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SOIL MANAGEMENT PLAN
EAST FIFTH AND BELL STREETS
DUBUQUE, IOWA

Project Number 07037005
August 18, 2006

Prepared for:

CITY OF DUBUQUE
Dubuque, Iowa

Prepared By:

TERRACON
Bettendorf, Iowa

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August 18, 2006

City of Dubuque
50 West 13th Street
Dubuque, Iowa 52001

Attention: Mr. Aaron DeJong
Assistant Economic Development Director

Re: Soil Management Plan
East Fifth and Bell Streets
Dubuque, Iowa
Terracon Project Number 07037005

Dear Mr. DeJong:

Terracon is pleased to present this Soil Management Plan (Plan) for the above referenced site. This Plan is in support of an Iowa Department of Natural Resources (IDNR) "Comfort Letter" for the East Fifth and Bell Streets site in Dubuque, Iowa. This property has been assessed using IDNR LRP risk-based protocols for the purpose of Brownfields redevelopment.

This Plan cannot be all inclusive nor anticipate every future condition involving workers or construction for on-site activity involving on-site soils. Rather, the Plan serves as a risk management advisory to persons and contractors involved with this property. The Plan attempts to instill a sense of total risk management to maintain the conditions which originally allowed closure and protection of public health and the environment.

Terracon appreciates this opportunity to provide environmental engineering services for the City of Dubuque. Should you have any questions or require additional information, please do not hesitate to contact our office.

Sincerely,
Terracon

J. David Wildharber, G.R.I.T.
Geologist

John F. Brimeyer, P.E.
Environmental Manager

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SOIL MANAGEMENT PLAN
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DUBUQUE, IOWA

Project Number 07037005
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1.0 INTRODUCTION

Previous site assessment activities identified the presence of uncontrolled fill, consisting primarily of building debris, sand and silty clay, across the site. Fill material was encountered to a depth of at least 18 feet on the site. Chemical impact associated with the fill material may exceed Statewide Standards established by the Iowa Department of Natural Resources (IDNR). Although many chemicals observed in property soils may be naturally occurring, identified impact appears to be associated with a random isolated "hotspot" in the fill material. These impacts have been evaluated for protection of public health and environment under direction and guidance of the IDNR. Risk-based evaluation of the identified chemical impact has been conducted in support of an IDNR issued "Comfort Letter".

Property conditions were evaluated using IDNR risk-based protocols for protecting public health and the environment. The program of drilling, sampling and testing has been conducted in support of an IDNR "Comfort Letter" for this site. Impairment does not pose a threat of immediate (acute) harm to workers or occupants of the property. Conditions are generally considered to be protective of human health and the environment providing the following occurs:

- The installation of drinking water wells is prohibited in the Port of Dubuque area.
- Soils with chemical impact remain where they are and disturbances are minimized.
- Property workers are informed of soil conditions relating to construction or maintenance.

Redevelopment of the site is part of an Iowa and national effort to bring abandoned, idled or under-used properties back to productive reuse. These properties are commonly called "brownfields", as opposed to locating new construction on previously undeveloped "green fields" at the edges of our cities.

This Soil Management Plan serves to inform workers as to the conditions of impairment. This plan provides the following information specific to soil conditions observed on this lot;

- General summary of conditions of chemical impairment, chemicals of concern and past assessment and evaluation under IDNR
- Generic discussions of public health issues relative to chemicals of concern
- Hazard recognition procedures in working with soils at the site
- Hazard response procedures, if needed, in working with soils at the site

- Suggested procedures regarding excavation, handling, storage, and disposal of excess soils at the site

2.0 PURPOSE

Contractors performing excavation or other activities that disturb soils at the site in Dubuque, Iowa, have the right to know that the soils they encounter are known to contain low concentrations of lead and polynuclear aromatic hydrocarbons (PAHs). It should be understood by site workers that the concentrations of the residual contaminants that may be encountered are of low concentration. Exposure and potential adverse health effects can be avoided if certain work precautions are practiced.

Lead is present in the site soils at a maximum concentration of 599.3 mg/kg, which exceeds the IDNR Statewide Standard of 400 mg/kg. The isolated lead "hot spots' appear to be the result of uncontrolled on-site fill activity identified in prior investigations.

Lead concentrations above the IDNR Statewide Standard were reported in one of 15 (6.7%) soil samples submitted during Terracon's Phase II and supplemental Phase II investigations. Under Iowa Administrative Code (IAC) 137.10(5).a(1), in order to demonstrate compliance with the Statewide Standard, 75% of soil samples submitted for lead analysis shall be less than or equal to the Statewide Standard with no sample exceeding the Statewide Standard by a factor of ten (75/10 rule). Therefore, under IAC 137.10(5).a(1), compliance with the Statewide Standard was demonstrated.

