Corrective Action Work Plan

Prepared For:

The Torrington Company
Former Heavy Bearings Facility
South Bend, Indiana

February 27, 1995

Revision 1

CORRECTIVE ACTION WORK PLAN

Prepared For:

The Torrington Company
Former Heavy Bearings Facility
3702 West Sample Street
South Bend, Indiana 46619

February 27, 1995

Prepared By:

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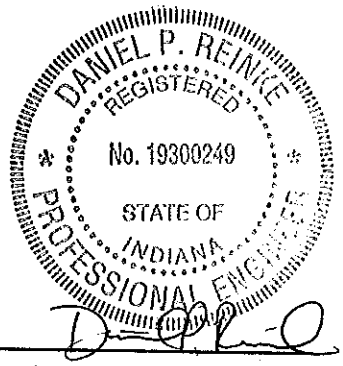

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INTRODUCTION

Capsule Environmental Engineering, Inc. (Capsule) was retained by The Torrington Company (Torrington) to design and implement corrective action measures to remediate contaminated soil and ground water at its former heavy bearings facility located at 3702 West Sample Street in South Bend, Indiana (Figure 3). The purpose of this Corrective Action Work Plan (Work Plan) is to outline the specific tasks associated with the installation, operation, and maintenance of the proposed system. A Project Communications Plan (PCP) and the criteria for verification of meeting the cleanup objectives are also included.

The Work Plan has been prepared in response to the telephone conference call between the Urban Enterprise Association (UEA), Torrington, and Capsule. This document has been modified to reflect comments provided by the UEA.

CONCEPTUAL DESIGN AND PURPOSE

A conceptual remediation system design was prepared as part of the "Soil Vapor Extraction/Air Sparging Documentation Report and Conceptual Design" prepared by Capsule and by Wenck Associates, Inc. of Maple Plain, Minnesota, dated June 21, 1994. This report provides a description of the system components and an explanation of installation and operational requirements. A copy of this report can be obtained by contacting the UEA.

Additional documents for this project include an air permit and formal system design drawings and specifications. Torrington has obtained an air permit for this system separate from any other air permits held for building tenant activities. The drawings and specifications will be used by contractors to install the proposed system. Torrington is looking to have this system installed and operational as soon as possible.

As presented in the June 21, 1994, report, the installed system will actually be comprised of two separate systems each of which combine in situ volatilization (ISV) and air sparging technologies as a complete remedial tool. Three areas of soil and ground water contamination, two inside (Areas A and B) and one outside (S-3 area) the building, will be addressed by two separate remedial systems. The systems have been designed to accomplish the following objectives at the site:

- Remediate soil contamination consisting of chlorinated volatile organic compounds (VOCs) in three areas.
- Remediate ground water containing dissolved concentrations of chlorinated VOCs in three areas.
- Remove free-phase petroleum hydrocarbons from the water table in the S-3 area.
- Reduce the potential for off-site contaminant migration.

BACKGROUND

Previous investigations at the site revealed the presence of soil and low level ground water contamination in three areas of the site. The locations of the areas of contamination are shown in Figure 1. In addition, free-phase petroleum product is present on the water table in the S-3 area. A free-phase product recovery system is currently operating on site to remove free-phase product from the aquifer. The system employs a depression pump and a free-product recovery pump. Extracted product is pumped to a tank inside a temporary treatment shed located on site. Extracted ground water is directly discharged to the sanitary sewer under a publicly owned treatment works (POTW) permit.

GEOLOGY

The geology at the Torrington site consists of a glacial outwash aquifer overlying a blue shale bedrock which is present at approximately 180 feet below grade level (bgl). The outwash aquifer consists primarily of medium to coarse grained sand and varying amounts of fine to medium gravel. Inter-bedded with the sand and gravel are small lenses of lower permeability sediments. The aquifer is divided by a 20-to 30-foot confining layer of clay which is present approximately 60 feet bgl at the site. This clay layer reportedly pinches out to the east of the site providing a hydraulic connection between the upper and lower aquifers. Ground water is encountered at the site at approximately 7 feet bgl.

TECHNOLOGY DESCRIPTION

ISV or soil vapor extraction is a method of remediating unsaturated zone soils containing VOCs. Extraction vents are installed with the screened area exposed to areas of contamination in the unsaturated zone. A source of vacuum is applied to the extraction vent to draw air through the void spaces in the unsaturated soils, thereby enhancing volatilization of contaminants into these induced subsurface air streams. Contaminants are thus removed in vapor phase in the air stream drawn out of the extraction vent. In the proposed system, air streams from several vents will be combined and discharged to the atmosphere.

Air sparging is a technology for the remediation of contaminated ground water. Air sparging points are installed with short screens, typically 2 to 5 feet long. The screened interval is placed in the saturated zone below the area of ground water contamination. Air is then injected into the sparging point where it flows out of the screen, flows through the saturated zone as small transient air pockets or "bubbles," and flows into the unsaturated zone. As air passes through the saturated zone, volatile contaminants are transferred from the ground water into the air and eventually reach the unsaturated zone. Conceptually, air sparging creates a subsurface, in situ "air stripper." Air sparging must be performed in conjunction with ISV to prevent uncontrolled migration of vapor-phase contaminants in the unsaturated zone. Generally, homogeneous aquifers are required for air sparging in order to promote

uniform controlled air flow from the aquifer to the unsaturated zone. In the case of the Torrington site, slight inhomogeneities exist in the aquifer in the form of lower permeability lenses within the sand and gravel. In order to minimize the potential for uncontrolled migration, relief vents will be installed in areas where inhomogeneities are identified. In the S-3 area, these relief vents may also be employed as part of a free-phase product recovery system.

CONCEPTUAL ORDER OF IMPLEMENTATION

The order of installation for the proposed system allows for concurrent activities of chosen contractors with a minimization of interference to facility businesses and personnel. As a concern for health and safety and as a matter of common courtesy, every effort will be made to minimize work in areas where businesses are currently operating within the facility. The order of installation for the proposed system is as follows:

1. Drilling/installation of extraction vents, air sparging points, and possibly relief vents in Area A. Concurrent with this will be modifications to the new equipment rooms #1 and #2, indoor installation of piping, and the vacuum and compressed air equipment.

2. Drilling/installation of extraction vents, air sparging points, and possibly relief vents in Area B. Concurrent with the drilling activities in Area B would be the piping and well outfitting installation activities in Area A.

3. Drilling/installation of extraction vents, air sparging points, and possibly relief vents in the S-3 area outside the building. Concurrent with the S-3 drilling activities will be the piping and well outfitting activities in Area B and final hookup of this first system to Areas A and B.

4. Piping and well outfitting activities in the S-3 area.

5. Transfer of existing free-product hydrocarbon recovery equipment from the existing shed to equipment room #1 in the S-3 area.

6. Final hookup of the second system to the S-3 area.

7. Performance testing and system checks for both systems.

8. System startup.

9. System monitoring and reporting.

10. Verification of cleanup goals through sampling and analysis.

11. Site cleanup and system dismantling upon completion of remedial activities.

DRILLING ACTIVITIES

The first phase of work in each of the three areas will be the installation of the extraction vents, air sparging points, and relief vents where needed. Listed below are details of the drilling activities to take place. All of the drilling activities will be in accordance with applicable American Society for Testing and Materials (ASTM) standards and Occupational, Safety, & Health Administration (OSHA) safety standards. It is anticipated that all of the drilling activities will be conducted utilizing Level D safety equipment including hard hats, eye protection, ear protection, and steel-toed boots.

CONTRACTOR AND EQUIPMENT

The drilling of the aforementioned points at the Torrington site is proposed to be done by Environmental Drilling and Contracting (EDAC) of Holland, Michigan, under the direction of a Capsule hydrogeologist. The hollow-stem auger drilling method will be used to install all of the points. The air sparging points will be 2-inch diameter points and will be installed with 4¼-inch inside diameter (I.D.) hollow-stem augers. The 4-inch extraction vents and relief vents will be installed with 8¼-inch I.D. hollow stem augers.

SAMPLING AND GEOLOGIC LOGGING

Continuous split-spoon samples will be collected from several of the borings in each area. In addition, samples will be collected in other borings at the discretion of the hydrogeologist. The samples will be logged by the on-site hydrogeologist and geologic logs will be completed in a field log book for each of the borings advanced. The logs will present the classification of the sediments encountered at the referenced depth and other information pertinent to the advancement of the boring. Well construction details will also be recorded in the field log book.

During the advancement of the borings, sediment samples will be screened for the presence of organic vapors by headspace analysis using a photoionization detector (PID). The PID will be calibrated with an isobutylene standard twice daily. Calibration records will be recorded in the field log book. The samples will be placed in a mason jar (approximately half full). The jars will be covered with foil and a lid, shaken vigorously, and allowed to sit for ten minutes. The jar will then be shaken again and the lid will be removed. The instrument tip will then be thrust through the foil into the headspace and the reading will be recorded in the field log book.

Based on the PID readings, select samples will be collected for laboratory analysis. The samples will be analyzed for the presence of VOCs by Environmental Protection Agency (EPA) Method 8260 and total petroleum hydrocarbons (TPH) utilizing the modified preparation method identified in the report dated December 18, 1992, and gas chromatography with flame ionization detection (GC/FID).

In addition, five Shelby tube samples will be collected during the drilling activities in the S-3 areas to determine the impact, if any, that the oils present in the soil and ground water in this area have on the soil permeability. This information will be used in the operation of the remedial system in this area.

The split-spoon sampler will be decontaminated following each sample collection. The sampler will be washed in trisodium phosphate (TSP) soap followed by a water rinse.

AIR SPARGING POINT INSTALLATION

The air sparging points will be constructed on top of the confining clay layer which is present at the site. All of the air sparging points installed will be constructed of 2-inch diameter, 2-foot long, 20-slot (0.020-inch) well screens and 2-inch diameter Schedule 40 polyvinyl chloride (PVC) well casing. The annular space will be filled with the appropriate sand pack to a depth of 2 feet above the top of the screen. A 2-foot bentonite seal will then be installed above the sand pack and the remaining annular space will be filled with neat cement grout.

EXTRACTION VENT INSTALLATION

The extraction vents in Areas A and B will be completed in the unsaturated sediments above the water table. However, in the S-3 area, the extraction vents will be completed through the unsaturated zone and into the saturated zone to a depth of approximately 20 feet. This will allow for collecting dissolved oxygen readings, ground water sampling, and identification of free-product liquid in this area. If free-product hydrocarbon is identified, these extraction vents could be retrofitted with free-product recovery pumps.

All extraction vents will be completed with 4-inch diameter, 20-slot (0.020-inch) well screens and 4-inch diameter Schedule 40 PVC well casing. The annular space will be filled with gravel pack to a depth above the top of the screen. A bentonite seal will then be installed above the sand pack, and the remaining annular space will be filled with neat cement grout.

RELIEF VENT INSTALLATION

Relief vents may be installed in areas where lower permeable sediments are present to guard against the potential of lateral contaminant plume spreading as a result of air sparging activities. The relief vents are designed to provide a pathway for vertical, rather than horizontal migration of the sparge air containing the dissolved contaminants. The completion

depth of the relief vents will be dependent upon the depth of the lower permeability sediments identified during the advancement of the borings for the air sparging wells in each of the three respective areas. In addition, the relief vents could be used as supplementary extraction vents and/or as free-phase petroleum product recovery wells.

The relief vents will be completed with 4-inch diameter, 20-slot (0.020-inch) well screens. The screen will extend the entire length of the completed vent to maximize the surface area available for sparge air migration. A short piece of 4-inch diameter well casing will be installed above the screen for completion purposes. The annular space around the screen will be filled with gravel pack, and the annular space above the screen will be filled with neat cement grout.

While the relief vents will be installed as a means of controlling lateral migration, due to the geologic conditions at the site, it is not possible to guarantee that lateral migration will not occur. However, every effort will be made to prevent lateral migration. This will be accomplished through a number of means including:

- Controlling injection and extraction flow rates. The system will be operated in a manner that ensures that the amount of air being extracted substantially exceeds the amount of air injected.

- Prior to starting up the air sparging system, the ISV system will be operating.

- In the event that the ISV system were to shut down, engineering controls will be in place to shut down the air sparging system.

- During system startup and until the sparging system is fully operational at its maximum flow rate, perimeter wells will be monitored for changes in dissolved oxygen levels. Changes in dissolved oxygen levels would be indicative of sparge air reaching these monitoring points.

COMPLETION DETAILS

All of the extraction wells, vents, and sparge points will be completed below grade. A subgrade box or manhole will be installed at each point that will allow enough room for piping and/or gauges to be attached at the well. The subgrade boxes will have bolt-down lids to minimize the infiltration of water and/or other foreign substances.

All extraction vents, sparge points, and relief vents intersecting the water table will be developed following completion.

DECONTAMINATION PROCEDURES

The drilling rig and down-hole equipment used in the installation of the extraction vents, air sparging points, and relief vents will be decontaminated daily and between borings when necessary to minimize the potential for cross-contamination. Decontamination will consist of pressure washing (steam cleaning) the equipment. All of the decontamination fluids will be collected in a preconstructed decontamination area and discharged to the sanitary sewer under the operating permit granted for the currently operational free-phase product recovery system.

FREE-PHASE PETROLEUM HYDROCARBON PRODUCT RECOVERY

During the advancement of the borings in the S-3 area, soil and ground water samples will be collected to characterize the lateral extent of free-phase petroleum hydrocarbon which is present in the area. Based upon the results of this characterization study, both the need for free product removal and the size of the system to remove the free product will be evaluated.

If it is determined that the amount of free product that is present will interfere with the operation of the ISV/air sparging system, free-product collection pumps will be placed in the affected wells. In addition, the appropriate subsurface piping will be installed to allow for the transport of compressed air from the centralized treatment room to the pumps and for free product from the pumps back to a centralized collection area in the treatment room. Treatment of the mixture of oil and water will utilize an oil/water separator. The oil will be discharged to a holding tank pending disposal, and the water will be discharged under the present POTW permit.

Operation of this system will occur until either all the free-product oil is removed, or the amount of oil remaining does not interfere with the operation of the ISV/air sparging system. Once oil collection is no longer necessary, the free-product pumps will be removed.

ACCESS AGREEMENT

Prior to beginning the installation of wells and piping along with the western boundary of the facility, an access agreement must be negotiated with the neighboring property owner (RACO). The UEA and the City of South Bend have committed to taking the lead in obtaining this agreement. Any delays in obtaining this agreement would ultimately delay the installation and startup of the system.

SYSTEM COMPONENTS AND INSTALLATION

As mentioned previously, two separate remedial systems will be constructed at the site. The systems will be installed by experienced construction firms. The chosen contractors will follow detailed specifications and drawings and will be under the direction of a Capsule

representative during all installation activities. The general installation activities associated with each system component are outlined below.

The mechanical components of the ISV/air sparging systems will consist of sparge points and extraction vents, pressure relief vents, vacuum blowers, air compressors, system controls, pressure and flow gauges and switches, monitoring ports, and discharge stacks.

All of the extraction vents and air sparging points will be piped individually to common header pipes that will be connected to a vacuum blower and/or the air compressor associated with each system. In the S-3 area, piping from the extraction vents and sparging points will run underground to a common header pipe which will run underground to the treatment building. For Areas A and B located inside the facility, piping will run beneath the floor to the nearest vertical support column or wall. The piping will then be run up the vertical support column or wall to a common overhead header pipe. The common header pipe will run overhead to the treatment room.

The extraction vents and sparging points located outside the facility will have the gauges and control valves located inside the subgrade boxes. The gauges and control valves for the vents and sparge points located inside the facility will be located in-line where the piping runs vertically up a support column or wall or at some other accessible location.

The vacuum blower, air compressor, and associated controls will be located in an equipment room for the S-3 area (the former table tennis lobby) and in an equipment room situated within the interior of the facility for Areas A and B. Electricity to control the equipment will be obtained from the facility. Meters will be placed on each system to tabulate the amount of electricity used by each system.

The condensate separated from the extracted air stream will be collected and discharged through a meter to the sanitary sewer under the existing POTW permit.

The off-gas discharge stacks for the two ISV vacuum blowers will be run through the roofs of the equipment rooms. The stacks will be properly attached depending on height to ensure stability. The stacks will be outfitted with sampling ports to monitor stack discharge concentrations.

Any associated free-phase petroleum product recovery equipment would be housed in the equipment room located in the S-3 area.

SYSTEM OPERATION AND MAINTENANCE

Routine monitoring and maintenance will be performed on the two systems to ensure that the systems are maintaining efficient performance. The specific operational and maintenance requirements and schedule will be determined following the installation of the complete system. An operations and maintenance log book will be maintained for each system to document monitoring or maintenance performed, system operating efficiency, problems, date, name of the person(s) performing the maintenance, and other pertinent information.

HEALTH AND SAFETY CONSIDERATIONS

All work associated with the hazardous area portions of the remediation system installation and/or operation will be conducted under a site-specific Health and Safety Plan (HASP) that will be developed by the hazardous waste contractor. At a minimum, the requirements identified under OSHA 1910.120 will be followed. Daily health and safety meetings for the hazardous area workers will be held prior to beginning work each day. If required, due to changes in site conditions, modifications in personal protection and safety issues will be made by the on-site supervisor/project manager in conjunction with Torrington. All drilling and excavation personnel on site will have the required OSHA 40-hour hazardous waste training.

CLEANUP CRITERIA

This project is being conducted by The Torrington Company on a voluntary basis. As such, the cleanup guidelines that were used for the system design and which will be used in determining when the cleanup is complete are based upon the levels set forth in the Indiana Department of Environmental Management's (IDEM's) Voluntary Cleanup Program "Calculations of Tier II Cleanup Goals Based on Human Health Evaluation" dated February 1, 1994 (see Appendix A).

For ease of reference, the Tier II cleanup goals for both soils and ground water have been summarized in the following table:

IDEM Tier II Cleanup Goals

Chemical Compound	DATA FROM IDEM TIER II CLEANUP GOALS IN TABLE 10 Subsurface Soil (mg/kg)	DATA FROM IDEM TIER II CLEANUP GOALS IN TABLE 8 Ground Water (mg/L)
vinyl chloride	0.13	0.01
chloroethane	1000.00	NA*
1,1-dichloroethylene	0.06	0.007
1,1-dichloroethane	1000.00	10.2
(cis) 1,2-dichloroethylene	102.49	1.02
Trichloroethylene	25.73	0.260
1,1,1-trichloroethane	1000.00	9.20

*NA - not applicable

It is anticipated that the system will be operational for a period of two to five years.

REGULATORY REQUIREMENTS

To operate the proposed remedial system, certain regulatory requirements need to be met. Torrington currently has an existing POTW permit with the City of South Bend. This permit, however, may need to be modified due to operational changes in the system. Currently, monthly effluent sampling of the water discharging to the POTW is conducted. This sampling will continue under the operation of the new system. The need for additional analytes for this sampling will be determined based on the expected discharge from the operating system. Capsule is in the process of determining whether a modification to the current permit is required.

To operate the ISV system, an air permit or a written exemption from permitting requirements is needed from the IDEM. A copy of the exemption has been included in the Appendix C.

Additional permits, such as construction/building permits may also be required depending on city/county regulations. These permits will be obtained by the appropriate contractor prior to beginning work activities.

ISV AIR EMISSIONS MONITORING

Periodic air sampling will be conducted on the off-gas emissions of the operation ISV system to determine cleanup progress and to verify compliance with the air permit guidelines. Because air emissions typically decrease parabolically following system startup, sampling frequency will decrease as the total system operation time increases. Air samples will be collected from both systems. The samples will be analyzed for VOCs. The following provides a proposed air sampling program for the operating system:

Week 1 through Week 4	Weekly stack sampling
Week 5 through Week 12	Bimonthly stack sampling
Week 13 through completion	Monthly stack sampling

GROUND WATER MONITORING

In order to determine the effectiveness of the operating system and to determine when cleanup levels have been achieved, selected wells will be sampled and analyzed for VOCs on a quarterly basis for the first year and on a biannual basis for subsequent years. The wells that are selected for sampling will be determined following the installation of the system.

The analytical results for each sampling event will be submitted to the UEA for their review. In addition, on an annual basis, a summary report will be prepared. This report will include

the results of all of the previous sampling events in tabular form along with an interpretation of the effectiveness of the system based upon the analytical results.

