
Chemical Formula: 03

SECTION II

Hazardous Ingredients:

OZONE - 2% by weight in dry air
3% by weight in oxygen

SECTION III

Physical Data:
Melting Point: Centigrade -251
Boiling Point: Centigrade -111
Water Solubility - 14 mg/l from 2% ozone in air
Appearance and odor at ambient temperature and pressure:
Clear colorless gas with pungent odor.

SECTION IV

Fire and Explosion Hazard Data:

Ozone is most often generated from air at concentrations of 1-10% by weight. At these concentrations ozone is non-explosive. Ozone at these concentrations will support combustion only slightly better than air itself. Firefighting equipment would be any equipment suitable for fighting fires suitable for other hazards.
If high ozone concentrations are present.
Self contained breathing apparatus should be used.

PERFORMANCE ▲ COMMITMENT ▲ INTEGRITY

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Material Safety Data Sheet
Page 2

8/98 PEZ

incorrect

0.1 PPM PEZ

0.1PPM = 0.20 mg/m³ + m³/10³l

.0002 mg/l

SECTION V

Health Hazard Data

Threshold limit value: 0.12 mg/l in air for a weighted 8 hour exposure according to O.S.H.A.
Effects of exposure: coughing, headaches, loss of appetite, drowsiness, inflammation of upper respiratory track.
Emergency and first aid procedures:
Remove from air containing ozone: administer oxygen, if necessary.

SECTION VI

Stability: Slowly decomposes to oxygen from which it was made.
Conditions to avoid: Concentrating ozone to high levels (20%) where its reactivity and rate of decomposition accelerates.
Incompatability: Most organic materials are ozone reactive. Reactivity increases with materials which are saturated.

SECTION VII

Leak Procedures:
Procedure in case ozone is released: Leave area and remove ozone by exhausting the atmosphere.

SECTION VIII

SPECIAL PROTECTION INFORMATION

Respiratory protection: Self-contained breathing apparatus approved by U.S.Bureau of Mines is adequate if used for a short period of time.

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Page 3
MSDS

Ventilation: Use in well ventilated areas if leaks are anticipated.
Protective gloves: Plastic rather than rubber.
Other Protective Equipment: Plastic suits.

SECTION IX
Special Precautions:

Precautions to be taken in handling: Do not attempt to produce pure or high concentrations of ozone. If leaks are anticipated use only in well
ventilated areas.

SECTION X

Primary route of entry is by the pulmonary system.

OTHER/msds

No. 409A

CRESYLIC ACID

Date December 1979

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CRESYLIC ACID

OTHER DESIGNATIONS: "Cresol", GE Material D5J3, CAS #001 319 773 (Cresol),
CAS #001 300 716 (Xylenol)

DESCRIPTION: Commercial mixtures of phenolic compounds of which at least 50% boils higher than 204 C (arbitrary standard; see Ref. 7) and which vary widely depending on b.p. and source.

MANUFACTURE: Material available from several suppliers, including Koppers Co., Inc., Organic Materials Division.

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	x	HAZARD DATA
Composition of Cresylic Acid Mixtures:		
Phenol (MSDS #355)	ca 0-8	8-hr TWA 5 ppm (skin)* or 19 mg/m^3
Cresol Isomers (MSDS #409)	<50	8-hr TWA 5 ppm (skin)* or 22 mg/m^3
Xylenol Isomers, Ethyl Phenol Isomers and C_9 Phenolics	>50	No TLV established**

*ACGIH (1979) and OSHA TLV.

**For regulatory purposes NIOSH has proposed that mixtures of xylenols with cresols be considered "cresols"; also NIOSH has proposed a 10-hr TWA of 2.3 ppm or 10 mg/m3 as the airborne exposure limit for both "cresols" and cresylic acids.

SECTION III. PHYSICAL DATA

Boiling range at 1 atm, deg C ---- 195-250*

Specific gravity (H_2O=1)---- 1.02-1.04

Vapor pressure at 50 C, mm Hg ---- <1*

Melting point, deg C ------- 0 to 50*

Water solubility -------------- Sl. Soluble

Appearance & Odor: Phenolic odor. Varied appearance: Mostly liquids but also slurries or solid depending on composition. Colorless to highly colored, depending on impurity.

*Illustrative property only; actual data depends on the composition of the individual cresylic acid.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
Usually >200 F				

Extinguishing Media: Foam, dry chemical, carbon dioxide, and water spray or fog. Cool fire-exposed metal containers with a water spray.

This combustible material can be a moderate fire hazard and a slight explosion hazard when exposed to heat or flame.

Toxic vapors and gases are emitted from this material in a fire situation; firefighters must wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This material is stable under conditions of normal handling and use. It does not underg hazardous polymerization. Its properties are analogous to phenol and cresol, but it has a higher molecular weight.

This combustible material is incompatible with strong oxidizing agents; it can react exothermically with strong bases, with oleum, nitric acid, and chlorosulfonic acid.

Thermal-oxidative degradation will produce toxic vapors and gases, including carbon monoxide.

Hot cresylic acid readily attacks copper, aluminum, magnesium, zinc and lead. Ordinary carbon steel resists corrosion satisfactorily, but use stainless steel to retain high purity. It will dissolve or soften many organic polymers.

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 470

DIESEL FUEL OIL NO. 2-D

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DIESEL FUEL OIL NO. 2-D
DESCRIPTION: Mixture of petroleum hydrocarbons; a distillate oil of low sulfur content
OTHER DESIGNATIONS: ASTM D975, CAS # 068 476 346
MANUFACTURER: Available from many suppliers

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Diesel Fuel Oil No. 2-D Complex mixture of paraffinic, olefinic, naphthenic and aromatic hydrocarbons**	>95	8-hr TWA 5mg/m^3* (mineral oil mist)
Sulfur content	<0.5	
Benzene***	<100 ppm	

*Current OSHA standard and ACGIH (1981) TLV

**Diesel fuels tend to be low in aromatics and high in paraffinics. A min. Cetane No. of 40 is required (ASTM D613).

***A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028).

SECTION III. PHYSICAL DATA

Boiling point range, deg F, -------	Ca 340-675	Specific gravity (H_2O=1) ----	<0.86
Solubility in water ---------------	negligible	Cloud point (wax), deg C ---	Ca 0
Viscosity at 40 C, cSt -----------	1.9-4.1		

Appearance and Odor: Clear, bright liquid with a mild petroleum odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
125F min (PM)	>500F	% by volume	0.6	7.5

Extinguishing Media: Dry chemical, carbon dioxide, foam, water spray. Use a water spray to cool fire exposed containers. Use a smothering technique for extinguishing fire of this combustible liquid. Do not use a forced water stream directly on oil fire as this will only scatter the fire. Material is a OSHA Class II combustible liquid.
Firefighters should wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Thermal -oxidative degradation may yield various hydrocarbons and hydrocarbon derivatives (partial oxidation products), CO_2 and CO and SO_2.

SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 oil (~~mist~~) (See Sect II)

Inhalation of excessive concentrations of vapor or mist can be irritating to the respiratory passages and can cause the following symptoms: headache, dizziness, nausea, vomiting, and loss of coordination. Prolonged or repeated skin contact may cause irritation of the hair follicles and block the sebaceous glands. This produces a rash of acne pimples and spots, usually on the arms and legs. (Good personal hygiene will prevent this).

Chemical pneumonitis may result when ingestion occurs and oil is aspirated in the lungs.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids.

Skin Contact: Remove contaminated clothing. Wipe excess oil off with a dry cloth. Wash affected area well with soap and water.

Inhalation: Remove to fresh air. Restore and/or support breathing as required.

Ingestion: Do not induce vomiting.

Seek medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.

Provide adequate ventilation. Clean-up personnel to use protection against liquid contact and vapor or mist inhalation. Contain spill by diking. Small spills can be contained by using absorbants, such as rags, straw, polyurethane foam, activated carbon, and sand. Clean up spills promptly to reduce fire or vapor hazards.

DISPOSAL: May be disposed of by a licensed waste disposal company, or by controlled incineration or burial in an approved landfill.

Follow Federal, State and Local regulations. Report large oil spills.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate ventilation where operating conditions (heating or spraying) may create excessive vapors or mists. Use explosion-proof equipment. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter & vapor respirator when vapor/mist concentrations are high. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist conc. may occur. Additional suitable protective clothing may be required depending on working conditions. An eyewash fountain and washing facilities to be readily available near handling and use areas.

Launder soiled or contaminated clothing before reuse (at least weekly laundering of work clothes is recommended) .

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from sources of open flame, heat, strong oxidizing agents, and ignition. Protect containers from physical damage. Use non sparking tools and explosion-proof electrical equipment. Prevent static electric sparks.

Avoid prolonged skin contact and breathing of vapors or mists.

No smoking in areas of use. Follow good hygienic practice in the use of this material. Do not wear oil contaminated clothing. Do not put oily rags into pockets. Wash exposed skin areas several times a day with soap and warm water when working with this material. DOT Classification: COMBUSTIBLE LIQUID

DATA SOURCE(S) CODE: 1,6,7,12

APPROVALS: MIS CRD

Industrial Hygiene and Safety 10-12-81

MEDICAL REVIEW: 21.October 1981

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

NO. 488

KEROSINE BURNER FUEL

DATE November 1982

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: KEROSINE BURNER FUEL*

DESCRIPTION: Refined petroleum middle distilate consisting of hydrocarbons having ~10-16 carbon atoms for use in burners and wick-fed lamps.

OTHER DESIGNATIONS: Kerosene Burner Fuel, Coal Oil, Range Oil, ASTM D3699, CAS #008 008 206.

MANUFACTURER: Available from many suppliers.

*The spelling "kerosine" is preferred by ASTM and ACS. See also Kerosene Solvent, MSDS #387

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Hydrocarbon Mixtures (variable) consisting of paraffins (mainly), naphthenes, olefins & aromatics	>98	No TLV Established*
Total Sulfur Content, max.		
Kerosine No. 1-K Low Sulfur Grade ---------------------	0.04	
Kerosine No. 2-K Regular Grade ------------------------	0.30	
(Flue connection required for burners for 2-K use.)		
Mercaptan Sulfur, max.	30 ppm	Rat, Oral LDLo 28 g/kg
*Exposure limits depend on components (variable); get supplier recommendation for product. NIOSH (1977) recommended 10-hr TWA of 100 mg/m^3 or about 14 ppm for kerosene with b.p. 347-617 F.		

SECTION III. PHYSICAL DATA

Boiling range, deg C at 1 atm ----	175-300	Specific gravity (H_2O=1) --	ca 0.8
Vapor pressure at 20 C, mm Hg ----	ca 5	Freezing point, deg C ---	below -30
Vapor density (Air=1) -------------	ca 4.5	Viscosity at 40 C, cSt ----	1.0-1.9
Solubility in water --------------	insoluble		

Appearance & Odor: Pale yellow or water-white, mobile, oily liquid; mild petroleum odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
100F (min) (CC)	>410F	Volume %	ca 0.8	ca 6

Extinguishing Media: Dry chemical, carbon dioxide, foam, water spray or fog. Use a smothering technique for extinguishing fire. A forced stream of water could scatter flames of burning kerosine. Flammable vapors will be emitted from heated liquid.

Use a water spray (Caution!) to cool fire-exposed containers to prevent violent rupture. Water runoff to sewer may carry combustible kerosine and create a fire or explosion hazard.

Firefighters should use self-contained breathing apparatus and protective clothing.

SECTION V. REACTIVITY DATA

This material is stable in closed containers at room temperature under normal storage and handling conditions. It does not polymerize. Heating greatly increases the flammability hazard of this OSHA Class II combustible liquid.

Kerosine is incompatible with strong oxidizing agents.

Thermal-oxidative degradation can yield partial oxidation products, hydrocarbons, carbon monoxide and dioxide, and small amounts of sulfur dioxide (depending on sulfur content).

EXHIBIT A-E

AIR MONITORING FORM
DAILY INSTRUMENT CALIBRATION CHECK FORM
NOISE MONITORING FORM

AIR MONITORING FORM

Project Name:

Project Number:

Contaminants:

Date	Time	Ionization Detector Reading		Explosimeter Reading		Detector Tube Readings (ppm)	Location	Purpose	Initials
		FID	PID	%LEL	$\%O_2$				

AIR MONITORING FORM

Project Name:

Project Number:

Contaminants:

Date	Time	Ionization Detector Reading		Explosimeter Reading		Detector Tube Readings (ppm)	Location	Purpose	Initials
		FID	PID	%LEL	%O_2				

DAILY INSTRUMENT CALIBRATION CHECK FORM

Project Name____________________ Instrument____

Job Number____________________ **ID #**____

DATE	INSTRUMENT	BATTERY CHECK OK?	ZERO ADJUST OK?	CALIBRATION GAS (PPM)	READING (PPM)	CALIBRATED BY:	COMMENTS

rev9-96

FLUOR DANIEL GTI

DAILY INSTRUMENT CALIBRATION CHECK FORM

Project Name____________________ Instrument____

Job Number____________________ **ID #**____

DATE	INSTRUMENT	BATTERY CHECK OK?	ZERO ADJUST OK?	CALIBRATION GAS (PPM)	READING (PPM)	CALIBRATED BY:	COMMENTS

NOISE MONITORING FORM

Project Name:

Project Number:

Noise: Equipment Used: (Type/Model)*

Date	Task	Location/Employee	Noise Reading dB(A)	Initials

*Pre-calibrate noise monitor prior to conducting noise survey.

NOISE MONITORING FORM

Project Name:

Project Number:

Noise: Equipment Used: (Type/Model)*

Date	Task	Location/Employee	Noise Reading dB(A)	Initials

*Pre-calibrate noise monitor prior to conducting noise survey.

EXHIBIT A-F

EXCAVATION/TRENCHING SAFETY PROCEDURES
TRENCH SAFETY DAILY FIELD REPORT
SOILS CLASSIFICATION CHECKLIST
SOILS ANALYSIS CHECKLIST
EXCAVATION/TRENCHING - UNDERGROUND UTILITIES
UNDERGROUND UTILITY CONTACT PREVENTION AND MANAGEMENT PLAN
EXCAVATION/TRENCHING - USTs
UST REMOVALS

ATTENTION:

THE TRENCH SAFETY DAILY FIELD REPORT FORM MUST BE COMPLETED AT LEAST DAILY DURING EXCAVATION/TRENCHING OPERATIONS AND MORE FREQUENTLY IF CONDITIONS CHANGE.

EXCAVATION/TRENCHING SAFETY PROCEDURES

Evaluation: Conducted by Competent Person 29 CFR 1926.

Two soil classifications must be completed to determine sloping/shoring requirements. Conduct daily inspections of all open excavations prior to entry.

Egress: Excavation areas 4 feet (1.22 meters) or more deep

Ladders must be spaced no more than 25 feet (7.62 meters) apart so that a person in the trench is always within 25 feet (7.62 meters) of a ladder for egress.

Shoring: Excavation areas 5 feet (1.52 meters) or more deep.

Excavations must be sloped or shored if personnel will be entering the excavation. Soil classification may be done only by a competent person using both a visual and manual test.

WARNING: One soil classification may not be enough. Outside disturbances during excavation may change even the best classification.
Inspect the soil after any condition change.

Storage: All excavations

Spoils and heavy equipment must be stored a minimum of 2 feet (0.61 meters) from the edge of the excavation.
Store spoils on the downhill side.

Maximum Allowable Slopes

Soil or Rock Type	Maximum allowable slopes (H:V)[1] for excavations less than 20 feet (6.10 meters) deep[2]	
Stable Rock[3]	Vertical (90°)	
Type **A** - highly cohesive soil	3/4:1	(53°)
Type **B** - cohesive soil with some sand	1:1	(45°)
Type **C** - loose, wet, or sandy soil	1½:1	(34°)

Notes:

[1] Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

[2] Sloping or benching for excavations greater than 20 feet (6.10 meters) deep shall be designed by a registered professional engineer.

[3] A short-term maximum allowable slope of ½ H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 meters) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 meters) in depth shall be 3/4 H:1V (53°)

TRENCH SAFETY DAILY FIELD REPORT

DATE:__________________

Project Name:____
Project Manager:______________________________________
Weather Conditions:

I hereby attest that the following conditions existed and that the following items were checked or reviewed during this inspection.

INSPECTION ITEM	YES	NO	NA
All open trenches were inspected.			
Were any tension cracks observed along top of any slopes?			
Was any water seepage noted on trench walls or trench bottom?			
Was bracing system installed in accordance with design?			
Type shoring being used____________________.			
Is shoring secure?			
Was there evidence of shrinkage cracks in trench walls?			
Was there any evidence of caving since the last field inspection?			
Trench box(s) certified with tabulated data?			
Traffic in area adequately away from trenching operations with barricades			
Surface encumbrances and other hazards in area accounted for?			
Protective measures taken for standing water in trench.			
All site personnel wearing reflective vest.			
Atmospheric testing conducted in trenched < 4 feet deep.			
Vibrations from equipment or traffic too close to trenching operation?			

Observations:____

Competent Person signature__________________________________

Soils Analysis Checklist

This checklist must be completed when soil analysis is conducted to determine the excavation soil type. A separate analysis must be performed on each layer of soil excavation walls. Additional soil analysis must also be performed for the excavation (trench) when it stretches over a distance where soil type may change.

Name:________________________ Date:__________ Time:________

Competent person:________________________

Where was the sample taken from?________________________

Excavation: Depth________________________ Width__________ Length________

SOIL CLASSIFICATION - VISUAL TEST

ITEM	TEST PROTOCOL	YES	NO	COMMENTS/ACTIONS
1	**Soil Particle Type** Fine Grained/Cohesive Course Grained(Sand or Gravel)			
2	**Excavation Water Conditions** Dry Surface Water Present Submerged Water Present			
3	**Soil Condition** Undisturbed Disturbed Layered Soil Dipping into Excavation Excavation Exposed to Vibrations Cracked/Fissures/Spalling Observed			
4	**Additional Excavation Hazards** Surface Encumbrances(If YES - What Type) Hazardous Atmosphere in Excavation (If YES - List Source and Conditions)			

SOIL ANALYSIS - MANUAL TEST

RESULTS	THUMB TEST	Check here if conducted
	Type A - Soil identified by thumb with great degree of effort	
	Type B - Soil identified by thumb with some degree of effort	
	Type C - Soil identified by thumb with little degree or no effort	

RESULTS	PENETROMETER OR SHEARVANE - Circle which used:	Write in brand/model
	Type A - Soil with unconfined compressive strength of 1.5 tons per square foot (tsf) or greater	
	Type B - Soil with unconfined compressive strength > 0.5 to 1.5 tsf	
	Type C - Soil with unconfined compressive strength < 0.5 tsf or soil that is submerged or exposed to water	

Soil Classification

Type A	Type B	Type C

Selection of Protective System (Appendix F)

PROTECTIVE SYSTEM

Sloping Specify angle____________________

____________ Timber shoring

____________ Aluminum hydraulic shoring

____________ Trench Shield Max Depth in this soil ____________

Note: Although OSHA will accept the above tests in most cases, some states do not - check your state safety requirements for trenching regulations.

Documentation:

Contact the local utility service (Digsafe, Misutility...), and document permit number
A company utility representative in questionable areas, elaborate trenching projects tight/tricky areas or whenever drilling adjacent to a building or structure
Contact the property owner and/or town building department for plans

Physical Location:

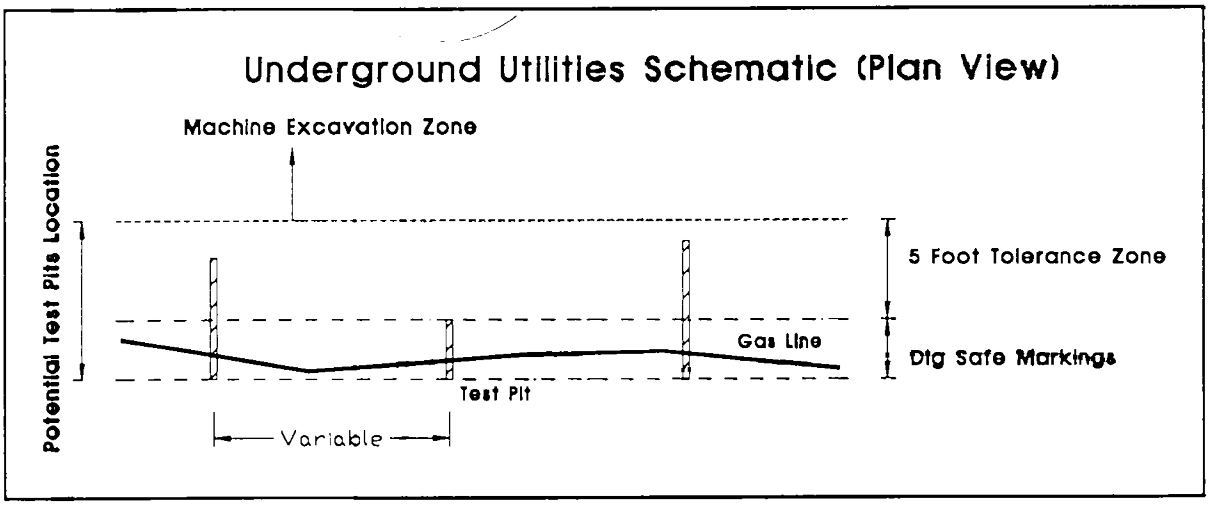
Use a metal detector to aid in the identification of obstructions
Observe utility markers, vent pipes, catch basins, newly paved areas, etc.

Safety Procedures:

Machine excavate five feet from any underground utility, tank, or utility marker
Hand dig in utility "five-foot tolerance zone" until the service is exposed
Utilize test pits to establish and QC markers for sensitive utility locations

General Notes:

Comply with local and state codes and regulations
Utilize experienced and trained equipment operators
Use appropriate subcontractors and applicable insurance riders
Hand dig per customer mandate



UTILITY MARK-OUT RECORD SHEET

Facility:____________________________ Location:____________________________

Fluor Daniel GTI Representative:______________________ Date Called:__________________

County of Work:______________________ Township of Work:______________________

Contact Miss Dig to have subgrade utilities marked. The nearest intersecting street for this site is: ________________. We need the entire site area marked since we do not know exactly where we will be drilling/excavating. The site needs to be marked by:____________________________

List which utilities they will have marked. Confirmation Number:____________________________

List other known utilities in the area that they do not mark:____________________________

Contact other known utilities not contracted by Miss Dig to have them mark the site.

____

MAJOR UTILITIES MARKED BY COLOR CODE

ELECTRIC - RED

OTHER CONTACTS:

GAS - YELLOW

COMMUNICATIONS/CABLE - ORANGE

WATER - BLUE

SEWER - GREEN

IMPORTANT NOTE: ALL UNDERGROUND UTILITIES MAY NOT BE LOCATED BY MISS DIG.

UNDERGROUND UTILITY CONTACT PREVENTION AND MANAGEMENT PLAN

Check Off When Completed

STEPS	TASK DESCRIPTION	RESPONSIBLE EMPLOYEE
STEP 1	Obtain site blueprints from client, if available, to show buried utility/conduits.	PM
	If site blueprints are unavailable **other methods should be employed to identify subsurface conduits in the field. Examples include privately contracted utility locators such as SM&P, a hand-held utility location device, field observations (cut pavement, signs and overhead lights, water, electric, and gas meters, etc.), and customer personnel with knowledge of conduit locations. No one tool should be relied upon. Instead, as many tools as practicable should be employed to insure that all known/suspect conduits have been identified.**	PM and/or field personnel
	Mark out any proposed digging locations with white survey paint.	
STEP 2	Contact underground utility locating service (before you dig). Give proposed drilling dates, location, etc. **Documented notification of the proper underground notification service at a minimum of 48 or 72 hours prior to the scheduled site work.* (Check with the state for notification requirements).**	PM Assistant for contacting "miss dig" and/or field personnel
	If possible, arrange site visit with client, facilities maintenance manager, or other site knowledgeable person to verify, utility and drilling/excavation locations.	PM
	Regarding subcontractors: at a minimum, excavation subcontractors will be required to supply sufficient labor to complete all requested installation tasks.	PM
STEP 3	**The HASP will be amended to include emergency telephone numbers for all utility companies identified during the notification process.**	Office safety coordinator updates HASP with PM approval.