PAHs including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene were identified in soils samples submitted during Terracon's Phase II and supplemental Phase II investigations. The observed PAH impact appears to be associated with random isolated "hot spots" from uncontrolled fill activity. Review of the analytical sample indicates that the 75/10 rule is met for the PAHs listed.

No environmental investigation can identify every location where impact may be present; however, the potential exists for the other compounds to be present. Proposed construction activities including excavation, utility installation, and footing placement may expose on-site workers to residual chemical impact.

This plan serves as an educational document to construction workers involved with soils on this property. The plan is intended to instill in the mind of the reader the concept and value of soil management and to provide contractors with knowledge. The plan provides an awareness of the conditions of the property observed during sampling and testing completed to be issued a "Comfort Letter" by the IDNR.

The plan provides contractors involved in construction with information for use in executing employer obligations for employee-right-to-know and responsibilities for worker safety supplemental to other programs of regulation. The plan provides general guidelines for minimization of potential exposures of occupants or workers to soils having chemical impact.

The plan provides for a process of observation and recognition to identify if conditions during construction differ significantly from those observed during testing and sampling. The plan provides a process for qualitatively and quantitatively identifying if the changed condition presents a potential hazard condition different from conditions evaluated.

The plan is not intended for direct, unmodified use by employers to protect workers. Rather this plan intends to provide general considerations and procedures for modification and incorporation by employers into their existing worker safety programs.

This document will discuss the previous use of land in this area and identify the contaminants that have been previously identified in site soils. Anticipated maximum contaminant concentrations and potential health effects of these compounds are addressed, as are the steps that should be taken to minimize exposure to construction personnel.

The purpose of the information provided herein is to inform construction personnel of potential contaminants present in site soils, and to identify work practices that should be used to reduce the potential for inhalation or ingestion of potential soil contaminants.

3.0 SITE HISTORY

The subject site was historically a slough from at least 1884 until at least 1909, and partially a slough until at least 1950. A portion of the subject site was developed as a sawmill by at least 1950, and apparently, completely as a sawmill facility by at least 1960. The site was observed to be vacant grass-covered land at the time of supplemental Phase II activities.

As part of the USEPA Brownfields Project for the Port of Dubuque, Terracon conducted a Phase I Environmental Site Assessment[1] (ESA), a Phase II ESA[2], and a supplemental Phase II ESA[3] of the subject site. Phase II assessment was conducted by Terracon to

[1] Phase I Environmental Site Assessment, Port of Dubuque Brownfields Redevelopment Project, EPA Region 7 Brownfields Assessment Demonstration Project, Southwest Corner of Bell and East 5th Streets, Parcel Number 1130110007, Dubuque, Iowa, *Terracon Project No. 07037005, April 18, 2005.*

[2] Phase II Environmental Site Assessment, Port of Dubuque Brownfields Redevelopment Project, An EPA Region 7 Brownfields Assessment Demonstration Pilot, Southwest Corner of Bell and East 5th Streets, Dubuque, Iowa, *Terracon Project No. 07037005, June 21, 2005.*

[3] Supplemental Phase II Environmental Site Assessment, East Fifth and Bell Streets, Port of Dubuque Brownfields Redevelopment Project, Dubuque, Iowa, *Terracon Project No. 07037005, June 29, 2006.*

determine if the RECs identified in the Phase I ESA resulted in environmental impairment to the subject site. Based on the results of the assessment, reported concentrations of lead and PAHs in soil, and arsenic and pesticides in groundwater exceeded Statewide Standards. The supplemental Phase II ESA was conducted based on comments from the IDNR. Laboratory data obtained from Phase II and supplemental investigation have demonstrated compliance with Statewide Standards under IAC 137.10(5).a(1). Terracon has requested a "Comfort Letter" from the IDNR and has developed this Soil Management Plan in support of the "Comfort Letter".

4.0 POTENTIAL SITE CONTAMINANTS

A summary of contaminants exceeding the Statewide Standards and the maximum concentrations identified in soils during the Terracon Phase II assessment are presented below. Copies of toxicological data fact sheets are attached as Appendix A.

Permissible Exposure Levels

Contaminant	OSHA Permissible Exposure Limit	Maximum Contaminant Concentration (soil)
Lead	0.05 mg/m^3	599.3 mg/kg
PAHs	0.2 mg/m^3	Benzo(a)anthracene – 7.1 mg/kg Benzo(a)pyrene – 6.8 mg/kg Benzo(b)fluoranthene – 8.6 mg/kg

mg/m^3 – milligrams per cubic meter
mg/kg – milligrams per kilogram, generally equivalent to parts per million

A Permissible Exposure Limit or PEL, is defined by the Occupational Safety and Health Administration (OSHA) as the maximum average level of a substance in air to which most workers may be exposed 8-hours a day, 40-hours a week without adverse heath effect. The PELs are based on scientific studies of the health effects of chemicals in animals and humans. Eight-hour exposures below the PEL are considered to pose negligible short and long-term health risks to most workers. However, prolonged exposure to contaminants at concentrations above the PEL may lead to harmful short or long-term health effects. PELs refer to breathable concentrations of chemical substances in air. The PELs do not apply to skin contact with, or to accidental swallowing of the compounds.