GROUND WATER SAMPLING PROTOCOL

Ground water sampling will be conducted under the appropriate EPA protocol. Prior to sampling a well, the depth to ground water will be measured and recorded in a field log book or ground water sampling form. The amount of water, in gallons, in the water column in the well will then be determined. A minimum of three well volumes of water will be purged from the well by bailing or pumping to achieve well stabilization prior to sampling. Sterile gloves will be worn at all times during well sampling. Disposable polyethylene bailers and/or decontaminated pumps will be used for purging and new disposable bailers will be used for sampling. A new bailer will be used for each well purged and/or sampled. The extracted water will be containerized and discharged to the sanitary sewer under the POTW permit. Following the extraction of each volume from the well, measurements of pH, temperature, and specific conductivity will be taken. A well will be considered purged adequately and stabilized when either five well volumes have been removed or when three consecutive readings (+/- 5%) have been obtained for the aforementioned parameters. Once stabilization has been achieved, the well will be sampled. After the sample has been collected, the sample will be placed on ice in a cooler and shipped via overnight courier to a laboratory for analysis. Accurate chain-of-custody records will be maintained at all times during the sampling activities.

REPORTING REQUIREMENTS

Sampling/analytical data packages will be submitted to the UEA as they become available. In addition, annual progress reports will be prepared and presented to the UEA for review and comment. The annual reports will present results and data on system operation and efficiency and the progress of the remedial effort. Recommendation for system changes and/or additional work will be presented in the annual reports, if applicable.

A final cleanup report will also be prepared following the completion of remedial activities.

FINAL CLEANUP VERIFICATION

Site cleanup verification will be based on analytical results from soil and ground water samples. The site will be considered "clean" when the following criteria have been met:

1. Ground water sample analytical results show levels below the levels set forth in the IDEM Voluntary Cleanup Program's Tier II Guidelines as identified on Page 9.

2. Soil sample analytical results from the source areas indicate VOC concentrations below the levels set forth under the IDEM Voluntary Cleanup Program's Tier II Guidelines as identified on Page 9.

3. Free-phase petroleum product is no longer present on the water table.

4. Concentrations of total petroleum hydrocarbon (TPH) in soils in the Pond #4 area are below the 100 parts per million (ppm) TPH IDEM guideline.

SYSTEM DISMANTLING

Following the completion of remedial activities, the remedial system will be dismantled and removed from the site. All associated equipment, controls, pumps, piping, and so forth, will be removed. In addition, the monitoring wells, extraction vents, sparge points, and relief vents used during the investigation and remediation phases of the project will be decommissioned using established abandonment procedures. All subsurface piping will be abandoned in place. All exposed and overhead piping will be removed at the direction of the UEA.

PROJECT COMMUNICATIONS PLAN FOR THE ENVIRONMENTAL CLEANUP EFFORT

OBJECTIVES OF THE PCP

This PCP was developed to provide the UEA and their tenants with the general procedures to be used by Torrington and Capsule to keep people informed during the environmental construction activities.

The main objectives of the project communications program are to:

1. Provide the tenants with an opportunity to learn about the site conditions and environmental cleanup work.

2. Provide timely responses to inquiries, concerns, and situations that may arise during the project.

These objectives allow an information network to be established early in the project, provide contacts for additional information and questions, establish a commitment to be proactive in responding to people, and give the tenants an opportunity to determine their level of interest and involvement.

TASKS OF THE PCP

The objectives of the PCP will be met by accomplishing the following tasks:

Objective 1 - Provide Project Overview

A Torrington representative, either the project manager or the on-site manager, with the assistance of the UEA, will canvass the building tenants. An attempt will be made to interview each tenant. The Torrington representative will be prepared to offer background information on the project and respond to questions. Additionally, a Torrington project fact sheet (Appendix B) will be provided to the tenants. The fact sheet contains the background on the site, information about the upcoming environmental construction activities, project contact people, and a toll free phone number for inquiries and concerns.

Any tenant not available for interviewing will be left with a fact sheet and business card.

Objective 2 - Response to Inquiries

Project Manager:	Jay Mattsfield, Capsule
On-site Engineer:	Daniel P. Reinke, Capsule
On-site Managers (alternates)	John J. McDermott, Capsule Dana Hayworth, Capsule
Capsule phone numbers:	(612) 636-2644
The Torrington Company:	Luther Longino
Torrington phone number:	(203) 626-2392

The on-site project manager will be responsible for providing the initial response to any questions or situations that arise from the tenants during the environmental construction activities. The preferred response is to talk directly to the interested person. The on-site manager will be responsible for documenting inquiries and followup in the project field log book.

Inquiries from interested parties, such as media representatives or environmental groups, will be directed to the project manager. After consulting with both Torrington and the UEA, these inquiries will be addressed.

SERVICE INTERRUPTION

While not expected, due to the nature of the work and the location of power and gas lines, it may be necessary to interrupt natural gas service and/or power to the facility. In an effort to minimize the impact to the tenants, this will be scheduled during off-hours or on weekends whenever possible. However, in the event that this is not possible and the interruptions must occur during working hours, tenants will be given notification at least 48 hours in advance of the interruption.

ACCESS

System construction activities will require access to a number of areas within the building. If access to an area that is occupied by a tenant is required, the tenant will be notified in writing at least 48 hours prior to conducting the work. This work will be scheduled in such a manner as to minimize the impact to the tenant. This will be done by working off-hours and/or on weekends when possible. Any physical disruptions such as concrete removal or piping runs, will be repaired or located to minimize their impact to the tenant.

Any work that is to be conducted in an area presently occupied by a tenant will be discussed with the tenant in the presence of a UEA employee prior to occurrence. This discussion will include what is being done, why it is being done, future access needs for the purpose of inspections, and any potential health and safety issues that may be of concern.

POTENTIAL TENANT IMPACTS

The only potential route of exposure to the tenants is through inhalation. This route of exposure could come from vapors released through the piping system, vapors coming through the floor, vapors from the stack discharges from the treatment systems, and point source discharges from the relief vents. Each of these exposure routes are addressed below.

PIPING LEAKS

The release of vapors caused by a leak in the piping is not considered to be a significant threat. This is due to the fact that there are two pipelines associated with the system. These are the vacuum line for the ISV system and a pressure line for the air sparging system.

The line that is associated with the removal of VOCs is a vacuum line. Consequently, if a leak were to occur, clean ambient air would be infiltrating the vacuum line rather than the contaminated line leaving the pipe and being released to the ambient air. Therefore, the potential for exposure from this source is minimal.

The pressure line that is associated with the air sparging system is under positive pressure. This line does not pose a threat since it will only be conveying clean air from the compressor to the sparge point.

VAPORS THROUGH THE FLOOR

Although the potential does exist for vapors to be released through the floor and into tenant spaces, this is highly unlikely due to the fact that the ISV system will be operated in such a manner as to ensure that more air is being removed than is being injected. This will ensure that there is a negative pressure associated with the soils in the unsaturated zone, and consequently, clean air from the surface will act as makeup air for the system. This clean air from the surface will infiltrate the unsaturated zone where it will be removed by the ISV system.

To ensure that a positive pressure situation does not occur at the site, engineering controls will be in place to shut down the air sparging system in the event that the ISV system were to shut down.

In addition, during system startup and for the first two months, ambient air within the facility will be monitored to verify that contaminants are not being released by the system.

STACK DISCHARGES FROM TREATMENT SYSTEM

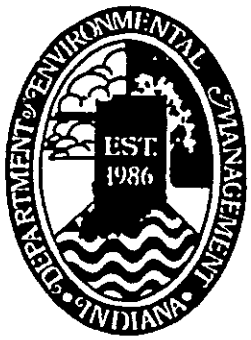
Although exposure to the stack discharges are possible, the access to these areas will be limited to personnel who are associated with testing, operation, and maintenance. In addition, the emissions from the stack need to meet the requirements of the permit and as such do not pose a threat.

POINT SOURCE RELEASES FROM RELIEF VENTS

The relief vents could constitute a source for a release if the vent was constructed using solid pipe from below the water table to the surface. However, these release vents will be incorporated into the ISV system and be operated at a low flow rate under negative pressure. Therefore, these vents do not pose a potential for releases.

APPENDIX A

IDEM TIER II CLEANUP GOALS



THE INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

CALCULATION OF TIER II CLEANUP GOALS BASED ON HUMAN HEALTH EVALUATION

Revised February 1, 1994

TIER II CLEANUP GOALS - HUMAN HEALTH EVALUATION

Cleanup goals for chemicals in source media for Tier II are calculated based on a human health evaluation using standard risk assessment assumptions. Cleanup goals are determined for one of two possible land use scenarios; non-residential or residential. The determination of whether cleanup goals based on a residential or non-residential scenario apply to a particular site depends on the environmental site setting (i.e., onsite and surrounding land use patterns) and projected future use. However, the use of cleanup goals to remediate a site based on an non-residential scenario will require some land use restrictions to prevent unrestricted future use of the site.

The methodology for calculation of Tier II, health-based cleanup goals was based on EPA's preliminary remediation goals (EPA, 1991), incorporating changes agreed upon by the Voluntary Remediation Program Technical Standards Subcommittee. The methodology for calculation of Tier II cleanup goals is provided in three parts. This first part presents background information and an overview of the health-based approach for determining preliminary remediation goals. Then detailed calculations are provided which outline the approach for calculating health-based goals specifically for the Tier II assessment. Finally, cleanup goals for selected compounds are presented that are applicable for remediation of sites with a Tier II assessment.

OVERVIEW OF EPA APPROACH FOR DETERMINING PRELIMINARY REMEDIATION GOALS

EPA has identified a standardized approach for calculating cleanup goals or preliminary remediation goals (PRGs) for the remedial investigation and feasibility study (RI/FS) process on federal Superfund sites. PRGs are equivalent in concept to Tier II cleanup goals such that they are health-based acceptable concentrations for chemicals of interest in a particular media. They are also derived independently for a site or sites without requiring a site-specific risk assessment (i.e., a Tier III risk assessment). The method for calculating these PRGs was outlined in the document *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual; Part B, Development of Risk-Based Preliminary Remediation Goals* (EPA, 9285.7-01B, December, 1991), an overview of which is discussed below.

EPA's approach for determining PRGS for a site include either applicable or relevant and appropriate requirements (ARARs) and/or health-based acceptable concentrations. This discussion, however, focuses only on the calculation of risk-based PRGs. Risk-based PRGs are calculated separately by chemical and media. The media evaluated in EPA Part B include soils and groundwater (and/or surface water used as a potable water source). However, for Tier II, soils were divided into two separate media based on their potential for exposure: surface soils and subsurface soils. Surface soils are defined as those soils within the top 2 feet of the surface that would be incidentally contacted by an industrial worker, while working, or by residents while playing (young children) and/or landscaping or gardening (adults). Subsurface soils were defined as soils below 2 feet that would only be contacted directly during excavation or construction activities. The potential for contact to subsurface or deeper soils would be less than for surface soils and would occur under different circumstances (i.e., excavation or

construction).

The development of risk-based PRGs begins with the determination of the probable future land use of the site and the potential receptor type that would apply. Potential exposure pathways are then identified using assumptions about the behavior and body parameters of the applicable receptor. For calculation of PRGs for each media, EPA identified applicable exposure pathways specific to the land use scenario evaluated. However, EPA only considered those exposure pathways that contribute significantly to the overall exposure and risk in the calculation of PRGs. Other relevant exposure pathways were assumed to contribute insignificantly to the overall exposure and were not included. Relevant exposure pathways were also assumed to vary according to residential and non-residential use scenarios. For the residential scenario, the exposure pathways considered applicable for groundwater were ingestion and inhalation of volatiles; and for soil was incidental ingestion. For the non-residential scenario, the exposure pathways considered applicable for determining PRGs for groundwater was ingestion; and for soil were incidental ingestion and inhalation of volatiles and fugitive dusts.

Once exposure pathways are identified, equations quantifying the health risk to the receptor can be developed. There are two general equations used in calculating potential human health effects in a risk assessment, one for carcinogenic effects, the other for noncarcinogenic effects. They are, for the carcinogenic assessment:

$$R_i = SF * I_i \quad (1)$$

where:
- R_i = excess lifetime cancer risk from exposure pathway *i*;
- SF = cancer slope factor $(mg/kg/day)^{-1}$;
- I_i = total chemical intake from exposure pathway *i* averaged over a lifetime (mg/kg/day)

and, for the noncarcinogenic assessment:

$$HI_i = \frac{I_i}{RfD} \quad (2)$$

where:
- HI_i = hazard index from exposure pathway *i*;
- I_i = average daily intake from exposure pathway *i* averaged over the period of exposure (mg/kg/day);
- RfD = reference dose (mg/kg/day).

Equations 1 and 2 are written in a general form in that chemical intake (I) varies according to exposure pathway and receptor. Total cancer risk and hazard index are then calculated by summing across all exposure pathways to give a total cancer risk (R_{tot}):

$$R_{tot} = \Sigma\ R_i \quad (3)$$

or total hazard index (HI_{tot}):

$$HI_{tot} = \Sigma\ HI_i \quad (4)$$

The equations quantifying the risk from a given chemical concentration in a particular medium can then be inverted to back-calculate a health-based acceptable chemical concentration, given an acceptable risk level. PRGs are then determined by using these equations with standard EPA default exposure factors, available toxicity data and appropriate target health effect levels. EPA designed the PRG methodology to be used initially to calculate PRGs for a site using strictly default parameters, and, at a later time, to be used with site-specific assumptions to update the PRGs. However, application of the PRGs concept for calculating Tier II cleanup goals assumes only the default parameters. Modification based on site-specific data, however, could be implemented as a part of a Tier III risk assessment.

Toxicity data refers to cancer slope factors (SFs) and reference doses (RfDs), collectively termed dose-response factors, used in Equations 1 and 2. Dose-response factors relate the intake or dose of a chemical to a carcinogenic effect or noncarcinogenic systemic effect from exposure to a contaminated medium. Dose-response factors are specific to a chemical and exposure pathway (i.e., oral versus inhalation). SFs and RfDs are obtained first from EPA's Integrated Risk Information System (IRIS), or if not available in IRIS, from EPA's Health Effects Assessment Summary Tables (HEAST).

Target health effect levels refer to the levels of cancer risks or hazard indices that are deemed acceptable by the EPA for a particular site. Target health effect levels are cancer risks and hazards indices below which the potential for effects to human health are assumed to be negligible or inconsequential. Generally, cancer risks are evaluated based on a range of acceptable risk from 1 in 10,000 (10^{-4}) to 1 in a 1,000,000 (10^{-6}). Noncarcinogenic effects are evaluated based on a hazard index of one or below which is generally deemed to be acceptable. The range of acceptable risk for the carcinogenic assessment reflects the range of uncertainty in the analysis and interpretation of the results for a particular site. This range also reflects the range of acceptability for various land uses. For federal Superfund sites investigated under the national contingency plan (NCP), sites with a cumulative total cancer risk level below 10^{-6} for all applicable receptors indicate no remedial action is needed. Whereas, for sites with cancer risk levels above 10^{-4}, some remedial action must be taken to mitigate potential cancer risks. For sites with maximum cancer risks in the range 10^{-4} to 10^{-6}, action is taken on a site-specific basis. Typically on sites with unrestricted future use (i.e., where residential use is possible), the target risk level is closer to 10^{-6}. However, on sites with restricted land uses for current and future non-residential purposes, target risk levels higher than 10^{-6} are often selected. Therefore, for determining health-based cleanup goals for carcinogens in the Tier II analysis, a "point of departure" for sites with unrestricted future use (i.e., including residential use) were based on a 10^{-6} target cancer risk level. For sites where current and future land use is restricted to non-residential purposes, the "point of departure" for carcinogens was the 10^{-5} target cancer risk level. The target hazard index used for evaluating noncarcinogenic compounds was 1, for

compounds that are not considered bioaccumulative, and 0.2, for compounds that are considered bioaccumulative. Table 1 of Water Quality Criteria for Specific Substances (Indiana Register, Volume 16, Number 7, April 1, 1993) was the basis for determining whether or not a compound was considered bioaccumulative.

CALCULATION OF HEALTH-BASED CLEANUP GOALS

Health-based cleanup goals were calculated for soils and groundwater according to EPA's PRG approach, with one exception. Cleanup goals for soils were developed separately for surface and subsurface soils since they differ in the potential for direct contact exposure. Cleanup goals for surface soils were based on EPA's PRG approach considering target receptors of either residents, for sites remediated for unrestricted future use, or industrial workers, for sites that are remediated for restricted land use for non-residential purposes. For subsurface or deep soils, applicable receptors are excavation workers (i.e., for utility placement or maintenance) or construction workers. These particular receptors would be exposed to subsurface soils at a higher rate (i.e., higher contact rate per day or event) than an non-residential worker or resident would be exposed to surface soils, but the exposure would occur over a shorter duration. The following paragraphs provide a discussion of calculating health-based criteria applicable for the non-residential and residential land use scenarios.

Non-Residential Land Use Scenario

Surface Soils: Potential exposure pathways considered applicable for surface soils in the non-residential scenario were incidental ingestion and inhalation of volatiles and fugitive dusts. The cancer risk, R, and hazard index, HI, for these exposure pathways by an industrial worker are calculated using equations written in the form of Equations 1 and 2, however they are expanded to consider specific formulas for calculating intake (I_i) as follows, for carcinogens:

$$R = \frac{EF * ED * C_s * \left[\left(SF_o * IR_{soil} * 10^{-6}\ Kg/mg\right) + \left(SF_i * IR_{air} * (1/VF + 1/PEF)\right)\right]}{BW * AT * 365 days/yr} \qquad (5)$$

and for noncarcinogens:

$$HI = \frac{EF * ED * C_s * \left[\left(1/RfD_o * IR_{soil} * 10^{-6}\ Kg/mg\right) + \left(1/RfD_i * IR_{air} * (1/VF + 1/PEF)\right)\right]}{BW * AT * 365 days/yr} \qquad (6)$$

The variables VF (soil to air volatilization factor) and PEF (particulate emissions factor) relate the exposure concentrations for the chemical in air to source concentration in soil. The values of VF and PEF are calculated according to the following equations:

$$VF\ (m^3/kg) = \left(\frac{LS * V * DH}{A}\right) * \frac{(3.14 * \alpha * T)^{1/2}}{2 * D_d * E * K_{ss} * 10^{-3} kg/g} \qquad (7)$$

where:

$$\alpha\ (cm^2/s) = \frac{D * E}{E + \frac{p_s*(1-E)}{K_{as}}} \quad (8)$$

and

$$PEF\ (m^3/kg) = \left(\frac{LS * V * DH * 3600s/h}{A}\right) * \left(\frac{1000g/kg}{0.036 * (1-G) * (U_m/U_t)^3 * F(x)}\right) \quad (9)$$

The definitions of variables in Equations 5 through 9 and their EPA recommended default values are provided in Table 1. Equations 5 and 6 above provide numeric estimates of cancer risk (R) and noncarcinogenic hazard index (HI) as a function of the concentration of a chemical in soil. These equations can be inverted to solve for the soil concentration which becomes the health-based criteria (C_{goal}) for a particular compound, as follows:

$$C_{goal} = \frac{BW * TR * AT * 365days/year}{EF * ED * \left(SF_o * 10^{-6}kg/mg * IR_{soil} + SF_i * IR_{air} * \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right)} \quad (10)$$

and

$$C_{goal} = \frac{BW * THI * AT * 365days/year}{EF * ED * \left((1/RfD_o) * 10^{-6}kg/mg * IR_{soil} + (1/RfD_i) * IR_{air} * \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right)} \quad (11)$$

where: TR = target cancer risk level; and
THI = target hazard index.

The above expression allows for the explicit calculation of a soil health-based criteria once target cancer risk and hazard index levels are established.

Under the default assumptions presented in Table 1, and assuming a target cancer risk level (TR) of 10^{-5} and target hazard index (THI) of 1 for the non-residential scenario, the above two equations reduce to:

$$C_{goal} = \frac{2.9*10^{-3}}{\left(5*10^{-5} * SF_o\right) + \left(SF_i * \left(\frac{20}{VF} + 4.3*10^{-9}\right)\right)} \quad (12)$$

and

$$C_{goal} = \frac{102}{\left(5*10^{-5}/RfD_o\right) + \left(1/RfD_i * \left(\frac{20}{VF} + 4.3*10^{-9}\right)\right)} \quad (13)$$

Subsurface Soils: As with surface soils, potential exposure pathways applicable for a construction or excavation worker exposed to subsurface soils are incidental ingestion and inhalation of volatiles and fugitive dusts. The cancer risk and hazard index for construction workers were calculated and combined for these exposure pathways based on Equation 5 for carcinogens and Equation 6 for noncarcinogens. The parameter definitions for variables specific for construction workers exposed to subsurface soils are provided in Table 2. As with surface soils, health-based criteria (C_{goal}) for subsurface soils are calculated based on inverting Equations 5 and 6 and generating equations similar to 10 and 11.