UNDERGROUND UTILITY CONTACT PREVENTION AND MANAGEMENT PLAN (continued)

STEPS	TASK DESCRIPTION	RESPONSIBLE EMPLOYEE
STEP 4	On the day that on-site activities are scheduled to begin, at the first tailgate safety meeting, the locations of all known/suspect utilities (subgrade and overhead) will be reviewed with all personnel in the field (Fluor Daniel GTI and subcontractors).	PM and/or field personnel
	Make sure that all underground utility locator markings are visible for each noted utility, etc. Note any discrepancies. Visually inspect for undocumented trenches, laterals, etc. that may be visible as discolored areas, patched pavement, and not marked accordingly.	PM and/or field personnel
STEP 5	Pre-screen each drilling/digging location by hand augering and/or post hole digger to a depth of at least 3 to 5 feet using a 3-inch OD minimum clam-shell style post hole digger and/or hand auger. Inspect excavation periodically with flashlight to check for visual obstructions. Discontinue immediately upon encountering any substantial resistance to hand auger and/or post hole digger.	Subcontractors to conduct hand augering and/or post hole digging under Fluor Daniel GTI oversight.
STEP 6	During excavation/trenching activities, barricades and cones with flags will be used to mark the 10-foot distance from a located conduit. This will serve as a reminder of the conduit's presence and to alert the Fluor Daniel GTI supervisor that it is time to pay close attention to excavation/trenching activities.	Field personnel

UNDERGROUND UTILITY CONTACT PREVENTION AND MANAGEMENT PLAN (continued)

STEPS	TASK DESCRIPTION	RESPONSIBLE EMPLOYEE
STEP 7 ENCOUNTER	In the unlikely event that a subsurface utility/conduit is encountered, immediately halt all drilling/digging operations and secure the area. Try to determine the source (i.e., gas line, water line, etc.) and contact the emergency numbers for that utility. Contact the PM immediately. Take all safety precautions to insure that all flames, etc. are extinguished, and all personnel are kept away from the area. Monitor for LEL, O_2, PID, and any other substances that may be present as appropriate for that utility encounter (i.e., gas line).	Fluor Daniel GTI field personnel secures area and contacts PM immediately.
	The PIR is filled out by field personnel and submitted to the PM.	PM contacts client, etc., to discuss appropriate actions. Fluor Daniel GTI field personnel contacts local emergency officials as necessary (i.e., fire, police, EPA, public works, etc.). PM submits PIR to appropriate Fluor Daniel GTI management and prepares follow-up report.

EXCAVATION/TRENCHING - UST

Documentation:

Refer to existing UST plans for potential location.
Contact property owners for potential location.
Contact local Fire or Building Department for information.

Physical Location Characteristics: Cross-check to existing documentation, if available

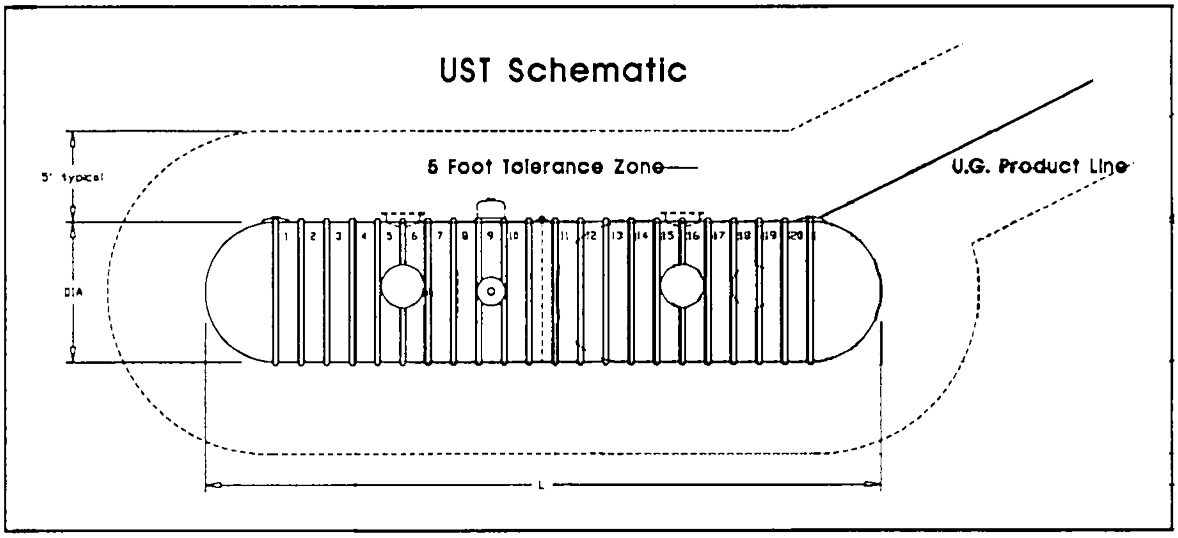
Determine tank capacity (from tank chart, owner, delivery records).
Determine tank opening locations and spacing.
Determine tank diameter (from tank chart, inventory records or gauge stick).
Determine if tank is fiberglass or steel; single walled or double walled
Refer to available UST vendor info charts on standard USTs for dimensions and tank opening locations.

Safety Procedures:

Empty tank of flammable liquids prior to excavation activities. Inert tank of flammable vapors and eliminate ignition sources (if practical).
Drill no closer than five feet from suspected tank location or other nearby underground utilities.

General Notes:

Concrete pad on top of the USTs is sized to overhang the footprint of the tanks by 1 to 2 feet in each direction. Beware of exceptions.
When possible, have the owner/client mark the locations for drilling and accept responsibility for potential mishaps in writing.
Redundant information cross-checking to reduce oversight errors
Visual inspection of augured or excavated materials for pre-gravel, etc., indicative of UST backfill/bedding.



UST Schematic

UST REMOVALS*

Minimum Action	Site Set-Up	Precautions
1. Ignition sources must be eliminated 2. Designate a **no smoking** zone or area. 3. Use pneumatic/nonsparking tools when appropriate. 4. Define the work area with barricades and hazard tape. 5. Contact local underground utility locating service: Check location of all utilities including water and sewer. 6. Wear Level D PPE: hard hat, safety glasses, steel-toed and shank boots, and traffic vest. Upgrade to modified Level D when possibility of contact to skin or work uniform can occur. Upgrade to Level C when air monitoring reveals action levels have been exceeded. This applies to all on-site personnel including subcontractors. 7. Perform air monitoring with an oxygen/combustimeter and an organic vapor analyzer at frequent intervals.	1. Ground vacuum truck. 2. Park vacuum truck downwind of excavation. 3. Vent vacuum truck vapors at least 12 feet from the ground surface; refer to the American Petroleum Institute (API) recommendations for greater clearance requirements. 4. Inert the tank with dry ice (1½ lbs. dry ice per 100 gallons tank capacity) or nitrogen. 5. Wear Level B PPE when cleaning tank interiors when indicated by HSR.	1. Verify tank inerting has been accomplished by measuring oxygen to be less than 8%. 2. Monitor LEL and organic vapors frequently in areas around tanks during removal process. **Note: LEL measurements taken in oxygen deficient atmospheres (e.g., in inerted tanks) will not be accurate.** 3. Check local/state requirements for tank removal/disposal regulations. 4. Assist subcontractor in performing tasks according to the HASP. 5. Notify the PM **immediately** when a sub-contractor will not follow site specific safety protocols. The PM must inform the client.

* Refer to Fluor Daniel GTI's UST Safety Training Manual for detailed information.

EXHIBIT A-G

CSE HAZARD ANALYSIS FORM
SITE-SPECIFIC CONFINED SPACES
CSE PERMIT
CONFINED SPACE PERSONNEL REQUIREMENTS

Fluor Daniel GTI, Inc.
CSE
Hazard Analysis Form

Site Name:________________________________

Site Address:________________________________

CSE Name/Number:________________________________

CSE Definition: Vault
Pit
Tank/Vessel
Other________________

CSE Dimensions:

Length =________________

Width =________________

Depth =________________

Sketch:

Tasks/Activity/Reasons for Entry:

- Well Gauging
- Bailing Product
- Pump Maintenance
- Well Sampling
- Product Recovery
- ________________

Potential hazards within space:

- Oxygen Deficiency
- Combustible Vapors
- Toxic Vapors
- Engulfment
- No Hazards

Other CSE Hazards:

- Greater than 5' deep
- Difficult access/egress
- Energy/isolation*
- Prone to flooding
- Slippery surface
- Hot surfaces (i.e., pipes)

*Check here if LO/TO must be performed inside confined space.

FOR USE BY AUTHORIZED CSE SUPERVISOR
CSE Classification

Class I________________

Class II________________

Class III________________

Requirements:

Completed by:________ Date________

Reviewed by:________ Date________

SITE-SPECIFIC CONFINED SPACES

Site work may require personnel to enter confined spaces. **No Fluor Daniel GTI employee or subcontractor shall enter an area identified as a confined space without using the CSE procedures described in this appendix and completing the site specific entry procedures presented in the CSE Permit.** The purpose of the CSE procedure is to protect employees from potentially hazardous environments and to facilitate immediate rescue in an emergency situation. A CSE Permit must be posted at the entrance to each confined space.

CONFINED SPACES

Definition

A confined space has limited or restricted means of entry or exit, is large enough for an employee to enter and perform assigned work, and is not designed for continuous occupancy by the employee.

Examples

These spaces may include, but are not limited to, underground vaults, tanks, storage bins, pits and diked areas, vessels, and silos.

Characteristics

A permit-required confined space is one that meets the definition of a confined space and has one or more of these characteristics:

Contains or has the potential to contain a hazardous atmosphere,
Contains a material that has the potential for engulfing an entrant,
Has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section, and/or
Contains any other recognized serious safety or health hazards.

Protocol for CSE

Personnel trained to conduct CSE procedures.
Perform the appropriate air monitoring activity at various depths in the space prior to entry.
Monitor for: (1) oxygen level, (2) flammable vapors, and (3) toxic vapors.
Ventilate the atmosphere in the space so that entry may be made safe without respiratory protection. If this is not feasible, appropriate respiratory protection must be worn by authorized entrants and attendants.
Wear appropriate respiratory protection when ventilation alone can not achieve acceptable atmospheric levels of oxygen or flammable or toxic vapors.
Have appropriate retrieval equipment worn by employees in the event of a mishap.

SITE-SPECIFIC CONFINED SPACES

Location	Permit Required (Y or N)	Buddy Required (Y or N)	Specific Entry Procedures

CSE PERMIT

This permit must be completed prior to entering any confined space and is **ONLY VALID FOR THE DATE AND TIME INDICATED ON THIS FORM.** All procedural requirements contained in Fluor Daniel GTI Health and Safety Policy and Procedure No. 11 must be followed. In the event a confined space emergency situation develops and rescue is required, notify the following appropriate emergency services:

Ambulance:__________________ Fire:__________________ Police:__________________

Purpose of entry:__________________ Location of confined space:__________________

Date:__________________ Authorized duration:__________________ Expires on:__________________

Atmospheric Hazards: ☐ Oxygen Deficiency ☐ Flammable ☐ Toxic ☐ Other__________ ☐ Other__________

Physical Hazards: ☐ Mechanical ☐ Electrical ☐ Chemical ☐ Engulfment ☐ Other__________

PRE-ENTRY REQUIREMENTS

Yes N/A
- ☐ ☐ Entry area is free of debris and objects
- ☐ ☐ Warning barriers and signs are in place
- ☐ ☐ Atmospheric monitoring conducted
- ☐ ☐ All hazardous lines have been isolated
- ☐ ☐ Hot work permit attached
- ☐ ☐ All energy sources have been locked out/tagged out
- ☐ ☐ The confined space has been drained and flushed
- ☐ ☐ Forced air or exhaust ventilation is provided
- ☐ ☐ Electrical equipment is properly grounded
- ☐ ☐ Ground fault circuit interrupters (GFCI) provided

Yes N/A
- ☐ ☐ Non-sparking tools used
- ☐ ☐ Low voltage (less than 25v) lighting used
- ☐ ☐ Electrical equipment rated for explosive atmospheres
- ☐ ☐ No compressed gas cylinders in the confined space
- ☐ ☐ Host employer and/or contractors notified
- ☐ ☐ Entry and emergency procedures have been reviewed
- ☐ ☐ All personnel have been trained (classroom/exercise)
- ☐ ☐ All personnel have been informed of potential hazards
- ☐ ☐ Attendant stationed at entrance and property inspected
- ☐ ☐ Rescue equipment on location and readily accessible

PROTECTIVE EQUIPMENT

Yes No
- ☐ ☐ Hard Hat
- ☐ ☐ Eye/Face Protect.
- ☐ ☐ Boots
- ☐ ☐ Gloves

Yes No
- ☐ ☐ Protective clothing
- ☐ ☐ Hearing protection
- ☐ ☐ Retrieval Device/Tripod
- ☐ ☐ Harness and Lifeline

Yes No
- ☐ ☐ Communications Equipment
- ☐ ☐ Ventilation to Provide Fresh Air
- ☐ ☐ Respirator (type)__________________
- ☐ ☐ Other__________________

Atmosphere Test(s) to be taken*	Yes	No	Acceptable Entry Conditions	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time
			Allowable Limits	Enter Air Monitoring Findings Below										
Oxygen			19.5% - 22.0%											
Combustible Gas			Below 10% LEL											
PID/FID														
Carbon Monoxide			0-15 PPM											
Hydrogen Sulfide			0-5 PPM											
Hydrogen Cyanide			0-2 PPM											
Sulfur Dioxide			0-1 PPM											
Ammonia			0-10 PPM											
Benzene			0-0.5 PPM											
Other														

SUPERVISOR APPROVAL: **I certify that all necessary precautions have been taken to make this confined space safe for entering and conducting the work during the prescribed time(s) as well as emergency response procedures.**

Print Name__________________ Sign Name__________________ Date__________________

Entry Supervisor__________________ Permit Prepared by__________________

Atmosphere Tester__________________ Attendant__________________

ENTRANT ACKNOWLEDGMENT: I HAVE BEEN PROPERLY INSTRUCTED FOR SAFE ENTRY INTO THIS CONFINED SPACE AND UNDERSTAND MY DUTIES AND EMERGENCY PROCEDURES

Print Entrant Name	Sign Entrant Name	Employee or S.S. No	Date	Time

*An evaluation should be performed to consider all potential air contaminants which could be present and represent a hazard.

ENTRANT INSTRUCTIONS

All personnel who enter confined spaces must be thoroughly familiar with the following duties for entrants as listed below. Your primary responsibilities include:

Understand the hazards of the confined space to be entered and the physical effects of those hazards.

Continuously monitor the atmosphere inside of the confined space with a calibrated, direct reading, air monitoring instrument.

Evacuate the confined space:

- If atmospheric hazards exceed the action level,
- If a hazardous condition is identified inside of the confined space, and
- Whenever attendant signals entrants to evacuate.

Read and understand the rescue procedures.

If PPE is required, the entrant must be properly trained on the use of the equipment prior to entry. PPE must be in good working condition.

ATTENDANT INSTRUCTIONS

You should be thoroughly familiar with the following duties when you assume the responsibility of attendant for a person or persons inside a confined space. Your primary responsibilities are the following:

Focus on the safety of the personnel inside.

Understand the hazards of the confined space to be entered and the physical effects of those hazards.

Maintain the conditions and requirements listed on entry permit.

Evacuate the space if you observe any condition which you consider hazardous.

Read and understand the rescue procedures. Get help if an emergency situation develops. never enter the confined space in an emergency unless you are trained and equipped with the proper equipment for confined space rescue operations (i.e., self contained breathing apparatus, safety harness, life line) and are relieved by another attendant.

Keep an accurate count of all personnel inside of the confined space at all times.

Do not leave the entrance to the confined space while any personnel are still inside unless you are properly relieved. These instructions must be passes onto your relief.

If you have any questions regarding the job, check with your supervisor or a health and safety professional.

ENTRY SUPERVISOR'S INSTRUCTIONS

You should be thoroughly familiar with the following details to quality as the Entry Supervisor for a permit-required CSE procedure.

Requirements for confined space entrant and attendant instructions.

Knowledge of the hazards that may be faced during entry, including information in the mode, signs and symptoms and consequences of exposure.

Ability to verify that the appropriate entries have been made on the permit, and that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.

Procedures to terminate the entry permit when the CSE operations have been complete or when a condition exists that is not allowed under entry permit requirements.

Ability to verify that rescue services are available and that the means of summoning them are operable.

Procedures to remove unauthorized individuals who enter or who attempt to enter the permit space during entry operations.

Ability to take responsibility for the confined space when entry is transferred to other personnel.

Ability to determine that entry operations are still consistent with the terms of the CSE permit and that the prescribed intervals regardless of changes in entry personnel.

EXHIBIT A-H

HOT WORK PERMIT
HOT WORK JSA

HOT WORK PERMIT

Project Name____________________ Job #____________________________________

Hot Work Task Description:____

Workers/Welders Conducting Hot Work____

(PERMIT MUST BE COMPLETED IN ITS ENTIRETY AND POSTED BEFORE HOT WORK BEGINS)

Action Item	Yes	No	NA
Has client representative been notified of intended hot work?			
Hazardous materials involved? Name:____________________			
Will hot work impact the general public, customers or operations employees?			
Will the intended hot work need to be coordinated with other contractors who may be working on the site to make them aware of any hazards and the scope of work to be performed?			
Have hazardous energy sources been identified, isolated, and locked out - tagged out before the start of the project?			
Will hot work be conducted within a confined space?			
All testing equipment (i.e., CGI, oxygen meter, etc.) and fire fighting equipment (i.e., extinguisher, etc.) have been checked to ensure proper operation and calibration before the start of this project?			
Does task require a designated fire watch (30 minutes after work)?			
Flammable and combustible materials within 35 feet have been cleared or shielded.			
All fuel sources have been identified and protected (USTs, ASTs, sewers, piping).			
The area has been restricted with proper barriers and signs.			
The area has been tested to be certain that atmosphere is 0% LEL before starting hot work.			
Flame sensitive areas and equipment (including cylinders and gas delivery lines) exposed to slag, heat, and sparks are protected by flame a resistant blanket, shield, or removed from the area?			
Escape routes have been identified before starting work?			
Is ventilation equipment needed? Type needed:____________________			

THE FOLLOWING PROTECTIVE EQUIPMENT WILL BE REQUIRED (PLEASE CHECK):

	Yes	No		Yes	No
Welding Goggles/Shield___ Tint	_	_	Hearing Protection	_	_
Safety Boots	_	_	Head Protection	_	_
Leather Gloves	_	_	Safety Harness	_	_
Supplied Air Respirator	_	_	Welding Leathers - Top	_	_
APR ___ Cartridge	_	_	Welding Leathers - Bottom	_	_

Cold Cut Only Method Required:____________________

Hot Cut Method Allowed:____________________

APPROVALS:

________________________________ ____________________

Fluor Daniel GTI Site Manager or Site Safety Officer Date

Name of Employee Performing Hot Work____________________ Fire Watch Representative____________________

Hot Work/JSA
Welding/Torch Cutting

Job Hazards	Safeguards/Precautions
1. Unsafe act Untrained worker	a. Require qualified operators only. b. Provide training per 29 CFR 1910.1200. c. Provide proper PPE. d. Inspect area prior to welding/cutting. e. Use permit system. f. Use fire watch for 30 minutes following termination of work.
2. Welder's flash to eye	a. Use filter lens based on actual hazard or welding technique in accordance with the American Welding Society Laws shade selector chart. b. Provide warning signals, barricades or similar means to protect other workers, general public. c. Provide screens or barriers to protect other workers, general public.
3. Radiation burns, skin burns, heat burns	a. Helmet with proper filter lens. b. Gauntlet gloves, leather apron. c. Cotton shirt, long sleeves, buttoned at sleeves and collar. d. Cotton cuffless pants. e. Steel toe boots, 6-inch minimum height. f. Hearing/ear cover protection as appropriate. g. Work zone definition - see 2(a) and (b) above.
4. Faulty equipment	a. Use equipment that is in good working condition. b. Inspect valves, regulators, and hoses prior to use. c. Preventive maintenance performed per manufacturer specifications.
5. Toxic fumes and gases	a. Provide source ventilation. b. Provide respiratory protection, selected based on hazard. c. Rope off area, define work area with cones, caution tape or similar (see 2(a) and (b) above).
6. Adjacent flammable/ combustible materials	a. Move combustibles at least 50 feet from work area. b. If they cannot be moved consider protection by metal guards or flame proof curtain. c. Openings in walls, floors or ducts should be covered if within 35 feet of work area. d. Assure facility sprinklers are in working condition and will not be taken out of service. e. Suitable fire extinguishing equipment shall be readily available at the work area. f. Designate a reliable means of contacting the Fire Department in the event of an emergency.

Hot Work/JSA
Welding/Torch Cutting

Job Hazards	**Safeguards/Precautions**
7. Flammable/combustible vapors	a. If in an environment classified as a hazardous location then define specific tasks using JSA technique. b. Provide equipment per classification (i.e., explosion proof, etc.) c. Post sign: DANGER - NO SMOKING, MATCHES OR OPEN LIGHTS. d. Ensure person is assigned as fire watch and fully charged extinguisher is present.
8. CSE	a. Follow CSE procedures. b. Use CSE permit. c. Define specific JSA techniques for that work. d. Exercise caution when using inertion to address O_2 deficiency. e. Exercise caution when using O_2/acetylene fuel mix, address O_2 enrichment from cylinder leak.
9. Unsecured compressed gas cylinders, cylinder handling	a. Store cylinders upright. b. Secure against stationary object. c. Cylinders in excess of 40 pounds in weight must be moved using wheeled cart or motorized truck. d. Lifting cylinders > 40 pounds in weight is prohibited. e. Compatible storage practices = separate O_2 cylinders from flammable combustible gases. f. Use tags on cylinders to mark full, in use or empty. g. Remove protective cap using hand method or use cylinder "cap wrench". Do not jam screwdriver or wrench in cap slots to loosen.
10. Unsafe practice during inactivity	a. Provide protective cap when cylinders are not in use. b. Valves or gas cylinders shall be closed and line pressure relieved. c. Power source of electric welding equipment shall be disconnected.
11. Improper flow of gases, gas mixing, pressure in gas lines	a. Label cylinders per 29 CFR 1910.1200. b. Color code hoses (green = O_2; red = fuel gases; black = inert gas or air hoses). c. Install "flash back" arresters for fuel mixing welding. d. Use acetylene at 15 pounds per square inch (psi) or less.
12. Improper ignition of oxygen/fuel torch	a. Use "spark lighter" to ignite. b. Don't use cigarette, match or lighter for ignition.
13. Static electricity	a. Provide and use grounding clamp for electric area welding equipment.

EXHIBIT A-I

HEAT/COLD STRESS PROCEDURES

HEAT/COLD STRESS PROCEDURES

1.0 HEAT STRESS

Heat stress is a significant potential hazard associated with the work task performed and the type and degree of protective equipment used in hot weather environments. Local weather conditions may produce conditions which will require restricted work schedules in order to protect employees. Monitoring for heat stress will follow one of two protocols depending on whether impermeable clothing (tyvek, saranex, rain gear, etc.) or permeable clothing (cotton coveralls) is worn. This section will apply to both hazardous and non-hazardous waste workers at the site. The SHSO with direction from HSR will determine the environmental wet bulb globe temperature (WBGT) and physiological (heart rate [HR] and oral temperature [OR]) monitoring to be conducted for both types of workers.

1.1 Workers Wearing Permeable Clothing

The ACGIH have set TLVs for worker exposure to heat stress in which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. The TLVs assume that workers are acclimatized, fully clothed in permeable clothing with adequate water and salt intake, and capable of functioning effectively under the given working conditions without exceeding a deep body temperature (BT) of 100.4Fahrenheit (F). Measurement of the WBGT has been found to be the most adequately measurable environmental factor in which to correlate with the deep BT and other physiological responses to heat. The following table reviews the work/rest regimen to be followed by all permeably clothed workers based upon routinely measured WBGT.

Permissible Heat Exposure TLVs Applicable to Workers Wearing Permeable Clothing

Work/Rest Regimen	Workload		
	Light	Moderate	Heavy
Continuous work	86 (76)	80 (70)	77 (67)
75% work - 25% rest, each hour	87 (77)	82 (72)	78 (68)
50% work - 50% rest, each hour	89 (79)	85 (75)	82 (72)
25% work - 75% rest, each hour	90 (80)	88 (78)	86 (76)

Values are given in F WBGT.

Rest means minimal physical activity. Rest should be accomplished in the shade. Any activity requiring only minimal activity can be performed during rest period.

() Parentheses indicate the 10 degree adjustment for working in impermeable protective clothing.

1.2 Workers Wearing Impermeable Clothing

Workers who must wear impermeable clothing are held at a higher risk of suffering heat stress. Impermeable clothing impedes sweat evaporation, one of the body's major cooling mechanisms. It is the duty of each employer to alert or notify the SHSO if symptoms of heat stress occur to their respective site personnel. Physiological and environmental monitoring of personnel wearing an impermeable protective equipment ensemble will commence when the ambient temperature rises above 70F. Environmental monitoring will be conducted continuously for as long as the ambient temperature stays above 70F and physiological monitoring will be conducted immediately before and after each work period. Frequency of physiological monitoring will increase as the ambient temperature increases or if slow recovery rates are indicated. The break time must be sufficient to allow workers to recover from the effects of heat stress. This will be accomplished by measuring the recovery HR and OT. The break time duration will be determined using the following methodology and criteria:

Seat person being monitored,
Take OT, and
Measure pulse in the following sequence:

- Pulse #1: 30 seconds to 1 minute after sitting
- Pulse #2: 2½ to 3 minutes after sitting

An excessive heat stress condition exists when any of the following conditions exist:

1. Oral or ear temperature exceeds 99.5F
2. If pulse #2 is greater than 90 beats/minute
3. Pulse #1 is greater than 100 beats/minute

Worker cannot return to work until:

Oral or ear temperature is below 99.5F
Pulse rate is below 90 beats/minute
Recovery HR for workers with HRs over 90 beats per minute is less than 10 beats per minute less than the original HR

Adhering to the guidelines for heat stress prevention and monitoring will greatly minimize the possibility of the occurrence of heat stress. Site personnel must also be aware of the symptoms of heat-related disorders and be prepared to administer the appropriate treatments.