5.0 HAZARD ASSESSMENT

The contaminant compounds listed above are the principal contaminants of concern previously identified during assessment activities at this project site. Soils at the site have been identified as containing elevated concentrations of lead and PAHs, most probably

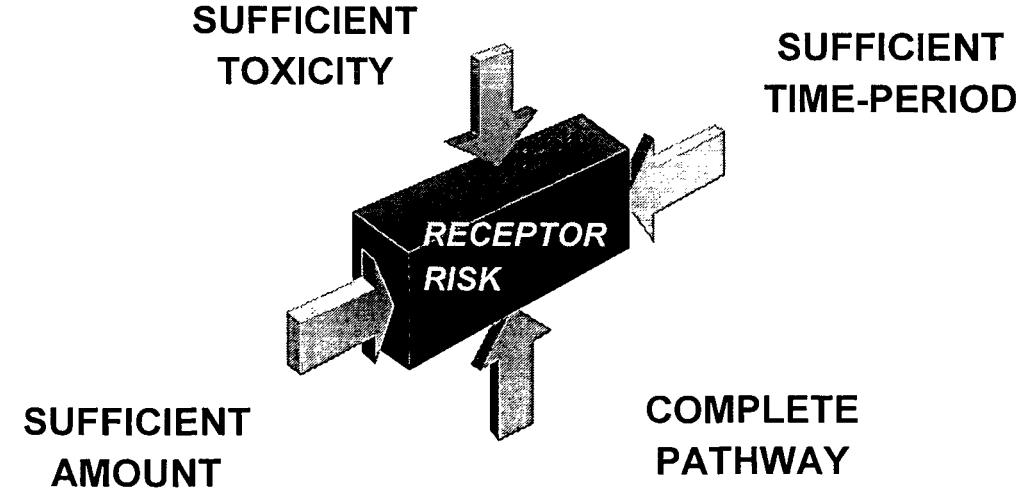
associated with random isolated "hot spots" resulting from uncontrolled fill on the site. Disturbance of soils at this site could expose personnel to this compound. The contaminants at the concentrations previously identified pose a minimal skin contact hazard. The primary exposure pathway is by accidental ingestion. Considering the maximum concentrations identified in site soils, the potential for exposures exceeding PELs is improbable. The use of good personal hygiene practices and gloves will reduce the potential for exposure by the ingestion pathway.

5.1 Chemical Risk

Chemical compounds make up everything physical in our lives. Most occur naturally, with thousands of man-made chemical compounds merely being manufactured or combined versions of natural chemical elements.

Humans are exposed to thousands of natural and man-made chemicals every day. They are in the water we drink, the air we breathe and in the materials and equipment we use daily in our personal and working lives. All of these chemicals could possibly cause us harm if they were encountered in sufficient amounts, if sufficient exposure occurred, and if enough material entered the body to produce a negative effect.

Excess chemical risk requires a chemical of sufficient toxicity, exposure to a sufficient amount over a sufficient time-period, and a complete pathway for the exposure to occur to produce excess, or unacceptable, chemical risk to the public.



5.2 Chemical Toxicity

When the amount of material helps (as in the case of medicine) or does not harm the body, a condition of acceptable chemical risk exists. When a chemical exceeds the amount where

it can begin to do harm immediately or over a long period, a condition of unacceptable risk is felt to exist. It is at this point of unacceptable risk where a chemical becomes harmful, or toxic. A chemical becomes toxic when the amount of material which enters the body begins to produce harm. If the harm is realized in a relatively short period (minutes, days or weeks), the material is said to have an acute toxicity. If harm is realized over a relatively long period (years, decades or a person's lifetime), the material has a chronic toxicity.

For example, a chemical used as a pain killer in medicine;

- In proper doses and short periods of exposure, has a beneficial medicinal effect.
- Used improperly in small doses over time (addiction), has a negative chronic effect.
- Used improperly in large doses (overdose), has a negative acute effect.

The IDNR does not make its own studies to determine a chemical's toxicity. The IDNR relies on the same chemistry and toxicity studies conducted by the United States Environmental Protection Agency (USEPA) used to set national levels of protection for our air and drinking water. These were used to calculate the statewide remediation objectives used to evaluate the site.

The Iowa programs must determine a level of target risk that is acceptable. For chemicals in Iowa the target risk for a chemical is to produce cancer effects as less than one additional cancer occurrence in one million, or 1-in-1,000,000. In comparison, workplace standards to protect workers from chemical exposure are often calculated using 1-in-10,000 risk levels. For chemicals which might produce other non-cancer health effects, the level is calculated to be protective of no ill effect over an average person's lifetime.