Under the default assumptions presented in Table 2, and assuming a target cancer risk level (TR) of 10^{-5} and THI of 1 for construction workers in the non-residential scenario, Equations 10 and 11 reduce to:

$$C_{goal} = \frac{5.1*10^{-2}}{\left(1*10^{-4} * SF_o\right) + \left(SF_i * \left(\frac{20}{VF} + 4.3*10^{-9}\right)\right)} \quad (14)$$

and

$$C_{goal} = \frac{5110}{\left(1*10^{-4}/RfD_o\right) + \left(1/RfD_i * \left(\frac{20}{VF} + 4.3*10^{-9}\right)\right)} \quad (15)$$

Groundwater: The exposure pathway considered applicable for groundwater in the non-residential land use scenario is ingestion. Cancer risks and hazard indices from this exposure pathway are calculated in equations that combine these intake assumptions as follows, for potential carcinogens:

$$R = \frac{EF * ED * C_w * SF_o * IR_w}{BW * AT * 365\ days/yr} \quad (16)$$

and, for noncarcinogens:

$$HI = \frac{EF * ED * C_w' * IR_w}{RfD_o * BW * AT * 365\ days/yr} \quad (17)$$

The definitions of variables in Equations 16 and 17, and the EPA recommended default values are provided in Table 3. Equations 16 and 17 present health effects as a function of concentration of a chemical in groundwater. These equations can be inverted to solve for water concentrations or health-based criteria (C_{goal}) for groundwater as follows:

$$C_{goal} = \frac{TR * BW * AT * 365\ days/yr}{EF * ED * SF_o * IR_w} \quad (18)$$

and

$$C_{goal} = \frac{THI * RfD_o * BW * AT * 365\ days/yr}{EF * ED * IR_w} \quad (19)$$

If the default assumptions presented in Table 3 are used and a target cancer risk of 10^{-5} and target hazard index of 1 are assumed, the above equations reduce to, for carcinogens:

$$C_{goal} = \frac{2.86 * 10^{-3}}{SF_o} \quad (20)$$

and, for noncarcinogens

$$C_{goal} = 102.2 * RfD_o \quad (21)$$

Residential Land Use Scenario

<u>Surface Soils:</u> The potential exposure pathway applicable for surface soils in the residential scenario was incidental ingestion. The equations of risk to a resident from soil ingestion are slightly different from the non-residential scenario as the ingestion rate is weighted to account for the change in body weight and ingestion rate as a resident child ages into a resident adult. The equations to be used to calculate risk and hazard index from soil ingestion under a residential scenario are:

$$R_{ing} = \frac{SF_o * C_s * 10^{-6}\ Kg/mg * EF * IF_{soil/adj}}{AT * 365\ days/year} \quad (22)$$

and for noncarcinogens:

$$HI_{ing} = \frac{C_s * 10^{-6}\ Kg/mg * EF * IF_{soil/adj}}{RfD_o * AT * 365\ days/year} \quad (23)$$

where $IF_{soil/adj}$ is the time-weighted average soil ingestion rate for residents divided body weight. Unlike the soil ingestion rate (IR_{soil}) used for a non-residential or construction worker, $IF_{soil/adj}$ is a parameter that accounts for the changing rate of soil intake as a child grows into a young adult in a residential setting. The variable $IF_{soil/adj}$ was calculated by the equation:

$$IF_{soil/adj}(mg\text{-}yr/Kg\text{-}day) = \frac{IR_{soil/age1-6} * ED_{age1-6}}{BW_{age1-6}} + \frac{IR_{soil/age\ 7-31} * ED_{age7-31}}{BW_{age7-31}} \quad (24)$$

The definitions of parameters in Equations 22, 23 and 24, and the EPA recommended default values are provided in Table 4. Equations 22 and 23 specify cancer risks and hazard indices as a function of soil concentration. These equations can be inverted to solve for soil concentrations or health-based criteria (C_{goal}) for surface soil as follows:

$$C_{goal} = \frac{TR * AT * 365 days/year}{SF_o * 10^{-6} kg/mg * EF * IF_{soil/adj}} \quad (25)$$

and

$$C_{goal} = \frac{THI * AT * 365 days/year}{1/RfD_o * 10^{-6} kg/mg * EF * IF_{soil/adj}} \quad (26)$$

where: TR = target cancer risk level; and
THI = target allowable hazard index.

If the default assumptions presented in Table 4 are used and a target cancer risk of 10^{-6} and target hazard index of 1 are assumed, the above equations reduce to:

$$C_{goal} = \frac{0.64}{SF_o} \quad (27)$$

and

$$C_{goal} = 2.7 * 10^5\ (RfD_o) \quad (28)$$

<u>Subsurface Soils:</u> As with subsurface soils in the non-residential scenario, subsurface soils in the residential scenario are assumed to only be contacted during excavation or construction activities. Therefore, the assumptions and equations determined for the non-residential scenario

would be applicable for the residential scenario. Thus, cleanup goals for subsurface soils in the residential scenario are the same as those determined for the non-residential scenario.

Groundwater: Potential exposure pathways considered applicable for groundwater in the residential land use scenario include ingestion and inhalation of volatiles. Cancer risks and hazard indices from these two exposure pathways are calculated in equations that combine these intake assumptions as follows, for potential carcinogens:

$$R = \frac{EF * ED * C_w * \left((SF_o * IR_w) + (SF_i * K * IR_a)\right)}{BW * AT * 365\ days/yr} \quad (29)$$

and, for noncarcinogens:

$$HI = \frac{EF * ED * C_w * \left((1/RfD_o * IR_w) + (1/RfD_i * K * IR_a)\right)}{BW * AT * 365\ days/yr} \quad (30)$$

The definitions of variables in Equations 29 and 30, and the EPA recommended default values are provided in Table 5. Equations 29 and 30 present health effects as a function of concentration of chemical in groundwater. These equations can be inverted to solve for water concentrations or health-based criteria (C_{goal}) for groundwater as follows:

$$C_{goal} = \frac{TR * BW * AT * 365\ days/yr}{EF * ED * \left((SF_o * IR_w) + (SF_i * K * IR_a)\right)} \quad (31)$$

and

$$C_{goal} = \frac{THI * BW * AT * 365\ days/yr}{EF * ED * \left((1/RfD_o * IR_w) + (1/RfD_i * K * IR_a)\right)} \quad (32)$$

If the default assumptions presented in Table 5 are used and a target cancer risk of 10^{-6} and target hazard index of 1 are assumed, the above equations reduce to, for carcinogens:

$$C_{goal} = \frac{1.7 * 10^{-4}}{(2 * SF_o) + (7.5 * SF_i)} \quad (33)$$

and, for noncarcinogens

$$C_{goal} = \frac{73}{(2/RfD_o) + (7.5/RfD_i)} \quad (34)$$

TIER II CLEANUP GOALS

Cleanup goals were calculated for a representative set of chemicals for the Tier II Voluntary Remediation Program based on the procedures outlined above. Table 6 presents this list of chemicals along with analytical detection limits and a determination of whether or not the compound is considered bioaccumulative. Table 7 presents appropriate chemical properties and dose-response data used for calculation of health-based criteria. This representative list of chemicals includes semi-volatiles, volatiles, pesticides and PCBs and inorganics (i.e., metals and cyanide). Literature sources for chemical property data include the following:

- Howard, P.H. 1989. *Fate and Exposure Data for Organic Chemicals.* Lewis Publishers, Chelsia Michigan.

- EPA, 1989. *Hazardous Waste Treatment, Storage and Disposal Facilities (TSDF) - Air Emissions Models.* Appendix D: Properties for Chemicals of Interest. EPA-450/3-87-026. November, 1989.

- EPA, 1986. *Superfund Public Health Evaluation Manual.* Appendix A: Summary Tables for Chemical-Specific Data. EPA/540/1-86/060. October, 1986.

- PADER, 1990. *Risk Assessment/Fate and Transport Modeling System.* Appendix B: Selected Parameter Values for Common Contaminants. Bureau of Waste Management, Pennsylvania Dept. of Environmental Resources. July 13, 1990.

Dose-response data were obtained from the Integrated Risk Information System (IRIS, 1993), and if not available in IRIS, from the Health Effects Assessment Summary Tables (HEAST, 1992: with Supplemental Updates Nos. 1 and 2). Only dose-response data for chemicals with toxicity data from IRIS (1993) and HEAST (1992) were used with the exception of potentially carcinogenic PAHs. Seven of the priority pollutant PAHs are classified as B2 probable carcinogens (IRIS, 1992) as follows:

- benzo(a)pyrene;
- chrysene;
- benzo(a)anthracene;
- benzo(k)fluoranthene;
- benzo(b)fluoranthene;
- dibenzo(a,h)anthracene; and
- indeno(1,2,3-c,d)pyrene.

However, EPA-verified CSFs only exist for benzo(a)pyrene (IRIS, 1992). Therefore, cancer slope factors are needed to perform a carcinogenic assessment for the other 6 potentially carcinogenic PAHs. EPA is currently considering evaluating the carcinogenicity of the other potentially carcinogenic compounds based on a toxicity equivalency factor (TEF) approach relative to carcinogenicity of benzo(a)pyrene. An interim draft policy for evaluating the carcinogenicity of the other PAHs was released in 1990 (EPA, 1990. *Draft Interim Policy for*

Estimating Carcinogenic Risks Associated With Exposures to Polycyclic Aromatic Hydrocarbons (PAHs), OSWER Directive #9285-4-02). This draft interim policy first identified the TEF approach for assessing the carcinogenicity of PAHs other than benzo(a)pyrene. This was further supported by a recent EPA memo from Kenneth A. Poirer, Director of Superfund Health Risk Technical Support Center for Chemical Mixtures and Assessment Branch, concerning PAH toxicity (*Risk Assessment for Polyaromatic Hydrocarbons*, Memo to Sarah Levinson, EPA Region 1, January, 1992). Also, the Environmental Criteria and Assessment Office (ECAO) of EPA in Cincinnati was contacted concerning the appropriate methodology for the carcinogenic assessment of PAHs. Dr. Rita Schoeny, Associate Director of Science for ECAO, stated that a TEF approach is appropriate for evaluating the carcinogenicity for the other six potentially carcinogenic PAH compounds using the TEF factors relative to that of benzo(a)pyrene. These TEF factors are as follows:

	PAH Compound		TEF	CSF
•	benzo(a)pyrene	-	1	7.3
•	benzo(a)anthracene	-	0.1	0.73
•	benzo(b)fluoranthene	-	0.1	0.73
•	benzo(k)fluoranthene	-	0.01	0.073
•	chrysene	-	0.001	0.0073
•	dibenzo(a,h)anthracene	-	1.0	7.3
•	indeno(1,2,3-c,d)pyrene	-	0.1	0.73

Therefore, with the absence of verified EPA CSFs for PAHs other than benzo(a)pyrene, PAHs carcinogenicity were assessed based on the TEF approach, suggested by EPA and recommended by Dr. Schoeny of EPA's ECAO.

An overview of health-based cleanup goals by scenario (non-residential or residential) and by media are provided below.

Non-Residential Scenario

Groundwater: Cleanup goals for groundwater in the non-residential scenario were determined based on health-based criteria from direct contact using the default Equations 20 and 21. However, for implementation purposes for a site remediation program, health-based concentrations were compared to practical quantitation limits (PQLs) and drinking water criteria (i.e., non-zero maximum contaminant level goals [MCLGs] or maximum contaminant levels [MCLs] from the Safe Drinking Water Act) for determination of the cleanup goal. The practical quantitation limit is the lowest level that can be reliably achieved for a particular analyte within specified limits of precision and accuracy during routine laboratory operating conditions for a particular procedure. PQLs were determined based on *Test Methods for Evaluating Solid Waste* (EPA, 1986; SW-846). Representative test methods considered applicable for compounds in water include:

- Method 8270 for semi-volatiles;
- Method 8240 for volatiles;
- Method 8080 for pesticides and PCBs;

- Method Series 200 for metals and inorganics.

However, final PQLs would vary according to the specific analytical method used. Health-based concentrations were first compared to PQLs. For those compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. Finally, health-based concentrations were compared to drinking water quality criteria (i.e., non-zero MCLGs and MCLs). For those compounds with criteria below MCLGs or MCLs, the cleanup goals were based on applicable drinking water criteria.

Table 8 presents applicable drinking water criteria, PQLs and health-based concentrations that were used to determine Tier II cleanup goals for groundwater in the non-residential scenario (i.e., on sites remediated for restricted future use). Health-based concentrations for carcinogens in the non-residential scenario were calculated assuming a 10^{-5} target risk level. Health-based concentrations for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative. Cleanup goals identified as NA for particular compounds indicate appropriate toxicity data is not available or not appropriate for that particular compound. For some compounds, cleanup goals were determined from both the carcinogenic and noncarcinogenic assessment. The appropriate cleanup goal would, therefore, be the lower of the two values. For other compounds, such as lead, no toxicity values were available and therefore, health-based cleanup goals could not be calculated based on this methodology. However, there are data available to assess cleanup goals for compounds such as lead, such as MCLs or other EPA documentation which should be consulted.

Surface Soils: Cleanup goals for surface soils in the non-residential scenario were determined based on health-based concentrations from direct contact using the default Equations 12 and 13. However, health-based concentrations were compared to practical quantitation limits (PQLs) for determination of the cleanup goal. The consideration of PQLs was considered necessary for application of cleanup goals to site remediation programs. For compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in surface soil according to the following criteria:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 9 presents PQLs and health-based concentrations that were used to determine Tier II cleanup goals for surface soils in the non-residential land use scenario (i.e., on sites remediated for restricted future use). Cleanup goals for carcinogens in the non-residential scenario were calculated assuming a 10^{-5} target risk level. Cleanup goals for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Subsurface Soils: Cleanup goals for subsurface soils in the non-residential scenario were determined based on two health-based criteria: direct contact using the default Equations 14 and 15; and based on leaching to groundwater and protection of a groundwater criteria or standard. The leaching pathway was not considered in the calculation of PRGs, however, the leaching of chemicals from soils to groundwater and the protection of groundwater was deemed an important consideration for establishing cleanup goals for subsurface soils. Subsurface soil concentrations that are considered protective of groundwater via leaching were calculated based on EPA's Organic Leaching Model (OLM) [*Final Organic Leaching Model (OLM)*; EPA 51 FR 41082, Nov. 13, 1986 - see Attachment II], which involves the equation:

$$C_l = 0.00211 * C_s^{0.678} * Sol^{0.373} \quad (35)$$

where: C_l = Concentration in the leachate (mg/L);
C_s = Concentration in the soil or solid media (mg/Kg); and
Sol = Aqueous solubility (mg/L).

By substituting a groundwater cleanup goal (C_{gw}) for C_l in Equation 35 and re-arranging term, an acceptable subsurface soil concentration (C_s) is calculated with the equation:

$$C_s = \left(\frac{C_{gw}}{0.00211 * Sol^{0.373}} \right)^{1/0.678} \quad (36)$$

The health-based criteria was the lower of the either the health-based concentration from the direct contact method or from the leaching method. However, as with surface soils, health-based criteria were compared to practical quantitation limits (PQLs) for determination of the final Tier II cleanup goal. This is necessary for implementation purposes in a remediation program on subsurface soils. For compounds having health-based criteria less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in subsurface soils, based on the discussion provided above for surface soils, including the following:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 10 presents PQLs and health-based concentrations from the direct contact and leaching methods for determination of Tier II cleanup goals for subsurface soils in the non-residential land use scenario (i.e., on sites remediated for restricted future use). Cleanup goals for carcinogens in subsurface soils from the non-residential scenario were calculated assuming a 10^{-5} target risk level. Cleanup goals for noncarcinogens were calculated based on a target

hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Residential Scenario

Groundwater: Cleanup goals for groundwater in the residential scenario were determined based on health-based criteria from direct contact using the default Equations 33 and 34. Health-based concentrations were compared to practical quantitation limits (PQLs) and non-zero maximum contaminant level goals (MCLGs) or maximum contaminant levels (MCLs) from the Safe Drinking Water Act, for determination of the cleanup goal. Health-based concentrations were first compared to PQLs. For those compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. Finally, health-based concentrations were compared to drinking water quality criteria (i.e., non-zero MCLGs and MCLs). For those compounds with criteria below MCLGs or MCLs, the cleanup goals were based on applicable drinking water criteria.

Table 11 presents applicable drinking water criteria, PQLs and health-based concentrations that were used to determine Tier II cleanup goals for groundwater in the residential scenario (i.e., on sites remediated for unrestricted future use). Health-based concentrations for carcinogens in the residential scenario were calculated assuming a 10^{-6} target risk level. Health-based concentrations for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Surface Soils: Cleanup goals for surface soils in the residential scenario were determined based on health-based concentrations from direct contact using the default Equations 27 and 28. Health-based concentrations were compared to practical quantitation limits (PQLs) for determination of the cleanup goal. For compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in surface soils which include the following:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 12 presents PQLs and health-based concentrations that were used to determine Tier II cleanup goals for surface soils in the residential land use scenario (i.e., on sites remediated for unrestricted future use). Cleanup goals for carcinogens in the residential scenario were calculated assuming a 10^{-6} target risk level. Cleanup goals for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Subsurface Soils: Cleanup goals for subsurface soils in the residential scenario were determined based on the discussion provided above for the non-residential scenario. However, the applicable groundwater criteria for the leaching assessment were based on the groundwater criteria discussed above for the residential scenario. The health-based criteria was the lower of the either the health-based concentration from the direct contact method or from the leaching method. Health-based criteria were then compared to practical quantitation limits (PQLs) for determination of the final Tier II cleanup goal. For compounds having health-based criteria less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in subsurface soils which include the following:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 13 presents PQLs and health-based concentrations from the direct contact and leaching methods for determination of Tier II cleanup goals for subsurface soils in the residential land use scenario (i.e., on sites remediated for restricted future use). Cleanup goals for carcinogens in subsurface soils from the residential scenario were calculated assuming a 10^{-6} target risk level. Cleanup goals for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Summary

This section discussed the calculation of cleanup goals for Tier II in the Voluntary Remediation Program. Cleanup goals were presented for surface soils, subsurface soils and groundwater separately for an non-residential and residential land use scenario. Tier II cleanup goals were presented for representative compounds. Tables 14 and 15 present cleanup goals for the non-residential and residential scenarios, respectively. Cleanup goals were determined based on health-based concentrations from a human health risk assessment. However, the determination of cleanup goals also considered practical quantitation limits (PQLs) based on available analytical methods for soils and groundwater. PQLs must be considered when establishing definable cleanup goals to be met in a site remediation program.