1.2.1 Prevention

A. Provide plenty of fluids. A 50 percent solution of fruit juice or similar solution in water, or plain water will be available. For workers performing work inside an EZ, fluid intake may occur in the CRZ. Workers must first perform a partial decontamination process which will include removal of gloves and washing of hands and face prior to consumption of fluids. The SHSO will monitor the partial decontamination and fluid consumption process to ensure that ingestion of site contaminants does not occur.

B. Work in pairs whenever conducting Level B activity or permit required CSE activity.

C. Provide cooling devices. Ice vests or on-site showers can be provided to reduce BT and/or cool protective clothing.

The amount and type of undergarments worn will be left to the preference of each individual unless prone to heat stress, especially heat rash. In this case, the worker can wear "long john" cotton type underwear to keep skin off chemical resistant clothing.

D. Adjustment of the work schedule. When practicable, the most labor-intensive tasks should be carried out during the coolest part of the day.

E. Shaded or cooled rest areas. Shaded or cooled rest areas will be provided when site environmental and/or workers physiological responses warrant.

1.1.3 Heat Stress Monitoring

Physiological monitoring of personnel wearing an impermeable protective ensemble will be conducted at regular intervals at the beginning and conclusion of the work period. HR must be periodically measured for all site personnel when heat stress conditions (climate or wearing impermeable clothing). Additional physiological monitoring such as BT and body water temperature (BWT) monitoring can be measured for extreme temperatures and when impermeable clothing is worn.

A. HR must be measured by the radial pulse for 30 seconds as early as possible in the resting period and repeated approximately 3 minutes into rest period.

The HR at the beginning of the rest period should not exceed 110 beats per minute. The HR also should not exceed 90 beats per minute after approximately 3 minutes of rest. If the HR does exceed the criteria, the next work period will be shortened by 33 percent, while the length of the rest period will remain the same. If the HR still exceeds the criteria at the beginning of the next rest period, the following work period will be shortened by 33 percent.

B. BT can be measured orally with a clinical or disposable thermometer, in accordance with manufacturer's instructions, as early as possible in the rest period (before drinking liquid). Oral or ear temperature at the beginning of the rest period should not exceed 99.5F. If it does, the next work period will be shortened by 33 percent while the length of the rest period will remain the same. However, if the OT exceeds 99.5F at the beginning of the next rest period, the following work period will be shortened by another 33 percent. A worker will not be permitted to wear a semi-permeable or impermeable protective ensemble when his/her BT exceed 99.5F.

C. Body water loss (BWL) due to perspiration can be measured by having the worker weigh him/her self at the beginning and end of each work day. Similar clothing should be worn at both weighing. BWL should not exceed 1.5 percent total body weight in a work day.

Suggested Frequency of Physiological Monitoring for Fit and Acclimated Workers[1]

Adjusted Temperature[2]	Normal Work Ensemble[3]	Impermeable Ensemble[4]
90F (32.2C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5-90F (30.8-32.2C)	After each 60 minutes of work	After each 30 minutes of work
82.5-87.5F (28.1-30.8C)	After each 90 minutes of work	After each 60 minutes of work
77.5-82.5F (25.3-28.1C)	After each 120 minutes of work	After each 90 minutes of work
72.5-77.5F (22.5-25.3C)	After each 150 minutes of work	After each 120 minutes of work

[1] For work levels of 250 kilocalories per hour.

[2] Calculate the adjusted air temperature (T_{adj}) using the following equation:

T_{adj} (F) = T_{adj} (F) + (13 x percent sunshine)

Measure the air temperature (T_{adj}) using a standard mercury-in-glass thermometer with the bulb shielded from radiant heat.

[3] A normal work ensemble consists of cotton overalls with long sleeves and pants.

[4] An impermeable work ensemble consists of impermeable coveralls with long sleeves and pants.

1.1.4 Recognition and Treatment

Any personnel who observes any of the following forms of heat stress either in themselves or in another worker, will report this information to his or her immediate supervisor or the SSHO.

A. Heat Rash (or prickly heat)

Cause: Continuous exposure to hot and humid air, aggravated by chafing clothing.

Symptoms: Eruption of red pimples around sweat ducts accompanied by intense itching and tingling.

Treatment: Remove sources of irritation and cool the skin with water or wet cloths.

B. Heat Cramps or Heat Prostration

Cause: Profuse perspiration accompanied by inadequate replenishment of body water and electrolytes.

Symptoms: Sudden development of pain and/or muscle spasms in the abdominal region.

Treatment: Remove the worker to the CRZ. Remove protective clothing. Decrease BT and allow a period of rest in a cool location.

C. Heat Exhaustion - **SERIOUS**

Cause: Overexertion in a hot environment and profuse perspiration accompanied by inadequate replenishment of body water and electrolytes.

Symptoms: Muscular weakness, staggering gait, nausea, dizziness, shallow breathing.

Treatment: Perform the following while simultaneously making arrangements for transport to a medical facility.

Remove the worker to the CRZ. Remove protective clothing. Lie the worker down on his or her back in a cool place, and raise the feet 6 to 12 inches. Keep warm, but loosen all clothing. If conscious, provide sips of a salt water solution consistency of one teaspoon salt in 12 ounces water. Transport the worker to a medical facility.

D. Heat Stroke - **EXTREMELY SERIOUS**

Cause: Same as heat exhaustion.

Symptoms: No perspiration, dry mouth, pain in the head, dizziness, nausea.

Treatment: Perform the following while making arrangements for transport to a medical facility.

Remove the worker to the CRZ. Remove protective clothing. Lie the worker down in a cool place and raise the head and shoulder slightly. **Cool without chilling.** Apply ice bags or cold wet cloth to the head. Sponge bare skin with cool water or rubbing alcohol. If possible, place the worker in a tub of cool water. Do not give stimulants. Transport to a medical facility.

HEAT STRESS MONITORING FORM

Project Name:____

Project Number:______________________________________

SHSO:____

Date	Title	Ambient Temp	WBGT	Work/ Rest Regimen	Employee/ Location	Pulse Rate	Body Temp	Body Water Loss	Comments

2.0 COLD STRESS

If work on this project begins in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Systemic cold exposure is referred to as hypothermia. Localized cold exposure is generally labeled frostbite.

A. Hypothermia: hypothermia is defined as a decrease in the patient core temperature below 96F. The BT is normally maintained by a combination of central (brain and spinal cord) and peripheral (skin and muscle) activity. Interferences with any of these mechanisms can result in hypothermia, even in the absence of what normally is considered a "cold" ambient temperature. Symptoms of hypothermia include: shivering, apathy, listlessness, sleepiness, and unconsciousness.

B. Frostbite: frostbite is both a general and medical term given to areas of local cold injury. Unlike systemic hypothermia, frostbite rarely occurs unless the ambient temperatures are less than freezing and usually less than 2F. Symptoms of frostbite are: a sudden blanching or whitening of the skin; the skin has a waxy or white appearance and is firm to the touch; tissues are cold, pale, and solid.

Prevention of cold related illness can be aided by educating workers on recognizing the symptoms of frostbite and hypothermia and by identifying and limiting known risk factors. The workers should be provided with enclosed, heated environments on or adjacent to the site, dry changes of clothing, and warm drinks.

To monitor the worker for cold related illnesses, start (oral) temperature recording at the job site:

> At the field team leader's discretion when suspicion is based on changes in a worker's performance or mental status.
> At a worker's request.
> As screening measure, two times per shift, under unusually hazardous conditions (e.g., wind-chill less than 20F, or wind-chill less than 30F with precipitation).
> As a screening measure whenever any one worker on the site develops hypothermia.

Workers developing moderate hypothermia (a core temperature of 92F) should not return to work for at least 48 hours.

Table 3. Progressive Clinical Symptoms of Hypothermia

Core Temperature (F)	Symptoms
99.6	Normal core body temperature
96.8	Metabolic rate increases
95.0	Maximum shivering
93.2	Victim conscious and responsive
91.4	Severe hypothermia
89.6 - 87.8	Consciousness clouded, blood pressure difficult to obtain, pupils dilated but react to light, shivering ceases
86.0 - 84.2	Progressive loss of consciousness, muscular rigidity increases, pulse and blood pressure difficult to get, respiratory rate decreases
78.8	Victim seldom conscious
64.4	Lowest accidental hypothermia victim to recover

In order to minimize the risk of the hazards of working in cold environments, workers will be trained and periodically reinforced in the recognition of the physiologic responses of the body to cold stress. In addition, the use of insulated work clothing, warm shelters and work/warming regimens may be used to minimize the potential hazards of cold stress. Also, special attention will be paid to equipment warm-up time and freeze protection for vessels, piping, equipment, tools, and walking/working surfaces. The current ACGIH TLVs for cold stress found in this appendix will be used as a guideline.

EXHIBIT A-J

JSA

JOB SAFETY ANALYSIS

ABANDON MONITORING WELL

TASK - JOB STEPS	JOB HAZARDS	CONTROL/SAFEGUARDS
Abandon Monitoring Well Remove or Cut off Well Casing	1. traffic hazards	1. a. proper work zone definition b. Level D PPE (traffic vest, etc.)
	2. a. cut steel well casing b. hand dig below surface c. use powered sawsall or d. use oxy-acetylene cutting torch	2. a. steel well casing b. leather work gloves for hand protection and safety glasses when digging c. goggles and faceshield; use cold cut technique (pneumatic reciprocating sawsall) for wells displaying explosive vapors; place dry ice in well to reduce oxygen levels to <10% d. place dry ice in well to reduce oxygen levels to >10%; leather chaps and leather gauntlet gloves; wear level C PPE - full face respirator (APR) fitted with a welding shield adaptor with a shade 5 or 6 lens; flash back arrestor for oxy-acetylene torch set up; fire watch with ABC multi-purpose fire extinguisher; complete hot work permit prior to any torch work.
	3. a. cut PVC well casing b. hand dig below surface c. use hacksaw or d. use powered sawsall	3. a. PVC well casing b. leatherwork gloves and safety glasses c. proper body positioning avoid over exertion d. safety goggles and faceshield
Backfill Well with Bentonite/Grout	1. heavy lifting-grout pellets	1. maintain 70# lifting rule
	2. obtain water supply from remote distance	2. safe transport to/from water supply
	3. flying objects - eye injury	3. safety goggles

JOB SAFETY ANALYSIS

AIR SPARGE INSTALLATION & PILOT TEST

TASK - JOB STEPS	JOB HAZARDS	CONTROL/SAFEGUARDS
1. Piping Construction/Design	A. improper PVC pipe pressure rating	A. specify proper schedule pipe/fittings
	B. improper PVC gluing type/technique	B. use rollers, drying time needs, etc.
	C. oversight of safety controls	C. install appropriate gauges, high pressure shutoffs and pressure relief valves.
2. Installation/Construction type of air compressor used	A. oversize/undersize specifications	A. identify compressor specifications - in design
	B. overheat due to undersize	B. monitor heat and stress to compressor(s)
	C. fuel refilling - hot surface hazard	C. shut off when refueling; no smoking
	D. noise/sound hazard	D. monitor sound w/SLM for personal and community noise exposure; wear PPE
3. Implementation of Air Sparge Pilot test	A. burst of pipes upon start up	A. shield accordingly; provide distance
	B. leak of pipes	B. wear goggles; faceshield as necessary
	C. noise	C. wear PPE; insulate and provide distance

JOB SAFETY ANALYSIS

BACKFILL COMPACT EXCAVATION

JOB STEPS	JOB HAZARDS	SAFEGUARDS & PRECAUTIONS
Backfill/Compact Excavation	1. Heavy Equipment	1. a. Only trained personnel will operate equipment b. Same as heavy equipment operations
	2. Physical Hazards: a. Crushing b. Hit in head c. Dust d. Foot injury	2. a. Hard Hat required b. Safety glasses required c. Steel toe boots d. Gloves leather
	3. Open Excavation	3. a. Restricted construction zone b. Barricaded, coned, fenced c. Same safeguards & precautions as excavation & trenching

JOB SAFETY ANALYSIS

BAIL FREE PRODUCT

TASK - JOB STEPS	JOB HAZARDS	CONTROL/SAFEGUARDS
Bail Free Product Liquid Phase Hydrocarbons (LPH)	1. toxic vapors	1. use PID/stay upwind
	2. explosive vapors	2. use LEL/ventilate
	3. static electricity	3. a. store bailed product in 5 gallon metal pail (DOT approved container) b. ground 5 gal. pail using bonding cable and grounding clip c. pour off into larger vessel (ie., 55 gallon drum) using bonding/grounding technique d. use dual action drum vent on 55 gallon drum when storing LPH for pressure relief valve purposes e. mark all container with pertinent warning signs and labels

JOB SAFETY ANALYSIS

BUILDING CONSTRUCTION

JOB STEPS	JOB HAZARDS	SAFEGUARD AND PRECAUTIONS
Building Construction	1. Physical hazard involving: a. heavy lifting/injury; b. sharp objects/hand laceration; c. flying objects/eye injury; d. drop equipment/foot injury; e. hit in head/head injury. f. falls while roofing/framing.	1. Training: a. mechanical device 70 lb. rule; b. leather gloves; c. safety glasses; d. steel toe boots; e. hard hat; f. fall protection
	2. Build up of explosive vapors, poor ventilation.	2. Install double doors, O_2/LEL upon entry.
	3. Electrical explosion.	3. a. Wiring done by licensed electrician by CODE. b. Explosion proof lighting.
	4. Swinging loads from cranes. Employee hit by moving equipment.	4. a. Back up signals on equipment. b. Traffic vest for all personnel. c. Foot traffic restricted in area. d. Establish hand signals for laborers assisting in equipment operations.
	5. Crane hazards during frame construction.	5. Follow safe work rules as defined in 29 CFR 1926.550
	6. Overhead utilities.	6. Minimum 20' distance, 10' distance if insulated.
	7. Electrical shock from live equipment.	7. a. De-energize equipment. b. Lockout/tagout
	8. Noise levels exceeding OSHA PEL.	8. Earmuffs and/or ear plugs.

FLUOR DANIEL GTI

JOB SAFETY ANALYSIS WORKSHEET

Operation: Mobile Cranes
Person Doing JSA: James R. Smith
Date: December 10, 1997

Job Steps		Job Hazards		Safeguards and Precautions	
1.	Inspect crane and rigging	1.	Mechanical failures such as brakes and back up alarms, hydraulic levels, and rigging failure causing personal injury.	1a.	Complete Safety Inspection Checklist for Construction Equipment (Form S70-2-9) prior to crane operations. Refer to Fluor Daniel's Accident Prevention Standards, APS 7-3, Attachment G.
				1b.	Ensure shackles, chockers, and other rigging does not exceed the safety factor of 5:1.
2.	Determine whether the load exceeds the cranes capacity	1.	Crane tip over or rigging fails, damaging equipment and injure personnel.	1a.	Complete Crane lift permit even if the load is not likely to exceed 75 percent of its rated capacity. Ensure the rigging has a safety factor of 5:1. Refer to Fluor Daniel's Accident Prevention Standards, Section APS 7-12, Attachment A.
3.	Level the crane	1.	Crane tips over	1a.	Extend all outriggers and use trench plates on non-solid ground.
4.	Crane Operation	1.	Confusion of lowering and rasing equipment	1a.	Use standard hand signals for cranes in accordance with ANSI standards and post on site.
		2.	Swinging of the counterweight could strike or crush personnel	2a.	Barricade the swing radius of the counter weight.
		3.	Equipment malfunction	3a.	A copy of the manufacture's operating manual will be inside the crane's cab.

Job Steps	Job Hazards	Safeguards and Precautions
4. Crane Operation (continued)	4. Load is swinging and bumps an object, injures personnel, or adds stress to the rigging.	4a. Use tag lines and maintain distances from beneath the load.
	5. Boom exceeds its critical angle of 80 percent from the horizontal	5a. Use boom stops to dis-engage the master clutch or kill the engine before it reaches Its critical angle.
	6. Person riding on the crane can be struck by the counter weight or other objects.	6a. Personnel are not to ride on the crane.
	7. Lift exceeds loads rated capacity	7a. A durable load chart and with clearly legible letters shall be posted where it is visible to the crane operator.
	8. Load becomes free of the rigging	8a. Hooks should be inspected periodically, chain slings are inspected every 3 months for wear and defective welds-stretch shall not exceed 5 percent, use manila rope, wire rope, and rope slings with a safety factor of 5:1. Where U-bolt wire rope is used to form eyes, the U section should be in contact with the dead end.
	9. Load falls on personnel.	9a. Loads (tools, equipment, and other materials) shall not be swung or suspended over employees.
	10. Crane traveling with the load causes the crane to tip.	10a. Use a flatbed truck, fork lift, or other means of transportation to move the load to another location.

JOB SAFETY ANALYSIS

EXCAVATE/TRENCHING

TASK - JOB STEPS	JOB HAZARDS	CONTROL/SAFEGUARDS
Excavate/Trenching	1. Collapse of pit; failure of slope	1. a. assign "competent person" as a supervisor per OSHA; b. excavation activities to be performed per OSHA 29 CFR 1926. 650(scope); 1926.651 (general); 1926.652 (protective system); Appendix A (soil classification); Appendix B (sloping/benching); or Appendix C (timber).
	2. Employee buried upon slope failure	2. a. see above; b. allow proper egress from excavations >4' deep using ladder every 25' distance.
	3. Damage to adjacent structures	3. Implement shoring/bracing to preserve integrity of adjacent structures.

JOB SAFETY ANAYLSIS
WORK FROM ELEVATED PLATFORMS

Job Steps	Job Hazards	Safeguards and Precautions
Access tanks and stripper from an arial lift.	Fall from elevated platform	1. Operator must have an effective procedure for leaving the platform when elevated. 2. The anchor point should be at the same height as the operator's harness D-ring. The lanyard should be no more than 4 feet. 3. Anchor points should be capable of withstanding twice the maximum arrest force of the fall arrest device to avoid the possibility of tip-over. 4. Never use the midrail as a step.
	Accessing elevated platform from a ladder.	1. Ladder must be set at a 4' to 1' angle to the tank. 2. Ladder must be tied off. 3. Always face the ladder when climbing or descending. Stay off the top two rungs. Never carry anything that will prevent holding on with both hands. 4. Inspect ladder before use for damage. 5. Metal ladders must not be used near any electrical lines or service. 6. When not in use, the ladder should be returned to storage. 7. The top of the ladder must extend at least three feet above top of tank or stripper. 8. For extenion ladders, check to see that safety dogs or latches are engaged.
	Work on elevated surfaces greater than six feet above the lower work surface.	1. A full body harness with lanyard must be secured to an adequate anchor point.

JOB SAFETY ANALYSIS

Precautions must be taken to prevent injuries and exposures to general potential hazards.

Potential Hazard	Control
Exposure to vapors and dusts	1. Stand up-wind of petroleum products whenever possible. 2. Minimize contact and contact time with petroleum products. 3. Avoid walking through discolored areas, puddles, leaning on drums, or contacting anything that is likely to be contaminated. 4. Do not eat, drink, smoke and/or apply cosmetics in the hot or warm zones. 5. Wear gloves when in contact with contaminated surfaces. 6. Safety glasses must be worn at a minimum. 7. Splash goggles must be worn when working with liquids. 8. >75 ppm organic vapors in breathing zone requires upgrade to Level C. 9. >750 ppm organic vapors in breathing zone requires upgrade from Level C to Level B.
Vehicular Traffic	1. Wear traffic safety vest when vehicle hazard exists. 2. Use cones, flags, barricades, and caution tape to define work area. 3. Use vehicle to block work area. 4. Engage police detail for high-traffic situations.
Vault Entry	1. Follow confined space entry procedures. 2. Obtain confined space entry permit. Post sign. 3. Remove vault cover using proper lifting techniques. 4. Promote natural ventilation by opening the space to fresh air. 5. Conduct remote air monitoring prior to entry. 6. Use trained "competent person" (entrant and attendant). 7. Enter if safe; conduct continuous air monitoring.
Inclement Weather	1. Stop outdoor work during extreme weather conditions such as electrical storms, high winds, driving rain, extreme heat or cold temperatures. 2. Take cover indoors or in vehicle. 3. Listen to local forecasts for warnings about specific weather hazards such as tornados, hurricanes and flash floods.
Noise	1. Wear hearing protection when equipment such as a drill rig, jackhammer, cut saw, air compressor, blower or other heavy equipment is operating on the site. 2. Wear hearing protection whenever you need to raise your voice above normal conversational speech due to a loud noise source; this much noise indicates the need for protection.
Electric Shock	1. Maintain appropriate distance from overhead utilities; **20-foot minimum clearance from power lines required; 10-foot minimum clearance from shielded power lines.** 2. Use ground-fault circuit interrupters as required. 3. Perform lockout/tagout procedures. 4. Use three-pronged plugs and extension cords. 5. Contact your local underground utility-locating service. 6. Follow code requirements for electrical installations in hazardous locations.

Potential Hazard	Control
Physical Injury	1. Wear hard hats and safety glasses when on site. 2. Maintain visual contact with the equipment operator and wear orange safety vest when heavy equipment is used on site. 3. Avoid loose-fitting clothing (driller and driller's helper). 4. Prevent slips, trips and falls; keep work area uncluttered. 5. Keep your hands away from moving parts (i.e. augers). 6. Test the emergency shutoff switch on the drill rig daily.
Back Injury	1. Use a mechanical lifting device or a lifting aid where appropriate. 2. If you must lift, plan the lift before doing it. 3. Check your route for clearance. 4. Bend at the knees and use leg muscles when lifting. 5. Use the buddy system when lifting heavy or awkward objects. 6. Do not twist your body while lifting.
Heat Stress	1. Increase water intake while working. 2. Increase number of rest breaks and/or rotate workers in shorter work shifts. 3. Watch for signs and symptoms of heat exhaustion and fatigue. 4. Plan work for early morning or evening during hot months. 5. Use ice vests when necessary. 6. Rest in cool, dry areas. 7. In the event of heat stroke, bring the victim to a cool environment and initiate first aid procedures.
Cold Stress	1. Take breaks in heated shelters when working in extremely cold temperatures . 2. Remove the outer layer of clothing and loosen other layers to promote evaporation of perspiration, upon entering the shelter. 3. Drink warm liquids to reduce the susceptibility to cold stress.
High Crime Areas	1. Be aware of surroundings. 2. Use the buddy system. 3. Request police detail when appropriate.
Insects	1. Tuck pants into socks. 2. Wear long sleeves. 3. Use insect repellent.
Poisonous Plants (such as poison ivy, oak or sumac)	1. Don't enter areas infested with poisonous plants. 2. Immediately wash any areas that come into contact with poisonous plants.
Ladders	1. Make sure ladder rungs are sturdy and free of cracks. 2. Use ladders with secure safety feet. 3. Pitch ladders at a 4:1 ratio. 4. Secure ladders at the top when possible. 5. Do not use ladders for access to air stripper towers. 6. Use non-conductive ladders near electrical wires.

Potential Hazard	**Control**
Fire Control	1. Smoke only in designated areas. 2. Keep flammable liquids in closed containers. 3. Keep site clean; avoid accumulating combustible debris such as paper. 4. Follow Hot Work Safety Procedures when welding or performing other activities requiring an open flame. 5. Isolate flammable and combustible materials from ignition sources. 6. Ensure fire safety integrity of equipment installations to Hazard Classification.