5.3 Exposure

Exposure is the manner in which a chemical encounters a body. Exposure consists of three basic parts;

- The physical material, or media, that carries the chemical to the body. For the site, this was determined to be soils with chemical impact above objectives.

- The period of time, or duration, that the body occupies the site impacted by the chemical. Under IDNR programs, this assumes 30 years residential occupancy at a site, 25 years for commercial occupancy, and 1 year for construction worker occupancy.

- The number of times, or frequency, that the contact and chemical delivery might occur during occupancy. Under IDNR programs, exposure frequency is assumed to occur 350 days per year for residential occupants, 250 days per year for commercial occupants, and 30 days per year for construction workers. A day is considered 24 hours.

In comparing to the objectives, it was assumed that the person is theoretically exposed to the maximum amount of chemical measured at the site. Chemical measurements at the site were typically less than the maximum used for comparison.

5.4 Completing Exposure Pathways

An exposure pathway is the physical manner in which the chemical moves from its source to enter the body to do harm. An exposure pathway for this lot was complete if the soils with chemicals are actually available to a person or if there is a likelihood in the future that this condition could occur. Basic considerations in determining pathway completions for the site were;

- Soils with impact below 3 feet from the surface are not available for exposure to commercial occupants through ingestion or skin contact.
- Soils with impact below 10 feet from the surface are not available for exposure to commercial occupants through inhalation of volatile chemical compounds.
- Soils beneath permanent buildings, pavement or other physical structures are not available for exposure to commercial occupants through ingestion or inhalation.
- Soils at any depth with chemical impact could be available for exposure to construction workers or maintenance workers disturbing soils in the course of construction or repairs, although individual exposures will likely be less than the 30 days per year, 24 hours per day assumed for.

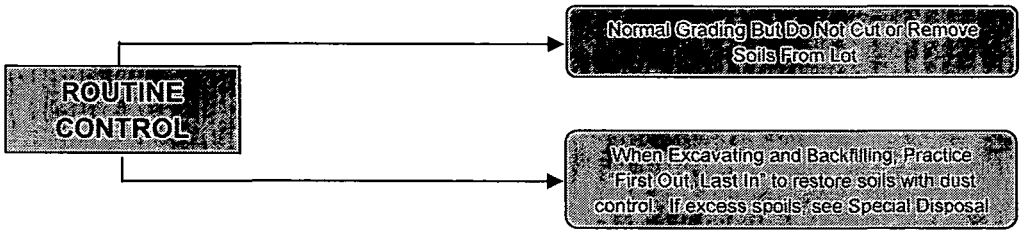
The analysis presented in this Soil Management Plan (Plan) is based upon data obtained from field activities and from other information discussed in this document. This Plan does not reflect any variations in subsurface stratigraphy which may occur between sample locations or across the site. Actual subsurface conditions may vary. The extent of such variations may not become evident without additional exploration.

6.0 CONTAMINANT EXPOSURE PRECAUTIONS

This Plan recognizes that initial and future construction will disturb soils at the site and that unplanned or yet unknown activities might expose workers to the chemicals identified in soils. The site investigation was comprehensive; however no testing and analysis program can test everywhere. Unknown conditions could occur between testing locations. The Plan must provide workers with precautionary measures to recognize and address potential new discoveries on the site.

6.1 Routine Control

Incidental disturbance of soils should be avoided. Earthwork and other necessary construction should be planned to minimize disturbance of soils from original locations and original elevations. Soils disturbed in construction should be restored whenever possible to original elevations. The worker or contractor must have a physical method of measuring and monitoring horizontal and vertical control when disturbing soils on the site to maintain the current conditions.



During routine operations involving soils on this lot, the worker should use normal construction safety apparel of their respective contractor's safety program, augmented with gloves to reduce soil contact. For purposes of this plan, this is referred to as Level 1 Safety.

For work beyond routine control, a site health and safety plan should be developed. The contractor may contact the environmental engineer for assistance if their firm does not have the necessary resources training to complete a site-specific health and safety plan under 29 CFR 1910.

6.2 Dust Control Measures

Dust control measures should be employed during excavation activities at the site. Personnel operating mobile equipment at this sire are instructed to drive slowly to reduce dust generation. Low tipping of excavated loads, and if surface materials are dry, covering of stockpiles should be used to limit the generation of visible airborne dusts. Use of a water spray unit to dampen surface materials should be considered if visible dusts are generated during excavation and soil movement. Construction personnel should avoid over-spraying the area to prevent run-off and mud-slick work surfaces.