TABLE 1
INTAKE ASSUMPTIONS FOR EXPOSURE TO SURFACE SOILS IN THE INDUSTRIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Surface Soil		
C_s	chemical concentration in soil (mg/Kg)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-5} (industrial)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
SF_i	inhalation cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
RfD_i	inhalation reference dose (mg/Kg/day)	chemical–specific
AT	averaging time (yr)	70 yr – carcinogenic 25 yr – noncarcinogenic
EF	exposure frequency (days/yr)	250 days/yr
ED	exposure duration (yr)	25 yr
IR_{soil}	soil ingestion rate (mg/day)	50 mg/day
IR_{air}	inhalation rate (m^3/day)	20 m^3/day
VF	volatiliztion factor (m^3/Kg)	(see Equation 7 and factors below)
PEF	particulate emissions factor (m^3/Kg)	(see Equation 9 and factors below)
Assumptions for Estimation of Volatilization Factor (VF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (cm^2)	20,250,000 cm^2
D_{ei}	effective diffusivity (cm^2)	$D_i \times E^{0.33}$
E	true soil porosity (unitless)	0.35
K_{sa}	soil/air partition coefficient (g soil/cm^3 air)	(H/K_d) x 41, where 41 is a units conversion factor
ρ_s	true soil density or particulate density (g/cm^3)	2.65 g/cm^3
T	exposure interval (s)	7.90E+08 s
D_i	molecular diffusivity (cm^2/s)	chemical–specific
H	Henry's law constant (atm–m^3/mol)	chemical–specific
K_d	soil–water partition coefficient (cm^3/g)	chemical–specific, or K_{oc} x OC
K_{oc}	organic carbon partition coefficient (cm^3/g)	chemical–specific
OC	organic carbon content of soil (fraction)	site–specific, or 0.02
Assumptions for Estimation of Particulate Emission Factor (PEF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (m^2)	2,025 m^2
0.036	respirable fraction (g/m^2–hr)	0.036 g/m^2–hr
G	fraction of vegetative cover (unitless)	0
U_m	mean annual wind speed (m/s)	4.5 m/s
U_t	equivalent threshold value of windspeed at 10 m (m/s)	12.8 m/s
F(x)	function dependent on U_m/U_t	0.0497

TABLE 2
INTAKE ASSUMPTIONS FOR EXPOSURE TO SUBSURFACE SOILS IN THE INDUSTRIAL AND RESIDENTIAL SCENARIOS

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Subsurface Soil		
C_s	chemical concentration in soil (mg/Kg)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-5} (industrial)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
SF_i	inhalation cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
RfD_i	inhalation reference dose (mg/Kg/day)	chemical–specific
AT	averaging time (yr)	70 yr – carcinogenic 2 yr – noncarcinogenic
EF	exposure frequency (days/yr)	175 5 days/wk, 35 weeks/yr
ED	exposure duration (yr)	2 yr
IR_{soil}	soil ingestion rate (mg/day)	100 mg/day
IR_{air}	inhalation rate (m^3/day)	20 m^3/day
VF	volatiliztion factor (m^3/Kg)	(see Equation 7 and factors below)
PEF	particulate emissions factor (m^3/Kg)	(see Equation 9 and factors below)
Assumptions for Estimation of Volatilization Factor (VF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (cm^2)	20,250,000 cm^2
D_d	effective diffusivity (cm^2)	$D_i \times E^{0.33}$
E	true soil porosity (unitless)	0.35
K_{sa}	soil/air partition coefficient (g soil/cm^3 air)	$(H/K_d) \times 41$, where 41 is a units conversion factor
ρ_s	true soil density or particulate density (g/cm^3)	2.65 g/cm^3
T	exposure interval (s)	7.90E+08 s
D_i	molecular diffusivity (cm^2/s)	chemical–specific
H	Henry's law constant (atm–m^3/mol)	chemical–specific
K_d	soil–water partition coefficient (cm^3/g)	chemical–specific, or $K_{oc} \times OC$
K_{oc}	organic carbon partition coefficient (cm^3/g)	chemical–specific
OC	organic carbon content of soil (fraction)	site–specific, or 0.02
Assumptions for Estimation of Particulate Emission Factor (PEF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (m^2)	2,025 m^2
0.036	respirable fraction (g/m^2–hr)	0.036 g/m^2–hr
G	fraction of vegetative cover (unitless)	0
U_m	mean annual wind speed (m/s)	4.5 m/s
U_t	equivalent threshold value of windspeed at 10 m (m/s)	12.8 m/s
F(x)	function dependent on U_m/U_t	0.0497

TABLE 3
INTAKE ASSUMPTIONS FOR EXPOSURE TO GROUNDWATER IN THE INDUSTRIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Groundwater		
Cw	chemical concentration in water (mg/L)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-5} (industrial)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor ((mg/Kg−day)$^{-1}$)	chemical−specific
RfD_o	oral reference dose (mg/Kg/day)	chemical−specific
BW	adult body weight (Kg)	70 Kg
AT	averaging time (yr)	70 yr − carcinogenic 25 yr − noncarcinogenic
EF	exposure frequency (days/yr)	250 days/yr
ED	exposure duration (yr)	25 yr
IR_w	daily water ingestion rate (L/day)	1 L/day

TABLE 4
INTAKE ASSUMPTIONS FOR EXPOSURE TO SURFACE SOILS IN THE RESIDENTIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Surface Soil		
C_s	chemical concentration in soil (mg/Kg)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-6} (residential)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
AT	averaging time (yr)	70 yr – carcinogenic
		30 yr – noncarcinogenic
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yr)	30 yr
$IF_{soil/adj}$	age–adjusted ingestion factor(mg–yr/Kg–day)	114 mg–yr/Kg–day
Assumptions for Calculation of $IF_{soil/adj}$		
$BW_{ages\ 1-6}$	average body weight from ages 1–6 (Kg)	15 Kg
$BW_{ages\ 7-31}$	average body weight from ages 7–31 (Kg)	70 Kg
$ED_{ages\ 1-6}$	exposure duration during ages 1–6 (yr)	6 yr
$ED_{ages\ 7-31}$	exposure duration during ages 7–31 (yr)	24 yr
$IR_{soil/ages\ 1-6}$	ingestion rate of soil age 1 to 6 (mg/day)	200 mg/day
$IR_{soil/ages\ 7-31}$	ingestion rate of soil all other ages (mg/day)	100 mg/day

TABLE 5
INTAKE ASSUMPTIONS FOR EXPOSURE TO GROUNDWATER IN THE RESIDENTIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Groundwater		
Cw	chemical concentration in water (mg/L)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-6} (residential)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor ($(mg/Kg-day)^{-1}$)	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
SF_i	inhalation cancer slope factor ($(mg/Kg-day)^{-1}$)	chemical–specific
RfD_i	inhalation reference dose (mg/Kg/day)	chemical–specific
BW	adult body weight (Kg)	70 Kg
AT	averaging time (yr)	70 yr – carcinogenic 25 yr – noncarcinogenic
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yr)	30 yr
IR_a	daily indoor inhalation rate (m^3/day)	15 m^3/day
IR_w	daily water ingestion rate (L/day)	2 L/day
K	volatilization factor (unitless)	0.0005*1000 L/m^3 (Andelman 1990)

TABLE 6
REPRESENTATIVE COMPOUNDS AND CHARACTERISTICS

Chemical Name	Compound Type[a]	Compound is Considered Bioaccumulatable[b] (yes/no)	Maximum Contaminant Level (MCL) (mg/L)	Maximum Contaminant Level Goal (MCLG) (mg/L)	Practical or Estimated Quantitation Limits[c]			
					Low Contaminated Soil		Groundwater	
					Value (mg/Kg)	Method	Value (mg/L)	Method
naphthalene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
acenaphthylene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
acenaphthene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
fluorene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
phenanthrene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
anthracene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
fluoranthene	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
pyrene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(a)anthracene	semivolatile	yes	0.0001	0	0.66	SW846 – 8270	0.01	SW846 – 8270
chrysene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(b)fluoranthene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(k)fluoranthene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(a)pyrene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
indeno(1,2,3–cd)pyrene	semivolatile	yes	0.0004	0	0.66	SW846 – 8270	0.01	SW846 – 8270
dibenzo(a,h)anthracene	semivolatile	yes	0.0003	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(g,h,i)perylene	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
3,3'–dichlorobenzidine	semivolatile	no			1.3	SW846 – 8270	0.02	SW846 – 8270
n–nitroso–di–n–propylamine	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
bis(2–chloroisopropyl)ether	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
4–chloroaniline	semivolatile	no			1.3	SW846 – 8270	0.02	SW846 – 8270
2–chloronaphthalene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4–dinitrotoluene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
hexachlorobutadiene	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
hexachloroethane	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
isophorone	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
benzyl alcohol	semivolatile	no			1.3	SW846 – 8270	0.02	SW846 – 8270
bis(2–chloroethyl)ether	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
nitrobenzene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
1,2–dichlorobenzene	semivolatile	no	0.6	0.6	0.66	SW846 – 8270	0.01	SW846 – 8270
1,3–dichlorobenzene	semivolatile	no	0.6	0.6	0.66	SW846 – 8270	0.01	SW846 – 8270
1,4–dichlorobenzene	semivolatile	no	0.075	0.075	0.66	SW846 – 8270	0.01	SW846 – 8270
1,2,4–trichlorobenzene	semivolatile	no	0.07	0.07	0.66	SW846 – 8270	0.01	SW846 – 8270
hexachlorobenzene	semivolatile	no	0.001	0	0.66	SW846 – 8270	0.01	SW846 – 8270
hexachlorocyclopentadiene	semivolatile	no	0.05	0.05	0.66	SW846 – 8270	0.01	SW846 – 8270
n–nitrosodiphenylamine	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
benzoic acid	semivolatile	no			3.3	SW846 – 8270	0.05	SW846 – 8270
2–nitroaniline	semivolatile	no			3.3	SW846 – 8270	0.05	SW846 – 8270
phenol	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
2–methylphenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
3–methylphenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
4–methylphenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2–chlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4–dichlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4,5–trichlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4,6–trichlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
pentachlorophenol	semivolatile	no	0.001	0	3.3	SW846 – 8270	0.05	SW846 – 8270
2,4–dinitrophenol	semivolatile	no			3.3	SW846 – 8270	0.05	SW846 – 8270
bis(2–ethylhexyl)phthalate	semivolatile	yes	0.006	0	0.66	SW846 – 8270	0.01	SW846 – 8270
butylbenzylphthalate	semivolatile	no	0.1	0	0.66	SW846 – 8270	0.01	SW846 – 8270
di–n–butylphthalate	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
diethylphthalate	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
di methyl phthalate	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
di–n–octyl phthalate	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270

TABLE 6 (con't)
REPRESENTATIVE COMPOUNDS AND CHARACTERISTICS

Chemical Name	Compound Type[a]	Compound is Considered Bioaccumulatable[b] (yes/no)	Maximum Contaminant Level (MCL) (mg/L)	Maximum Contaminant Level Goal (MCLG) (mg/L)	Practical or Estimated Quantitation Limits[c]			
					Low Contaminated Soil		Groundwater	
					Value (mg/Kg)	Method	Value (mg/L)	Method
benzene	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
toluene	volatile	no	1	1	0.005	SW846 – 8240	0.005	SW846 – 8240
ethylbenzene	volatile	no	0.7	0.7	0.005	SW846 – 8240	0.005	SW846 – 8240
xylenes	volatile	no	10	10	0.005	SW846 – 8240	0.005	SW846 – 8240
vinyl chloride	volatile	no	0.002	0	0.01	SW846 – 8240	0.01	SW846 – 8240
chloroethane	volatile	no			0.01	SW846 – 8240	0.01	SW846 – 8240
1,1–dichloroethylene	volatile	no	0.007	0.007	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1–dichloroethane	volatile	no			0.005	SW846 – 8240	0.005	SW846 – 8240
1,2–dichloroethylene (cis)	volatile	no	0.07	0.07	0.005	SW846 – 8240	0.005	SW846 – 8240
1,2–dichloroethane	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
trichloroethylene	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,1–trichloroethane	volatile	no	0.2	0.2	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,2–trichloroethane	volatile	no	0.005	0.003	0.005	SW846 – 8240	0.005	SW846 – 8240
tetrachloroethylene	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,1,2–tetrachloroethane	volatile	no			0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,2,2–tetrachloroethane	volatile	no			0.005	SW846 – 8240	0.005	SW846 – 8240
chloroform	volatile	no	0.1		0.005	SW846 – 8240	0.005	SW846 – 8240
acetone	volatile	no			0.1	SW846 – 8240	0.1	SW846 – 8240
4–methyl–2–pentanone	volatile	no			0.05	SW846 – 8240	0.05	SW846 – 8240
methyl ethyl ketone	volatile	no			0.1	SW846 – 8240	0.1	SW846 – 8240
Aldrin	pest/herb/PCB	yes			0.00268	SW846 – 8080	0.0000	SW846 – 8080
gamma–BHC (Lindane)	pest/herb/PCB	yes	0.0002	0.0002	0.00603	SW846 – 8080	0.0000	SW846 – 8080
chlordane	pest/herb/PCB	yes	0.002	0	0.00938	SW846 – 8080	0.0001	SW846 – 8080
DDD	pest/herb/PCB	yes			0.00737	SW846 – 8080	0.0001	SW846 – 8080
DDE	pest/herb/PCB	yes			0.00268	SW846 – 8080	0.0000	SW846 – 8080
DDT	pest/herb/PCB	yes			0.00804	SW846 – 8080	0.0001	SW846 – 8080
dieldrin	pest/herb/PCB	yes			0.00134	SW846 – 8080	0.0000	SW846 – 8080
endosulfan sulfate	pest/herb/PCB	no			0.04422	SW846 – 8080	0.0006	SW846 – 8080
endrin	pest/herb/PCB	yes	0.002	0.002	0.00402	SW846 – 8080	0.0000	SW846 – 8080
heptachlor	pest/herb/PCB	yes	0.0004	0	0.00201	SW846 – 8080	0.0000	SW846 – 8080
heptachlor epoxide	pest/herb/PCB	no	0.0002	0	0.05561	SW846 – 8080	0.0008	SW846 – 8080
PCBs	pest/herb/PCB	yes	0.0005	0	0.04355	SW846 – 8080	0.0006	SW846 – 8080
lead	inorganic	no	0.015	0	0.5	SW846 – 7421	0.003	SW846–200.7
cadmium	inorganic	no	0.005	0.005	0.5	SW846 – 6010	0.005	SW846–200.7
silver	inorganic	no			1	SW846 – 6010	0.01	SW846–200.7
mercury	inorganic	yes	0.002	0.002	0.1	SW846 – 7471	0.0002	SW846–245.1
chromium vi	inorganic	no	0.1	0.1	1	SW846 – 7196	0.01	SW846–7196
chromium iii	inorganic	no	0.1	0.1	1	SW846 – 6010	0.01	SW846–200.7
barium	inorganic	no	2	2	20	SW846 – 6010	0.2	SW846–200.7
arsenic	inorganic	no	0.05		1	SW846 – 7060	0.01	SW846–206.2
antimony	inorganic	no	0.006	0.006	6	SW846 – 7041	0.06	SW846–204.2
beryllium	inorganic	no	0.004	0.004	0.5	SW846 – 6010	0.005	SW846–200.7
cyanide	inorganic	no	0.2	0.2	0.125	SW846 – 9012	0.01	SW846–335.3
nickel	inorganic	no	0.1	0.1	4	SW846 – 6010	0.04	SW846–200.7
selenium	inorganic	no	0.05	0.05	0.5	SW846 – 7740	0.005	SW846–270.2
vanadium	inorganic	no			5	SW846 – 6010	0.05	SW846–200.7
zinc	inorganic	no			2	SW846 – 6010	0.02	SW846–200.7

NOTES: a – Determined according to analytical methods summarized in *Test Methods for Evaluating Solid Waste*, EPA SW–846.
b – Determined according to *Water Quality Criteria for Specific Substances*, Ind. Reg. Vol 17, No. 7, April 1, 1993.
c – Practical quantitation limits based on *Test Methods for Evaluating Solid Waste*, EPA SW–846, 1986 for GC/MS methods. However, PQLs will change according to the specific analytical method used.

TABLE 7
SUMMARY OF CHEMICAL PROPERTIES AND DOSE-RESPONSE

Chemical Name	CHEMICAL PROPERTIES: Molecular Weight [MW] (g/g-mol)	Org Car Part-Koc [KOC] (L/Kg)	Aqueous Solubil [SOL] (mg/L)	Henry Law [H] (atm/mol)	Vapor Phase Diffus Coeff. [D_i] (cm2/s)	DOSE-RESPONSE DATA: Reference Doses Oral mg/kg/day	Reference Doses Inhalation mg/kg/day	Cancer Slope Factors Oral $(mg/kg/day)^{-1}$	Cancer Slope Factors Inhalation $(mg/kg/day)^{-1}$
naphthalene	128.2	1.28E+03	31.7	1.18E-03	5.90E-02	0.04			
acenaphthylene	152.21	4.79E+03	3.93	1.14E-04	6.60E-02				
acenaphthene	154.21	1.78E+01	3.42	7.71E-03	6.50E-02	0.06			
fluorene	166	5.01E+03	1.69	1.17E-04	6.20E-02	0.04			
phenanthrene	178.22	1.67E+04	1	6.05E-03	5.90E-02				
anthracene	178.23	2.17E+04	0.045	8.60E-05	5.90E-02	0.3			
fluoranthene	202	4.17E+04	0.26	6.73E-02	5.60E-02	0.04			
pyrene	202.3	6.90E+04	0.132	7.00E-09	5.50E-02	0.03			
benzo(a)anthracene	228.3	1.38E+06	0.014	1.38E-09	4.30E-02			0.73	
chrysene	228.2	2.45E+05	0.002	1.18E-09	5.10E-02			0.0073	
benzo(b)fluoranthene	252.32	5.50E+05	0.0015	1.19E-05	5.00E-02			0.73	
benzo(k)fluoranthene	252.32	4.37E+06	0.0008	3.94E-05	4.70E-02			0.073	
benzo(a)pyrene	252.3	8.81E+05	0.0038	1.38E-09	4.30E-02			7.3	6.1
indeno(1,2,3-cd)pyrene	276.34	3.09E+07	0.00053	6.86E-08	4.60E-02			0.73	
dibenzo(a,h)anthracene	278.35	1.84E+06	0.0005	7.33E-08	4.50E-02			7.3	
benzo(g,h,i)perylene	276.34	7.76E+06	0.00026	5.34E-08	4.80E-02				
3,3'-dichlorobenzidine	253.13	2.00E+03	4	8.33E-07	NA			0.45	
n-nitroso-di-n-propylamine	130.19	1.02E+01	9900	NA	NA			7	
bis(2-chloroisopropyl)ether	171.1	6.17E+01	1700	1.13E-04	6.02E-02	0.04		0.07	0.035
4-chloroaniline	127.47	3.23E+02	3.9	1.07E-05	7.50E-02	0.004			
2-chloronaphthalene	162.62	8.51E+03	6.74	1.82E-02	6.60E-02	0.08			
2,4-dinitrotoluene	182.1	6.17E+01	270	4.07E-06	2.03E-01	0.002			
hexachlorobutadiene	260.8	4.68E+03	2	4.57E+00	5.61E-02	0.002		0.078	0.078
hexachloroethane	237	2.19E+03	50	2.49E-06	6.50E-02	0.001		0.0142	0.0142
isophorone	138.21	3.09E+01	12000	5.76E-06	6.23E-02	0.2		0.00095	
benzyl alcohol	108.15	9.55E+01	35000	6.10E-07	7.90E-02	0.3			
bis(2-chloroethyl)ether	143	1.41E+01	10200	1.30E-05	6.92E-02			1.1	1.1
nitrobenzene	123.1	9.72E+01	1900	1.31E-05	7.60E-02	0.0005			
1,2-dichlorobenzene	147	3.66E+02	145	1.94E-03	6.90E-02	0.09			
1,3-dichlorobenzene	147.01	4.40E+02	123	3.61E-03	6.98E-02				
1,4-dichlorobenzene	147	2.09E+02	79	1.60E-03	6.90E-02		0.19999	0.024	
1,2,4-trichlorobenzene	181.5	9.39E+02	30	1.42E-03	6.80E-02	0.01			
hexachlorobenzene	284.8	4.55E+03	0.006	6.80E-04	5.42E-02	0.0008		1.6	1.6
hexachlorocyclopentadiene	272.77	4.27E+03	1.8	1.37E-02	5.61E-02	0.007	0.00001		
n-nitrosodiphenylamine	198.23	5.75E+02	34.7	NA	9.70E-02			0.0049	
benzoic acid	122.13	1.40E+02	2700	1.82E-08	7.40E-02	4			
2-nitroaniline	138.14	2.66E+01	1280	5.00E-07	7.30E-02	0.00006	0.00005		
phenol	94.1	2.19E+01	93000	4.54E-07	8.20E-02	0.6			
2-methylphenol	108.1	2.19E+01	24660	2.60E-06	7.40E-02	0.05			
3-methylphenol	108.1	3.50E+01	21928	4.43E-07	7.40E-02				
4-methylphenol	108.1	1.57E+02	19543	4.43E-07	7.90E-02	0.05			
2-chlorophenol	128.6	3.63E+02	28500	1.78E-05	7.90E-02	0.005			
2,4-dichlorophenol	163.01	7.00E+02	4500	4.80E-06	7.10E-02	0.003			
2,4,5-trichlorophenol	197.45	1.74E+03	1202	2.18E-04	6.50E-02	0.1			
2,4,6-trichlorophenol	197.46	7.19E+02	800	1.77E-05	6.60E-02			0.011	0.01
pentachlorophenol	266.4	2.63E+03	14	2.80E-06	5.60E-02	0.03		0.12	
2,4-dinitrophenol	184	1.78E+01	5600	1.53E-07	2.73E-02	0.002			
bis(2-ethylhexyl)phthalate	391.07	1.00E+05	0.4	3.00E-07	3.51E-02	0.02		0.014	
butylbenzylphthalate	312.39	1.53E+02	2.9	1.08E-02	4.30E-02	0.2			
di-n-butylphthalate	278.3	1.38E+03	13	2.80E-07	4.38E-02	0.1			
diethylphthalate	222	6.92E+01	896	1.11E-02	5.30E-02	0.8			
di methyl phthalate	194.2	1.91E+02	4320	2.15E-06	5.68E-02	10			
di-n-octyl phthalate	390.58	9.77E+08	3	1.37E-01	3.60E-02	0.02			