JOB SAFETY ANALYSIS

GAUGE & BAIL WELLS

(Operations & Maintenance)

TASK - JOB STEPS	JOB HAZARDS	CONTROL/SAFEGUARDS
Gauge & bail water from monitoring wells	1. metal burr on well cap	1. wear NBR gloves
	2. toxic vapors	2. use PID/stay upwind
	3. explosive vapors	3. use LEL/ventilate
	4. static electricity	4. use grounding clip on IP
	5. muscle strain-back	5. proper posture crouch or squat, don't bend exercise and stretch use lumber support belt
	6. muscle strain-shoulder	6. use pump for large volume wells exercise and stretch, avoid over exertion, take breaks
	7. splashing liquid-eyes	7. wear PPE-splash goggles
	8. splashing liquid-skin	8. wear PPE-NBR gauntlet gloves
	9. contamination	9. proper zone set up, zone definition, etc.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location: Westinghouse/Union City - Hi Vac Pilot Test/Construction of System

Person Doing JSA: Jack Geissert/Tom Tourish Date: 12/14/93

JOB STEPS	JOB HAZARDS	SAFEGUARDS/PRECAUTIONS
Construction of system: -Skid delivery of equipment -Shed construction -Install Pipe and Equipment	1. Back injury	1. Use combination of techniques to lift safe
	2. Electric shock	2a. Lockout/Tagout power 2b. GFCI for portable tools
Start-up	3. Xylene vapors at start-up	3. FID/PID action level of 50 ppm for upgrade to Level C
	4. Explosive Vapors	4. Use LEL meter
	5. Noise from blower	5. Hearing protection
	6. Possible welding	6. Permit for any cutting or welding
	7. Overhead crane hazard	7. Control access to site and don't lift load directly over personnel. Hard hats required.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location: Westinghouse/Union City - Hi Vac Pilot Test - Operation of System

Person Doing JSA: Jack Geissert/Tom Tourish

Date: 12/14/93

JOB STEPS	JOB HAZARDS	SAFEGUARDS/PRECAUTIONS
Operation and Maintenance of System	1. Noise	1. Hearing Protectors
	2. Organic vapors in shed	2. FID/PID @ 50 ppm action level
	3. Explosive atmosphere	3. LEL test <10%
	4. Electric shock	4. Specify O&M tasks and spec where lockout/tagout needs to be done -specify on Appendix C-1
	5. Moving GAC units	5. Use proper lift equipment to move

JOB SAFETY ANALYSIS

HEAVY EQUIPMENT OPERATIONS

TASK - JOB STEPS	JOB HAZARDS	CONTROL/SAFEGUARDS
Heavy Equipment Operations (Backhoes, Drill Rigs, Dump Trucks)	1. Employee run over or hit by moving equipment	1. a. back up signals on equipment; b. traffic safety vest for all field personnel; c. foot traffic restricted in areas of operation; d. establish standard hand signals for laborers assisting in equipment operations.
	2. Physical hazards; a. hit in head b. foreign body in eye c. foot injury	2. a. hard hat; b. safety glasses c. steel toe boots
	3. overhead utilities/overhead obstacles	3. Minimum 20' distance, 10' distance if insulated

JOB SAFETY ANALYSIS

INSTALL EQUIPMENT

JOB STEPS	JOB HAZARDS	SAFEGUARD & PRECAUTIONS
Install Equipment	1. Physical Hazards a. Lifting b. Sharp objects c. Drop equipment d. Loose coils of rope/wires e. Slips, trips & falls	1. Trained Personnel Install Equipment a. 70# lifting rule b. Use mechanical lifting devices c. Gloves, hard hat, steel toes, safety glasses d. Proper footing/general awareness e. Practice good housekeeping
	2. Electrical Shock	2. Make Sure De-Energized a. Use Lockout/Tagout procedures b. Use proper grounding & bonding techniques c. Trained personnel (electrician) perform wiring

FLUOR DANIEL GTI

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location:____

Person Doing JSA: ______________________________ Date________

Job Steps	Job Hazards	Safeguards and Precautions

JOB SAFETY ANALYSIS

MOBILIZE PERSONNEL & EQUIPMENT

JOB STEPS	JOB HAZARDS	SAFEGUARD & PRECAUTIONS
Mobilize Personnel & Equipment to Site	1. Vehicles - Traffic In & Out of site	1. a. Provide traffic cones b. Barricade of construction zones c. Provide construction equipment
	2. Heavy Equipment/Construction Supplies	2. a. Provide lay down zone: hardhats, safety glasses, steel toe boots, traffic vests b. Provide mechanical lifting equipment - remember 70# lifting rule

JOB SAFETY ANALYSIS

OPERATIONS & MAINTENANCE

(Pneumatic System)

JOB STEPS	JOB HAZARDS	SAFEGUARD & PRECAUTIONS
Air Compressor for Pneumatic Maintenance (Filter Change) (Oil Check) Condensate/Knock-outs Drain	1. a. Air Under Pressure b. Direct Skin Injection c. Dust d. Electricity	1. a. Safety Goggles b. Gloves/Dermal Protection c. Bleed Off Excess Air d. De-energize System e. De-Energize Lockout/Tagout

JOB SAFETY ANALYSIS

INSTALL RECOVERY TRENCH

JOB STEPS	JOB HAZARDS	SAFEGUARDS & PRECAUTIONS
Install Recovery Trench	Heavy Equipment Operating Noises Physical	1. Establish Heavy Equipment Work Area a. Backup signals on equipment b. Traffic vests for field personnel c. Foot traffic restricted zones d. Establish hand signals for laborers e. Ear plugs/muffs f. Hard hat, steel toe/shank boots, safety glasses, gloves
	Structural Clearances - Utilities Buildings etc.	2. Clearances a. Minimum 20 feet; Distance from overhead
	Trench - Excavation Pit/Trench Collapse/Slope Failure	3. Establish Construction Equipment Work Zone a. Barriers - Construction Fence b. Trench Box/Side Sloping c. Competent trained supervisor per OSHA 29 CFR 1926.650 (slope) 1926.651 (grounded) 1926.652 (protective system) d. Allow proper egress from excavations with >4' deep using ladders every 25' e. Implement shoring/bracing to preserve integrity of trench walls especially in areas of adjacent structures.

JOB SAFETY ANALYSIS

SOIL EXCAVATION

JOB STEPS	JOB HAZARDS	SAFEGUARDS & PRECAUTIONS
Soil Excavation	1. Exposure to airborne contaminants released during intrusive activities. Flammable atmospheres encountered in excavation.	1. Monitor for airborne contaminants. Allow test pits to purge and/or use personal protective equipment.
	2. Sides of excavation can cave in. Possible burying or crushing of workers due to: (1) absence of shoring, (2) misjudgment of stability, (3) defective shoring, and/or (4) undercut sides.	2. a. Provide adequate shoring or sloping of sides of the excavation. Regularly inspect trenches for changing conditions. b. Solid rock, cemented sand or gravel = 90 degrees. c. Compact angular gravel = 63 degrees 26 ft. deep. d. Compacted sharp sand = 33 degrees 41 ft. deep. e. Rounded loose sand = 26 degrees 34 ft. deep.
	3. Falling during access/egress or while monitoring or dismounting equipment, or stumbling into the excavation.	3. Provide ramps or ladders to trenches to allow safe access and egress.
	4. An overhead hazard can result from material, tools, rock and/or soil falling into the excavation.	4. Provide an adequate barrier around open pits. Material from pit must be placed away from edge to prevent cave ins and instability of pit.
	5. Congested work area due to too many workers in a small area.	5. Maintain ample work room between workers.

FLUOR DANIEL GTI

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location: LaGuardia Airport

Person Doing JSA: John Reinemann, CIH

Date 8/18/98

Job Steps	Job Hazards	Safeguards and Precautions
Steam cleaning equipment associated with tank removal and cleaning activities	Burns Chemical contact via direct contact and splashing	Cleaning to be conducted through a hole cut in the tank. No tank entry required. Personnel will wear appropriate PPE according to the HASP. Should confined space entry be required, FDGTI confined space entry program, or contractors' program, if equal to FDGTI, will be followed. Personnel will be trained on chemical hazards of the tank contents prior to the cleaning process.

JOB SAFETY ANALYSIS

UTILITY HOOK UP

JOB STEPS	JOB HAZARDS	SAFEGUARD & PRECAUTIONS
Utility Hook-Up	1. Back strain from clearing vegetation for road construction with a scythe or other cutting tool.	1. Back strain can be prevented by frequent breaks in routine. Use slow, even movements and proper lifting techniques (i.e. with the legs). Work gloves will reduce the incidence of hand injury and blisters associated with hand tools.
	2. Irritation from dust generated from road construction.	2. Dust suppression techniques, i.e., wetting the soil with water, will reduce dust exposure.
	3. Driving vehicles, placing trailers, and collecting rubbish, on uneven surfaces creates a possibility of the vehicle rolling, getting stuck in mud or ditches, or of an accident due to flat tires or striking obstacles, and the vehicles.	3. Proper vehicles maintenance will prevent avoidable vehicle breakdown in the field. In order to minimalize accidents from uneven terrain, a site surveillance should be performed on foot to choose a clear driving path. Seatbelts should be worn at all times.
	4. Several types of hazards can be associated with utility hook-up depending on the particular work activity.	4. Hazards associated with the particular utility would be anticipated and proper measures should be undertaken by the subcontractor employer. General provisions of 29 CFR 1910/1926 Subpart K, should be implemented in order to prevent electrical hazards.
	5. Electrical Shock	5. Ensure that all lines, junction boxes, and control panels are properly labeled.

Job Safety Analysis
Welding/Torch Cutting

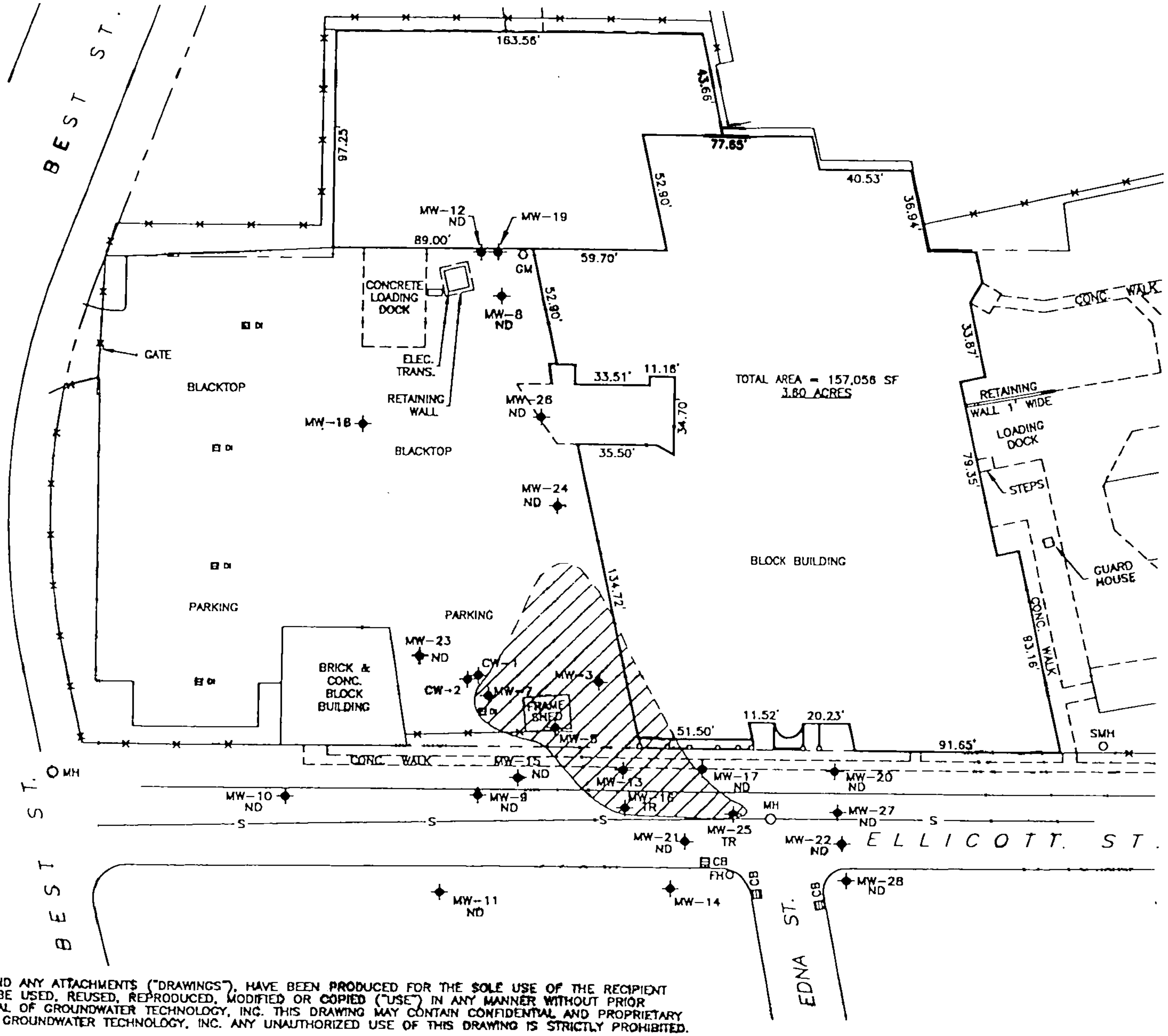
Job Hazards	Safeguards/Precautions
1. Unsafe act Untrained worker	1. a. Require qualified operators only. b. Provide training per 29 CFR 1910.1200. c. Provide proper PPE. d. Inspect area prior to welding/cutting. e. Use permit system. f. Use fire watch.
2. Welder's flash to eye	2. a. Use filter lense based on actual hazard or welding technique in accordance with the American Welding Society Laws shade selector chart. b. Provide warning signals, barricades or similar means to protect other workers, general public. c. Provide screens or barriers to protect other workers, general public.
3. Radiation burns, skin burns, heat burns	3. a. Helmet with proper filter lense. b. Gaunglet gloves, leather apron. c. Cotton shirt, long sleeves, buttoned at sleeves and collar. d. Cotton cuffless pants. e. Steel toe boots, 6" minimum height. f. Hearing/ear cover protection as appropriate. f. Work zone definition - see 2(a) and (b) above.
4. Faulty equipment	4. a. Use equipment that is in good working condition. b. Inspect valves, regulators and hoses prior to use. c. Preventive maintenance performed per manufacturer specifications.
5. Toxic fumes and gases	5. a. Provide source ventilation. b. Provide respiratory protection, selected based on hazard. c. Rope off area, define work area with cones, caution tape or similar (see 2(a) and (b) above).
6. Adjacent flammable/combustible materials	6. a. Move combustibles at least 50' from work area. b. If they cannot be moved consider protection by metal guards or flame proof curtain. c. Openings in walls, floors or ducts should be covered if within 35' of work area. d. Assure facility sprinklers are in working condition and will not be taken out of service. e. Suitable fire extinguishing equipment shall be readily available at the work area. f. Designate a reliable means of contacting the Fire Department in the event of an emergency. *(continued)*

Job Safety Analysis
Welding/Torch Cutting

Job Hazards	Safeguards/Precautions
7. Flammable/combustible vapors	7. a. If in an environment classified as a hazardous location then define specific tasks using JSA technique. b. Provide equipment per classification (i.e., explosion proof, etc.) c. Post sign: DANGER - NO SMOKING, MATCHES OR OPEN LIGHTS.
8. Confined space entry	8. a. Follow CSE procedures. b. Use CSE permit. c. Define specific JSA techniques for that work. d. Exercise caution when using inertion to address O_2 deficiency. e. Exercise caution when using O_2/acetylene fuel mix, address O_2 enrichment from cylinder leak.
9. Unsecured compressed gas cylinders	9. a. Store cylinders upright. b. Secure against stationary object. c. Cylinders in excess of 40 pounds in weight must be moved using wheeled cart or motorized truck. d. Lifting cylinders > 40 pounds in weight is prohibited. e. Compatible storage practices = separate O_2 cylinders from flammable combustible gases. f. Use tags on cylinders to mark full, in use or empty.
10. Unsafe practice during inactivity	10. a. Provide protective cap when cylinders are not in use. b. Valves or gas cylinders shall be closed and line pressure relieved. c. Power source of electric welding equipment shall be disconnected.
11. Improper flow of gases, gas mixing, pressure in gas lines	11. a. Label cylinders per 29 CFR 1910.1200. b. Color code hoses (green = O_2; red = fuel gases; black = inert gas or air hoses). c. Install "flash back" arrestors for fuel mixing welding. d. Use acetylene at 15 psi or less.
12. Improper ignition of oxygen/fuel torch	12. a. Use "spark lighter" to ignite. b. Don't use cigarette, match or lighter for ignition.
13. Static electricity	13. a. Provide and use grounding clamp for electric area welding equipment.

EXHIBIT A-K

SITE MAPS



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LEGEND

✦	MONITORING WELL
⊗	MONITORING POINT
⊙	SOIL BORING
O MH	**MANHOLE**
o FH	FIRE HYDRANT
—x—x—	FENCE
—S—	SEWER LINE
▨	APPROXIMATE EXTENT OF LNAPL
ND	NONE DETECTED

0 50 100
SCALE FEET

GT ENGINEERING
1245 KINGS ROAD
SCHENECTADY, NY 12303
(518) 370-5631

REV. NO.:
DRAWING DATE: 8/3/98
ACAD FILE: LNAPL

AREAL EXTENT OF LNAPL

CLIENT: OSMOSE WOOD PRESERVING COMPANY
PM: BWA

LOCATION: ELLICOTT STREET
BUFFALO, NEW YORK
GEO: JOG

DESIGNED: JOG
DETAILED: MET/DEO/SSH
PROJECT NO.: 01110-5307
FIGURE: 2-1

EXHIBIT A-L

FLUOR DANIEL GTI FIELD INSPECTION FORM

Personal Protective Equipment

ITEM	YES	NO	N/A	YES	NO	N/A	YES	NO	N/A
Name									
Hard Hat									
Safety Glasses									
Safety Boots									
Traffic Vest									
Uniform or Coveralls									
Hearing Protection									

Site Safety Plan	Yes	No	N/A
1. Site Specific SSP on site and available.	___	___	___
2. All personnel on site have signed and acknowledged SSP.	___	___	___
3. Site map is attached to SSP with hospital location indicated.	___	___	___

Vehicle Inspection			
1. Windshields free of "vision-impaired" cracks.	___	___	___
2. Mirrors are in good working order.	___	___	___
3. First Aid Kit is complete and available.	___	___	___
4. Fire extinguisher is mounted in vehicle, ABC type 10 pound at a minimum.	___	___	___
5. Vehicle MSDS Package in vehicle.	___	___	___
7. Seat belt warning sign in vehicle.	___	___	___
8. Eyewash available.	___	___	___

Respiratory Protective Equipment	Yes	No	N/A
1. Only GTI approved air purifying respirators are used.	___	___	___
2. Respirators are stored in a company provided safety equipment bag.	___	___	___
3. Supplies to clean respirators are available.	___	___	___
4. Respirators appear in good working condition.	___	___	___
5. GTI Facial Hair Policy is in force.	___	___	___
6. Personnel with corrective lenses have obtained a respirator spectacle kit.	___	___	___
Contamination Control			
1. Access to exclusion (hot) zone is restricted and clearly defined through the use of cone(s), caution tape or another similar barricade.	___	___	___
2. Good housekeeping enforced.	___	___	___
Toxic Vapor Monitoring			
1. Air monitoring for organic vapor concentrations has been conducted to assess worker protection and it is documented.	___	___	___
2. Instrumented calibration and maintenance is performed as recommended by the manufacturer and it is documented.	___	___	___
3. Organic vapor air monitoring instrument operating manual is readily available.	___	___	___
4. Confined space entry (CSE) permit is utilized as required.	___	___	___
5. Full body harness retrieval system (tripod) is utilized. for CSE work if appropriate.	___	___	___
6. The buddy system is in effect for CSE as required.			
7. Continuous air monitoring is performed for CSE.	___	___	___

Fire Prevention and Protection

		Yes	No	N/A
1.	Air monitoring for flammable concentrations has been conducted to assess worker protection and it is documented.	___	___	___
2.	Instrument calibration and maintenance is performed as recommended by the manufacturer and it is documented.	___	___	___
3.	Oxygen/combustible vapor air monitoring instrument operating manual is readily available.	___	___	___
4.	Portable fire extinguishers are appropriate for the job, charged, deemed operable and have current annual inspection tag by a qualified licensed vendor.	___	___	___

Electrical Safety

		Yes	No	N/A
1.	Electrical equipment is properly rated if used in hazardous areas.	___	___	___
2.	Systems are properly grounded/bonded.	___	___	___
3.	Extension cords have a 3 prong plug for grounding.	___	___	___
4.	Extension cords and electrical cords are in good working condition.	___	___	___
5.	A ground fault circuit interrupter (GFCI) is being used as required.	___	___	___
6.	Lockout/Tagout is performed as required.	___	___	___

Comments/Notes:____

____

____

____

____

____

		Yes	No	N/A
Construction Safety				
1.	Excavation area has been sloped or shored at depths beyond 5 feet for personnel entry.	___	___	___
2.	Excavation areas 4 feet or greater in depth have ladders spaced so there is no greater than 25 foot travel distance for egress.	___	___	___
3.	Soils have been stored back greater than 2 feet from top of slope.	___	___	___
4.	Forks or buckets are in the down position when equipment is not in use.	___	___	___
5.	Construction vehicles and equipment display back alarms as required.	___	___	___
Ladder Safety				
1.	Ladder rungs are sturdy and free of cracks or breaks.	___	___	___
2.	Ladders have secure safety feet.	___	___	___
3.	Ladders are pitched at a 4:1 ratio.	___	___	___
4.	Ladders are secured at the top.	___	___	___
5.	Ladders are not used for access to air stripper towers.	___	___	___
Chemical Safety				
1.	All recovery vessels stored on a GTI site shall be marked with appropriate hazard warning label.	___	___	___
2.	All sheds and/or temporary storage structures shall be marked with a 10 inch diamond placard indicating any hazardous contents contained within that structure.	___	___	___
3.	Compressed gas cylinders are properly stored.	___	___	___
4.	Incompatible chemicals are segregated.	___	___	___
5.	MSDS' are available for all chemicals on site.	___	___	___
6.	Manufacturers chemical containers and transfer containers are properly labeled.	___	___	___

FIELD AUDIT REPORT

Performed By__________

Audit Date__________ Project Manager__________

Project Name__________ Project Number__________

Name

Site Activity

CC:

DC4:FIELDAUD.N91

HEALTH AND SAFETY SELF-AUDIT CHECKLIST

Name:__________________ Date:__________ Site Location__________________

Personnel on site:____

PLEASE INDICATE AS ACCEPTABLE (A), UNACCEPTABLE (U), OR NOT APPLICABLE (NA)

A. PROTECTIVE EQUIPMENT

1. Hard hat _____
2. Safety glasses _____
3. Safety boots _____
4. Traffic vest _____
5. Respirator _____
6. Ear plugs/muffs _____

B. SITE SAFETY

1. SSP on site & available _____
2. SSP has map to hospital _____
3. Nearest phone identified _____
4. Tailgate meeting conducted _____
5. GFCI's used appropriately _____
6. Lockout/Tagout for elec. work _____

C. SITE CONTROL

1. Access to exclusion (hot) zone restricted & properly defined _____
2. Additional precautions taken in high traffic areas _____

D. VEHICLE INSPECTION

1. First aid kit _____
2. Fire extinguisher _____
3. MSDS package _____
4. Mirrors _____
5. Headlights/brakelights/signals _____
6. Housekeeping _____

E. AIR MONITORING

1. Vapor monitoring has been conducted per the SSP _____
2. Calibration and maintenance has been performed per mfg. _____
3. Confined space entry permit has been utilized as required _____

F. CONSTRUCTION SAFETY

1. Excavations >4' have ladders spaces every 25' _____
2. Excavations > 5' have been sloped or shored for entry _____
3. Soils have been stored back > 2' from the pit _____

COMMENTS/CORRECTIONS NEEDED:____

____

____

__________________ cc: District Manager, Completed by:__________________

____
Project Manager

DTC5:CHECKLST.AUD

EXHIBIT A-M

DAILY TAILGATE SAFETY MEETING FORM

FLUOR DANIEL GTI
DAILY TAILGATE SAFETY MEETING

Project/Site:____

Date:____

Presented by:________________________Title:______________

Topic(s)/Information Reviewed:______________________________

Comments/Follow-up Actions:

Sign in:

NAME	SIGNATURE	COMPANY

Instructions:

Conduct a Daily Tailgate Safety Meeting prior to beginning each day's site activities.

Complete form and file with Site HASP.

Follow-up on any noted items and document resolution of any action items.

EXHIBIT A-N

AIR MONITORING AND VAPOR RESPONSE

COMMUNITY AIR MONITORING PLAN
VAPOR EMISSION RESPONSE PLAN
MAJOR EMISSION RESPONSE PLAN

APPENDIX A-N
SPECIFIC AIR MONITORING AND VAPOR RESPONSE

Community Air Monitoring Plan

Real-time air monitoring, for volatile organic compounds (VOCs) and particulate levels will be performed. This plan will include the following:

- VOCs will be monitored downwind of the work zone daily at 15 minute intervals during disturbance activities (i.e., excavation and/or drilling). If total organic vapor levels exceeds 5 parts per million (ppm) above background, activity will be halted and monitoring continued under provisions of the Vapor Emission Response Plan.
- Particulates will be continuously monitored downwind of the work zone with a portable particulate monitor. The monitor will have an alarm set at 150 ug/m3 above background. In the event downwind particulate levels exceed 150 ug/m3 above background particulate levels upwind of the work site will be measured. If downwind particulate levels exceed 2½ times the upwind level, the disturbances activity will be stopped and a corrective action plan implemented. All readings will be recorded and will be available for NYB DEC and DOH review.

Vapor Emission Response Plan

If the ambient air concentration of VOCs exceeds 5 ppm above background downwind of the work zone, activities will be halted while monitoring is continued. If VOC levels decrease below 5 ppm above background, the disturbance activity will resume with a more frequent monitoring interval. If VOC levels are greater than 5 ppm over background, but less than 25 ppm over background at the parameter of the work zone, disturbance activity will resume provided:

- the VOC level 200 feet downwind of the work zone or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm over background, and
- more frequent intervals of monitoring, as directed by the Safety Officer, are conducted.

If VOC level is above 25 ppm at the perimeter of the work zone, work activities will be shut down. When work shutdown occurs, downwind air monitoring as directed by the Safety Officer will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission Section.

Major Vapor Emission

If any organic levels greater than 5 ppm over background are identified 200 feet downwind from the work zone, or half the distance to the nearest residential or commercial property, whichever is less, all work activities will be halted.