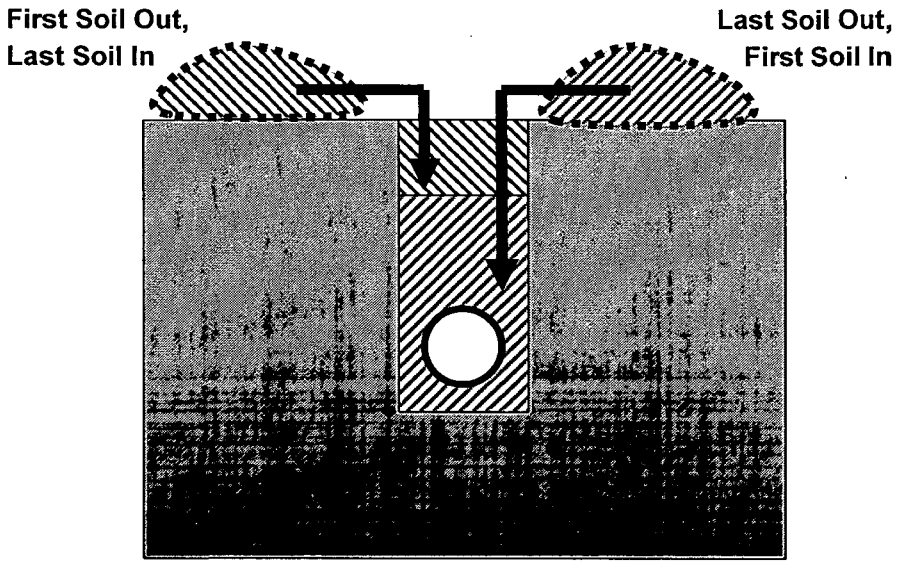
6.3 Surface Grading

When working at existing grades, workers should minimize the movement of surface soils from their original location to other areas of the site. Contractors should plan their work to account for minimal soil movement and to adapt types and application of grading equipment to this end.

Surface disturbances such as rutting should be repaired immediately by localized leveling. Contractors involved in grading should minimize leveling of the surface through "back-dragging" by earthmoving equipment until imported fills have been placed. The Plan recognizes that absolute restoration of materials to original locations is difficult. However, workers should attempt to restore soils to original conditions as is practical.

6.4 Underground Excavation and Trenching

Vertical control of soils is very important. The Plan recognizes the construction of utilities or other structures will disturb the vertical positions of soil/fills. The general rule will be to remove and stockpile soils so that a "last out, first in" process occurs. For example, during excavation soils in the upper three feet should be stockpiled to one side and are the first materials removed. These soils should be the last returned to the excavation during backfill. Similarly soils removed from below three feet should be replaced first.



Concerns and methods for environmental handling of soils do not preclude nor modify any of the OSHA requirements for worker safety incumbent upon contractors for regular site safety and trenching/excavation activities. OSHA requirements will dictate adjustment of the soil management method where necessary.

Installation of utilities or structures may displace soil volume in these zones, resulting in excess soils as excavation spoils. Excess spoils from excavations not needed on the site will require special handling and disposal. See discussion later on Disposition of Excess Soils.

7.0 PERSONAL PROTECTION

7.1 Skin Protection

It is recommended that construction personnel begin project activity in the following work attire.

- Standard work uniform
- Rubberized safety footwear or safety footwear with disposable latex covers
- Hard hat
- Cotton lined impermeable gloves of nitrile rubber or PVC

In order to minimize the potential for carrying contaminated soils off-site that could later be accidentally ingested by site workers or family members, especially children, it is suggested that clothing soiled on site be changed at the project site or removed and laundered as soon as possible following each work day. Do not wear garments soiled on site until they have been laundered. It is recommended that soiled clothing be laundered separately from other articles of clothing.

7.2 Personal Hygiene

Site personnel are advised to use good personal hygiene practices during activities that disturb soils at this project site. It is recommended that work gloves as outlined above be worn and that hands, face and forearms be washed with soap and water prior to eating, drinking, smoking, or using the restroom facilities. Personnel should avoid chewing gum and tobacco, and refrain from any other behavior that could increase the possibility of hand-to-mouth transfer of potentially contaminated soils.

7.3 Decontamination

Contractors should use brushes, shovels etc. to conduct gross soil removal on equipment used to excavate or move soils at this project site. Considering the low levels of potential site contaminants, decontamination with high-pressure wash is not considered mandatory, however, it may be considered by contractors performing work at the site.

Personnel decontamination should consist of thorough washing of hands, forearms and face before eating, drinking, or smoking. Gross soils should be removed from footwear before leaving the project site. As indicated above, wash hands, face, and forearms with soap and water after removing gloves. It is recommended that a full-body shower be taken as soon as possible upon completion of the work shift. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of potentially contaminated soils must be avoided in the work area.