TABLE 7 (con't)
SUMMARY OF CHEMICAL PROPERTIES AND DOSE-RESPONSE

Chemical Name	CHEMICAL PROPERTIES: Molecular Weight [MW] (g/g-mol)	Org Car Part-Koc [KOC] (L/Kg)	Aqueous Solubil [SOL] (mg/L)	Henry Law [H] (atm/mol)	Vapor Phase Diffus Coeff. [D_i] (cm2/s)	DOSE-RESPONSE DATA: Reference Doses Oral mg/kg/day	Reference Doses Inhalation mg/kg/day	Cancer Slope Factors Oral $(mg/kg/day)^{-1}$	Cancer Slope Factors Inhalation $(mg/kg/day)^{-1}$
benzene	78.1	7.91E+01	1750	5.50E-03	8.80E-02			0.029	0.029
toluene	92.4	1.62E+02	535	6.68E-03	8.70E-02	0.2	0.11428		
ethylbenzene	106.2	1.81E+02	152	6.44E-03	7.50E-02	0.1	0.28571		
xylenes	106.2	3.32E+02	198	7.04E-03	7.47E-02	2			
vinyl chloride	62.5	2.45E+00	2670	8.60E-02	1.06E-01			1.9	0.3
chloroethane	64.52	3.24E+00	5740	1.11E-02	2.71E-01		2.857		
1,1-dichloroethylene	97	6.46E+01	2250	2.61E-02	1.00E-01	0.009		0.6	1.2
1,1-dichloroethane	98.96	3.02E+01	5500	5.62E-03	9.60E-02	0.1	0.1		
1,2-dichloroethylene (cis)	96.95	4.90E+01	3500	4.08E-03	7.36E-02	0.01			
1,2-dichloroethane	99	1.64E+01	8520	9.78E-04	1.04E-01	0.3		0.091	0.091
trichloroethylene	131.4	9.63E+01	1100	9.58E-03	7.90E-02	0.006		0.011	0.017
1,1,1-trichloroethane	133.4	1.42E+02	1500	1.72E-02	7.80E-02	0.09	0.3		
1,1,2-trichloroethane	133.4	6.87E+01	4500	7.42E-04	7.80E-02	0.004		0.057	0.057
tetrachloroethylene	165.83	6.69E+01	150	2.87E-02	7.20E-02	0.01		0.051	0.00182
1,1,1,2-tetrachloroethane	168	3.99E+02	1099	2.00E-03	7.10E-02	0.03		0.026	0.026
1,1,2,2-tetrachloroethane	168	7.55E+01	2900	3.80E-04	7.10E-02			0.2	0.02
chloroform	119.4	4.42E+01	8200	3.39E-03	1.04E-01	0.01		0.0061	0.0805
acetone	58	3.72E-01	1000000	2.50E-05	1.24E-01	0.1			
4-methyl-2-pentanone	100.16	6.17E+00	21300	4.95E-05	7.50E-02	0.05			
methyl ethyl ketone	72.1	1.23E+00	137190	4.35E-05	8.08E-02	0.05	0.2857		
Aldrin	364.93	4.07E+02	0.18	4.96E-04	5.00E-02	0.00003		17	17.1
gamma-BHC (Lindane)	290.83	1.32E+03	7.8	4.93E-07	5.30E-02	0.0003		1.3	
chlordane	410	2.29E+05	0.056	3.67E-05	4.80E-02	0.00006		1.3	1.29
DDD	320.05	4.37E+04	0.09	3.89E-05	5.00E-02			0.24	
DDE	318.03	4.93E+05	0.014	3.89E-05	4.90E-02			0.34	
DDT	354.49	3.13E+05	0.005	3.89E-05	4.70E-02	0.0005		0.34	0.34
dieldrin	380.93	2.07E+04	0.195	5.84E-05	NA	0.00005		16	16.1
endosulfan sulfate	422.9	2.34E+03	0.117	NA	NA	0.00005			
endrin	380.93	8.32E+03	0.26	NA	4.70E-02	0.0003			
heptachlor	373.35	2.19E+04	0.18	8.19E-04	5.10E-02	0.0005		4.5	4.55
heptachlor epoxide	389.2	2.09E+04	0.35	3.50E-01	NA	0.00001		9.1	9.1
PCBs	328	5.30E+05	0.0031	1.07E-03	4.80E-02			7.7	
lead	207.19	NA	NA	NA	5.50E-02				
cadmium	112	NA	NA	NA	5.50E-02	0.0005			6.1
silver	107.9	NA	NA	NA	NA	0.005			
mercury	200.59	NA	NA	1.14E-02	2.76E-02	0.0003	0.00008		
chromium vi	52	NA	NA	NA	NA	0.005			41
chromium iii	52	NA	NA	NA	NA	1			
barium	137	NA	NA	NA	NA	0.07			
arsenic	74.92	NA	NA	NA	5.50E-02	0.0003			50
antimony	121.8	NA	NA	NA	NA	0.0004			
beryllium	9.012	NA	0.2	NA	NA	0.005		4.3	8.4
cyanide	27	1.00E+00	1000000	2.70E-06	NA	0.02			
nickel	58.7	NA	NA	NA	NA	0.02			0.84
selenium	78.96	NA	NA	NA	NA	0.005			
vanadium	51	NA	NA	NA	NA	0.007			
zinc	65	NA	NA	NA	5.50E-02	0.3			

NOTES: * - Assumes TEF approach.
NA - Data not available or not applicable.

TABLE 8 REV: 11/01/93
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater: Carcinogenic Effects @10^{-5} (mg/L)	Groundwater: Noncarcinogenic Effects (mg/L)	Groundwater Criteria (mg/L)
naphthalene	no		0.01	NA	4.09E+00	4.09E+00
acenaphthylene	no		0.01	NA	NA	NA
acenaphthene	no		0.01	NA	6.13E+00	6.13E+00
fluorene	no		0.01	NA	4.09E+00	4.09E+00
phenanthrene	no		0.01	NA	NA	NA
anthracene	no		0.01	NA	3.07E+01	3.07E+01
fluoranthene	yes		0.01	NA	8.18E-01	8.18E-01
pyrene	no		0.01	NA	3.07E+00	3.07E+00
benzo(a)anthracene	yes	0.0001	0.01	3.92E-03	NA	1.00E-02
chrysene	yes	0.0002	0.01	3.92E-01	NA	3.92E-01
benzo(b)fluoranthene	yes	0.0002	0.01	3.92E-03	NA	1.00E-02
benzo(k)fluoranthene	yes	0.0002	0.01	3.92E-02	NA	3.92E-02
benzo(a)pyrene	yes	0.0002	0.01	3.92E-04	NA	1.00E-02
indeno(1,2,3-cd)pyrene	yes	0.0004	0.01	3.92E-03	NA	1.00E-02
dibenzo(a,h)anthracene	yes	0.0003	0.01	3.92E-04	NA	1.00E-02
benzo(g,h,i)perylene	yes		0.01	NA	NA	NA
3,3'-dichlorobenzidine	no		0.02	6.36E-03	NA	2.00E-02
n-nitroso-di-n-propylamine	no		0.01	4.09E-04	NA	1.00E-02
bis(2-chloroisopropyl)ether	no		0.01	4.09E-02	4.09E+00	4.09E-02
4-chloroaniline	no		0.02	NA	4.09E-01	4.09E-01
2-chloronaphthalene	no		0.01	NA	8.18E+00	8.18E+00
2,4-dinitrotoluene	no		0.01	NA	2.04E-01	2.04E-01
hexachlorobutadiene	yes		0.01	3.67E-02	4.09E-02	3.67E-02
hexachloroethane	yes		0.01	2.01E-01	2.04E-02	2.04E-02
isophorone	no		0.01	3.01E+00	2.04E+01	3.01E+00
benzyl alcohol	no		0.02	NA	3.07E+01	3.07E+01
bis(2-chloroethyl)ether	no		0.01	2.60E-03	NA	1.00E-02
nitrobenzene	no		0.01	NA	5.11E-02	5.11E-02
1,2-dichlorobenzene	no	0.6	0.01	NA	9.20E+00	9.20E+00
1,3-dichlorobenzene	no	0.6	0.01	NA	NA	NA
1,4-dichlorobenzene	no	0.075	0.01	1.19E-01	NA	1.19E-01
1,2,4-trichlorobenzene	no	0.07	0.01	NA	1.02E+00	1.02E+00
hexachlorobenzene	no	0.001	0.01	1.79E-03	8.18E-02	1.00E-02
hexachlorocyclopentadiene	no	0.05	0.01	NA	7.15E-01	7.15E-01
n-nitrosodiphenylamine	no		0.01	5.84E-01	NA	5.84E-01
benzoic acid	no		0.05	NA	4.09E+02	4.09E+02
2-nitroaniline	no		0.05	NA	6.13E-03	5.00E-02
phenol	yes		0.01	NA	1.23E+01	1.23E+01
2-methylphenol	no		0.01	NA	5.11E+00	5.11E+00
3-methylphenol	no		0.01	NA	NA	NA
4-methylphenol	no		0.01	NA	5.11E+00	5.11E+00
2-chlorophenol	no		0.01	NA	5.11E-01	5.11E-01
2,4-dichlorophenol	no		0.01	NA	3.07E-01	3.07E-01
2,4,5-trichlorophenol	no		0.01	NA	1.02E+01	1.02E+01
2,4,6-trichlorophenol	no		0.01	2.60E-01	NA	2.60E-01
pentachlorophenol	no	0.001	0.05	2.38E-02	3.07E+00	5.00E-02
2,4-dinitrophenol	no		0.05	NA	2.04E-01	2.04E-01
bis(2-ethylhexyl)phthalate	yes	0.006	0.01	2.04E-01	4.09E-01	2.04E-01
butylbenzylphthalate	no	0.1	0.01	NA	2.04E+01	2.04E+01
di-n-butylphthalate	yes		0.01	NA	2.04E+00	2.04E+00
diethylphthalate	no		0.01	NA	8.18E+01	8.18E+01
di methyl phthalate	no		0.01	NA	1.02E+03	1.02E+03
di-n-octyl phthalate	no		0.01	NA	2.04E+00	2.04E+00

TABLE 8 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

REV: 11/01/93

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater		Groundwater Criteria (mg/L)
				Carcinogenic Effects @10^{-5} (mg/L)	Noncarcinogenic Effects (mg/L)	
benzene	no	0.005	0.005	9.86E-02	NA	9.86E-02
toluene	no	1	0.005	NA	2.04E+01	2.04E+01
ethylbenzene	no	0.7	0.005	NA	1.02E+01	1.02E+01
xylenes	no	10	0.005	NA	2.04E+02	2.04E+02
vinyl chloride	no	0.002	0.01	1.51E-03	NA	1.00E-02
chloroethane	no		0.01	NA	NA	NA
1,1-dichloroethylene	no	0.007	0.005	4.77E-03	9.20E-01	7.00E-03
1,1-dichloroethane	no		0.005	NA	1.02E+01	1.02E+01
1,2-dichloroethylene (cis)	no	0.07	0.005	NA	1.02E+00	1.02E+00
1,2-dichloroethane	no	0.005	0.005	3.14E-02	3.07E+01	3.14E-02
trichloroethylene	no	0.005	0.005	2.60E-01	6.13E-01	2.60E-01
1,1,1-trichloroethane	no	0.2	0.005	NA	9.20E+00	9.20E+00
1,1,2-trichloroethane	no	0.003	0.005	5.02E-02	4.09E-01	5.02E-02
tetrachloroethylene	no	0.005	0.005	5.61E-02	1.02E+00	5.61E-02
1,1,1,2-tetrachloroethane	no		0.005	1.10E-01	3.07E+00	1.10E-01
1,1,2,2-tetrachloroethane	no		0.005	1.43E-02	NA	1.43E-02
chloroform	no	0.1	0.005	4.69E-01	1.02E+00	4.69E-01
acetone	no		0.1	NA	1.02E+01	1.02E+01
4-methyl-2-pentanone	no		0.05	NA	5.11E+00	5.11E+00
methyl ethyl ketone	no		0.1	NA	5.11E+00	5.11E+00
Aldrin	yes		0.00004	1.68E-04	6.13E-04	1.68E-04
gamma-BHC (Lindane)	yes	0.0002	0.00009	2.20E-03	6.13E-03	2.20E-03
chlordane	yes	0.002	0.00014	2.20E-03	1.23E-03	2.00E-03
DDD	yes		0.00011	1.19E-02	NA	1.19E-02
DDE	yes		0.00004	8.41E-03	NA	8.41E-03
DDT	yes		0.00012	8.41E-03	1.02E-02	8.41E-03
dieldrin	yes		0.00002	1.79E-04	1.02E-03	1.79E-04
endosulfan sulfate	no		0.00056	NA	5.11E-03	5.11E-03
endrin	yes	0.002	0.00006	NA	6.13E-03	6.13E-03
heptachlor	yes	0.0004	0.00003	6.36E-04	1.02E-02	6.36E-04
heptachlor epoxide	no	0.0002	0.00083	3.14E-04	1.33E-03	8.30E-04
PCBs	yes	0.0005	0.00065	3.71E-04	NA	6.50E-04
lead	no	0.015	0.003	NA	NA	NA
cadmium	no	0.005	0.005	NA	5.11E-02	5.11E-02
silver	no		0.01	NA	5.11E-01	5.11E-01
mercury	yes	0.002	0.0002	NA	6.13E-03	6.13E-03
chromium vi	no	0.1	0.01	NA	5.11E-01	5.11E-01
chromium iii	no	0.1	0.01	NA	1.02E+02	1.02E+02
barium	no	2	0.2	NA	7.15E+00	7.15E+00
arsenic	no	0.05	0.01	NA	3.07E-02	5.00E-02
antimony	no	0.006	0.06	NA	4.09E-02	6.00E-02
beryllium	no	0.004	0.005	6.65E-04	5.11E-01	5.00E-03
cyanide	no	0.2	0.01	NA	2.04E+00	2.04E+00
nickel	no	0.1	0.04	NA	2.04E+00	2.04E+00
selenium	no	0.05	0.005	NA	5.11E-01	5.11E-01
vanadium	no		0.05	NA	7.15E-01	7.15E-01
zinc	no		0.02	NA	3.07E+01	3.07E+01

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

TABLE 9
REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils		Surface Soil Criteria (mg/Kg)
			Carcinogenic Effects @10^{-5} (mg/Kg)	Noncarcinogenic Effects (mg/Kg)	
naphthalene	no	0.66	NA	81,600.00	10,000.00
acenaphthylene	no	0.66	NA	NA	NA
acenaphthene	no	0.66	NA	122,400.00	10,000.00
fluorene	no	0.66	NA	81,600.00	10,000.00
phenanthrene	no	0.66	NA	NA	NA
anthracene	no	0.66	NA	612,000.00	10,000.00
fluoranthene	yes	0.66	NA	16,320.00	10,000.00
pyrene	no	0.66	NA	61,200.00	10,000.00
benzo(a)anthracene	yes	0.66	79.45	NA	79.45
chrysene	yes	0.66	7,945.21	NA	7,945.21
benzo(b)fluoranthene	yes	0.66	79.45	NA	79.45
benzo(k)fluoranthene	yes	0.66	794.52	NA	794.52
benzo(a)pyrene	yes	0.66	7.94	NA	7.94
indeno(1,2,3-cd)pyrene	yes	0.66	79.45	NA	79.45
dibenzo(a,h)anthracene	yes	0.66	7.95	NA	7.95
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	128.89	NA	128.89
n-nitroso-di-n-propylamine	no	0.66	8.29	NA	8.29
bis(2-chloroisopropyl)ether	no	0.66	93.12	81,600.00	93.12
4-chloroaniline	no	1.3	NA	8,160.00	8,160.00
2-chloronaphthalene	no	0.66	NA	163,200.00	10,000.00
2,4-dinitrotoluene	no	0.66	NA	4,080.00	4,080.00
hexachlorobutadiene	yes	0.66	1.78	816.00	1.78
hexachloroethane	yes	0.66	2,898.99	408.00	408.00
isophorone	no	0.66	61,052.63	408,000.00	10,000.00
benzyl alcohol	no	1.3	NA	612,000.00	10,000.00
bis(2-chloroethyl)ether	no	0.66	4.06	NA	4.06
nitrobenzene	no	0.66	NA	1,020.00	1,020.00
1,2-dichlorobenzene	no	0.66	NA	183,600.00	10,000.00
1,3-dichlorobenzene	no	0.66	NA	NA	NA
1,4-dichlorobenzene	no	0.66	2,416.67	11,788.20	2,416.67
1,2,4-trichlorobenzene	no	0.66	NA	20,400.00	10,000.00
hexachlorobenzene	no	0.66	6.87	1,632.00	6.87
hexachlorocyclopentadiene	no	0.66	NA	2.02	2.02
n-nitrosodiphenylamine	no	0.66	11,836.73	NA	10,000.00
benzoic acid	no	3.3	NA	8,160,000.00	10,000.00
2-nitroaniline	no	3.3	NA	42.90	42.90
phenol	yes	0.66	NA	244,800.00	10,000.00
2-methylphenol	no	0.66	NA	102,000.00	10,000.00
3-methylphenol	no	0.66	NA	NA	NA
4-methylphenol	no	0.66	NA	102,000.00	10,000.00
2-chlorophenol	no	0.66	NA	10,200.00	10,000.00
2,4-dichlorophenol	no	0.66	NA	6,120.00	6,120.00
2,4,5-trichlorophenol	no	0.66	NA	204,000.00	10,000.00
2,4,6-trichlorophenol	no	0.66	1,922.89	NA	1,922.89
pentachlorophenol	no	3.3	483.33	61,200.00	483.33
2,4-dinitrophenol	no	3.3	NA	4,080.00	4,080.00
bis(2-ethylhexyl)phthalate	yes	0.66	4,142.86	8,160.00	4,142.86
butylbenzylphthalate	no	0.66	NA	408,000.00	10,000.00
di-n-butylphthalate	yes	0.66	NA	40,800.00	10,000.00
diethylphthalate	no	0.66	NA	1,632,000.00	10,000.00
di methyl phthalate	no	0.66	NA	20,400,000.00	10,000.00
di-n-octyl phthalate	no	0.66	NA	40,800.00	10,000.00

TABLE 9 (con't) REV: 11/01/93
SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils: Carcinogenic Effects @10^{-5} (mg/Kg)	Surface Soils: Noncarcinogenic Effects (mg/Kg)	Surface Soil Criteria (mg/Kg)
benzene	no	0.005	16.63	NA	16.63
toluene	no	0.005	NA	2,552.81	1,000.00
ethylbenzene	no	0.005	NA	7,180.32	1,000.00
xylenes	no	0.005	NA	4,080,000.00	1,000.00
vinyl chloride	no	0.01	0.02	NA	0.02
chloroethane	no	0.01	NA	2,580.36	1,000.00
1,1-dichloroethylene	no	0.005	0.15	18,360.00	0.15
1,1-dichloroethane	no	0.005	NA	973.47	973.47
1,2-dichloroethylene (cis)	no	0.005	NA	20,400.00	1,000.00
1,2-dichloroethane	no	0.005	5.27	612,000.00	5.27
trichloroethylene	no	0.005	24.97	12,240.00	24.97
1,1,1-trichloroethane	no	0.005	NA	3,998.01	1,000.00
1,1,2-trichloroethane	no	0.005	22.74	8,160.00	22.74
tetrachloroethylene	no	0.005	101.23	20,400.00	101.23
1,1,1,2-tetrachloroethane	no	0.005	75.91	61,200.00	75.91
1,1,2,2-tetrachloroethane	no	0.005	75.41	NA	75.41
chloroform	no	0.005	5.28	20,400.00	5.28
acetone	no	0.1	NA	204,000.00	1,000.00
4-methyl-2-pentanone	no	0.05	NA	102,000.00	1,000.00
methyl ethyl ketone	no	0.1	NA	6,726.27	1,000.00
Aldrin	yes	0.00268	0.27	12.24	0.27
gamma-BHC (Lindane)	yes	0.00603	44.62	122.40	44.62
chlordane	yes	0.00938	39.45	24.48	24.48
DDD	yes	0.00737	241.67	NA	241.67
DDE	yes	0.00268	170.59	NA	170.59
DDT	yes	0.00804	153.01	204.00	153.01
dieldrin	yes	0.00134	3.62	20.40	3.62
endosulfan sulfate	no	0.04422	NA	102.00	102.00
endrin	yes	0.00402	NA	122.40	122.40
heptachlor	yes	0.00201	4.16	204.00	4.16
heptachlor epoxide	no	0.05561	6.37	26.52	6.37
PCBs	yes	0.04355	7.53	NA	7.53
lead	no	0.5	NA	NA	NA
cadmium	no	0.5	NA	1,020.00	1,020.00
silver	no	1	NA	10,200.00	10,000
mercury	yes	0.1	NA	122.40	122.40
chromium vi	no	1	NA	10,200.00	10,000
chromium iii	no	1	NA	2,040,000.00	10,000
barium	no	20	NA	142,800.00	10,000
arsenic	no	1	NA	612.00	612.00
antimony	no	6	NA	816.00	816.00
beryllium	no	0.5	13.49	10,200.00	13.49
cyanide	no	0.125	NA	40,800.00	1,000.00
nickel	no	4	NA	40,800.00	10,000
selenium	no	0.5	NA	10,200.00	10,000
vanadium	no	5	NA	14,280.00	10,000
zinc	no	2	NA	612,000.00	10,000