If, following the cessation of the work activities, organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the work zone, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 foot zone). If efforts to abate the emission source are unsuccessful and if any of the following levels persist for more than 30 minutes in the 20 foot zone, then the Major Vapor Emission Response Plan shall automatically be placed into effect:

- Organic vapor levels greater than 5 ppm above background

Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

1. The local police authorities will immediately be contacted by the Safety Officer and advised of the situation.
2. Frequent air monitoring will be conducted for 10 minute intervals within the 20 foot zone. If four successive readings below action levels are measured, air monitoring may be halted or modified by the Safety Officer.

APPENDIX B

CITIZEN PARTICIPATION PLAN

APPENDIX B

CITIZEN PARTICIPATION PLAN
FOR RD/RA IMPLEMENTATION

OSMOSE, INC.
980 ELLICOTT STREET
BUFFALO, NEW YORK

Fluor Daniel GTI Project: 011108061

NYSDEC Site No. 915143

September 1998

TABLE OF CONTENTS

Tables

1.0 INTRODUCTION

In January, 1999, Osmose, Inc. (Osmose) entered into an Order on Consent with the New York State Department of Environmental Conservation (NYSDEC) to design and implement a remediation system for the Ellicott Street site. Osmose, with oversight from the NYSDEC and the New York State Department of Health, is committed to implementing a citizen participation plan as a part of its responsibilities for the site remedial program. Implementation of a citizen participation program will promote public understanding of activities at the site.

2.0 BASIC SITE INFORMATION

The Osmose site is located at 980 Ellicott Street, Buffalo New York, and serves as the executive and accounting headquarters, along with research and product production. Osmose purchased the site in 1951 and has operated the facility since that time. Osmose currently manufactures a variety of preservatives used in the treatment of lumber and wood products. The facility employs approximately 150 people from Buffalo and the surrounding communities.

The Osmose property is approximately 3.6 acres in area. The topography of the site is flat with a slight slope to the east.

Hydrocarbon impacts, primarily polynuclear aromatic hydrocarbons (PAHs) and No. 2 fuel oil, were detected at the site during activities associated with closure of three underground storage tanks (USTs) located in the southern parking lot. In December 1995, Osmose submitted a *Feasibility Study* report which recommended source removal, groundwater collection, *in situ* chemical treatment (ozone injection), and monitoring as the preferred remedial alternative. In January 1997, the NYSDEC issued a Record of Decision (ROD) which formally concurred with the recommended remedial action.

3.0 PROJECT DESCRIPTION

The overall objective of the present program is to design and install remediation system to clean the site to acceptable conditions as defined by the remedial action objectives. The design portion of the project is anticipated to extend through October 1998. Pending NYSDEC approval, installation of the treatment system is anticipated to begin in December 1998. Installation will consist of:

- trenching to install subsurface piping
- construction of a treatment compound/shed to house the treatment equipment

Trenching will occur within the sidewalk area and Ellicott Street in front of the Osmose facility. These trenching activities are anticipated to occur over a two-week period. Pedestrian access will be limited during excavation activities.

4.0 IDENTIFICATION OF INTERESTED PARTIES

The project contact list (**Table B-1**) will be used to inform interested parties of the construction activities. It is made up of elected officials, neighborhood people, and organizations directly affected by the construction activities. The list will be updated based on expressions of interest or written requests for inclusion.

5.0 PROJECT CONTACTS

Osmose, Inc.:	Mr. Michael Rider Facilities Manager Osmose, Inc. 980 Ellicott Street Buffalo, New York 14209 Phone: (716) 882-5905
New York State Department of Environmental Conservation:	Mr. Jaspal Walia, P.E. Project Manager NYSDEC 270 Michigan Avenue Buffalo, New York Phone: (716) 851-7220
NYSDEC Hazardous Waste Toll-Free Information Number:	(800) 342-9296
New York State Department of Health:	Michael J. Kadlec NYSDOH 2 University Place Room 205 Albany, New York 12203-3399 (518) 458-6309
New York State Department of Health Information Line	1-800-458-1158

6.0 DOCUMENT REPOSITORY

Project documents may be reviewed at the following locations:

Buffalo and Erie County Public Library
North Jefferson Branch
332 East Utica
Buffalo, New York 14208
(716) 883-4418
Tuesday-Friday 10 a.m. - 8 p.m.
Saturday 9 a.m. - 12 noon

New York State Department of Environmental Conservation
Region 9
270 Michigan Avenue
Buffalo, New York 14203
(716) 851-7220
Open Monday thru Friday 8:30 a.m. - 4:30 p.m.

7.0 SCHEDULE OF CITIZEN PARTICIPATION ACTIVITIES

Following the NYSDEC approval of the Final Remedial Design, the following activities will take place:

- A copy of the Final Remedial Design will be placed at the project repositories in the NYSDEC regional office and the Buffalo and Erie County Public Library (North Jefferson Branch)
- A newsletter (fact sheet) will be sent to immediately adjacent property owners describing the schedule of activities.
- Osmose's Project Manager will meet during the course of the project with any adjacent property owner or other interested party that requests a such a meeting.

Following completion of the construction/installation activities, the following activities will take place:

- A newsletter (fact sheet) will be sent to immediately adjacent property owners and government officials summarizing the field activities.
- A copy of the as-built drawings will be placed in the project repositories.

8.0 DEFINITION OF COMMONLY USED CITIZEN PARTICIPATION TERMS

Citizen Participation - A process to inform and involve the interested/affected public in the decision-making process during identification, assessment and remediation of inactive hazardous waste sites. This process helps to assure that the best decisions are made from a technical, environmental, human health, and economic perspectives.

Citizen Participation Plan - A document that describes the site-specific citizen participation activities that will take place to complement the "technical" (remedial) activities. It also provides site background and rationale for the selected citizen participation program for the site. A plan may be updated or altered as public interest or the technical aspects of the program change.

Consent Order - A legal and enforceable negotiated agreement between the NYSDEC and responsible parties where responsible parties agree to undertake investigation and cleanup or pay for the costs of investigation and cleanup work at a site. The order includes a description of the remedial actions to be undertaken at the site and a schedule for implementation.

Contact List - Names, addresses and/or telephone numbers of individuals, group, organizations and media interested and/or affected by a particular hazardous waste site compiled and updated by NMPC. Interest in the site, stage of remediation and other factors guide how comprehensive the list becomes. Used to assist NMPC to inform and involve the interested/affected public.

Document Repository - Typically a regional NYSDEC office and/or public building, such as a library, near a particular site, at which documents related to remedial and citizen participation activities at the site are available for public review. Provides access to documents at times and a location convenient to the public. Environmental Management Councils (EMCs), Conservation Advisory Committees (CACs) as well as active local groups often can serve as supplemental document repositories.

Feasibility Study (FS) - A process for developing, evaluating and selecting remedial actions, using data during the remedial investigation to: define the objectives of the remedial program for the site and broadly develop remedial action alternatives; perform an initial screening of these alternatives; and perform a detailed analysis of a limited number of alternatives which remain after the initial screening stage.

Project Manager - A staff member with responsibility for the day-to-day administration of activities, and ultimate disposition of, one or more hazardous waste sites. The Project Manager works with Public Affairs as well as fiscal and legal staff to accomplish site-related goals and objectives.

Public - The universe of individuals, groups and organization: a) affected (or potentially affected) the site and/or its remedial program; b) interested in the site and/or its remediation; c) having information about the site and its history.

Public Notice - A written or verbal information technique for telling people about an important part of a site's remedial program (examples: announcement that a report is publicly available; a public meeting has been scheduled; etc.).

Remedial Design - Once a remedial action has been selected, technical drawings and specifications for remedial construction at a site are developed, as specified in the final RI/FS report. Design documents are used to bid and construct the chosen remedial actions. Remedial design is prepared by consulting engineers with experience in environmental remediation.

Remedial Investigation (RI) - A process to determine the nature and extent of chemical impacts by collecting data and analyzing the site. It includes sampling and monitoring, as necessary, and includes the gathering of sufficient information to determine the necessity for, and proposed extent of, a remedial program for the site.

Toll-Free Information Number - Provides member of the public who have questions, concerns or information with cost-free access to agencies and companies. The NYSDEC Hazardous Waste Toll-Free Information Number takes or records calls 24 hours a day. NYSDEC staff contacts the caller as soon as possible (usually the same day). The NYSDOH Environmental Health Information line is staffed from 8:00 am to 4:30 pm on business days. After hours callers can leave a message which will be returned the next business day.

TABLE B-1
CONTACT LIST
FINAL RD/RA

Councilwoman Barbara Williams
Buffalo Common Council
1316A Buffalo City Hall
Buffalo, NY 14202

Mr. Dennis Sutton
Buffalo Environment Office Staff
916 Buffalo City Hall
Buffalo, NY 14202

Mr. Martin Doster
NYSDEC, Region 9
270 Michigan Avenue
Buffalo, NY 14203

Mr. Cameron O'Connor
NYSDOH, Buffalo
584 Delaware Avenue
Buffalo, NY 14202

Mr. David Cates
51 Northampton Street
Buffalo, NY 14209

Mr. Hayward Powell
326 High Street
Buffalo, NY 14204

Mr. Michael Rider
Osmose Wood Preserving
980 Ellicott Street
Buffalo, NY 14209

Mr. Roscoe Henderson
Buffalo Common Council Staff
1316A Buffalo City Hall
Buffalo, NY 14202

Mr. William Nowak
City Chief of Staff's Office
1403 Buffalo City Hall
Buffalo, NY 14202

Mr. Michael Podd
NYSDEC, Region 9
270 Michigan Avenue
Buffalo, NY 14203

Mr. Michael Kadlec
NYSDOH, Room 205
2 University Place
Albany, NY 12203-3399

Mr. Charles Johnson
14 Shumway Street
Buffalo, NY 14206

Mr. Kittrell Whitlock
47 St. Paul Mall-South
Buffalo, NY 14209

Mr. James Smith
Buffalo Environment Office
916 Buffalo City Hall
Buffalo, NY 14202

Ms. Thelma Roberts
Home Space
1030 Ellicott Street
Buffalo, NY 14209

Mr. Jaspal Walia
NYSDEC, Region 9
270 Michigan Avenue
Buffalo, NY 14203

Mr. Milton Brown
35 St. Paul Mall-South
Buffalo, NY 14209

Mr. Randy Muldrow
1007 Ellicott Street
Buffalo, NY 14209

Mr. Bruce Ahrens
13 British American Blvd
Albany, NY 12110

TABLE B-1
CONTACT LIST
FINAL RD/RA

Ms. Pauline Bell
36 Dodge Street
Buffalo, NY 14209

Ms. Rosemary Segarra
38 Dodge Street
Buffalo, NY 14209

Ms. Debra Johnson
40 Dodge Street
Buffalo, NY 14209

Mr. Jerome Owens
73 Dodge Street
Buffalo, NY 14209

Mr. Jake Yarns
77 Dodge Street
Buffalo, NY 14209

Mr. Floyd Bush
80 Dodge Street
Buffalo, NY 14209

Ebony Canzater
82 Dodge Street
Buffalo, NY 14209

Joseph & Anne Skrzynski
8 Edna Place
Buffalo, NY 14218

D. Wright
5 Edna Place
Buffalo, NY 14209

Desmond Madison
9 Edna Place
Buffalo, NY 14209

Mr. Alex Goldstein
17 Edna Place
Buffalo, NY 14218

Mr. Richard Michnik
18 Edna Place
Buffalo, NY 14218

Jessie McGee
20 Edna Place
Buffalo, NY 14209

Louise Nealy
20 Edna Place
Buffalo, NY 14209

Frances Dabolt
22 Edna Place
Buffalo, NY 14209

Ms. Joan Ramadhan
35 Edna Place
Buffalo, NY 14209

Ms. Carrie Carswell
36 Edna Place
Buffalo, NY 14209

K. A. Stevens
973 Ellicott Street
Buffalo, NY 14209

Angeline & Anthony Costner
975 Ellicott Street
Buffalo, NY 14209

Eugene Jacobs
991 Ellicott Street
Buffalo, NY 14209

Ms. Dorothy Bryant
997 Ellicott Street
Buffalo, NY 14209

Cynthia & Fred Green
30 St. Paul Mall - North
Buffalo, NY 14209

TABLE B-1
CONTACT LIST
FINAL RD/RA

Mr. James Glover
38 St. Paul Mall - North
Buffalo, NY 14209

Ms. Marguerite O'Connor
42 St. Paul Mall - North
Buffalo, NY 14209

F. Perry
46 St. Paul Mall - North
Buffalo, NY 14209

Nakia Ball
29 St. Paul Mall - South
Buffalo, NY 14209

Dana A & K. Holley
31 St. Paul Mall - South
Buffalo, NY 14209

Joseph Wilhelm
33 St. Paul Mall - South
Buffalo, NY 14209

Curtis Brown
35 St. Paul Mall - South
Buffalo, NY 14209

Gloria Quarles
43 St. Paul Mall - South
Buffalo, NY 14209

Norma Woods
David Clark
39 St. Paul Mall - South
Buffalo, NY 14209

Geneva Flood
Randolph Edwards
41 St. Paul Mall - South
Buffalo, NY 14209

Kittrell Witlock
47 St. Paul Mall - South
Buffalo, NY 14209

APPENDIX C

TECHNICAL SPECIFICATIONS

APPENDIX C

TECHNICAL SPECIFICATIONS
OSMOSE, INC.
980 ELLICOTT STREET
BUFFALO, NEW YORK

Fluor Daniel GTI Project: 011108061

NYSDEC Site No. 915143

September 1998

APPENDIX D

CONSTRUCTION QUALITY ASSURANCE PLAN

C

APPENDIX C

TECHNICAL SPECIFICATIONS

APPENDIX C

TECHNICAL SPECIFICATIONS
OSMOSE, INC.
980 ELLICOTT STREET
BUFFALO, NEW YORK

Fluor Daniel GTI Project: 011108061

NYSDEC Site No. 915143

September 1998

SPECIFICATIONS

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

Work performed under this section shall include furnishing all labor, tools, equipment, and materials for site layout, obtaining all necessary permits, control of dust, and erosion and sedimentation control features.

1.01 SUMMARY

A. Section Includes:

1. Site Layout.
2. Utility Notification.
3. Permit Acquisition.
4. Dust Control.
5. Erosion and Sediment Control.

B. RELATED DOCUMENTS

All other terms and provisions of the Contract are included as a part of this Section.

1.02 DEFINITIONS

A. Structures and Surface Features: Existing structures and surface features including buildings, pavements, curb and gutter, signs, posts, fences, trees, shrubs, landscaped surface features, and other miscellaneous items.

B. Utilities: Existing gas mains, water mains, steam lines, electric lines and conduits, telephone and other communication lines and conduits, sewer pipe, cable television, other utilities, and appurtenances.

C. Dust Control: Dust Control and Erosion Control measures and the disposal of excess soils.

D. Salvaged Topsoil: Natural loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils available from overlying portions of areas to be excavated for construction.

1.03 PROJECT/SITE CONDITIONS

A. Do not block or obstruct roads or streets with excavated soils or materials, except as authorized by OWNER. When performing work in Ellicott Street, the Excavation Contractor shall notify the proper authorities, employ proper resources for routing of traffic, and maintain traffic routing, as appropriate, until all work in Ellicott Street has been completed.

B. All work shall be performed within limits shown on Contract Drawings.

1.04 SUBMITTALS

A. Excavation Contractor shall submit a dust control and an erosion control plan to the ENGINEER for approval prior to mobilization.

B. Excavation Contractor shall submit utility notification logs to the Engineer.

C. Excavation Contractor shall obtain and submit any necessary permits required to perform work.

D. Mechanical Contractor shall obtain and submit necessary building permits.

E. Electrical Contractor shall obtain and submit necessary electrical permits.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PROTECTION

A. Protect existing utilities against damage.

B. Contact utilities' "Diggers Hot Line" before beginning excavation.

C. Locate existing underground utilities by hand excavation.

D. If uncharted utilities are encountered during excavation, stop work and notify OWNER immediately.

1. Repair damaged utilities, charted and uncharted, at Excavation Contractor's expense.

E. Preserve and protect groundwater monitoring wells. Replace damaged or destroyed monitoring wells at Excavation Contractor's expense.

F. Make arrangements with utilities to protect or remove and relocate services. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in place during work in accordance with requirements of owners of services.

G. Erosion Controls. The Excavation Contractor shall schedule and conduct his operations to minimize erosion of soils and to prevent silting and muddying of storm sewers and lands adjacent to or affected by the work. Erosion control measures include sedimentation basins or traps, berms, tarping, staked hay bales, silt fence, and seeding, mulching, covering with netting or sodding disturbed areas. The area of soil exposed by construction at any one time should be kept to a minimum and final restoration should be carried out upon completion of construction in disturbed areas, weather permitting. If weather conditions prohibit proper planting or germination, the Excavation Contractor shall return in the spring to perform final restoration.

H. Excess soil disposal. All excess soils that have no evidence of impact shall be disposed of on the site in an area designated by the OWNER. All impacted excess soils (well cuttings, etc.) will be placed into drums or rolloffs, as appropriate, for proper off-site disposal. OWNER will arrange for off-site disposal at OWNER's expense.

I. Dust control.

1 . Definition: Reducing the amount of wind-blown soil from development sites and disturbed soil areas to acceptable levels.

2. Purpose: To control wind-blown soil pollution of air and water; to improve on-site working conditions; to protect glass and polished surfaces from sandblasting; to prevent highway accidents on nearby roads that may result from a momentary loss of visibility; to protect adjacent developed areas from receiving any wind-blown soils and/or debris.

3. Applications: This practice applies to areas subject to wind erosion where off-site damage is likely. Treatments near populated areas are of prime importance.

4. Control: Dust shall be controlled by wetting or covering, as appropriate.

3.02 PREPARATION

A. Excavation Contractor shall provide a minimum of 3 working days notice, prior to beginning construction, to owners of existing utilities, structures, and surface features.

B. Excavation Contractor shall clearly mark out the well locations, trench layout, and building footprint prior to any other site work.

3.03 RESTORATION

A. Excavation Contractor shall restore existing utilities, surface features, and structures to conditions which existed prior to construction that are to remain after restoration.

B. Excavation Contractor shall replace to original condition or better, damaged landscape work within construction limits and those areas disturbed by Excavation Contractor outside the construction limits.

PART 4 PAYMENT

4.01 GENERAL

A. Payment for all work in this section shall be included in Payment Item #1 - Site Preparation.

* * * END OF SECTION * * *

SECTION 02221
TRENCHING AND BACKFILLING

PART 1 GENERAL

Work performed under this section shall include furnishing all labor, tools, equipment, and materials for trenching, backfilling, and compacting of trenches and removal and disposal of spoils from the trenches.

1.01 SUMMARY

A. Section Includes:

1. Saw cutting of existing asphalt surfaces to the required width of the trench.
2. Excavating of trenches to the lines and grades shown on the Drawings.
3. Stockpiling, managing, and disposing of excavated soils.
4. Preparation of subgrade surfaces.
5. Hauling and placement of borrow materials for backfilling.
6. Compaction of backfill.

1.02 QUALITY CONTROL

A. The Excavation Contractor shall engage the services of a qualified testing laboratory to make tests and determine acceptability of backfill materials. The laboratory shall be acceptable to the ENGINEER.

B. Excavation Contractor shall perform excavation and backfill work in accordance with applicable requirements of governing authorities having jurisdiction. Strict compliance with NYS Industrial Code 53 and OSHA 40 CFR Part 1910 and 1926 shall be required at all times.

1.03 SUBMITTALS

A. Excavation Contractor shall submit gradation test results for all materials.

B. The Excavation Contractor shall submit modified proctor test results for subbase material and standard proctor test results for pipe bedding material.

PART 2 PRODUCTS

2.01 BACKFILL

A. Materials suitable for backfilling within one foot of the piping shall conform to the following:

1. Gradation in accordance with NYSDOT Item No. 703-03, Mortar Sand:

Sieve Size	Minimum % Passing by Weight
No. 4	100
No. 8	95 - 100
No. 50	10 - 40
No. 100	0 - 15

B. Materials suitable for the backfilling within one foot of the asphalt surface shall conform to the following:

1. Gradation in accordance with NYSDOT Item No. 304 Subbase Type 1:

Sieve Size	Minimum % Passing by Weight
3 inch	100
2 inch	95 - 100
1/4 inch	30 - 65
No. 40	5 - 40
No. 200	0 - 10

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavation Contractor shall saw cut asphalt to the required width of the trenches.

B. Excavate to elevations and dimensions indicated, or required to accomplish work.

C. At all times during the work, the Excavation Contractor shall keep the excavations dry and free from water as determined by the ENGINEER until the structures are completed or accepted and backfilled. The Excavation Contractor shall provide sufficient pumps and other equipment to handle and dispose of the water to the satisfaction of the ENGINEER.

D. The Excavation Contractor shall adhere to all environmental constraints of the site and shall obtain all necessary permits.

E. Protect bottoms of excavations from the entry of frost into the ground surfaces to the satisfaction of the ENGINEER. The Excavation Contractor shall not place frozen or unsuitable backfill into the trench and shall not place and compact backfill onto frozen subgrade.

F. The Excavation Contractor shall supply all necessary forms, shoring, bracing, sheathing, or other equipment necessary to excavate in a safe workman-like manner.

G. In general, sheathing and bracing shall be removed carefully and the voids filled and compacted to the satisfaction of the ENGINEER.

H. All excavation for installation of piping and electrical conduit shall be carefully controlled to avoid damaging the nearby structures.

I. All excavation outside the lines and grades shown and which is not approved by the ENGINEER, together with the removal and disposal of the associated material shall be at the Excavation Contractor's expense. The unauthorized excavation shall be filled and compacted with approved backfill by the Excavation Contractor at the Excavation Contractor's expense.

J. All off-site sources shall have valid mining permits and shall meet the approval of the ENGINEER.

PART 4 PAYMENT

4.01 GENERAL

A. Payment for all work in this section shall be included in Payment Item #2 - Trenching.

* * * END OF SECTION * * *

SECTION 02433
VAPOR EXTRACTION WELL

PART 1 GENERAL

Drilling Contractor shall furnish all labor, materials and equipment required to install the vapor extraction wells as shown on the drawings and specifications.

1.01 SUMMARY

A. Section Includes:

1. Drilling of vapor extraction well.
2. Construction of vapor extraction well.
3. Proper disposal of cuttings.

1.02 SUBMITTALS

A. Drilling Contractor shall submit final boring logs for each well.

B. Drilling Contractor shall submit construction diagrams for each well.

C. Drilling Contractor shall submit well construction pipe data.

D. Drilling Contractor shall submit well filter pack data.

E. Drilling Contractor shall submit bentonite data.

1.03 QUALITY ASSURANCE

A. Work shall be supervised by a professional experienced in installation of vapor extraction wells.

B. The quality of all materials and workmanship shall be subject to the inspection and approval of the ENGINEER.

1.04 PROJECT/SITE CONDITIONS

A. Obstructions are sometimes encountered when drilling, many of which can be drilled through. Drilling Contractor is expected to make reasonable effort to drill through obstructions and will be paid for offset redrilling and boring abandonment if approved in writing by ENGINEER.

PART 2 PRODUCTS

2.01 PIPE

A. Vapor Extraction Wells:

1. Well Riser Pipe: 4-inch nominal diameter, nonperforated, Schedule 80 PVC.
2. Well Screen: 4-inch nominal diameter, slotted, Schedule 80 PVC with end slip cap. Slots shall be cut to 0.020 inches.
3. Well Coupling: Well riser pipe and screen shall be flush threaded.
4. Well Cap: 4-inch nominal diameter, ventilated well cap will be installed on each well casing.
5. Well Protection: 15-inch round pull box with locking (bolted) cap.

2.02 AGGREGATE

A. Filter Pack

1. Filter pack material shall consist of clean ,well rounded silica sand.
2. Filter pack size will be Morie No. 3 or approved equal.

B. Bentonite Pellet Seal

1. Bentonite pellet seal material shall consist of rounded pellets capable of dropping through to the interval shown on the Drawings prior to hydrating.
2. Bentonite seal shall be:
   a. American Colloid
   b. Or approved equal

C. Cement/Bentonite Grout

1. Cement/bentonite grout shall consist of approximately 90% cement and 10% bentonite.
2. Cement shall be:
   a. Portland
   b. Or approved equal
3. Bentonite shall be:
   a. Baroid
   b. American Colloid
   c. Or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Only brand new well construction materials shall be used. All materials shall be cleaned prior to installation.

3.02 SPOILS DISPOSAL

A. Soil Disposal:

1. Drill cuttings that have not been impacted shall be spread on-site at a location designated by the OWNER. Drill cuttings that have been impacted shall be placed in either drums or a rolloff for proper off-site disposal. Off-site disposal will be arranged for by the OWNER at the OWNER's expense.

3.03 DRILLING

A. Drilling will be performed in accordance with the site health and safety plan.

B. Borings shall be advanced using hollow-stem augers with a nominal outside diameter suitable for well installation and an inside diameter suitable for sampling with a two-inch split spoon sampler.

C. Field Measurements/Observations:

1. Record depth measurements and backfill layers to nearest 1/10th foot on boring logs.

2. Record general description of soils at 2-foot intervals on boring logs, starting at a depth of 5 feet.
3. Record moisture level of soils at 2-foot intervals on boring logs (i.e., dry, moist, wet).
4. Record reference point for all measurements.
5. Record total depth of completed boring and wells.
6. Record nominal borehole diameter.