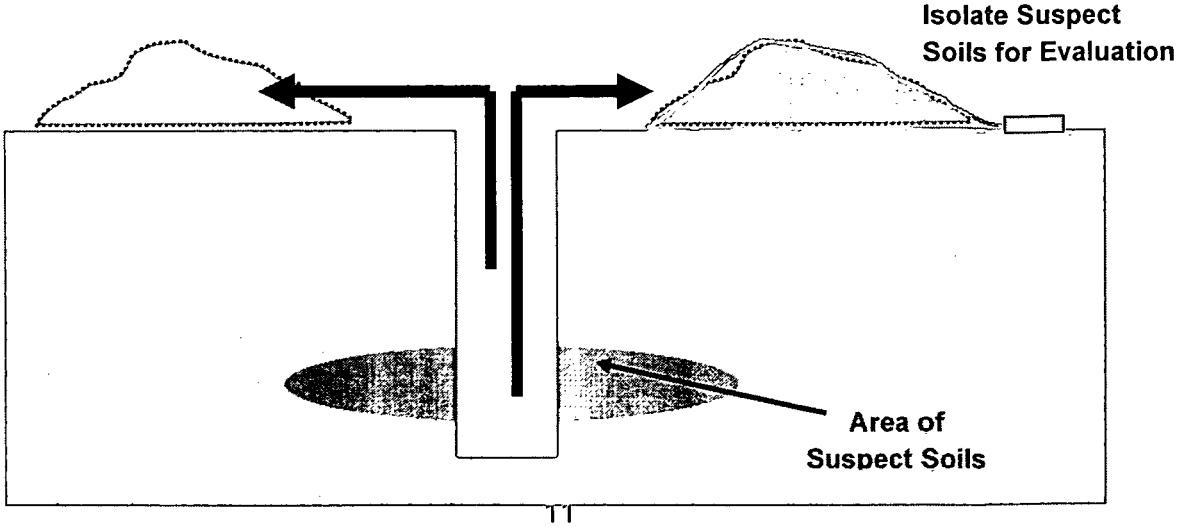
8.0 CHANGED CONDITIONS

If chemical odors, stained or saturated soils, or other evidence of potential chemical contamination of soil is encountered during excavation activities at this project site, it is recommended that a qualified individual mobilize to the project site with a direct reading air monitoring instrument such as a photoionization detector or flame ionization detector. Air monitoring in the breathing zone of site workers should be conducted to determine the potential for exposure to volatile organic compounds. Personnel should be advised to don impermeable gloves of butyl or neoprene rubber and rubberized outer footwear. If clothing contact cannot be avoided, personnel should don outer coveralls such as polycoated Tyvek® or rain gear to prevent clothing contact with contaminated soils. If screening of the atmosphere in the breathing zone of site workers demonstrates sustained airborne concentration of volatile organic compounds above 10 parts per million (ppm), it is recommended that samples of the contaminants be collected and analyzed, and that a modification of this plan be developed to include air monitoring "action levels" and provisions for possible upgrade to respiratory protection.

8.1 Isolate Suspect Soils

Contractors should upgrade normal construction safety attire with rubber gloves, and in the case of odors, provide sufficient open air ventilation consistent with his employer's safety plan.

The suspect soils should be isolated as soon as possible from contact and disturbance by rain and wind until evaluation of the materials can be completed. Suspect soils should be placed on and covered with plastic sheeting. The plastic sheeting should be weighted with planks or sandbags. Do not remove the soils from the excavated area unless they are placed in a container with total enclosure, such as a waste dumpster.



Until the spoils are covered, construction flagging tape attached to stakes can be used to prevent accidental movement of the soils by earthwork operations.