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

TABLE 10 REV: 11/01/93
SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Subsurface Soils		Leaching to Groundwater		Subsurface Soil Criteria (mg/Kg)
			Carcinogenic Effects @10^{-5} (mg/Kg)	Noncarcinogenic Effects (mg/Kg)	Groundwater Criteria (mg/L)	Subsurface Soil Criteria (mg/Kg)	
naphthalene	no	0.66	NA	58,400.00	4.09E+00	10,534.54	10,000.00
acenaphthylene	no	0.66	NA	NA	NA	NA	NA
acenaphthene	no	0.66	NA	87,600.00	6.13E+00	65,215.08	10,000.00
fluorene	no	0.66	NA	58,400.00	4.09E+00	52,850.39	10,000.00
phenanthrene	no	0.66	NA	NA	NA	NA	NA
anthracene	no	0.66	NA	438,000.00	3.07E+01	7,585,812.53	10,000.00
fluoranthene	yes	0.66	NA	11,680.00	8.18E-01	13,782.92	10,000.00
pyrene	no	0.66	NA	43,800.00	3.07E+00	140,591.20	10,000.00
benzo(a)anthracene	yes	0.66	698.63	NA	1.00E-02	103.88	103.88
chrysene	yes	0.66	69,863.01	NA	3.92E-01	67,777.62	10,000.00
benzo(b)fluoranthene	yes	0.66	698.63	NA	1.00E-02	354.98	354.98
benzo(k)fluoranthene	yes	0.66	6,986.30	NA	3.92E-02	3,759.12	3,759.12
benzo(a)pyrene	yes	0.66	69.85	NA	1.00E-02	212.87	69.85
indeno(1,2,3-cd)pyrene	yes	0.66	698.63	NA	1.00E-02	629.17	629.17
dibenzo(a,h)anthracene	yes	0.66	69.86	NA	1.00E-02	649.66	69.86
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	1,133.33	NA	2.00E-02	12.86	12.86
n-nitroso-di-n-propylamine	no	0.66	72.86	NA	1.00E-02	0.06	0.06
bis(2-chloroisopropyl)ether	no	0.66	1,472.23	58,400.00	4.09E-02	1.32	1.32
4-chloroaniline	no	1.3	NA	5,840.00	4.09E-01	1,117.69	1,117.69
2-chloronaphthalene	no	0.66	NA	116,800.00	8.18E+00	68,632.75	10,000.00
2,4-dinitrotoluene	no	0.66	NA	2,920.00	2.04E-01	39.07	39.07
hexachlorobutadiene	yes	0.66	31.18	584.00	3.67E-02	46.06	31.18
hexachloroethane	yes	0.66	29,818.48	292.00	2.04E-02	3.31	3.31
isophorone	no	0.66	536,842.11	292,000.00	3.01E+00	256.03	256.03
benzyl alcohol	no	1.3	NA	438,000.00	3.07E+01	4,356.75	4,356.75
bis(2-chloroethyl)ether	no	0.66	66.24	NA	1.00E-02	0.06	0.06
nitrobenzene	no	0.66	NA	730.00	5.11E-02	1.73	1.73
1,2-dichlorobenzene	no	0.66	NA	131,400.00	9.20E+00	15,093.56	10,000.00
1,3-dichlorobenzene	no	0.66	NA	NA	NA	NA	NA
1,4-dichlorobenzene	no	0.66	21,250.00	16,873.31	1.19E-01	34.67	34.67
1,2,4-trichlorobenzene	no	0.66	NA	14,600.00	1.02E+00	1,405.37	1,405.37
hexachlorobenzene	no	0.66	101.56	1,168.00	1.00E-02	165.57	101.56
hexachlorocyclopentadiene	no	0.66	NA	2.89	7.15E-01	3,904.08	2.89
n-nitrosodiphenylamine	no	0.66	104,081.63	NA	5.84E-01	567.80	567.80
benzoic acid	no	3.3	NA	5,840,000.00	4.09E+02	813,796.56	10,000.00
2-nitroaniline	no	3.3	NA	45.47	5.00E-02	2.08	2.08
phenol	yes	0.66	NA	175,200.00	1.23E+01	658.78	658.78
2-methylphenol	no	0.66	NA	73,000.00	5.11E+00	375.93	375.93
3-methylphenol	no	0.66	NA	NA	NA	NA	NA
4-methylphenol	no	0.66	NA	73,000.00	5.11E+00	427.24	427.24
2-chlorophenol	no	0.66	NA	7,300.00	5.11E-01	11.63	11.63
2,4-dichlorophenol	no	0.66	NA	4,380.00	3.07E-01	15.12	15.12
2,4,5-trichlorophenol	no	0.66	NA	146,000.00	1.02E+01	5,507.44	5,507.44
2,4,6-trichlorophenol	no	0.66	24,779.61	NA	2.60E-01	30.65	30.65
pentachlorophenol	no	3.3	4,250.00	43,800.00	5.00E-02	24.95	24.95
2,4-dinitrophenol	no	3.3	NA	2,920.00	2.04E-01	7.37	7.37
bis(2-ethylhexyl)phthalate	yes	0.66	36,428.57	5,840.00	2.04E-01	1,406.25	1,406.25
butylbenzylphthalate	no	0.66	NA	292,000.00	2.04E+01	421,659.24	10,000.00
di-n-butylphthalate	yes	0.66	NA	29,200.00	2.04E+00	6,188.56	6,188.56
diethylphthalate	no	0.66	NA	1,168,000.00	8.18E+01	139,039.43	10,000.00
di methyl phthalate	no	0.66	NA	14,600,000.00	1.02E+03	2,427,459.10	10,000.00
di-n-octyl phthalate	no	0.66	NA	29,200.00	2.04E+00	13,865.50	10,000.00

REV: 11/01/93

TABLE 10 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Subsurface Soils: Carcinogenic Effects @10^{-5} (mg/Kg)	Subsurface Soils: Noncarcinogenic Effects (mg/Kg)	Leaching to Groundwater: Groundwater Criteria (mg/L)	Leaching to Groundwater: Subsurface Soil Criteria (mg/Kg)	Subsurface Soil Criteria (mg/Kg)
benzene	no	0.005	289.96	NA	9.86E-02	4.77	4.77
toluene	no	0.005	NA	3,631.30	2.04E+01	23,897.46	1,000.00
ethylbenzene	no	0.005	NA	9,928.27	1.02E+01	17,179.71	1,000.00
xylenes	no	0.005	NA	2,920,000.00	2.04E+02	1,232,453.05	1,000.00
vinyl chloride	no	0.01	0.30	NA	1.00E-02	0.13	0.13
chloroethane	no	0.01	NA	3,693.46	NA	NA	1,000.00
1,1-dichloroethylene	no	0.005	2.59	13,140.00	7.00E-03	0.08	0.08
1,1-dichloroethane	no	0.005	NA	1,386.78	1.02E+01	2,385.62	1,000.00
1,2-dichloroethylene (cis)	no	0.005	NA	14,600.00	1.02E+00	102.49	102.49
1,2-dichloroethane	no	0.005	91.96	438,000.00	3.14E-02	0.37	0.37
trichloroethylene	no	0.005	437.11	8,760.00	2.60E-01	25.73	25.73
1,1,1-trichloroethane	no	0.005	NA	5,600.68	9.20E+00	4,173.92	1,000.00
1,1,2-trichloroethane	no	0.005	391.20	5,840.00	5.02E-02	1.05	1.05
tetrachloroethylene	no	0.005	1,634.72	14,600.00	5.61E-02	8.01	8.01
1,1,1,2-tetrachloroethane	no	0.005	1,291.02	43,800.00	1.10E-01	7.24	7.24
1,1,2,2-tetrachloroethane	no	0.005	1,052.52	NA	1.43E-02	0.21	0.21
chloroform	no	0.005	92.76	14,600.00	4.69E-01	20.33	20.33
acetone	no	0.1	NA	146,000.00	1.02E+01	136.29	136.29
4-methyl-2-pentanone	no	0.05	NA	73,000.00	5.11E+00	407.48	407.48
methyl ethyl ketone	no	0.1	NA	9,032.18	5.11E+00	146.24	146.24
Aldrin	yes	0.00268	4.35	8.76	1.68E-04	0.06	0.06
gamma-BHC (Lindane)	yes	0.00603	392.31	87.60	2.20E-03	0.34	0.34
chlordane	yes	0.00938	368.21	17.52	2.00E-03	4.51	4.51
DDD	yes	0.00737	2,125.00	NA	1.19E-02	48.34	48.34
DDE	yes	0.00268	1,500.00	NA	8.41E-03	80.49	80.49
DDT	yes	0.00804	1,418.50	146.00	8.41E-03	141.83	141.83
dieldrin	yes	0.00134	31.87	14.60	1.79E-04	0.06	0.06
endosulfan sulfate	no	0.04422	NA	73.00	5.11E-03	12.00	12.00
endrin	yes	0.00402	NA	87.60	6.13E-03	10.12	10.12
heptachlor	yes	0.00201	55.28	146.00	6.36E-04	0.44	0.44
heptachlor epoxide	no	0.05561	56.04	18.98	8.30E-04	0.45	0.45
PCBs	yes	0.04355	66.23	NA	6.50E-04	4.23	4.23
lead	no	0.5	NA	NA	NA	NA	NA
cadmium	no	0.5	NA	730.00	5.11E-02	NA	10,000
silver	no	1	NA	7,300.00	5.11E-01	NA	10,000
mercury	yes	0.1	NA	87.60	6.13E-03	NA	87.60
chromium vi	no	1	NA	7,300.00	5.11E-01	NA	10,000
chromium iii	no	1	NA	1,460,000.00	1.02E+02	NA	10,000
barium	no	20	NA	102,200.00	7.15E+00	NA	10,000
arsenic	no	1	NA	438.00	5.00E-02	NA	10,000
antimony	no	6	NA	584.00	6.00E-02	NA	10,000
beryllium	no	0.5	118.60	7,300.00	5.00E-03	NA	118.60
cyanide	no	0.125	NA	29,200.00	2.04E+00	NA	1,000.00
nickel	no	4	NA	29,200.00	2.04E+00	NA	10,000
selenium	no	0.5	NA	7,300.00	5.11E-01	NA	10,000
vanadium	no	5	NA	10,220.00	7.15E-01	NA	10,000
zinc	no	2	NA	438,000.00	3.07E+01	NA	10,000

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

TABLE 11
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

REV: 11/01/93

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater: Carcinogenic Effects @10^{-6} (mg/L)	Groundwater: Noncarcinogenic Effects (mg/L)	Groundwater Criteria (mg/L)
naphthalene	no		0.01	NA	1.22E+00	1.22E+00
acenaphthylene	no		0.01	NA	NA	NA
acenaphthene	no		0.01	NA	1.82E+00	1.82E+00
fluorene	no		0.01	NA	1.22E+00	1.22E+00
phenanthrene	no		0.01	NA	NA	NA
anthracene	no		0.01	NA	9.12E+00	9.12E+00
fluoranthene	yes		0.01	NA	2.43E-01	2.43E-01
pyrene	no		0.01	NA	9.12E-01	9.12E-01
benzo(a)anthracene	yes	0.0001	0.01	1.16E-04	NA	1.00E-02
chrysene	yes	0.0002	0.01	1.16E-02	NA	1.16E-02
benzo(b)fluoranthene	yes	0.0002	0.01	1.16E-04	NA	1.00E-02
benzo(k)fluoranthene	yes	0.0002	0.01	1.16E-03	NA	1.00E-02
benzo(a)pyrene	yes	0.0002	0.01	1.16E-05	NA	1.00E-02
indeno(1,2,3-cd)pyrene	yes	0.0004	0.01	1.16E-04	NA	1.00E-02
dibenzo(a,h)anthracene	yes	0.0003	0.01	1.16E-05	NA	1.00E-02
benzo(g,h,i)perylene	yes		0.01	NA	NA	NA
3,3'-dichlorobenzidine	no		0.02	1.89E-04	NA	2.00E-02
n-nitroso-di-n-propylamine	no		0.01	1.21E-05	NA	1.00E-02
bis(2-chloroisopropyl)ether	no		0.01	4.22E-04	1.22E+00	1.00E-02
4-chloroaniline	no		0.02	NA	1.22E-01	1.22E-01
2-chloronaphthalene	no		0.01	NA	2.43E+00	2.43E+00
2,4-dinitrotoluene	no		0.01	NA	6.08E-02	6.08E-02
hexachlorobutadiene	yes		0.01	1.09E-03	1.22E-02	1.00E-02
hexachloroethane	yes		0.01	5.99E-03	6.08E-03	1.00E-02
isophorone	no		0.01	8.95E-02	6.08E+00	8.95E-02
benzyl alcohol	no		0.02	NA	9.12E+00	9.12E+00
bis(2-chloroethyl)ether	no		0.01	1.63E-05	NA	1.00E-02
nitrobenzene	no		0.01	NA	1.52E-02	1.52E-02
1,2-dichlorobenzene	no	0.6	0.01	NA	2.74E+00	2.74E+00
1,3-dichlorobenzene	no	0.6	0.01	NA	NA	NA
1,4-dichlorobenzene	no	0.075	0.01	3.54E-03	1.62E+00	7.50E-02
1,2,4-trichlorobenzene	no	0.07	0.01	NA	3.04E-01	3.04E-01
hexachlorobenzene	no	0.001	0.01	5.31E-05	2.43E-02	1.00E-02
hexachlorocyclopentadiene	no	0.05	0.01	NA	2.13E-01	2.13E-01
n-nitrosodiphenylamine	no		0.01	1.73E-02	NA	1.73E-02
benzoic acid	no		0.05	NA	1.22E+02	1.22E+02
2-nitroaniline	no		0.05	NA	1.82E-03	5.00E-02
phenol	yes		0.01	NA	3.65E+00	3.65E+00
2-methylphenol	no		0.01	NA	1.52E+00	1.52E+00
3-methylphenol	no		0.01	NA	NA	NA
4-methylphenol	no		0.01	NA	1.52E+00	1.52E+00
2-chlorophenol	no		0.01	NA	1.52E-01	1.52E-01
2,4-dichlorophenol	no		0.01	NA	9.12E-02	9.12E-02
2,4,5-trichlorophenol	no		0.01	NA	3.04E+00	3.04E+00
2,4,6-trichlorophenol	no		0.01	1.75E-03	NA	1.00E-02
pentachlorophenol	no	0.001	0.05	7.08E-04	9.12E-01	5.00E-02
2,4-dinitrophenol	no		0.05	NA	6.08E-02	6.08E-02
bis(2-ethylhexyl)phthalate	yes	0.006	0.01	6.07E-03	1.22E-01	1.00E-02
butylbenzylphthalate	no	0.1	0.01	NA	6.08E+00	6.08E+00
di-n-butylphthalate	yes		0.01	NA	6.08E-01	6.08E-01
diethylphthalate	no		0.01	NA	2.43E+01	2.43E+01
di methyl phthalate	no		0.01	NA	3.04E+02	3.04E+02
di-n-octyl phthalate	no		0.01	NA	6.08E-01	6.08E-01

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TABLE 11 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater: Carcinogenic Effects @10^{-6} (mg/L)	Groundwater: Noncarcinogenic Effects (mg/L)	Groundwater Criteria (mg/L)
benzene	no	0.005	0.005	6.17E-04	NA	5.00E-03
toluene	no	1	0.005	NA	8.04E-01	1.00E+00
ethylbenzene	no	0.7	0.005	NA	1.31E+00	1.31E+00
xylenes	no	10	0.005	NA	6.08E+01	6.08E+01
vinyl chloride	no	0.002	0.01	2.81E-05	NA	1.00E-02
chloroethane	no		0.01	NA	2.32E+01	2.32E+01
1,1-dichloroethylene	no	0.007	0.005	1.67E-05	2.74E-01	7.00E-03
1,1-dichloroethane	no		0.005	NA	6.40E-01	6.40E-01
1,2-dichloroethylene (cis)	no	0.07	0.005	NA	3.04E-01	3.04E-01
1,2-dichloroethane	no	0.005	0.005	1.97E-04	9.12E+00	5.00E-03
trichloroethylene	no	0.005	0.005	1.14E-03	1.82E-01	5.00E-03
1,1,1-trichloroethane	no	0.2	0.005	NA	1.29E+00	1.29E+00
1,1,2-trichloroethane	no	0.003	0.005	3.14E-04	1.22E-01	5.00E-03
tetrachloroethylene	no	0.005	0.005	1.47E-03	3.04E-01	5.00E-03
1,1,1,2-tetrachloroethane	no		0.005	6.88E-04	9.12E-01	5.00E-03
1,1,2,2-tetrachloroethane	no		0.005	3.09E-04	NA	5.00E-03
chloroform	no	0.1	0.005	2.76E-04	3.04E-01	1.00E-01
acetone	no		0.1	NA	3.04E+00	3.04E+00
4-methyl-2-pentanone	no		0.05	NA	1.52E+00	1.52E+00
methyl ethyl ketone	no		0.1	NA	9.18E-01	9.18E-01
Aldrin	yes		0.00004	5.00E-06	1.82E-04	4.00E-05
gamma-BHC (Lindane)	yes	0.0002	0.00009	6.54E-05	1.82E-03	2.00E-04
chlordane	yes	0.002	0.00014	6.54E-05	3.65E-04	2.00E-03
DDD	yes		0.00011	3.54E-04	NA	3.54E-04
DDE	yes		0.00004	2.50E-04	NA	2.50E-04
DDT	yes		0.00012	2.50E-04	3.04E-03	2.50E-04
dieldrin	yes		0.00002	5.31E-06	3.04E-04	2.00E-05
endosulfan sulfate	no		0.00066	NA	1.52E-03	1.52E-03
endrin	yes	0.002	0.00006	NA	1.82E-03	2.00E-03
heptachlor	yes	0.0004	0.00003	1.89E-05	3.04E-03	4.00E-04
heptachlor epoxide	no	0.0002	0.00083	9.34E-06	3.95E-04	8.30E-04
PCBs	yes	0.0005	0.00065	1.10E-05	NA	6.50E-04
lead	no	0.015	0.003	NA	NA	NA
cadmium	no	0.005	0.005	NA	1.52E-02	1.52E-02
silver	no		0.01	NA	1.52E-01	1.52E-01
mercury	yes	0.002	0.0002	NA	1.82E-03	2.00E-03
chromium vi	no	0.1	0.01	NA	1.52E-01	1.52E-01
chromium iii	no	0.1	0.01	NA	3.04E+01	3.04E+01
barium	no	2	0.2	NA	2.13E+00	2.13E+00
arsenic	no	0.05	0.01	NA	9.12E-03	5.00E-02
antimony	no	0.006	0.06	NA	1.22E-02	6.00E-02
beryllium	no	0.004	0.005	1.98E-05	1.52E-01	5.00E-03
cyanide	no	0.2	0.01	NA	6.08E-01	6.08E-01
nickel	no	0.1	0.04	NA	6.08E-01	6.08E-01
selenium	no	0.05	0.005	NA	1.52E-01	1.52E-01
vanadium	no		0.05	NA	2.13E-01	2.13E-01
zinc	no		0.02	NA	9.12E+00	9.12E+00