C. Well Depths: Wells shall extend to depths as shown on Drawings or as determined in the field by the ENGINEER.

3.04 INSTALLATION

A. Well piping and screen shall be installed as a single continuous unit.

1. Install piping to minimize flexural stress tó unit.
2. Riser pipe shall be extended to provide a minimum stick-up of 12 inches above the bottom of the pull box.

B. Screen Section Backfill:

1. Measure depth to bottom of well.
2. Backfill with filter pack.
3. Extend filter pack 1 feet above screen, as shown on Drawings.

C. Bentonite Pellet Seal

1. Place 2 foot bentonite pellet seal material directly on sand.
2. Provide water for hydration, if necessary.

E. Cement/Bentonite Grout

1. A tremie rod shall be used to fill the annular space above the bentonite pellet seal with cement/bentonite grout to ground surface.

F. Protective Well Casing

1. Install protective 15-inch round pull box upon completion of the well.
2. Protective casing shall be flush mounted with the asphalt surface.
3. Secure protective casing in-place with cement backfill to the final grade.

G. As the bentonite backfill and filter pack is placed, the working casing shall be withdrawn to expose these materials to the formation. Care shall be taken to avoid "locking" of these materials such that the well screen and casing are extracted as the working casing is withdrawn from the borehole.

H. In no instance shall the well casing and screen be driven or forced into the borehole or filter pack.

I. Lost drilling tools or materials shall not be allowed to remain in the boreholes.

PART 4 PAYMENT

4.01 GENERAL

A. Payment for all work in this section shall be included in Payment Item #3 - SVE Well Installation

* * * END OF SECTION * * *

SECTION 02434
OZONE INJECTION WELL

PART 1 GENERAL

Drilling Contractor shall furnish all labor, materials and equipment required to install the ozone injection wells as shown on the drawings and specifications.

1.01 SUMMARY

A. Section Includes:

1. Direct push of ozone injection well screen with tubing.
2. Construction of ozone injection well.

1.02 SUBMITTALS

A. Drilling Contractor shall submit direct push rate and proposed equipment.

B. Drilling Contractor shall submit construction diagrams for each well.

C. Drilling Contractor shall submit well injection well screen data.

D. Drilling Contractor shall submit bentonite data.

1.03 QUALITY ASSURANCE

A. Work shall be supervised by a professional experienced in installation of injection wells.

B. The quality of all materials and workmanship shall be subject to the inspection and approval of the ENGINEER.

1.04 PROJECT/SITE CONDITIONS

A. Obstructions are sometimes encountered when using direct push technology. Drilling Contractor is expected to make reasonable effort to push through obstructions and will be paid for offset pushing and well abandonment if approved in writing by ENGINEER.

PART 2 PRODUCTS

2.01 WELL SCREEN

A. Ozone injection Wells:

1. Drive point shall be 1.25-inch nominal diameter.
2. Drive point shall be vee-wire stainless steel.
3. Drive point shall have 0.010 slot openings.
4. Drive point shall be equipped with a 1.25-inch to 0.5-inch adapter for stainless steel riser section.
5. Well protection shall be 15-inch round pull box with locking (bolted) cap.

2.02 BENTONITE

A. Bentonite Pellet Seal

1. Bentonite slurry seal material shall consist of powder bentonite capable of falling and sealing to the interval shown on the Drawings.
2. Bentonite shall be:
   a. Baroid
   b. American Colloid
   c. Or approved equal

PART 3 EXECUTION

3.01 PREPARATION

A. Only brand new well construction materials shall be used. All materials shall be cleaned prior to installation.

3.02 DRIVING

A. Driving will be performed in accordance with the site health and safety plan, and in accordance with manufacturers recommendations.

B. Field Measurements/Observations:

1. Record depth measurements and backfill layers to nearest 1/10th foot on boring logs.
2. Record reference point for all measurements.
3. Record total depth of completed boring and wells.

C. Drive Depth: Drive points shall be driven to depths as shown on Drawings or as determined in the field by the ENGINEER.

D. Drive points shall be driven plumb with a tolerance of 1 percent of the length.

3.03 INSTALLATION

A. Drive point and stainless steel riser shall be installed as a single continuous unit.

1. Install riser to minimize flexural stress to unit.
2. Riser shall be extended to provide a minimum stick-up of 4 inches above the bottom of the pull box.

B. Protective Well Casing

1. Install protective 15-inch round pull box upon completion of the well.
2. Protective casing shall be flush mounted with the asphalt surface.
3. Secure protective casing in-place with cement backfill to the final grade.

PART 4 PAYMENT

4.01 GENERAL

A. Payment for all work in this section shall be included in Payment Item # 5 - Ozone Injection wells

* * * END OF SECTION * * *

SECTION 02435
GROUNDWATER RECOVERY WELL

PART 1 GENERAL

Drilling Contractor shall furnish all labor, materials and equipment required to install the groundwater recovery wells as shown on the drawings and in accordance with these specifications.

1.01 SUMMARY

A. Section Includes:

1. Drilling of groundwater recovery well.
2. Construction of groundwater recovery well.
3. Installation of pumps.
4. Proper disposal of cuttings.

1.02 SUBMITTALS

A. Drilling Contractor shall submit final boring logs for each well.

B. Drilling Contractor shall submit construction diagrams for each well.

C. Drilling Contractor shall submit for approval, data on casing, screen, pitless unit, pumps, fittings and appurtenances, bentonite, and results of sieve analysis for backfill materials.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. CONTRACTOR shall be thoroughly familiar with the equipment and methodology necessary for the installation of groundwater recovery wells.

B. Reference Standards:

1. Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

   (a) ASTM A53
   (b) AWWA A100

C. The quality of all materials and workmanship shall be subject to the inspection and approval of the ENGINEER.

1.04 PROJECT/SITE CONDITIONS

A. Obstructions are sometimes encountered when drilling, many of which can be drilled through. Drilling Contractor is expected to make reasonable effort to drill through obstructions and will be paid for offset redrilling and boring abandonment if approved in writing by ENGINEER.

PART 2 PRODUCTS

2.01 PIPE

A. Groundwater Recovery Wells:

1. Well Riser Pipe: 6-inch nominal inside diameter, nonperforated, Schedule 80 FRE.
2. Well Screen: 6-inch nominal inside diameter, slotted, Schedule 80 FRE with end cap. Slots shall be cut to 0.020 inches.
3. Well Coupling: Well riser pipe and screen shall be butt fused.
4. Well Cap: 6-inch nominal diameter, ventilated well cap will be installed on each well casing.
5. Well Protection: 15-inch round pull box and extension with locking (bolted) cap.

B. Centralizers

1. The upper two centralizers shall be constructed of carbon steel materials and the lower centralizer shall be stainless steel and approved by the ENGINEER.

2.02 AGGREGATE

A. Filter Pack

1. Filter pack material shall consist of clean, well rounded silica sand with a uniformity coefficient not greater than 2.5.
2. Filter pack size will be Grade 0 Morie or approved equal.
3. Filter pack shall be:

    (a) Morie Cape May
    (b) Or approved equal.

B. Sand Choke

1. Sand choke size shall be Grade 00 or approved equivalent.
2. Sand choke shall have a uniformity coefficient not greater than 2.5.
3. Sand shall be:

    (a) Morie Cape May
    (b) Or approved equal.

C. Bentonite

1. Backfill annular space from the bottom of the clay layer to 2-feet in thickness as shown.
2. Bentonite seal material shall consist of rounded pellets capable of dropping through water to the interval shown on the Drawings prior to hydrating.
3. Bentonite seal shall be:

    (a) American Colloid
    (b) Or approved equal

D. Cement/Bentonite Grout

1. Cement/bentonite grout shall consist of 90% cement and 10% bentonite.
2. Cement shall be:

(a) Portland
(b) Or approved equal

3. Bentonite shall be:

(a) Baroid
(b) American Colloid
© Or approved equal.

E. Well Cap

1. Well caps shall be installed on each well casing.
2. Well caps shall be ventilated type.
3. Well caps shall be:

(a) Baker # 8V
(b) Or approved equal.

F. Pitless Unit

1. Pitless unit shall have welded casing fittings for 1.25-inch diameter discharge.
2. Drop pipe fitting shall be for 1.25-inch diameter drop pipe.
3. Pitless units shall be:

(a) Baker
(b) MAASS
© Or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Only brand new well construction materials shall be used. All materials shall be cleaned prior to installation.

3.02 SPOILS DISPOSAL

A. Soil Disposal:

1. Drill cuttings that have not been impacted shall be spread on-site at a location designated by the OWNER. Drill cuttings that have been impacted shall be placed in either drums or a rolloff for proper off-site disposal. Off-site disposal will be arranged for by the OWNER at the OWNER's expense.

3.03 DRILLING

A. Drilling will be performed in accordance with the site health and safety plan.

B. Borings shall be advanced using hollow-stem augers with a nominal inside diameter suitable for well construction and an inside diameter suitable for sampling with a two-inch split spoon sampler.

C. Field Measurements/Observations:

1. Record depth measurements and backfill layers to nearest 1/10th foot on boring logs.
2. Record general description of soils at 2-foot intervals on boring logs, starting at a depth of 5 feet.
3. Record moisture level of soils at 2-foot intervals on boring logs (i.e., dry, moist, wet).
4. Record reference point for all measurements.
5. Record total depth of completed boring and wells.
6. Record nominal borehole diameter.
7. Record details pertaining to development of recovery well (i.e., method, water production, etc.)

D. Well Depths: Wells shall extend to depths as shown on Drawings or as determined in the field by the ENGINEER.

3.04 INSTALLATION

A. Well piping and screen shall be installed as a single continuous unit.

1. Install piping to minimize flexural stress to unit.
2. Riser pipe shall be extended to provide a minimum stick-up of 12 inches above the bottom of the pull box.

B. Screen Section Backfill:

1. Measure depth to bottom of well.
2. Backfill with filter pack.
3. Extend filter pack 1 feet above screen, as shown on Drawings.

C. Bentonite Pellet Seal

1. Place 2 foot bentonite pellet seal material directly on sand choke.
2. Provide water for hydration, if necessary.

D. Cement/Bentonite Grout

1. A tremie rod shall be used to fill the annular space above the bentonite pellet seal with cement/bentonite grout to ground surface.

E. Protective Well Casing

1. Install protective 15-inch round pull box upon completion of the well.
2. Protective casing shall be flush mounted with the asphalt surface.
3. Secure protective casing in-place with cement backfill to the final grade.

F. The well casing, screen and sump shall be centered within the working casing using one centralizer placed at the base of the sump, a second centralizer above the well screen and a third centralizer placed between the well screen and the ground surface to ensure concentric well construction.

G. The bentonite material shall be placed evenly avoiding bridging or voids and shall extend from the top of the sand choke layer up to 2-feet into the clay layer.

H. The Drilling Contractor shall place two (2) feet of silica "choker" sand (sand choke) as an interface between the filter pack and the bentonite seal.

I. As the bentonite backfill, filter pack and sand choke is placed, the working casing shall be withdrawn to expose these materials to the formation. Care shall be taken to avoid "locking" of these materials such that the well screen and casing are extracted as the working casing is withdrawn from the borehole.

J. The annular space above the bentonite seal shall be filled with cement bentonite grout to ground surface.

K. In no instance shall the well casing and screen be driven or forced into the borehole or filter pack.

L. Lost drilling tools or materials shall not be allowed to remain in the boreholes.

3.04 WELL DEVELOPMENT

A. The wells shall be developed for a minimum of 4 hours to remove native clays, silts and finer fractions of the formation to ensure the maximum efficiency of the well. Development shall continue until the clarity of the development fluid stabilizes and is sand-free, and there is a leveling off of the specific capacity of the completed wells.

B. The development of each well shall be accomplished by mechanical surging and pumping using a double surge block, the drill rig and an appropriate pump, or by other means approved by the ENGINEER.

C. All development water shall be discharged to the existing water treatment facility. Under no circumstances shall development water be allowed to discharge onto the ground surface.

3.05 PUMP TESTS

A. Step rate tests shall be performed on each completed well prior to the installation of the pitless unit.

B. Step rate tests shall be performed using a pump with a capacity of 5 gpm or less as specified by the ENGINEER. The appropriate pumps shall be supplied by the Drilling Contractor.

C. Drilling Contractor shall provide continuous pumping for a duration sufficient to determine a sustained yield for each well. Each step should last for a minimum duration of 60 minutes.

D. Drilling Contractor shall obtain water level measurements from the newly installed recovery wells, and previously installed monitoring wells prior to and during the pump test to identify potential responses for the duration of each yield test.

E. If any of the monitoring wells indicate a response to the yield testing, Drilling Contractor shall perform an eight (8) hour constant rate pump test and monitor the aforementioned monitoring wells and each newly installed recovery well for the duration of the test. CONTRACTOR shall also provide monitoring for a period of eight (8) hours after terminating the pump test or until static conditions are re-established (whichever comes first).

F. Discharge shall be piped to the existing water treatment facility or to a location approved by the ENGINEER.

G. Drilling Contractor shall provide the following data for each recovery well:

1. Test pump make, model, capacity, head characteristics;
2. Depth of test pump setting;
3. Static water level to nearest 0.01 foot from top of casing and feet above mean sea level; and
4. Water-level measurements and time of measurements.

H. Step Rate/Constant Rate Pump Test Data:

1. Drilling Contractor shall provide flow rate and water level data associated with each flow rate. For each Step Rate Test and the pumping portion of the Constant Rate Pump Test (if performed) Drilling Contractor shall provide and record water levels as follows:

   PUMPING WELL

Time Since Pumping Began/Ended	Measurement Time Intervals
0-5 min	30 sec
5-15 min	1 min
15-50 min	5 min
50-100 min	10 min
100 - End of Test	30 min

   MONITORING WELLS

Time Since Pumping Began	Measurement Time Intervals
0-50 min	10 min
50 - End of Test	50 min

2. Pump rate to be measured by water meter every ten (10) minutes for the first hour and every half hour for the duration of the test.
3. For the recovery portion of the Step Rate and Constant Rate Tests, data should be collected according to the same time intervals specified for the pumping portion of the test. Step Rate Test recovery data shall be collected until static conditions are reestablished or a maximum of one (1) hour has elapsed (whichever comes first) after pump shut down. Recovery data after the pumping test (if performed) shall be collected until static conditions are re-established or a maximum of eight (8) hours has elapsed after pump shut down.

I. Well and pump test data collected above shall be submitted to the ENGINEER for approval.

PART 4 PAYMENT

4.01 GENERAL

A. Payment for all work in this section shall be included in Payment Item #4 - Groundwater Recovery Well.

* * * END OF SECTION * * *

SECTION 02501
PAVING

PART 1 GENERAL

The Excavation Contractor shall include the furnishing of all labor, tools, equipment and materials for the removal and replacement of street, driveway and other asphalt surfaces where surfaces were removed for trenching or other damaged areas due to construction activities. Unless otherwise specified in this section, all material and workmanship shall be in accordance with the latest edition of the New York State Department of Transportation Standard Specifications.

1.01 SUMMARY

A. Section includes:

1. Procurement and placement of asphalt.

1.02 SUBMITTALS

A. The Excavation Contractor shall submit to the ENGINEER the name and location of the intended sources of supply for all the bituminous pavement products. Asphalt concrete will be accepted only from a New York State Department of Transportation approved automated plant equipped with interlocks and printouts meeting the requirements of ASTM D995.

1.03 QUALITY ASSURANCE

A. The ENGINEER will maintain a program of required quality documentation, quality assurance, inspection and sampling to provide reasonable assurance to the OWNER that all asphalt concrete materials and pavements in the completed construction substantially conform to contract requirements and match the existing pavement. The Excavation Contractor shall provide labor, equipment, and traffic controls. In areas where there is an apparent or suspected deficiency, the Excavation Contractor shall collect core samples for the ENGINEER. The Excavation Contractor shall patch all areas where samples are taken with hot asphalt properly tamped to fill all voids. Final grades shall be smooth and flush with the surrounding asphalt.

1.04 REFERENCES

A. New York State Department of Transportation Standard Specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Subbase

1. NYSDOT Item 304.02 Type 1

B. Bituminous Pavements

1. Base Course - Hot Plant Mix
   NYSDOT Item 403.11 (Type 1 - Base)
2. Intermediate Course - Hot Plant Mix
   NYSDOT Item 403.13 (Type 3 - Binder)
3. **Top** Course - Hot Plant Mix

NYSDOT Item 403.17

4. **Top** Course - Cold Plant Mix
   NYSDOT Item 405.0101

C. Tack Coat

   1. Bituminous Asphalt Emulsion
      NYSDOT Item 407.0101

D. Bituminous Surface Treatments (oil and stone penetration)

   1. Single Course for Pavement
      NYSDOT Item 410.01
   2. Double Course for Pavement
      NYSDOT Item 410.02
   3. Single Course for Shoulders
      NYSDOT Item 410.03

E. Stabilized Gravel Surface Course

   1. Stabilized gravel without additives (water only)
      NYSDOT Item 411.01
   2. Stabilized gravel with Calcium Chloride
      NYSDOT Item 411.03

PART 3 EXECUTION

3.01 INSTALLATION

A. The CONTRACTOR shall install all paving materials in accordance with the provisions and procedures as specified in NYSDOT "Standard Specifications for Construction and Materials" dated January 2, 1990, latest revisions.

B. Additional materials may be required in order to achieve a stabilized finished result. The Excavation Contractor shall place the additional materials as ordered by the ENGINEER.

C. All existing pavement edges, prior to placement of new paving, shall be saw cut to neat and smooth lines parallel with the existing street or saw cut perpendicular to the street and squared off at 90 degree angles. Areas outside the pay limits shown on the plans and disturbed during construction shall be repaired at the Excavation Contractor's expense.

D. The Excavation Contractor shall be required to maintain all streets during construction to insure the safety of the public and shall promptly repair all areas as directed by the ENGINEER.

E. Repair of Damage Surface and Structures - Should the street, driveway surfacing, curbs, gutters, etc., outside the width provided above the cutting and removal of surface material, be damaged, cracked, settled, disturbed or injured in any manner by the work, such damage or injury must be replaced and the surfacing, etc. restored to its original condition by the Excavation Contractor, at the Excavation Contractor's expense.

F. Prime Coat - In areas where the bituminous street surface is to be replaced, after the backfill base material has been placed, thoroughly compacted and settled and properly cured, the base shall be thoroughly cleaned and primed with asphalt grade RC-2 or MC-30 at a rate of 0.3 gallons per square yard, making sure the exposed edges of adjacent existing bituminous surfaces are thoroughly tacked. If required by the ENGINEER, the Excavation Contractor shall place a sufficient amount of stone on the prime coat to prevent "picking up" by traffic.

G. Cleaning Up - After replacing street or driveway surface, the Excavation Contractor shall remove all excess excavated material, rubbish and debris from adjacent street surfaces, gutters, sidewalks, parking areas, grass plots, and shall be left in a neat and acceptable condition. No measurement for payment will be made until the entire block is replaced and satisfactorily cleanup up.

H. Repair of Street Surfaces After Construction - Should repair of street surfaces be required after finish surfaces have been placed, the ENGINEER will direct the Excavation Contractor as to the size and method of repair required. In general, repairs will be made with the original materials specified at no additional cost or compensation provided. If, however, in the judgement of the ENGINEER, other suitable materials are necessary due to traffic or unforeseen conditions, the ENGINEER shall direct the Excavation Contractor to repair the area with the material necessary for the conditions. The Excavation Contractor shall then be compensated for the new materials at the unit cost price for such material quoted in the Bid Proposal.

PART 4 PAYMENT

A. Payment for all work under this section shall be included in Payment Item # 6 - Paving.

*** END OF SECTION ***

SECTION 03300
CONCRETE

PART 1 GENERAL

The Mechanical Contractor shall provide all labor, materials, equipment, and incidentals required to perform all concrete work required, as shown on the Drawings, and as specified herein.

1.01 SUMMARY

A. Section includes:

  1. Procurement and installation of concrete and reinforcing for the building slab.

1.02 SUBMITTALS

A. Construction drawings showing concrete and reinforcement details and proposed plan of concrete placement sequence. Indicate details of reinforcing steel, splicing and laps of rods, space between reinforcement and forms and ground, pipes, conduits, sleeves, hangers, anchors, and other work required to be built into concrete including finishes and other pertinent work.

B. Certifications by concrete supplier of conformance of all concrete ingredients and design mixes to specified requirements.

1.03 QUALITY ASSURANCE

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the ENGINEER. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be removed from the job at once. All materials which have been rejected, shall be removed and replaced, entirely at the Mechanical Contractor's expense.

B. Imperfections in sections may be repaired, subject to the approval of the ENGINEER, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days when tested in 3 inch by 6 inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the ENGINEER.

1.04 MIXES AND TESTING

A. The Mechanical Contractor shall be responsible for all concrete design mixes and shall submit trial mix proportions and test results to the ENGINEER no less than 10 working days prior to proposed placement. The Mechanical Contractor shall employ an independent testing laboratory to sample and test the concrete in accordance with the specifications.

B. Concrete strength tests:

  1. Mechanical Contractor shall provide test cylinders and concrete specimens for strength testing. Samples for strength tests of concrete placed each day shall be taken at a rate of not less than one sample per day per structure.

  2. Samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in

accordance with ASTM C 39 or ASTM C78, by an approved testing laboratory. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days, unless otherwise approved. The minimum 28 day strength shall be 4,000 psi.

3. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test falls below the required strength by more than 500 psi.

D. Concrete slump tests shall be performed by the Mechanical Contractor in accordance with ASTM C 143.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement shall be domestic portland cement conforming to ASTM C 150, Type II.

B. Fine aggregate shall be washed natural sand conforming to ASTM C 33

C. Coarse aggregate shall be well graded crushed stone conforming to ASTM C 33, size No. 467

D. Water shall be potable, clean, and free from deleterious amounts of acids, alkalis, oils, chlorides, or organic matter.

E. No admixtures shall be used unless approved by the ENGINEER in writing.

F. Reinforcing steel shall be deformed intermediate grade, steel bars conforming to ASTM A 615, Grade 60. Rail-steel bars will not be permitted in the work.

G. Wire mesh reinforcing shall be welded steel conforming to ASTM A 185.

H. Expandable water stops shall be Volclay Waterstop-RX as manufactured by American Colloid Company.

I. Concrete materials ready mix concrete shall conform to ASTM C 94, using Type II portland cement. Only one brand of any one type of cement shall be used for exposed concrete surfaces.

J. Preformed joint filler shall be nonextruding, resilient bituminous or nonbituminous type commercially used in concrete paving or construction, ½-inch thick in accordance with ASTM D 1751.

K. Form coating shall be nonstaining oil or form release agent that will not deleteriously affect concrete surfaces or impair subsequent applications.

L. Form materials shall be plywood or hardboard especially made for concrete form use or other materials that will produce the specified finishes without adversely affecting the concrete surfaces.

M. Form ties shall be metal factory fabricated removable or snap-off that will leave holes not less than 1/4-inch or more than 1-inch in diameter and not more than 1-inch deep. That portion of the tie remaining permanently in the concrete shall not project beyond the surface of the concrete and shall be recessed at least 1-inch from any concrete surface that will be exposed or damp proofed.

N. Joint sealant shall be hot or cold applied, made specifically for sealing joints in concrete against moisture infiltration conforming to ASTM D1190 or ASTM D 1850, respectively.

2.02 STORAGE

A. Materials shall be stored so as not to deteriorate or become contaminated.

PART 3 EXECUTION

3.01 CONCRETE QUALITY

A. Proportioning of concrete mixes to meet the requirements specified below shall be the responsibility of the Mechanical Contractor. Concrete mix design shall be submitted to the ENGINEER for approval prior to delivery.

B. Entrained air content shall be maintained at 3 to 5 percent by volume of concrete.

C. Slump shall be 2 to 3 inches

D. Water cement ratio: 0.45 maximum

3.02 FORM WORK

A. FORM WORK shall provide for concrete conforming to the indicated shapes, lines, dimensions, and with surfaces free of offset, waviness, or bulges. Where surfaces are to be exposed, panels shall be manufacture's stock size material using smaller panels cut to required dimensions only where required by openings or joints. Exposed corners shall be rounded. Surfaces shall be thoroughly cleaned and coated before each use. Forms shall be removed at a time and in a manner that will not damage the concrete.

3.03 REINFORCEMENT

A. Reinforcement detailing and placement shall conform to ACI SP-66 and ACI-318. Reinforcement shall be interrupted 2-inches clear on each side of expansion joints in slabs on grade and perimeter joints. Wire-mesh reinforcement shall be continuous between expansion joints in slabs on grade. Laps shall be at least one full mesh plus 2-inches; staggered to avoid continuous lap in either direction; and securely wired or clipped with the standard clips. Bars shall be supported on precast units in a manner that will support the bars at the height indicated.

3.04 PLACING

A. The Mechanical Contractor shall not place any concrete until the ENGINEER has inspected and approved the foundation material. Concrete slabs shall be placed upon clean undisturbed material or compacted structural backfill free from frost, ice, or water. Dry or pervious surfaces receiving concrete shall be covered with impervious sheeting. Concrete may be placed on impervious surfaces that are thoroughly moistened but not muddy unless otherwise shown on the Drawings. Concrete shall not be placed in layers over 12-inches in depth. Concrete shall be protected from freezing. Concrete to receive other construction shall be screened to the proper level.