8.2 Measurement of Changed Condition

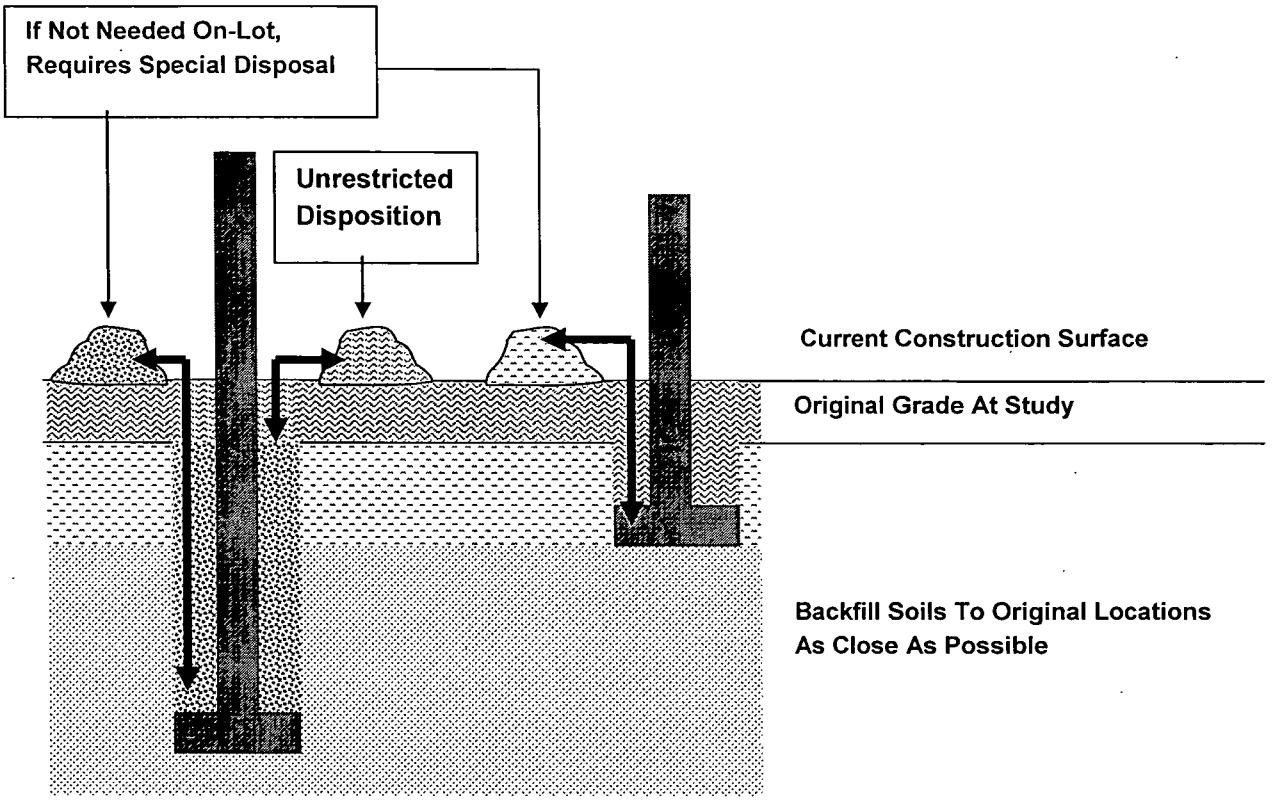
Upon discovery of a possible changed condition, it is necessary to make detailed chemical measurements to determine if chemicals in soil actually pose an excess chemical risk. This requires testing in the laboratory. Laboratory testing requires time. The amount of time varies depending on the type of test. In general, the laboratory analysis can take on the order of 10-15 days unless special arrangements are made with the laboratory for more expensive "RUSH" results.

The soils should be further isolated from worker and public exposure. Special handling and care must be taken in sampling and transporting soils for the laboratory tests to be accurate. The workers in physical contact with soils should have training consistent with 29 OSHA 1910.120. Alternatively, the contractor may elect to contact the environmental engineering firm to assist with containment and sampling activities.

9.0 DISPOSITION OF EXCESS SOILS

Soils at this site have varying degrees of chemical impacts, ranging from no measurement to elevated concentrations of chemicals of concern. In the locations and at conditions of exposure evaluated by the assessment activities, these chemical impacts do not pose excess chemical risk as determined by the IDNR program. If soils leave their original locations or the site, the on-site conditions which allow control of exposures and risk management may no longer apply. If excess soils are produced from excavation as spoils which cannot be restored to original depths through the process of "first out, last in", they must be handled with special care.

The contractor should plan from onset of construction to maintain physical segregation of soils by degrees of depth during excavation activity. The worker or contractor must exercise care in documenting and recording the location and original elevations of the source of soils relative to site benchmarks and the original lot boundaries.



Excess soils produced by excavation and construction which cannot be used on the lot must be managed as discussed.

9.1 On-Site Disposition

Excess soil generated as excavation spoils will require testing consistent as described. If the laboratory testing indicates that chemicals are less than the Statewide Standard, the material is considered "clean" soil and can be reincorporated into the project as fill material.

9.2 Off-Site Removal

Soils which are not eligible for on-site redistribution must be removed from the site. The contractor should isolate, and preferably contain, these soil for testing as done for suspect soils of new discovery. The contractor should seek assistance in these efforts from an environmental consultant relative to proper disposal of soil off-site.

Some alternative reuse relative to construction (i.e., landscaped berms, fill under roadways) might be coordinated for the project. However, this would not be a fast process and would require considerable pre-planning. The routine removal and off-site disposal of soil should

be considered and planned for as transport and disposal to a landfill facility. Soils identified to date with chemical impact should be allowed for disposal at a local sanitary landfill permitted for waste disposal, known as a Subtitle D solid waste facility.

The landfill may require additional laboratory testing prior to accepting the soil material for disposal to demonstrate the material is not a hazardous waste. The landfill may allow disposal on the basis of testing conducted previously for the closure of the site. Only the landfill can make this decision. The contractor must contact the landfill for the required procedures and tests.