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

TABLE 12
REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils		Surface Soil Criteria (mg/Kg)
			Carcinogenic Effects @10^{-6} (mg/Kg)	Noncarcinogenic Effects (mg/Kg)	
naphthalene	no	0.66	NA	10,800.00	10,000.00
acenaphthylene	no	0.66	NA	NA	NA
acenaphthene	no	0.66	NA	16,200.00	10,000.00
fluorene	no	0.66	NA	10,800.00	10,000.00
phenanthrene	no	0.66	NA	NA	NA
anthracene	no	0.66	NA	81,000.00	10,000.00
fluoranthene	yes	0.66	NA	2,160.00	2,160.00
pyrene	no	0.66	NA	8,100.00	8,100.00
benzo(a)anthracene	yes	0.66	0.88	NA	0.88
chrysene	yes	0.66	87.67	NA	87.67
benzo(b)fluoranthene	yes	0.66	0.88	NA	0.88
benzo(k)fluoranthene	yes	0.66	8.77	NA	8.77
benzo(a)pyrene	yes	0.66	0.09	NA	0.66
indeno(1,2,3-cd)pyrene	yes	0.66	0.88	NA	0.88
dibenzo(a,h)anthracene	yes	0.66	0.09	NA	0.66
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	1.42	NA	1.42
n-nitroso-di-n-propylamine	no	0.66	0.09	NA	0.66
bis(2-chloroisopropyl)ether	no	0.66	9.14	10,800.00	9.14
4-chloroaniline	no	1.3	NA	1,080.00	1,080.00
2-chloronaphthalene	no	0.66	NA	21,600.00	10,000.00
2,4-dinitrotoluene	no	0.66	NA	540.00	540.00
hexachlorobutadiene	yes	0.66	8.21	108.00	8.21
hexachloroethane	yes	0.66	45.07	54.00	45.07
isophorone	no	0.66	673.68	54,000.00	673.68
benzyl alcohol	no	1.3	NA	81,000.00	10,000.00
bis(2-chloroethyl)ether	no	0.66	0.58	NA	0.66
nitrobenzene	no	0.66	NA	135.00	135.00
1,2-dichlorobenzene	no	0.66	NA	24,300.00	10,000.00
1,3-dichlorobenzene	no	0.66	NA	NA	NA
1,4-dichlorobenzene	no	0.66	26.67	NA	26.67
1,2,4-trichlorobenzene	no	0.66	NA	2,700.00	2,700.00
hexachlorobenzene	no	0.66	0.40	216.00	0.66
hexachlorocyclopentadiene	no	0.66	NA	1,890.00	1,890.00
n-nitrosodiphenylamine	no	0.66	130.61	NA	130.61
benzoic acid	no	3.3	NA	1,080,000.00	10,000.00
2-nitroaniline	no	3.3	NA	16.20	16.20
phenol	yes	0.66	NA	32,400.00	10,000.00
2-methylphenol	no	0.66	NA	13,500.00	10,000.00
3-methylphenol	no	0.66	NA	NA	NA
4-methylphenol	no	0.66	NA	13,500.00	10,000.00
2-chlorophenol	no	0.66	NA	1,350.00	1,350.00
2,4-dichlorophenol	no	0.66	NA	810.00	810.00
2,4,5-trichlorophenol	no	0.66	NA	27,000.00	10,000.00
2,4,6-trichlorophenol	no	0.66	58.18	NA	58.18
pentachlorophenol	no	3.3	5.33	8,100.00	5.33
2,4-dinitrophenol	no	3.3	NA	540.00	540.00
bis(2-ethylhexyl)phthalate	yes	0.66	45.71	1,080.00	45.71
butylbenzylphthalate	no	0.66	NA	54,000.00	10,000.00
di-n-butylphthalate	yes	0.66	NA	5,400.00	5,400.00
diethylphthalate	no	0.66	NA	216,000.00	10,000.00
di methyl phthalate	no	0.66	NA	2,700,000.00	10,000.00
di-n-octyl phthalate	no	0.66	NA	5,400.00	5,400.00

TABLE 12 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

REV: 11/01/93

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils: Carcinogenic Effects @10^{-6} (mg/Kg)	Surface Soils: Noncarcinogenic Effects (mg/Kg)	Surface Soil Criteria (mg/Kg)
benzene	no	0.005	22.07	NA	22.07
toluene	no	0.005	NA	54,000.00	1,000.00
ethylbenzene	no	0.005	NA	27,000.00	1,000.00
xylenes	no	0.005	NA	540,000.00	1,000.00
vinyl chloride	no	0.01	0.34	NA	0.34
chloroethane	no	0.01	NA	NA	NA
1,1-dichloroethylene	no	0.005	1.07	2,430.00	1.07
1,1-dichloroethane	no	0.005	NA	27,000.00	1,000.00
1,2-dichloroethylene (cis)	no	0.005	NA	2,700.00	1,000.00
1,2-dichloroethane	no	0.005	7.03	81,000.00	7.03
trichloroethylene	no	0.005	58.18	1,620.00	58.18
1,1,1-trichloroethane	no	0.005	NA	24,300.00	1,000.00
1,1,2-trichloroethane	no	0.005	11.23	1,080.00	11.23
tetrachloroethylene	no	0.005	12.55	2,700.00	12.55
1,1,1,2-tetrachloroethane	no	0.005	24.62	8,100.00	24.62
1,1,2,2-tetrachloroethane	no	0.005	3.20	NA	3.20
chloroform	no	0.005	104.92	2,700.00	104.92
acetone	no	0.1	NA	27,000.00	1,000.00
4-methyl-2-pentanone	no	0.05	NA	13,500.00	1,000.00
methyl ethyl ketone	no	0.1	NA	13,500.00	1,000.00
Aldrin	yes	0.00268	0.04	1.62	0.04
gamma-BHC (Lindane)	yes	0.00603	0.49	16.20	0.49
chlordane	yes	0.00938	0.49	3.24	0.49
DDD	yes	0.00737	2.67	NA	2.67
DDE	yes	0.00268	1.88	NA	1.88
DDT	yes	0.00804	1.88	27.00	1.88
dieldrin	yes	0.00134	0.04	2.70	0.04
endosulfan sulfate	no	0.04422	NA	13.50	13.50
endrin	yes	0.00402	NA	16.20	16.20
heptachlor	yes	0.00201	0.14	27.00	0.14
heptachlor epoxide	no	0.05561	0.07	3.51	0.07
PCBs	yes	0.04355	0.08	NA	0.08
lead	no	0.5	NA	NA	NA
cadmium	no	0.5	NA	135.00	135.00
silver	no	1	NA	1,350.00	1,350.00
mercury	yes	0.1	NA	16.20	16.20
chromium vi	no	1	NA	1,350.00	1,350.00
chromium iii	no	1	NA	270,000.00	10,000
barium	no	20	NA	18,900.00	10,000
arsenic	no	1	NA	81.00	81.00
antimony	no	6	NA	108.00	108.00
beryllium	no	0.5	0.15	1,350.00	0.50
cyanide	no	0.125	NA	5,400.00	1,000.00
nickel	no	4	NA	5,400.00	5,400.00
selenium	no	0.5	NA	1,350.00	1,350.00
vanadium	no	5	NA	1,890.00	1,890.00
zinc	no	2	NA	81,000.00	10,000

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

TABLE 13
REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Subsurface Soils		Leaching to Groundwater		Subsurface Soil Criteria (mg/Kg)
			Carcinogenic Effects @10^{-6} (mg/Kg)	Noncarcinogenic Effects (mg/Kg)	Groundwater Criteria (mg/L)	Subsurface Soil Criteria (mg/Kg)	
naphthalene	no	0.66	NA	58,400.00	1.22E+00	1,761.78	1,761.78
acenaphthylene	no	0.66	NA	NA	NA	NA	NA
acenaphthene	no	0.66	NA	87,600.00	1.82E+00	10,906.50	10,000.00
fluorene	no	0.66	NA	58,400.00	1.22E+00	8,838.64	8,838.64
phenanthrene	no	0.66	NA	NA	NA	NA	NA
anthracene	no	0.66	NA	438,000.00	9.12E+00	1,268,642.93	10,000.00
fluoranthene	yes	0.66	NA	11,680.00	2.43E-01	2,305.04	2,305.04
pyrene	no	0.66	NA	43,800.00	9.12E-01	23,512.32	10,000.00
benzo(a)anthracene	yes	0.66	698.63	NA	1.00E-02	103.88	103.88
chrysene	yes	0.66	69,863.01	NA	1.16E-02	379.27	379.27
benzo(b)fluoranthene	yes	0.66	698.63	NA	1.00E-02	354.98	354.98
benzo(k)fluoranthene	yes	0.66	6,986.30	NA	1.00E-02	501.64	501.64
benzo(a)pyrene	yes	0.66	69.85	NA	1.00E-02	212.87	69.85
indeno(1,2,3-cd)pyrene	yes	0.66	698.63	NA	1.00E-02	629.17	629.17
dibenzo(a,h)anthracene	yes	0.66	69.86	NA	1.00E-02	649.66	69.86
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	1,133.33	NA	2.00E-02	12.86	12.86
n-nitroso-di-n-propylamine	no	0.66	72.86	NA	1.00E-02	0.06	0.06
bis(2-chloroisopropyl)ether	no	0.66	1,472.23	58,400.00	1.00E-02	0.17	0.17
4-chloroaniline	no	1.3	NA	5,840.00	1.22E-01	186.92	186.92
2-chloronaphthalene	no	0.66	NA	116,800.00	2.43E+00	11,478.07	10,000.00
2,4-dinitrotoluene	no	0.66	NA	2,920.00	6.08E-02	6.53	6.53
hexachlorobutadiene	yes	0.66	31.18	584.00	1.00E-02	6.78	6.78
hexachloroethane	yes	0.66	29,818.48	292.00	1.00E-02	1.15	1.15
isophorone	no	0.66	536,842.11	292,000.00	8.95E-02	1.43	1.43
benzyl alcohol	no	1.3	NA	438,000.00	9.12E+00	728.62	728.62
bis(2-chloroethyl)ether	no	0.66	66.24	NA	1.00E-02	0.06	0.06
nitrobenzene	no	0.66	NA	730.00	1.52E-02	0.29	0.29
1,2-dichlorobenzene	no	0.66	NA	131,400.00	2.74E+00	2,524.23	2,524.23
1,3-dichlorobenzene	no	0.66	NA	NA	NA	NA	NA
1,4-dichlorobenzene	no	0.66	21,250.00	16,873.31	1.00E-02	0.90	0.90
1,2,4-trichlorobenzene	no	0.66	NA	14,600.00	3.04E-01	235.03	235.03
hexachlorobenzene	no	0.66	101.56	1,168.00	1.00E-02	165.57	101.56
hexachlorocyclopentadiene	no	0.66	NA	2.89	2.13E-01	652.91	2.89
n-nitrosodiphenylamine	no	0.66	104,081.63	NA	1.73E-02	3.18	3.18
benzoic acid	no	3.3	NA	5,840,000.00	1.22E+02	136,098.44	10,000.00
2-nitroaniline	no	3.3	NA	45.47	5.00E-02	2.08	2.08
phenol	yes	0.66	NA	175,200.00	3.65E+00	110.17	110.17
2-methylphenol	no	0.66	NA	73,000.00	1.52E+00	62.87	62.87
3-methylphenol	no	0.66	NA	NA	NA	NA	NA
4-methylphenol	no	0.66	NA	73,000.00	1.52E+00	71.45	71.45
2-chlorophenol	no	0.66	NA	7,300.00	1.52E-01	1.95	1.95
2,4-dichlorophenol	no	0.66	NA	4,380.00	9.12E-02	2.53	2.53
2,4,5-trichlorophenol	no	0.66	NA	146,000.00	3.04E+00	921.06	921.06
2,4,6-trichlorophenol	no	0.66	24,779.61	NA	1.00E-02	0.25	0.25
pentachlorophenol	no	3.3	4,250.00	43,800.00	5.00E-02	24.95	24.95
2,4-dinitrophenol	no	3.3	NA	2,920.00	6.08E-02	1.23	1.23
bis(2-ethylhexyl)phthalate	yes	0.66	36,428.57	5,840.00	1.00E-02	16.43	16.43
butylbenzylphthalate	no	0.66	NA	292,000.00	6.08E+00	70,517.83	10,000.00
di-n-butylphthalate	yes	0.66	NA	29,200.00	6.08E-01	1,034.97	1,034.97
diethylphthalate	no	0.66	NA	1,168,000.00	2.43E+01	23,252.80	10,000.00
di methyl phthalate	no	0.66	NA	14,600,000.00	3.04E+02	405,965.59	10,000.00
di-n-octyl phthalate	no	0.66	NA	29,200.00	6.08E-01	2,318.85	2,318.85

TABLE 13 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

REV: 11/01/93

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Subsurface Soils		Leaching to Groundwater		Subsurface Soil Criteria (mg/Kg)
			Carcinogenic Effects @10^{-6} (mg/Kg)	Noncarcinogenic Effects (mg/Kg)	Groundwater Criteria (mg/L)	Subsurface Soil Criteria (mg/Kg)	
benzene	no	0.005	289.96	NA	5.00E-03	0.06	0.06
toluene	no	0.005	NA	3,631.30	8.04E-01	202.16	202.16
ethylbenzene	no	0.005	NA	9,928.27	1.31E+00	834.37	834.37
xylenes	no	0.005	NA	2,920,000.00	6.08E+01	206,114.09	1,000.00
vinyl chloride	no	0.01	0.30	NA	1.00E-02	0.13	0.13
chloroethane	no	0.01	NA	3,693.46	2.32E+01	7,788.24	1,000.00
1,1-dichloroethylene	no	0.005	2.59	13,140.00	5.00E-03	0.05	0.05
1,1-dichloroethane	no	0.005	NA	1,386.78	6.40E-01	40.07	40.07
1,2-dichloroethylene (cis)	no	0.005	NA	14,600.00	3.04E-01	17.14	17.14
1,2-dichloroethane	no	0.005	91.96	438,000.00	5.00E-03	0.02	0.02
trichloroethylene	no	0.005	437.11	8,760.00	5.00E-03	0.08	0.08
1,1,1-trichloroethane	no	0.005	NA	5,600.68	1.29E+00	229.64	229.64
1,1,2-trichloroethane	no	0.005	391.20	5,840.00	5.00E-03	0.03	0.03
tetrachloroethylene	no	0.005	1,634.72	14,600.00	5.00E-03	0.23	0.23
1,1,1,2-tetrachloroethane	no	0.005	1,291.02	43,800.00	5.00E-03	0.08	0.08
1,1,2,2-tetrachloroethane	no	0.005	1,052.52	NA	5.00E-03	0.04	0.04
chloroform	no	0.005	92.76	14,600.00	5.00E-03	0.03	0.03
acetone	no	0.1	NA	146,000.00	3.04E+00	22.79	22.79
4-methyl-2-pentanone	no	0.05	NA	73,000.00	1.52E+00	68.15	68.15
methyl ethyl ketone	no	0.1	NA	9,032.18	9.18E-01	11.62	11.62
Aldrin	yes	0.00268	4.35	8.76	4.00E-05	0.01	0.01
gamma-BHC (Lindane)	yes	0.00603	392.31	87.60	9.00E-05	0.00	0.003
chlordane	yes	0.00938	368.21	17.52	1.40E-04	0.09	0.09
DDD	yes	0.00737	2,125.00	NA	3.54E-04	0.27	0.27
DDE	yes	0.00268	1,500.00	NA	2.50E-04	0.45	0.45
DDT	yes	0.00804	1,418.50	146.00	2.50E-04	0.79	0.79
dieldrin	yes	0.00134	31.87	14.60	2.00E-05	0.00	0.003
endosulfan sulfate	no	0.04422	NA	73.00	1.52E-03	2.01	2.01
endrin	yes	0.00402	NA	87.60	1.82E-03	1.69	1.69
heptachlor	yes	0.00201	55.28	146.00	3.00E-05	0.00	0.005
heptachlor epoxide	no	0.05561	56.04	18.98	8.30E-04	0.45	0.45
PCBs	yes	0.04355	66.23	NA	6.50E-04	4.23	4.23
lead	no	0.5	NA	NA	NA	NA	NA
cadmium	no	0.5	NA	730.00	1.52E-02	NA	730.00
silver	no	1	NA	7,300.00	1.52E-01	NA	7,300.00
mercury	yes	0.1	NA	87.60	1.82E-03	NA	87.60
chromium vi	no	1	NA	7,300.00	1.52E-01	NA	7,300.00
chromium iii	no	1	NA	1,460,000.00	3.04E+01	NA	10,000.00
barium	no	20	NA	102,200.00	2.13E+00	NA	10,000.00
arsenic	no	1	NA	438.00	1.00E-02	NA	438.00
antimony	no	6	NA	584.00	6.00E-02	NA	584.00
beryllium	no	0.5	118.60	7,300.00	5.00E-03	NA	118.60
cyanide	no	0.125	NA	29,200.00	6.08E-01	NA	10,000.00
nickel	no	4	NA	29,200.00	6.08E-01	NA	10,000.00
selenium	no	0.5	NA	7,300.00	1.52E-01	NA	7,300.00
vanadium	no	5	NA	10,220.00	2.13E-01	NA	10,000.00
zinc	no	2	NA	438,000.00	9.12E+00	NA	10,000.00

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

TABLE 14

REV: 11/01/93

SUMMARY OF TIER II CLEANUP GOALS FOR THE NON-RESIDENTIAL SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
naphthalene	no	10,000.00	10,000.00	4.09E+00
acenaphthylene	no	NA	NA	NA
acenaphthene	no	10,000.00	10,000.00	6.13E+00
fluorene	no	10,000.00	10,000.00	4.09E+00
phenanthrene	no	NA	NA	NA
anthracene	no	10,000.00	10,000.00	3.07E+01
fluoranthene	yes	10,000.00	10,000.00	8.18E-01
pyrene	no	10,000.00	10,000.00	3.07E+00
benzo(a)anthracene	yes	79.45	103.88	1.00E-02
chrysene	yes	7,945.21	10,000.00	3.92E-01
benzo(b)fluoranthene	yes	79.45	354.98	1.00E-02
benzo(k)fluoranthene	yes	794.52	3,759.12	3.92E-02
benzo(a)pyrene	yes	7.94	69.85	1.00E-02
indeno(1,2,3-cd)pyrene	yes	79.45	629.17	1.00E-02
dibenzo(a,h)anthracene	yes	7.95	69.86	1.00E-02
benzo(g,h,i)perylene	yes	NA	NA	NA
3,3'-dichlorobenzidine	no	128.89	12.86	2.00E-02
n-nitroso-di-n-propylamine	no	8.29	0.06	1.00E-02
bis(2-chloroisopropyl)ether	no	93.12	1.32	4.09E-02
4-chloroaniline	no	8,160.00	1,117.69	4.09E-01
2-chloronaphthalene	no	10,000.00	10,000.00	8.18E+00
2,4-dinitrotoluene	no	4,080.00	39.07	2.04E-01
hexachlorobutadiene	yes	1.78	31.18	3.67E-02
hexachloroethane	yes	408.00	3.31	2.04E-02
isophorone	no	10,000.00	256.03	3.01E+00
benzyl alcohol	no	10,000.00	4,356.75	3.07E+01
bis(2-chloroethyl)ether	no	4.06	0.06	1.00E-02
nitrobenzene	no	1,020.00	1.73	5.11E-02
1,2-dichlorobenzene	no	10,000.00	10,000.00	9.20E+00
1,3-dichlorobenzene	no	NA	NA	NA
1,4-dichlorobenzene	no	2,416.67	34.67	1.19E-01
1,2,4-trichlorobenzene	no	10,000.00	1,405.37	1.02E+00
hexachlorobenzene	no	6.87	101.56	1.00E-02
hexachlorocyclopentadiene	no	2.02	2.89	7.15E-01
n-nitrosodiphenylamine	no	10,000.00	567.80	5.84E-01
benzoic acid	no	10,000.00	10,000.00	4.09E+02
2-nitroaniline	no	42.90	2.08	5.00E-02
phenol	yes	10,000.00	658.78	1.23E+01
2-methylphenol	no	10,000.00	375.93	5.11E+00
3-methylphenol	no	NA	NA	NA
4-methylphenol	no	10,000.00	427.24	5.11E+00
2-chlorophenol	no	10,000.00	11.63	5.11E-01
2,4-dichlorophenol	no	6,120.00	15.12	3.07E-01
2,4,5-trichlorophenol	no	10,000.00	5,507.44	1.02E+01
2,4,6-trichlorophenol	no	1,922.89	30.65	2.60E-01
pentachlorophenol	no	483.33	24.95	5.00E-02
2,4-dinitrophenol	no	4,080.00	7.37	2.04E-01
bis(2-ethylhexyl)phthalate	yes	4,142.86	1,406.25	2.04E-01
butylbenzylphthalate	no	10,000.00	10,000.00	2.04E+01
di-n-butylphthalate	yes	10,000.00	6,188.56	2.04E+00
diethylphthalate	no	10,000.00	10,000.00	8.18E+01
di methyl phthalate	no	10,000.00	10,000.00	1.02E+03
di-n-octyl phthalate	no	10,000.00	10,000.00	2.04E+00