B. Before depositing concrete, all debris, foreign matter, dirt, and water shall be removed from the forms. The surface of the concrete previously placed, such as construction joint, shall be cleaned. Concrete shall not be placed in water or submerged within 24-hours after placing, nor shall running water be permitted to flow over the surface of concrete within four days of placing.

C. High frequency mechanical vibrators shall be used to the extent necessary to obtain proper consolidation of the concrete. Care should be taken to avoid segregation of the aggregates by excessive vibration. Concrete adjacent to forms shall be carefully spaded or rodded.

3.05 FINISHES

A. Fins and loose material shall be removed. Unsound concrete, voids over ½-inch in diameter, and tie-rod and bolt holes shall be cut back to solid concrete, reamed, brush-coated with cement grout, and filled solid with a stiff portland cement-sand mixture. Patchwork shall finish flush with adjoining surfaces in texture and color. Patchwork shall be cured for 72 hours.

B. Surfaces exposed to view shall be trowel finished. Special care shall be taken to ensure that bearing areas for steel plates and equipment shall be of sound concrete and level.

3.06 CONCRETE SLAB FINISHES

A. Slab shall be finished to a true plane with no deviation exceeding 1/8-inch when tested with a 10-foot straight edge. Surfaces shall be pitched to drain to the sump location shown on the Drawings. Surfaces shall be screened and floated to the required finish level with no coarse aggregate visible before finishing.

B. Immediately after concrete is floated, it shall be given a scored texture by drawing a broom or burlap bag across the surface

3.07 CURING AND PROTECTION

A. Concrete shall be protected from moisture loss, rapid temperature changes, mechanical injury, and injury from rain or flowing water for a period of four days after placing. Concrete shall be maintained in a moist condition at temperatures above 50 degrees Fahrenheit throughout the specified curing period. Curing activities shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing. If there is any delay between the placing and finishing of concrete, the concrete shall be protected against moisture loss.

B. Unformed surfaces shall be covered with burlap or mats, wetted before placing, and overlapped 6-inches. Burlap or mats shall be kept in continuous contact with the surface. Where formed, forms shall be kept wet. If forms are removed prior to curing period, curing shall be continued as on unformed surfaces using suitable materials.

PART 4 PAYMENT

A. Payment for work under this section shall be included in the building item in the Bid Form.

*** END OF SECTION ***

SECTION 03310
PRECAST CONCRETE

PART 1 GENERAL

The Drilling Contractor shall provide all labor, materials, equipment, and incidentals required to install the 15-inch round pull box, security frames and covers, and appurtenances as shown on the contract drawings and as specified herein.

1.01 SUMMARY

A. Section includes:

1. Procurement and installation of 15-inch round pull box for well protection.

   Each pull box will include the precast section, cast iron frame and sealed frost proof security cover, excavation, backfill, bedding material, and all work or material as called for in the specifications or as shown on the contract plans.

1.02 SUBMITTALS

A. Submit to the ENGINEER, shop drawings showing details of construction, pipe connections, frames, and covers.

1.03 QUALITY ASSURANCE

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the ENGINEER. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Drilling Contractor's expense.

B. At the time of inspection, the materials will be carefully examined for compliance with the latest ASTM designation specified below and these Specifications, and with the approved manufacturer's drawings. All manhole sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

C. Imperfections in sections may be repaired, subject to the approval of the ENGINEER, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days when tested in 3 inch by 6 inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the ENGINEER.

1.04 REFERENCES

A. American Society for Testing Materials (ASTM)

1. ASTM A48-83 - Standard Specification for Gray Iron Castings.
2. ASTM C478-88 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

3. ASTM C923-89 Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

4. ASTM C443-85 Specifications for Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE PULL BOX

A. Precast concrete pull box shall conform to Specifications for Precast Concrete and meet the following requirements:

1. The wall thickness shall not be less than 2.25 inches for 15"-inch inside diameter round pull box.

2. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.

3. Precast concrete with frames and covers shall be designed for a minimum of H-20 loading plus 30% impact, a super-imposed earth load of 130 lb/cf and a concrete dead load of 150 lb/cf minimum.

4. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on each precast section.

5. Precast concrete bases shall be constructed and installed as shown on the contract drawings. The thickness of the bottom slab of the precast bases shall not be less than 2-inches.

6. The groundwater recovery wells will require a twenty-inch extension to ensure piping is run below the frost line.

2.02 FRAME AND COVER

A. Castings for frames and covers and all other iron castings required for the work shall be of tough gray iron, free from injurious defects, and of such quality that a blow from a hammer on a square edge will produce an indentation of the casting without flaking the metal.

B. All castings shall be made accurately to the dimensions required and shall be planed where marked or where otherwise necessary to secure perfectly flat and true surfaces. Allowance shall be made in the patterns so that the thickness required will not be reduced by the planing. Covers shall fit the frame in any position.

C. Frames and covers shall be designed and manufactured to safely resist AASHTO H20-44 truck loading (16,000 lb. wheel load) plus 30% impact. Frames shall be completely mortared into place to prevent displacement.

D. Watertight covers (no vent holes) shall be bolted down with four bolts and gasketed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Pull Box Installation

1. Pull box shall be constructed as specified in these Specifications. All work shall be protected against flooding and floatation.

2. The precast bases shall be placed on a 6 inch bed of 1½ inch crushed stone.

3. Precast pull boxes shall be set so as to be vertical and with sections in true alignment with a ¼ inch maximum tolerance to be allowed. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides.

C. Setting Frames and Covers

1. Set frames with the tops at finished grade. Set frames concentric with the precast concrete rings and in a full bed of mortar so that the space between the pull box and the bottom flange of the frame is completely filled and watertight. Frames shall be set ¼"± (one-quarter inch) below finish grade in roadway pavements, to prevent damage to snowplows.

PART 4 PAYMENT

A. Payment for work under this section shall be included in the appropriate well installation item in the Bid Form.

*** END OF SECTION ***

SECTION 06192
BUILDING REQUIREMENTS

PART 1 GENERAL

Mechanical Contractor shall furnish all labor, materials and equipment required to construct the ozone generation building as shown on the drawings and in accordance with these specifications.

1.01 SUMMARY

A. Section Includes:

1. Wood framing and exterior of building.
2. Heating of building.
3. Insulation installation.
4. Shingles.
5. Overhead door and steel door and frame.

1.02 SUBMITTALS

A. Mechanical Contractor shall submit detailed design drawings, data, and descriptive literature on all pre-engineered wood trusses.

B. Mechanical Contractor shall submit proposed insulation data and descriptive literature.

C. Mechanical Contractor shall submit details of construction, dimensions, profiles, textures, and color of shingles.

D. Mechanical Contractor shall obtain and submit local building permits required to perform work.

E. Mechanical Contractor shall submit details of construction, dimensions, and literature on the heating unit(s) for the building.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Pre-engineered roof trusses shall provide certification of design whose product is tested and proved structurally sound. Trusses shall comply with all local, and state building codes and regulations. The quality of the installation and materials shall be subject to approval of the ENGINEER as well as local and state building inspectors.
2. Insulation shall comply with all local, and state building codes and regulations. The quality of the installation and materials shall be subject to approval of the ENGINEER.
3. Shingles: Provide products that are identical to those tested for specified fire performance characteristics by UL or other testing and inspection organizations acceptable to the authorities having jurisdiction. Shingles shall have a useful life of twenty years.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pre-Engineered Trusses

1. Trusses shall be constructed 16-inches on center as shown and detailed. Trusses shall be capable of supporting snow and wind loads anticipated for this area.

B. Treatment System Building

1. The wood frame and exterior plywood shall be constructed using the wood and materials as shown and detailed.
2. Only quality lumber and materials shall be used in constructing the wood structure. Any substitute materials or design must be approved by the ENGINEER in writing prior to installation.

C. Ventilation Fan

1. The ventilation fan shall be capable of exchanging 400 cubic feet of air per minute.
2. Fan shall be activated by a switch at the door and automatically on 24-hour pin timer, as manufactured by Torque or approved equal.
3. Ventilation fan shall be supplied with motorized louver/damper.
4. Ventilation fan shall be as manufactured by Acme, Dayton, or approved equal.

D. Heater

1. Heating unit shall be sized by the Mechanical Contractor and shall be capable of maintaining the building at a temperature of 68 degrees Fahrenheit.

E. Insulation

1. Insulation rated R-19 shall be used within the building walls and between the roof trusses.
2. Mechanical Contractor shall follow manufacturer specifications for allowable insulation installation and usage.
3. Insulation shall be manufactured by Owens-Corning or approved equal.

F. Shingles

1. Shingles shall be square tab, UL Class C standard weight shingles.
2. Shingles shall be mineral surfaced, self-sealing, three tab, organic felt based, complying with ASTM D 225.
3. Felt underlayment shall be No. 15 unperforated organic felt , 36-inches wide complying with ASTM D 226 Type I.
4. Nails shall be aluminum or hot dipped galvanized, 11 or 12-gage and of sufficient length to penetrate through plywood sheathing.
5. Metal drip edge shall be 0.024-inch mill finish aluminum sheet in lengths of 8 or 10-feet.

G. Steel Door

1. Steel door shall be 18-gage, hollow metal door.
2. Door shall include a visual panel and all push/pull hardware and lock.
3. Steel door and frame shall be manufactured by Steel Craft or approved equal.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. The roof structure and roof trusses shall be adapted for the installation of ventilation piping, heater vents, and treatment system vents.

B. The roof trusses shall be installed with aluminum vent ridging, vent soffits and fascias.

C. Roof felt and shingles shall be installed in accordance with manufacturers specifications.

D. All framing and carpentry work shall be performed in accordance with accepted practices.

PART 4 PAYMENT

4.01 GENERAL

A. Payment for all work in this section shall be included in Payment Item # 7 - Building.

* * * END OF SECTION * * *

SECTION 06602
PIPING

PART 1 GENERAL

Excavation Contractor shall furnish all labor, materials, and equipment to install Polyvinyl Chloride (PVC) piping, Halar piping, PVDF and Teflon tubing for the construction of the ozone injection, vapor extraction, and groundwater recovery lines. Mechanical Contractor shall furnish all labor, materials, and equipment to install Stainless Steel piping for the construction of the ozone generation system.

1.01 SUMMARY

A. Section includes:

1. Procurement and installation of piping and tubing.

1.02 SUBMITTALS

A. Submit manufacturers data on pipe, fittings, and appurtenances along with the manufacturers recommended installation procedures.

B. Submit survey of as-builts for the pipe locations, turning points, and elevations.

1.03 QUALITY CONTROL

A. Manufacturer's Qualifications

1. The piping manufacturer shall be thoroughly familiar with the design intent of the system and provide suitable piping.

B. Each type of piping shall be obtained from a single manufacturer.

C. The quality of all materials, process of manufacturer, installation, and the finished pipe, and fittings shall be subject to the inspection and approval of the ENGINEER.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle all pipe and fittings carefully with approved handling devices. Do not drop or roll pipe off trucks. Do not otherwise drop, roll or skid pipe. Pipe materials that are cracked, gouged, chipped, dented, or otherwise damaged will not be approved and shall be removed and replaced at Contractor's expense.

B. Store pipe and fittings on heavy wood blocking or platforms so that they are not in contact with the ground.

C. Pipe interiors shall be kept completely free of dirt and foreign matter at all times.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ozone Secondary Containment Piping:

1. ABS pipe shall be 2, 3 or 4-inch schedule 80, as shown on the Drawings.

2. The pipe shall be manufactured in accordance with ASTM D 1784.

3. All joints shall be solvent welded.

4. ABS pipe shall be manufactured by:

    a. ICC Industries
    b. Or approved equal.

B. Vapor Extraction Piping:

1. PVC pipe shall be 2-inch schedule 80.

2. The pipe shall be manufactured in accordance with ASTM D 1784.

3. All joints shall be solvent welded.

4. PVC pipe shall be manufactured by:

    a. National Pipe Company
    b. Certainteed Corporation
    c. Or approved equal.

C. Halar Pipe:

1. SDR-11, 3-inch, diameter shall be field verified prior to ordering. Diameter shall match the existing Natural Fuel Gas existing pipeline.

2. Butt fusion welded joints as outlined in ASTM D2657

3. Halar pipe shall be manufactured by:

    a. Asahi/America
    b. Or approved equal

D. Teflon Tubing

1. Teflon tubing shall be ½-inch with a wall thickness of 0.025 inches.

2. Teflon tubing shall be manufactured in accordance with ASTM D 3295.

3. All connections shall be Swagelok stainless steel quick disconnect couplings.

4. Teflon tubing shall be manufactured by:

    a. Markel Corporation
    b. Or approved equal

E. Stainless Steel

1. Stainless steel piping shall be 316 and the diameters will be as shown on the Drawings

2. Stainless steel shall be threaded for standard screwed joints.

F. PVDF Tubing

1. PVDF tubing shall be 1.25-inches for use in the groundwater recovery system.
2. All connections shall be Swagelok stainless steel quick disconnect couplings.
3. Teflon tubing shall be manufactured by:
    a. Markel Corporation
    b. Or approved equal

PART 3 EXECUTION

3.01 PREPARATION

A. Excavation required for piping installation shall conform to the requirements of Section 02221, Trenching and Backfill.

3.02 INSTALLATION

A. General

1. All pipe and fittings shall be installed in accordance with the manufacturers' instructions.
2. Cutting of pipe shall be done in a satisfactory manner so as to not damage the pipe and to leave a smooth end.
3. Stainless steel pipe threads shall be wrapped with teflon tape prior to joining and sealed with GE 1000.
4. Gaskets for the Halar pipe shall be teflon coated EPDM.
5. Flange bolts shall be tightened in accordance with manufacturers recommendations
6. PVDF and teflon tubing shall be continuous from the wellhead to the sparge manifold. Tubing shall be connected using Swagelok quick disconnect stainless steel tubing connectors.

PART 4 PAYMENT

4.01 GENERAL

A. Payment for all work in this section shall be made under Payment Item # 8 - Piping.

*** END OF SECTION ***

SECTION 11210
PUMPS, EQUIPMENT, AND APPURTENANCES

PART 1 - GENERAL

Work performed under this section shall include but not be limited to all labor, materials, equipment and incidentals necessary for the installation of total fluids pumps, blowers, ozone generating equipment, oil/water separator, solenoid and check valves, and flow meters as shown on the Drawings and as specified herein.

1.01 SUMMARY

A. Section includes:

1. Installation of the total fluids pumps for the groundwater recovery wells
2. Installation of blowers, ozone reducing catalyst and associated piping
3. Testing, certification, and installation of the ozone generation equipment
4. Installing the oil/water separator and holding tank
5. Installing and testing of solenoid valves
6. Installing and testing of check valves
7. Installing and calibrating flow meters

1.02 SUBMITTALS

A. Shop Drawings: Mechanical Contractor shall submit for approval, detailed drawings and data on pump and blower curves showing performance characteristics with system operation point plotted, dimensional drawings with connection details, location of all valves, labels for all valves, and three sets of operation and maintenance manuals.

B. Mechanical Contractor shall ensure testing of the ozone generator prior to shipping in accordance with this specification, and submit a certification from the manufacturer that the ozone generator has been calibrated and the rated output. Mechanical Contractor shall also submit three sets of operation and maintenance manuals for the ozone generation equipment.

C. Mechanical Contractor shall submit dimensions and operating data for the oil/water separator prior to shipping. Mechanical Contractor shall also submit three sets of operation and maintenance manuals for the oil/water separator.

D. Mechanical Contractor shall submit all data, including ozone and oxygen compatibility, cracking pressures, flow ranges, and calibration data for all valves and meters. Mechanical Contractor shall also submit three sets of operation and maintenance manuals for the valves and meters.

E. Mechanical Contractor shall submit methods and equipment to be used for leak testing of all connections.

1.03 QUALITY ASSURANCE

A. Inspection: The quality of all equipment and labor shall be subject to the inspection and approval of the ENGINEER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Groundwater Recovery Well Pumps

   1. Provide five (5) pneumatic total fluid type pumps of stainless steel construction (including casing and impellers).

   2. Pumps shall meet the following requirements:

      a. Nominal 4-inch diameter
      b. 1.25-inch discharge tubing
      c. Top inlet

   3. Air capacity will be determined following installation of the recovery wells and completion of pump tests.

   4. Pumps shall be:

      a. QED Hammerhead, Model H45SET
      b. Or approved equal.

B. Blowers

   1. Mechanical Contractor shall furnish and install two (2) blowers as indicated on the Drawings.

   2. Booster blower in the ozone generation building shall be installed to increase the flowrate to approximately 10 scfm and to purge the injection lines, if necessary.

   3. Booster blower shall be EG&G Rotron Model PRP195W72, or approved equal.

   4. Vapor extraction blower shall have an air flowrate of 600 scfm with a vacuum of 30-inches of water. Blower shall have an in-line air filter.

   5. Vapor extraction blower shall be EG & G Rotron Model EN909BD72WL 460V,or approved equal. The flowrate and vacuum are estimated and may vary due to subsurface conditions, therefore, this blower shall be rented for one-month to determine adequate sizing.

   6. Vapor extraction blower shall be equipped with a moisture separator with a liquid capacity of at least 40 gallons, such as EG&G Rotron Model MS600BS, or approved equal.

C. Flow Meters

   1. Mechanical Contractor shall furnish and install two (2) 3/4" rotameters for the ozone discharge line as shown on the Drawings.

   2. Rotameters shall be capable of measuring flows from 1 - 10 cfm and 1 - 20 cfm, as located on the Drawings, in a minimum of 0.2 cfm increments.

   3. Mechanical Contractor shall furnish and install eleven (11) flow meters/totalizers for the groundwater recovery well discharge lines as shown on the Drawings. Meters shall be capable of recording flows from 0.1 to 15 gpm in a minimum of 0.1 increments.

D. Solenoid Valves

1. Mechanical Contractor shall furnish and install twenty (20) ½-inch solenoid valves as shown on the Drawings.

2. Solenoid valves shall be stainless steel with teflon seals.

3. Solenoid valves shall be explosion proof and operate with 120V.

4. Solenoid valves shall be:

   a. ASCO Red-Hat
   b. Or approved equal.

E. Valves

1. Mechanical Contractor shall furnish and install two (2) 3/4-inch check valves on the ozone discharge line, one (1) 3/4-inch check valve on the sump pump line, and eleven (11) 1.25-inch check valves on the groundwater recovery discharge lines as shown on the Drawings. Check valves for the ozone line shall be stainless steel with teflon seals, check valve for the sump pump line shall be PVC, and check valves for the groundwater discharge lines shall be PVDF.

2. Check valves shall have a 1 psi cracking pressure.

3. Mechanical Contractor shall furnish and install twenty-three (23) 2-inch PVC ball valves on the SVE lines as shown on the Drawings.

4. Mechanical Contractor shall furnish and install eleven (11) needle valves on the air supply line for the total fluids pumps as shown on the Drawings.

F. Ozone Generator

1. Mechanical Contractor shall furnish and install the ozone generator.

2. The ozone generator shall produce a minimum of 16.5 pounds of ozone per day at a minimum concentration of 6 percent by weight in oxygen.

3. Ozone generator shall be designed to operate at 15 to 22 psi gauge.

4. Ozone generator shall provide physical separation of process piping and electrical controls within the cabinet.

5. The power factor of the ozone generator shall be not less than 0.95.

6. Oil free dry air with a maximum dew point of -60 degrees Fahrenheit shall be provided to the ozone generator at a rate of 3 -13 scfm.

7. A high voltage transformer shall be incorporated into the ozone generator. The transformer shall be rated at not less than 5 percent above maximum anticipated KVA. The secondary voltage shall not be in excess of 10KVA to insure that the glass electrode will not fail due to high voltages.

8. The ozone generator shall have a main circuit breaker sized to protect the generator due to power surges, brownouts, and blackouts. There shall be a 5 second start-up delay

incorporated into the generator to delay the production of ozone until the unit is activated and all interlocks are cleared.

9. The ozone generator shall be protected against excess internal pressure.

10. The ozone generator shall include a flowmeter to measure air flow to the nearest 0.2 scfm, a pressure gauge to measure the pressure of the generators cell, and a humidity indicator for the incoming oxygen stream.

11. The ozone generator shall be provided with switches to activate and deactivate the ozone generator, allow activation from a remote control station, manual or automatic control adjustments for the output of the ozone in a linear range of 10 to 100 percent of rated output.

12. Turn down of the ozone generator by variations of the oxygen stream shall not be deemed acceptable.

13. The generator shall have safety controls which do not allow the generation of ozone when the panel or door to the generator is open, when there is insufficient air flow, when the dew point of the incoming oxygen stream is excessive, when cooling water flow falls below 50 percent, and when temperature of the ozone leaving the generator is excessive.

14. There shall be provisions for an external interlock which can shut down the ozone generator when there is excessive ozone in the generator room, when there is no exhaust air flow in the ozone contact chamber, or when there is a closed contact which indicates that a condition may cause unsafe or improper operation of the ozonation system.

15. Interlocks shall be of LED type for high reliability. One switch shall be provided to test all lamps.

16. Separate red pilot light shall glow when an interlock is activated and a fail contact shall close to allow for the sounding of a remote alarm.

17. The ozone generator shall be capable of running in a manual or automatic mode.

18. Shutdown of the generator shall include a purging with air after the generator has been turned off.

19. The generator shall include an ozone indicator that reads the ozone output on a linear scale from 0 to 125 percent of the rated output.

20. Mechanical Contractor shall furnish and install associated ozone generating equipment including but not limited to the air compressor, sieve banks and control panel, oxygen receiving tank, and the recirculating chiller. All equipment shall be properly sized for the ozone generator.

21. All cooling water components shall be brass.

G. Oil/Water Separator

1. The oil/water separator shall be rated at approximately 20 gpm.

2. The separator shall gravity discharge to a 500 gallon holding tank from which the water can be pumped out of for treatment.

3. The oil/water separator shall have coalescing plates that are chemically compatible with creosote.

H. Sump Pump

1. The sump pump shall be self-priming and be capable of pumping 10 gpm against 8 feet of head.

2. The pump shall be single phase 120V.

3. Sump pump shall be:

   a. Goulds
   b. Gorman Rupp
   c. Or approved equal.

I. Ozone Reducing Catalyst

1. The ozone reducing catalyst shall be placed in a 55-gallon drum with a 4-inch inlet and outlet.

2. Carulite extrusions shall be contained within wire mesh screens with a maximum opening size of 3/16-inches, or with solid steel tops with 3/16-inch perforations and lifting handles, or approved equal.

3. Ozone reducing catalyst shall be:

   a. Carus Chemical Co., Carulite 200
   b. Or approved equal.

J. Condensate Pump

1. Condensate pump shall be a screw pump and have a capacity of approximately 5 gpm.

2. Condensate pump shall be:

   a. Moyno
   b. Or approved equal

K. Gauges

1. Mechanical Contractor shall furnish and install all gauges shown on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Prior to installation, the Mechanical Contractor shall provide to the ENGINEER, a description of the installation procedures for all equipment. Materials shall not be installed without approval of the ENGINEER.

B. The pneumatic total fluids pumps and all related equipment shall be assembled and installed in accordance with the manufacturer's recommendations.

C. All valves shall be installed in accordance with manufacturer's recommendations.

D. The ozone generator and all related equipment shall be assembled and installed in accordance with the manufacturer's recommendations.

3.02 TESTING

A. The ozone generator shall be tested before shipping. The testing shall be performed at the factory at the generators maximum rated ozone output for at least 24 continuous hours. During this testing period the ozone generator may be inspected by the Owner or his representative. The ozone generator shall be calibrated and the ozone output certification document shall be submitted. The certification shall list all of the operating parameters under which the machine produced its maximum rated output. A notarized certificate of compliance, signed by a company officer shall be supplied with the generator.

B. All pipe joints and tubing unions shall be tested for leaks.

PART 4 PAYMENT

A. Payment for all work under this section shall be included in the appropriate payment items.

*** END OF SECTION ***

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

This Section includes general administrative and procedural requirements for electrical installations.

1.01 SUMMARY

A. Section includes:

1. General electrical installation
2. Record Drawings
3. Maintenance Manuals

1.02 SUBMITTALS

A. Submit the quantity listed below to allow for required distribution of each submittal.

1. Shop Drawings: 2 copies blue- or black-line prints.
2. Product Data: 2 copies of each item.
3. Samples: 1 set.
4. Record Drawings: 2 copies
5. Maintenance Manuals: 2 copies

B. Additional copies may be required by individual sections of these Specifications.

1.03 RECORD DOCUMENTS

A. Prepare record documents and indicate installed conditions for:

1. Major raceway systems, size and location, locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
2. Equipment location dimensioned from prominent permanent structures.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.04 MAINTENANCE MANUALS

A. Prepare maintenance manuals and include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include startup, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions, if any.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and schedules.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

3.01 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16.

3.02 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements.

1. Coordinate electrical systems, equipment, and materials installation with other components.
2. Verify all dimensions by field measurements.
3. Sequence, coordinate and integrate installation of electrical materials and equipment for efficient flow of the Work.
4. Coordinate connection of electrical systems with underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service. Pay all utility company charges.
5. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the ENGINEER.
6. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other systems and components.
7. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
8. Install systems materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
9. Obtain NYBFU inspection and pay for same. Submit copy of inspection report. Correct all deficiencies noted.