If analysis determines that excess soils meet the definition of a hazardous waste under the Resource Conservation and Recovery Act (RCRA), the material must be transported to a permitted hazardous waste disposal facility under hazardous waste manifest forms.

10.0 SUMMARY

This document has been developed to inform contract personnel of the potential for encountering contaminated soils during construction activities at the site in Dubuque, Iowa, and to support previous subsurface investigation conducted by Terracon for the issuance of an IDNR "Comfort Letter". The low-level concentrations of lead and PAHs in soils pose a limited health hazard to construction personnel via inhalation of contaminated dust and the accidental ingestion pathway. The precautions included herein are intended to reduce the potential for adverse health effect to personnel excavating and moving soils at this site. As indicated, if soils contaminated with volatile organic contaminants such as petroleum hydrocarbons are encountered, a modification of this plan should be developed and an air monitoring regimen should be employed to determine the potential for airborne exposure to organic vapors.

This plan is intended to address the potential for health hazard to contaminants previously identified in soils at this project site. It is not intended as a comprehensive construction safety program. Each contractor engaged in activities at this project site is considered responsible for conducting site activities in accordance with federal, state and local safety regulations, including but not limited to, the Occupational Safety and Health Act of 1970, and those applicable standards issued thereunder.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

LEAD

CAS # 7439-92-1

Division of Toxicology and Environmental Medicine ToxFAQs™ **September 2005**

This fact sheet answers the most frequently asked health questions (FAQs) about lead. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. Lead has been found in at least 1,280 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.

Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from gasoline, paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years.

What happens to lead when it enters the environment?

- Lead itself does not break down, but lead compounds are changed by sunlight, air, and water.
- When lead is released to the air, it may travel long distances before settling to the ground.
- Once lead falls onto soil, it usually sticks to soil particles.
- Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil.

How might I be exposed to lead?

- Eating food or drinking water that contains lead. Water pipes in some older homes may contain lead solder. Lead can leach out into the water.
- Spending time in areas where lead-based paints have been used and are deteriorating. Deteriorating lead paint can contribute to lead dust.
- Working in a job where lead is used or engaging in certain hobbies in which lead is used, such stained glass.
- Using health-care products or folk remedies that contain lead.

How can lead affect my health?

The effects of lead are the same whether it enters the body through breathing or swallowing. Lead can affect almost every organ and system in your body. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults can result in decreased performance in some tests that measure functions of the nervous system. It may also cause weakness in fingers, wrists, or ankles. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people and can cause anemia. Exposure to high lead levels can severely damage the brain and kidneys in adults or children and ultimately cause death. In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production.

How likely is lead to cause cancer?

We have no conclusive proof that lead causes cancer in humans. Kidney tumors have developed in rats and mice that had been given large doses of some kind of lead compounds. The Department of Health and Human Services (DHHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens and the EPA has determined that lead is a probable human carcinogen. The International Agency for Research on

Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

How can lead affect children?

Small children can be exposed by eating lead-based paint chips, chewing on objects painted with lead-based paint, or swallowing house dust or soil that contains lead.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead may develop blood anemia, severe stomachache, muscle weakness, and brain damage. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, lead can affect a child's mental and physical growth.

Exposure to lead is more dangerous for young and unborn children. Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead. Some of these effects may persist beyond childhood.

How can families reduce the risks of exposure to lead?

- ❑ Avoid exposure to sources of lead.
- ❑ Do not allow children to chew or mouth painted surfaces that may have been painted with lead-based paint.
- ❑ If you have a water lead problem, run or flush water that has been standing overnight before drinking or cooking with it.
- ❑ Some types of paints and pigments that are used as make-up or hair coloring contain lead. Keep these kinds of products away from children
- ❑ If your home contains lead-based paint or you live in an area contaminated with lead, wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Is there a medical test to determine whether I've been exposed to lead?

A blood test is available to measure the amount of lead in your blood and to estimate the amount of your recent exposure to lead. Blood tests are commonly used to screen children for lead poisoning. Lead in teeth or bones can be measured by X-ray techniques, but these methods are not widely available. Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (µg/dL). These tests usually require special analytical equipment that is not available in a doctor's office. However, your doctor can draw blood samples and send them to appropriate laboratories for analysis.

Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) recommends that states test children at ages 1 and 2 years. Children should be tested at ages 3-6 years if they have never been tested for lead, if they receive services from public assistance programs for the poor such as Medicaid or the Supplemental Food Program for Women, Infants, and Children, if they live in a building or frequently visit a house built before 1950; if they visit a home (house or apartment) built before 1978 that has been recently remodeled; and/or if they have a brother, sister, or playmate who has had lead poisoning. CDC considers a lead level of 10 µg/dL to be a level of concern for children.

EPA limits lead in drinking water to 15 µg per liter.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for lead (Draft for Public Comment). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Agency for Toxic Substances and Disease Registry ToxFAQs September 1996

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.

- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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