TABLE 14 (con't) REV: 11/01/93

SUMMARY OF TIER II CLEANUP GOALS FOR THE NON-RESIDENTIAL SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
benzene	no	16.63	4.77	9.86E-02
toluene	no	1,000.00	1,000.00	2.04E+01
ethylbenzene	no	1,000.00	1,000.00	1.02E+01
xylenes	no	1,000.00	1,000.00	2.04E+02
vinyl chloride	no	0.02	0.13	1.00E-02
chloroethane	no	1,000.00	1,000.00	NA
1,1-dichloroethylene	no	0.15	0.08	7.00E-03
1,1-dichloroethane	no	973.47	1,000.00	1.02E+01
1,2-dichloroethylene (cis)	no	1,000.00	102.49	1.02E+00
1,2-dichloroethane	no	5.27	0.37	3.14E-02
trichloroethylene	no	24.97	25.73	2.60E-01
1,1,1-trichloroethane	no	1,000.00	1,000.00	9.20E+00
1,1,2-trichloroethane	no	22.74	1.05	5.02E-02
tetrachloroethylene	no	101.23	8.01	5.61E-02
1,1,1,2-tetrachloroethane	no	75.91	7.24	1.10E-01
1,1,2,2-tetrachloroethane	no	75.41	0.21	1.43E-02
chloroform	no	5.28	20.33	4.69E-01
acetone	no	1,000.00	136.29	1.02E+01
4-methyl-2-pentanone	no	1,000.00	407.48	5.11E+00
methyl ethyl ketone	no	1,000.00	146.24	5.11E+00
Aldrin	yes	0.27	0.06	1.68E-04
gamma-BHC (Lindane)	yes	44.62	0.34	2.20E-03
chlordane	yes	24.48	4.51	2.00E-03
DDD	yes	241.67	48.34	1.19E-02
DDE	yes	170.59	80.49	8.41E-03
DDT	yes	153.01	141.83	8.41E-03
dieldrin	yes	3.62	0.06	1.79E-04
endosulfan sulfate	no	102.00	12.00	5.11E-03
endrin	yes	122.40	10.12	6.13E-03
heptachlor	yes	4.16	0.44	6.36E-04
heptachlor epoxide	no	6.37	0.45	8.30E-04
PCBs	yes	7.53	4.23	6.50E-04
lead	no	NA	NA	NA
cadmium	no	1,020.00	10,000.00	5.11E-02
silver	no	10,000.00	10,000.00	5.11E-01
mercury	yes	122.40	87.60	6.13E-03
chromium vi	no	10,000.00	10,000.00	5.11E-01
chromium iii	no	10,000.00	10,000.00	1.02E+02
barium	no	10,000.00	10,000.00	7.15E+00
arsenic	no	612.00	10,000.00	5.00E-02
antimony	no	816.00	10,000.00	6.00E-02
beryllium	no	13.49	118.60	5.00E-03
cyanide	no	1,000.00	1,000.00	2.04E+00
nickel	no	10,000.00	10,000.00	2.04E+00
selenium	no	10,000.00	10,000.00	5.11E-01
vanadium	no	10,000.00	10,000.00	7.15E-01
zinc	no	10,000.00	10,000.00	3.07E+01

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

TABLE 15
REV: 11/01/93

SUMMARY OF TIER II CLEANUP GOALS FOR THE RESIDENTIAL SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
naphthalene	no	10,000.00	1,761.78	1.22E+00
acenaphthylene	no	NA	NA	NA
acenaphthene	no	10,000.00	10,000.00	1.82E+00
fluorene	no	10,000.00	8,838.64	1.22E+00
phenanthrene	no	NA	NA	NA
anthracene	no	10,000.00	10,000.00	9.12E+00
fluoranthene	yes	2,160.00	2,305.04	2.43E-01
pyrene	no	8,100.00	10,000.00	9.12E-01
benzo(a)anthracene	yes	0.88	103.88	1.00E-02
chrysene	yes	87.67	379.27	1.16E-02
benzo(b)fluoranthene	yes	0.88	354.98	1.00E-02
benzo(k)fluoranthene	yes	8.77	501.64	1.00E-02
benzo(a)pyrene	yes	0.66	69.85	1.00E-02
indeno(1,2,3-cd)pyrene	yes	0.88	629.17	1.00E-02
dibenzo(a,h)anthracene	yes	0.66	69.86	1.00E-02
benzo(g,h,i)perylene	yes	NA	NA	NA
3,3'-dichlorobenzidine	no	1.42	12.86	2.00E-02
n-nitroso-di-n-propylamine	no	0.66	0.06	1.00E-02
bis(2-chloroisopropyl)ether	no	9.14	0.17	1.00E-02
4-chloroaniline	no	1,080.00	186.92	1.22E-01
2-chloronaphthalene	no	10,000.00	10,000.00	2.43E+00
2,4-dinitrotoluene	no	540.00	6.53	6.08E-02
hexachlorobutadiene	yes	8.21	6.78	1.00E-02
hexachloroethane	yes	45.07	1.15	1.00E-02
isophorone	no	673.68	1.43	8.95E-02
benzyl alcohol	no	10,000.00	728.62	9.12E+00
bis(2-chloroethyl)ether	no	0.66	0.06	1.00E-02
nitrobenzene	no	135.00	0.29	1.52E-02
1,2-dichlorobenzene	no	10,000.00	2,524.23	2.74E+00
1,3-dichlorobenzene	no	NA	NA	NA
1,4-dichlorobenzene	no	26.67	0.90	7.50E-02
1,2,4-trichlorobenzene	no	2,700.00	235.03	3.04E-01
hexachlorobenzene	no	0.66	101.56	1.00E-02
hexachlorocyclopentadiene	no	1,890.00	2.89	2.13E-01
n-nitrosodiphenylamine	no	130.61	3.18	1.73E-02
benzoic acid	no	10,000.00	10,000.00	1.22E+02
2-nitroaniline	no	16.20	2.08	5.00E-02
phenol	yes	10,000.00	110.17	3.65E+00
2-methylphenol	no	10,000.00	62.87	1.52E+00
3-methylphenol	no	NA	NA	NA
4-methylphenol	no	10,000.00	71.45	1.52E+00
2-chlorophenol	no	1,350.00	1.95	1.52E-01
2,4-dichlorophenol	no	810.00	2.53	9.12E-02
2,4,5-trichlorophenol	no	10,000.00	921.06	3.04E+00
2,4,6-trichlorophenol	no	58.18	0.25	1.00E-02
pentachlorophenol	no	5.33	24.95	5.00E-02
2,4-dinitrophenol	no	540.00	1.23	6.08E-02
bis(2-ethylhexyl)phthalate	yes	45.71	16.43	1.00E-02
butylbenzylphthalate	no	10,000.00	10,000.00	6.08E+00
di-n-butylphthalate	yes	5,400.00	1,034.97	6.08E-01
diethylphthalate	no	10,000.00	10,000.00	2.43E+01
di methyl phthalate	no	10,000.00	10,000.00	3.04E+02
di-n-octyl phthalate	no	5,400.00	2,318.85	6.08E-01

TABLE 15 (con't)
SUMMARY OF TIER II CLEANUP GOALS
FOR THE RESIDENTIAL SCENARIO

REV: 11/01/93

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
benzene	no	22.07	0.06	5.00E-03
toluene	no	1,000.00	202.16	1.00E+00
ethylbenzene	no	1,000.00	834.37	1.31E+00
xylenes	no	1,000.00	1,000.00	6.08E+01
vinyl chloride	no	0.34	0.13	1.00E-02
chloroethane	no	NA	1,000.00	2.32E+01
1,1-dichloroethylene	no	1.07	0.05	7.00E-03
1,1-dichloroethane	no	1,000.00	40.07	6.40E-01
1,2-dichloroethylene (cis)	no	1,000.00	17.14	3.04E-01
1,2-dichloroethane	no	7.03	0.02	5.00E-03
trichloroethylene	no	58.18	0.08	5.00E-03
1,1,1-trichloroethane	no	1,000.00	229.64	1.29E+00
1,1,2-trichloroethane	no	11.23	0.03	5.00E-03
tetrachloroethylene	no	12.55	0.23	5.00E-03
1,1,1,2-tetrachloroethane	no	24.62	0.08	5.00E-03
1,1,2,2-tetrachloroethane	no	3.20	0.04	5.00E-03
chloroform	no	104.92	0.03	1.00E-01
acetone	no	1,000.00	22.79	3.04E+00
4-methyl-2-pentanone	no	1,000.00	68.15	1.52E+00
methyl ethyl ketone	no	1,000.00	11.62	9.18E-01
Aldrin	yes	0.04	0.01	4.00E-05
gamma-BHC (Lindane)	yes	0.49	0.003	2.00E-04
chlordane	yes	0.49	0.09	2.00E-03
DDD	yes	2.67	0.27	3.54E-04
DDE	yes	1.88	0.45	2.50E-04
DDT	yes	1.88	0.79	2.50E-04
dieldrin	yes	0.04	0.003	2.00E-05
endosulfan sulfate	no	13.50	2.01	1.52E-03
endrin	yes	16.20	1.69	2.00E-03
heptachlor	yes	0.14	0.005	4.00E-04
heptachlor epoxide	no	0.07	0.45	8.30E-04
PCBs	yes	0.08	4.23	6.50E-04
lead	no	NA	NA	NA
cadmium	no	135.00	730.00	1.52E-02
silver	no	1,350.00	7,300.00	1.52E-01
mercury	yes	16.20	87.60	2.00E-03
chromium vi	no	1,350.00	7,300.00	1.52E-01
chromium iii	no	10,000.00	10,000.00	3.04E+01
barium	no	10,000.00	10,000.00	2.13E+00
arsenic	no	81.00	438.00	5.00E-02
antimony	no	108.00	584.00	6.00E-02
beryllium	no	0.50	118.60	5.00E-03
cyanide	no	1,000.00	10,000.00	6.08E-01
nickel	no	5,400.00	10,000.00	6.08E-01
selenium	no	1,350.00	7,300.00	1.52E-01
vanadium	no	1,890.00	10,000.00	2.13E-01
zinc	no	10,000.00	10,000.00	9.12E+00

NOTES: a – Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b – Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* – Assumes TEF approach.

NA – Data not available or not applicable.

APPENDIX B

FACT SHEET

THE TORRINGTON COMPANY FACT SHEET

The Torrington Company (Torrington) operated a heavy bearings manufacturing facility at 3702 West Sample Street in South Bend, Indiana, between 1935 and 1983. Torrington purchased the operations from the Bantam Bearings Corporation which began manufacturing at the facility in 1928. Following closure of the facility in 1983, Torrington transferred ownership of the facility to the Urban Enterprise Association (UEA) of South Bend, Indiana.

As a result of transfer negotiations with the UEA, several environmental assessments were performed. The investigations revealed the presence of chlorinated volatile organic compounds (VOCs) and petroleum hydrocarbons in the soil and ground water at the site. VOCs are commonly used in industry for parts cleaning and degreasing and petroleum hydrocarbons (cutting and lubricating oils, coolants, and so forth) are also commonly used in industry.

Torrington began an environmental investigation of the situation and retained Capsule Environmental Engineering, Inc. (Capsule) of St. Paul, Minnesota, to provide technical assistance and project oversight. The impacted soil and ground water were reported to the Indiana Department of Environmental Management (IDEM).

Capsule has directed a program to determine the extent of the impacted soil and ground water. So far, the investigation has resulted in Torrington installing one cleanup system in 1992 to remove free-phase petroleum hydrocarbons from the ground water near the southwestern corner of the facility. The system uses a well outfitted with a two-pump configuration to remove contaminated ground water and free-phase petroleum hydrocarbon.

Additional investigation since that time has resulted in the design of a full scale system to address the impacted soil and ground water at the site. The system will consist of two parts, one that will remove VOCs from the soil and one that will remove VOCs from the ground water. A work plan and engineering design has been completed for the full scale system and it is anticipated to be operational in early 1995.

Torrington continues to work aggressively to address this environmental condition. In addition, the UEA has been actively involved with and approved what Torrington has done to address this condition. If you have any questions, please contact Jay Mattsfield, the Capsule project manager, or Dan Reinke, the Capsule project engineer, at (800) 328-8246.

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We make Indiana a cleaner, healthier place to live

Evan Bayh
Governor
Kathy Prosser
Commissioner

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P.O. Box 6015
Indianapolis, Indiana 46206-6015
Telephone 317-232-8603
Environmental Helpline 1-800-451-6027

December 5, 1994

FILE
ID# 105-434
SERVICE: Remed
BG, OF, CO, MD, FL
SAV/HAZ SPACE DESIGN
CORRESPONDENCE:

PERMITS
DEC 13 1994
CAPSULE

Certified Mail Z 339 826 478

The Torrington Company
59 Field Street
Torrington, Connecticut 06790

Attention: Jay Mattsfield - Project Manager

Re: Exempt Construction and Operation Status
CP# 141-4182
ID# 141-00070

Ladies and Gentlemen:

The Torrington Company application has been reviewed. Based on the data submitted and the provisions in Section 1 of 326 IAC 2-1, it has been determined that the following, to be located at 3702 West Sample Street, South Bend, Indiana is classified as exempt from air pollution permit requirements:

One (1) Soil and Groundwater Remediation System consisting of the following equipment:
Three (3) Air sparging wells, each connected to One (1) Electric air compressor.

One (1) Vacuum/Condensate Tank, Capacity: Sixty (60) gallons, connected via auxillary piping and controls to: Eleven (11) Pressure relief vents, Eleven (11) Soil vapor extraction wells, One (1) Condensate Pump, and One (1) Vacuum Pump, exhausting through Stack 001, Height: 35 feet, diameter: 0.51 feet, Gas discharge temperature: 260°F, Gas flow rate: 690 acfm.

One (1) Soil and Groundwater Remediation System consisting of the following equipment:
Three (3) Air sparging wells, each connected to One (1) Electric air compressor.

One (1) Vacuum/Condensate Tank, Capacity: Sixty (60) gallons, connected via auxillary piping and controls to: Seven (7) Pressure relief vents, Eleven (11) Soil vapor extraction wells, One (1) Condensate Pump, and One (1) Vacuum Pump, exhausting through Stack 002, Height: 30 feet, diameter: 0.51 feet, Gas discharge temperature: 260°F, Gas flow rate: 560 acfm.

On October 1, 1993 the Indiana Department of Environmental Management published a first notice of rulemaking which addressed possible future revisions to solid waste and air pollution control rules. These rulemaking revisions apply to facilities which process petroleum contaminated soils. This proposed operation may be subject to any rules that are derived from this rulemaking. This exemption does not apply to any other future state or federal rulemakings requirements. You are urged to participate in any future rulemakings regarding this matter.

The Torrington Company
South Bend, Indiana
CP# 141-4182

Any change or modification which may increase the potential emissions to 15 pounds of volatile organic compound per day or more from the equipment covered in this letter must be approved by the Office of Air Management before such change may occur.

Sincerely,

Timothy J. Method, Acting Branch Chief
Permit Branch
Office of Air Management

KAW/kaw
cc: St. Joseph County Health Department
Northwest Office
Compliance Branch - Tracking
Data Support Section

FIGURE 1

SPARGING/SVE AREAS OF CONTAMINATION MAP

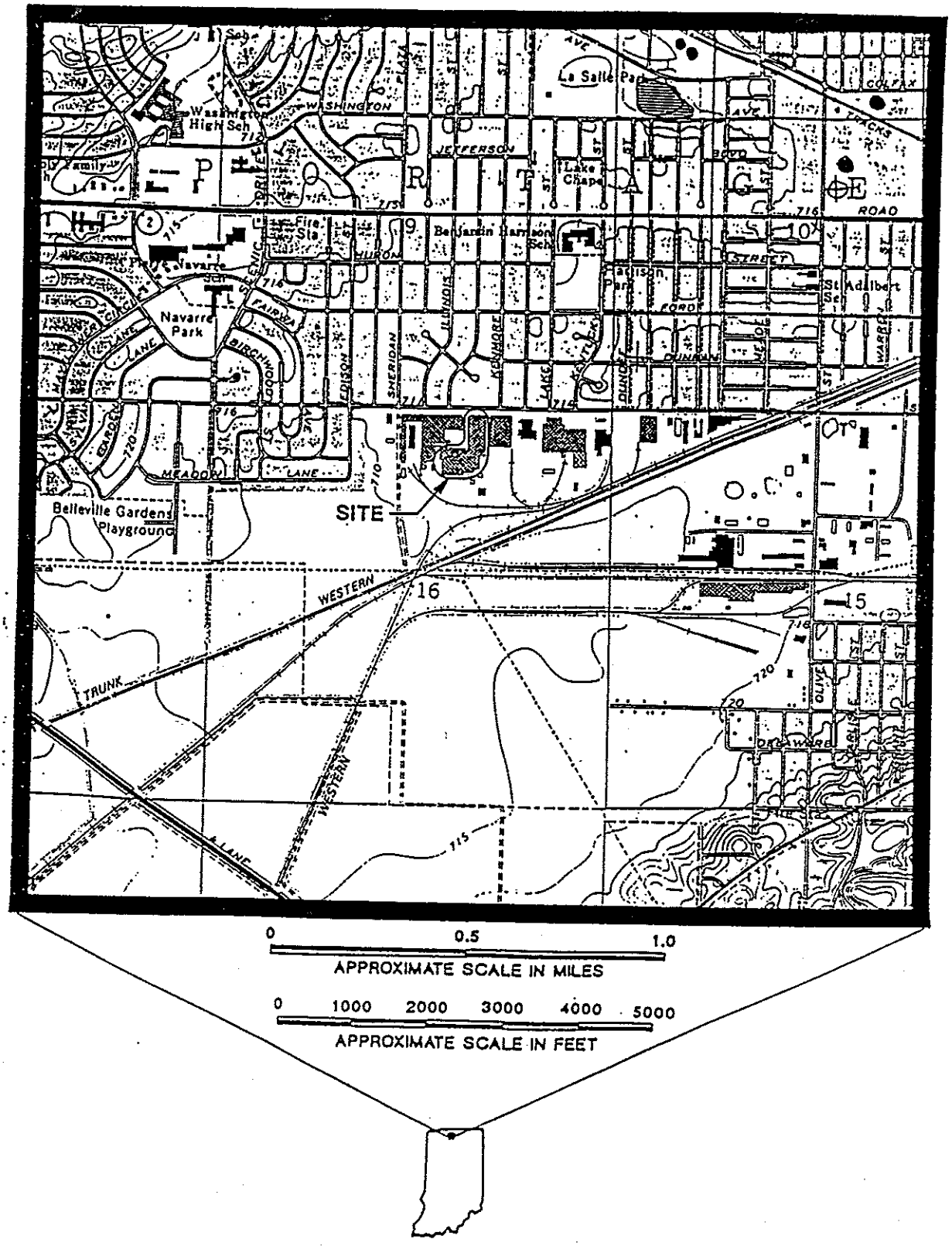
FIGURE 2

SPARGING/SVE DESIGN LAYOUT MAP

FIGURE 3

SITE LOCATION MAP

SOURCE: U.S. GEOLOGICAL SURVEY; 7.5 MINUTE SERIES (TOPOGRAPHIC)
SOUTH BEND WEST, INDIANA QUADRANGLE; PHOTOREVISED 1986.



THE TORRINGTON COMPANY
3702 WEST SAMPLE STREET
SOUTH BEND, INDIANA

CAPSULE
ENVIRONMENTAL ENGINEERING INC.
1970 Oakcrest Avenue, Suite 215
St. Paul, Minnesota 55113
(612) 636-2644

SITE LOCATION MAP

FIGURE 3

APPENDIX C

EXEMPT CONSTRUCTION AND OPERATIONS STATUS OF AIR PERMIT