3.03 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with the requirements specified below:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    a. Uncover Work to provide for installation of ill-timed Work.
    b. Remove and replace defective Work.
    c. Remove and replace Work not conforming to requirements of the Contract Documents.
    d. Remove samples of installed Work as specified for testing.
    e. Install equipment and materials in existing facilities.

    f. Upon written instructions from the ENGINEER, uncover and restore Work to provide for ENGINEER's observation of concealed Work.

2. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
3. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

PART 4 PAYMENT

A. Payment for all work under this section shall be made under Payment Item # 12 - Electrical.

*** END OF SECTION ***

D

APPENDIX D

CONSTRUCTION QUALITY ASSURANCE PLAN

GT ENGINEERING
GT Engineering, P. C.
1245 Kings Road, Schenectady, NY 12303 USA
Tel: (518) 370-0392 Fax: (518) 370-5864

APPENDIX D

CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PLAN
OSMOSE, INC.
OZONE SPARGE/SVE SYSTEM
BUFFALO, NEW YORK

GT Engineering Project 011108061

January 6, 1999

Prepared for:

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#151reps/osmose/8061qaqc.199

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1.0 INTRODUCTION

1.1 Construction Quality Assurance (CQA) Quality Control (CQC) Plan Objectives

This Construction Quality Assurance (CQA) Quality Control (CQC) Plan focuses on the installation of the ozone sparge/SVE remedial system at the Osmose, Inc. (Osmose) facility located in Buffalo, New York (see **Figure 1.1**). It is designed to assure the quality of the installation by monitoring, inspecting, sampling, and testing during the construction process. Details of the remedial system design are included in the *Final Remedial Design Report* prepared by GT Engineering, P.C., dated January 6, 1999.

The objective of this CQA/CQC document is to identify and standardize measures to provide confidence that construction activities for the ozone sparge/SVE system will be completed in accordance with contract plans and specifications, applicable local, state and federal regulations and appropriate industrial standards. Specific objectives of this plan establish protocols and procedures for the following components:

1. Responsibility and Authority -- The responsibility and authority of the key personnel involved in the construction of the ozone sparge/SVE system.
2. CQA/CQC Personnel Qualifications -- Establish the qualifications of the CQA and CQC Officers to fulfill the CQA/CQC program in its entirety.
3. Inspection and Testing Activities -- Establish the observations, inspections, and tests that will be used to ensure that the construction and/or installation activities for the site meet or exceed all design criteria, (i.e., plans, specifications, and local, state and federal regulations).
4. Sampling Strategies -- Establish the sampling activities and methods including frequency and acceptance criteria for ensuring that material and performance specifications and applicable regulations will be met during the construction process.
5. Documentation and Reporting -- Establish completion reports, photographic reports, inspection data sheets, problem identification and corrective measures summaries and final documentation.
6. Construction Quality Control Meetings -- Establish meeting content and documentation to enhance the communication between personnel responsible for design, inspection, and construction of the systems.

1.2 Summary of Construction Elements and Key Products

1.2.1 Earthwork

Earthwork required for the project includes excavating utility trenches approximately 3.5 feet wide and 4 feet deep for placement of utility piping (ozone lines, soil vapor lines, electrical and instrumentation conduits). Approximately 740 feet of trench will be excavated to place the utility pipes connecting all the ozone sparge, vapor extraction, and combination points to the appropriate equipment. Earthwork shall also include the placement and compaction of pipe bedding and general backfill soils.

1.2.2 Erosion Control

A silt fence will not be required around the work zone for the duration of the project. Care will be taken to keep all excavated soils stockpiled and covered by plastic when not in use.

1.2.3 Fluid Conveyance

Soil vapors and groundwater will be conveyed through Schedule 80 PVC piping buried in shallow 4 foot deep utility trenches. All pipes and fittings within the trenches will be threaded or solvent welded by trained technicians in a secured area to prevent PVC glue or primer from contacting the soils. Ozone sparge gas will be conveyed through Teflon tubing with ABS piping used for secondary containment. All piping conveying liquids will be secondarily contained below ground.

The sparge wells will be constructed of welded stainless steel pre-packed screen and riser. The topmost part of the riser will transition to Teflon tubing. The SVE wells and piping will be constructed of Schedule 80 PVC.

1.2.4 Utility Piping

A portion of the existing National Fuel Gas natural gas pipeline that runs under the sidewalk along Ellicott Street will be replaced with Halar pipe. Halar is a material suitable for use in the natural gas industry and resistant to degradation when (if) exposed to ozone. Halar pipe is connected by heat fusion welding.

1.2.5 Materials and Equipment

All materials and equipment are designed to meet specific project needs. Each delivery of materials and/or equipment will be inspected upon arrival by the construction foreman and stored at a designated area inside the Osmose facility warehouse until site mobilization occurs.

2.0 RESPONSIBILITY AND AUTHORITY

Responsibilities of each member of the construction project team are described below.

2.1 Remedial Design Professional

Responsible Party: GT Engineering, P.C.; Michael Sykes, P.E.
The design engineer's primary responsibility is to design the treatment systems that fulfill the operational and performance requirements. Design activities will not end until the systems are completed; the design engineer may be requested to change some component designs if unexpected site conditions are encountered or construction methods are identified that could adversely affect remedial performance. CQA provides assurance that these changes or unexpected conditions will be detected, documented, and addressed during construction, as outlined in Section 2.5 of this CQA/CQC Plan.

2.2 Remedial Action Contractor

Responsible Party: Fluor Daniel GTI, Inc.
The Remedial Action Contractor is responsible for the construction and operation/maintenance of the facility. This responsibility includes complying with the requirements of the permitting agencies in order to obtain permits and assuring the permitting agency, by the submission of documentation required by the CQA/CQC program, that the facility is constructed as specified in the design. The remedial action contractor also has the authority to accept or reject the materials and workmanship of any subcontractors at the site.

It is the responsibility of the remedial action contractor to construct the facility in strict adherence with design criteria, plans, and specifications, using the standard industry construction procedures and techniques.

Fluor Daniel GTI is responsible to ensure a functional quality control organization is active during the project and provide support for the CQC system to perform inspections, tests and retesting in the event of failure of any item of work, including that of subcontractors, to assure compliance with the contract provisions. The CQC system includes, but is not limited to, the inspections and tests required in the technical provisions of the contract specifications and will cover all project operations, including on-site and off-site fabrication.

2.3 Construction Quality Assurance (CQA) Officer

Responsible Party: GT Engineering, P.C.: Kevin Dufek

The overall responsibility of the CQA officer is to perform those activities in this CQA plan deemed necessary to assure the quality of construction and support quality control efforts. The CQA will provide Osmose and the NYSDEC an assurance that the facility was constructed as specified in the design. The CQA representative will make regular site visits during construction activities too inspect activities.

Specific responsibilities of the CQA officer include:

- Verifying that the data are properly recorded, validated, reduced, summarized, and interpreted by performing audits
- Confirming that the test data are properly recorded and maintained (this may involve selecting reported results and backtracking them to the original observation and test data sheets)
- Confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process; and
- Confirming that regular calibration of testing equipment occurs and is properly recorded
- Evaluates the construction activities and the CQC's efforts
- Providing the NYSDEC a copy of all QA reports

The Quality Assurance Program will be implemented through inspection, sampling, testing, and review of services and workmanship. The responsibility of the CQA officer is to ensure the quality of construction meets or exceeds that defined by specification and/or engineering plans and identified in the CQA Plan.

2.4 Construction Quality Control (CQC) Officer

Responsible Party: Fluor Daniel GTI; Jeff Gutowski

A CQC representative, supplemented as necessary by additional personnel, is to be on the work site at all times during the construction progress, with complete authority to take any action necessary to ensure compliance with the design plans and specifications and is necessary to achieve quality in the constructed system. Specific responsibilities of the CQC representative include:

- Reviewing design, plans, and specifications for clarity and completeness so that the construction activities can be effectively implemented.
- Verifying that the contractor's and all subcontractor's construction quality is in accordance with the CQA plan.
- Performing on-site inspection and tests as specified in the CQA.
- Reporting the results of all observations and tests as the work progresses and interacting with the contractor to provide assistance in modifying the materials and work to comply with the specified design. This includes:
  - — providing reports on the inspection results to the CQA Officer;
  - — review and interpretation of all data sheets and reports;
  - — identification of work that the CQC representative believes should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval; and
  - — rejection of defective work and verification that corrective measures are implemented.
- Reporting to the CQA officer results of all inspections including work that is not of acceptable quality or that fails to meet the specified design.
- Verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the proper standardized procedures.
- Verifying that materials are installed as specified, except where necessary field modifications are encountered.

A Construction QA/QC Organizational Chart is included as **Exhibit D-2**. Resumes of relevant personnel are also included in **Exhibit D-2**.

2.5 Design Changes

Design and/or specification changes may be required during construction. In such cases, the CQC Officer will notify the CQA Officer and the Design Engineer. The CQA Officer will notify the NYSDEC of all design and/or specification changes.

Design and/or specification changes will be made only with the written agreement of the Design Engineer, CQA Officer, and Osmose. Changes will take the form of an addendum, clarification, or modification to the Project Specifications.

2.6 Site and Project Control

To obtain a high degree of quality control, clear and open channels of communication are essential between Osmose, CQA/CQC team, Design Engineer, the Contractor and its subcontractors. A pre-construction meeting will be held at the site prior to the start of work. As a minimum the meeting will be attended by a representative of Osmose, Design Engineer, Contractor, and each of the subcontractors.

Specific topics to be considered for the meeting include:

- Make any appropriate modifications to the CQA/CQC Plan;
- review the responsibilities of each party;
- review the lines of authority and communication;
- review methods for documenting and reporting, and for distributing documents and reports;
- establish protocols for sampling and testing;
- establish protocols for handling deficiencies, repairs, and retesting;
- review the time schedule for all operations;
- establish procedures for use of the butt-fusion pipe welding apparatus;
- review the pipe testing procedures;
- confirm soil borrow locations, excavation procedures, and erosion and sedimentation control requirements;
- coordinate work with any utilities in the project area (i.e. electric, gas, phone, etc.);
- conduct a site walk-around to verify existing site conditions and to review material storage locations; and
- establish haul routes and soil stockpiling locations.

The meeting will be documented by the CQA Officer.

In addition to the pre-construction meeting, a weekly progress meeting will be held between the CQA Officer, CQC Officer, and a representative for each subcontractor working on the site. The meeting will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Officer will log any problems, decisions, or questions arising at the meeting and distribute to Osmose, Design Engineer, and attendees.

A special meeting will be held if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be held by Osmose, CQA Officer, CQC Officer, and appropriate subcontractors. If the problem requires a design modification, the Design Engineer should also be present. The purpose of the meeting is to define and resolve the work or problem deficiency as follows:

- Define and discuss the problem or deficiency;
- review alternative solutions and costs; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the CQA Officer and distributed to the appropriate parties. The NYSDEC will be notified of all meetings. A copy of the minutes from the meetings will be submitted to the NYSDEC within a week of the meeting.

3.0 FIELD QUALITY CONTROL INSPECTIONS, TESTING, AND SAMPLING REQUIREMENTS

3.1 Well Construction

The following inspections and tests will be performed to insure proper construction of all wells proposed in the *Final Remedial Design Report.* These wells include:

- Twenty vertical ozone sparge wells
- Twenty-three vertical SVE wells
- Recovery well

Sand Pack
Material used as a sand pack for wells will have a sieve analysis performed by the supplier. This analysis will be reviewed, recorded and approved by the CQC inspector prior to placement.

Bentonite Seal
Material used as a Bentonite seal for wells will be visually inspected, recorded and approved by the CQC inspector prior to placement.

Well Screen
Material used as a well screen for wells will be visually inspected, recorded and approved by the CQC inspector prior to placement.

Well Depth
The screened portion of the SVE wells shall be placed directly beneath the clay layer. The CQC Inspector shall determine the bottom of the clay layer in the field by sampling during installation. The ozone sparge wells shall extend to the depths shown in the ozone sparge well schedule.

3.2 Trenching and Backfill Operations

All excavation activities will be observed and recorded by the CQC inspector noting soil type, color, moisture, foreign objects, odor and any other notable characteristics. Trenches will be a maximum of 4.5 feet deep. All excavated soils will be stockpiled on diked 10 mil polyethylene sheeting and field screened with a Photoionization Device (PID) equipped with an 10.2 electron volt (eV) lamp.

Trenching, backfilling, and compacting of the soils will be observed and documented by the CQC inspector.

The pipe bedding material shall meet the gradation requirements for NYSDOT, mortar sand. The Contractor shall submit results of laboratory grain-size analyses tests and standard proctor tests performed on samples from the aggregate source. The material shall be placed in loose lifts which will result in a compacted lift thickness not exceeding twelve inches. The material shall be compacted to at least 95 percent of the materials standard Proctor maximum dry density.

The granular fill above the native soils returned to the trench and directly underneath the pavement layer shall meet the gradation requirements for NYSDOT, Subbase Course Type 1. The Contractor shall submit results of laboratory grain-size analyses tests and modified proctor tests performed on samples from the aggregate source. The material shall be placed in loose lifts which will result in a compacted lift thickness not exceeding twelve inches. The material shall be compacted to at least 90 percent of the materials modified Proctor maximum dry density.

Asphalt shall be replaced in kind by the Contractor.

3.3 Utility Piping Installation

3.3.1 Halar Pipe

Prior to the shipping of Halar pipe, the Contractor shall obtain the following information from the pipe manufacturer:

- a properties sheet including minimum values of the pipe dimensions, pressure ratings, collapse pressures, velocity and pressure drops, and recommended bolt torque values for Teflon gaskets;
- a certification that the minimum values are guaranteed by the pipe manufacturer; and
- a certification that the Halar pipe and Teflon gaskets are chemically compatible, little or no effect, with ozone and natural gas for the operating temperatures of 0 to 60 degrees Celsius.

The pipe manufacturer shall continuously indent-print the pipe size, SDR, and other pertinent information every five feet along the pipe length.

3.3.2 *Handling and Laying of Pipe*

The Contractor shall handle all pipes and fittings in such a manner as to ensure that the materials are not damaged in any way. The CQC Officer will verify compliance with the following:

- the handling of the joined pipe line is conducted in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects;
- ropes, fabric, or rubber protected slings and straps are used when handling the pipe and they are not positioned on butt-fused joints (Halar pipe) or solvent connections (PVC pipe);
- chains, cables, or hooks are not inserted into the pipe ends as a means of handling the pipe;
- pipe or fittings are not dropped into trenches, care should be taken to prevent damage or twisting the pipe when lowering into position, and pipe should not be placed on rocky or unprepared ground;
- when pipe laying is not actively in progress, open ends of pipe shall be closed with a water tight plug;
- no pipe is brought into position until the preceding length has been bedded and secured, blocking under the pipe is not permitted; and
- placement of backfill over the pipe is conducted in accordance with the requirements of the Specifications, and in a manner to prevent damage to the pipe.

The pipe and fittings will be carefully examined by the CQC Officer for cracked, damage, or defects before installation. The maximum allowable depth of cuts, gouges, or scratches on the exterior surface of the pipe or fittings is 10 percent of the wall thickness. The CQC Officer shall require that sections of pipe or fittings having cuts, gouges, or scratches deeper than 10 percent of the wall thickness are removed from the site. The CQC Officer will note the condition of the interior of the pipe and fittings. Foreign materials will be removed from the pipe interior prior to being placed into the final position. No pipe will be laid until the CQC Officer has observed the condition of the pipe.

3.3.3 *Halar Pipe Joints and Connections*

Lengths of pipe will be assembled into suitable installation lengths by the butt-fusion process. Butt-fusion means the joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure. This process will be applied under the supervision of the CQC Officer by personnel experienced with the process. The person performing this work shall be certified by the manufacturer of the butt-seaming apparatus to perform the work. All adjacent sections of pipe so joined will be made from the same class and type of raw material and will be made by the same raw material supplier.

Flange connections will be required to be butt fused to the pipe where connections are required to the existing natural gas pipeline. Gaskets for the flange connection shall consist of Teflon bonded EPDM.

The CQC Officer will verify that the flanges are at approximately the same temperature of the surrounding soil at the time they are bolted tight to prevent relaxation of the flange bolts due to thermal contraction. Bolts shall be drawn up evenly and in line, in accordance with the manufacturers recommendations.

3.3.4 Nondestructive Testing

All Halar pipe and fittings shall be nondestructively tested. Halar pipe shall be pressure tested by the CQC inspector at a pressure of 1.5 times the working pressure for a period of 1 hour. Any temperature corrected variance greater than +/- 2% will be cause for inspection, repair and retesting of the piping.

All teflon tubing with stainless steel connections and PVC pipes (ozone sparge and SVE lines) will be pressure tested by the CQC inspector at a pressure of 1.5 times the working pressure for a period of 1 hour. Any temperature corrected variance greater than +/- 2% will be cause for inspection, repair and retesting of the piping.

The CQC Officer shall reject any pipe joint that displays a pressure drop in excess of the above stated standards. The CQC Officer shall report any non-conformance of testing methods to the CQA Officer. If the pipe leaks during the test, the pipe will be repaired by removing leaking segments of pipe and refusing the pipe sections. After the repair, the entire section of the pipe will be retested successfully prior to being covered.

All testing will be reported by the CQC Officer in writing, to be included in the final report of CQC/CQA activities. Test data shall include the date and time of the test, person performing the test, pipe size and location along with the length of the tested segment, ambient weather conditions (temperature and sunlight) at 15-minute intervals, test pressure at 15-minute intervals, the nature of any leaks, and any repair procedures including retest data.

3.4 Remedial Equipment

All remedial equipment (compressor, oxygen separator, ozone generator, recirculating chiller, and expansion chamber) will be tested by the supplying vendor prior to shipping to the site. Verification of the testing will be provided to the CQA officer by the equipment vendor. A 30-day start-up testing period will be used to evaluate all remedial equipment after installation and prior to full operation. Approval of the equipment and installation will be provided by the CQA officer.

3.5 Surveying

Surveying will be performed under the direct supervision of a qualified land surveyor registered in the State of New York. The surveyor shall perform the initial layout for construction, verify that the constructed products meet the tolerances identified within the specifications, and shall prepare a certified site plan depicting the as-built locations of all wells and structures.

The surveyor shall locate the permanent benchmarks previously established by Osmose. Also, the surveyor will establish any new benchmarks using standard surveying practices. The vertical and horizontal controls for the benchmarks will be confirmed by the surveyor prior to the start of any certifying survey work. The CQC Officer will verify that the coordinates and elevation of the benchmark have been verified.

The following surfaces will be surveyed as part of the Surveyor's duties:

- coordinates and elevations for each of the ozone injection and vapor extraction wells;
- coordinates and elevations for each major change in direction of the ozone sparge and SVE pipelines, as well as the instrumentation conduits;
- coordinates and elevations for each of the natural gas pipeline flange connections and every 100 feet along the pipe alignment; and
- location of the ozone treatment building.

The survey instruments used for this work shall have a precision of 0.01 feet and a setting accuracy of 10 seconds. The surveyor shall coordinate with the contractor and subcontractors to ensure proper coverage and avoid delaying the project. Surveying for the purposes for controlling the work is the responsibility of the contractor. The surveyor shall produce record plans for the CQA Officer as the job progresses.

4.0 DOCUMENTATION & REPORTING REQUIREMENTS FOR CQA/CQC ACTIVITIES

The value of the CQA plan will be assured by proper documentation techniques. The CQA inspection team will be guided by data sheets, schedules and checklists. The documentation of the inspection activities will facilitate the adherence to the design documents and maintain the level of reporting required by the NYSDEC.

4.1 Inspection Reports

In general, documentation will involve daily photographic reports including sketches of a particular section or activity and inclusion of inspections in site log book which includes a corrective measure summary and schedule summary. The documentation will be organized into a comprehensive report upon completion of the project construction and inspection activities. Specific documentation procedures are listed in the following subsections. Example documents and formats are located in **Appendix A of this document.**

As-Builts Record Drawings
The CQA Officer shall ensure that one set of full sized (D-sized, 24"x36") construction drawings marked to show any deviations which have been made from the design drawings, including buried or concealed structures and utilities which are revealed during the course of site work, are kept current on a daily basis. The CQA Officer shall initial each variation or revision. The CQA Officer shall, upon completion of site work certify the accuracy of the as-built record drawings and the Contractor shall submit them to the Osmose project manager.

Daily Construction Log
Daily construction logs outline the specific construction activities for each individual working day. Each log will document and monitor the daily activities and problems that accrued during the work day. It will allow the reader to follow the flow of progress on the site and relate the CQC inspections to that progress. The daily log must be completed by the CQC inspector on a daily basis. A log book will be kept on site during the construction activities. After construction is completed, the book will be kept in Fluor Daniel GTI's Schenectady, New York office.

Progress Photo Log
Progress photo logs are designed to document construction activities by still photos. Photo logs may also be used to photographically record activities recorded in a daily construction log or an as-built sketch log.

Daily Inspection Log

The daily inspection log is designed to document all inspection activities and how they correspond to the engineered plans and specifications. All observations, field and/or laboratory tests will be recorded on a daily inspection log. It is important to note recorded field observations may take the form of notes, charts, sketches, or photographs.

Phone Logs

Telephone/Facsimile conversations and transmittals will be recorded on phone log sheets. Contact, titles, telephone numbers, topics and conversation summaries will be recorded to maintain the CQA plan as information and situations are relayed to/from the CQC team.

Meeting Logs

Each meeting involving an individual or individuals and any member of the CQC team will be recorded by a designated CQC representative on a Meeting Log. Meeting logs are designed to limit misunderstandings that may develop in controlled conversations.

Variance Logs

Required changes to the engineered plans and specifications will be processed through the use of a variance log. The variance log will be included in the Daily Construction Log. Approvals from Osmose, the design engineer as well as the CQA Officer are required to recommend a change to the engineered drawings and specifications. Once an approved recommended plan change is received by the design engineer an addendum to the engineered plans and specifications can be completed and returned to the job site.

4.2 Completion Report

At the completion of the project the CQA Officer will prepare and submit a final report to the Project Manager. This report will include a summary of all of the daily construction logs, inspection logs, photographic log, phone logs, meeting logs, and as-built data sheets. This document will be certified, approved and signed on the front page of the report by the CQA Officer and the construction contractor indicating its completeness. The report will be certified by an engineer licensed to practice engineering in New York State verifying that the work was performed and constructed in accordance with the plans and specifications. A copy of the report will be forwarded to the NYSDEC.

5.0 REFERENCES

Final Remedial Design Report, January 6, 1999, GT Engineering, P.C.

Health & Safety Plan, September 10, 1998, Fluor Daniel GTI, Inc.

EXHIBIT D-1

LOG FORMS

OSMOSE, INC.
OZONE SPARGE/SVE SYSTEM

Page of:
Date:

DAILY INSPECTION LOG

Location: ____________________

Work being performed: ____________________

Inspection type: ____________________

Personnel involved: ____________________

Observations or test data: ____________________

Inspection results compared with specification requirements: ____________________

Was a corrective measure report completed? ____________________

If so, cross reference # ____________________

Authorized CQA representative on site ____________________

Date ____________________

OSMOSE, INC.
OZONE SPARGE/SVE SYSTEM

Page: of
Date:

DAILY AS-BUILT SKETCH LOG

Location of sketch area:____

Sketch area below include cross sections/plan views:______________________

________________________________ _______________
Authorized CQA representative on site Date

OSMOSE, INC.
OZONE SPARGE/SVE SYSTEM

Page: of:
Date:

DAILY PHOTOGRAPHIC LOG

Location:____

Time:____

Photograph purpose:____

Weather:____

Description:____

CQA Representative on Site

Date

OSMOSE, INC.
OZONE SPARGE/SVE SYSTEM

Page: of:
Date:

VARIANCE LOG

Location:____

Drawing/specification reference # ____________________________

____

Description/proposed changes to engineered plans and specs ____________

____

____

____

____

____

Requested by: ____________________ Date:________________

Approved by:____________________ Date:________________
Project Manager

____________________ Date:________________
CQA Program Manager

____________________ Date:________________
CQA representative on site

OSMOSE, INC.
OZONE SPARGE/SVE SYSTEM

Page: of:
Date:

MEETING LOG

Date:____

Time:____

Location:______________________________________

Participants:____________________________________

____

Subject:_______________________________________

Minutes of the meeting:____________________________

____

____

____

Action items and due dates:

1.____

2.____

3.____

Comments:______________________________________

____

____________________ ________________
CQA representative on site Date

OSMOSE, INC.
OZONE SPARGE/SVE SYSTEM

Page: of:

PHONE LOG

Date:____

Call received by (signature):____________________________

Made call ☐ Received call ☐ Returned call ☐

Contact:__________________ Title ____________________

Company name:______________ Phone ____________________

Address:____

Topic:____

Summary of conversation:____________________________

CQA representative on site

Date

INSTRUMENT CALIBRATION LOG

INSTRUMENT:

GTI #: SERIAL #:

Date Inspected	Calibrated	Condition	Battery	Repairs

EXHIBIT D-2

ORGANIZATIONAL CHART AND RESUMES

PROJECT ORGANIZATIONAL CHART