U.S. ARMY ENGINEER DIVISION
HUNTSVILLE, ALABAMA

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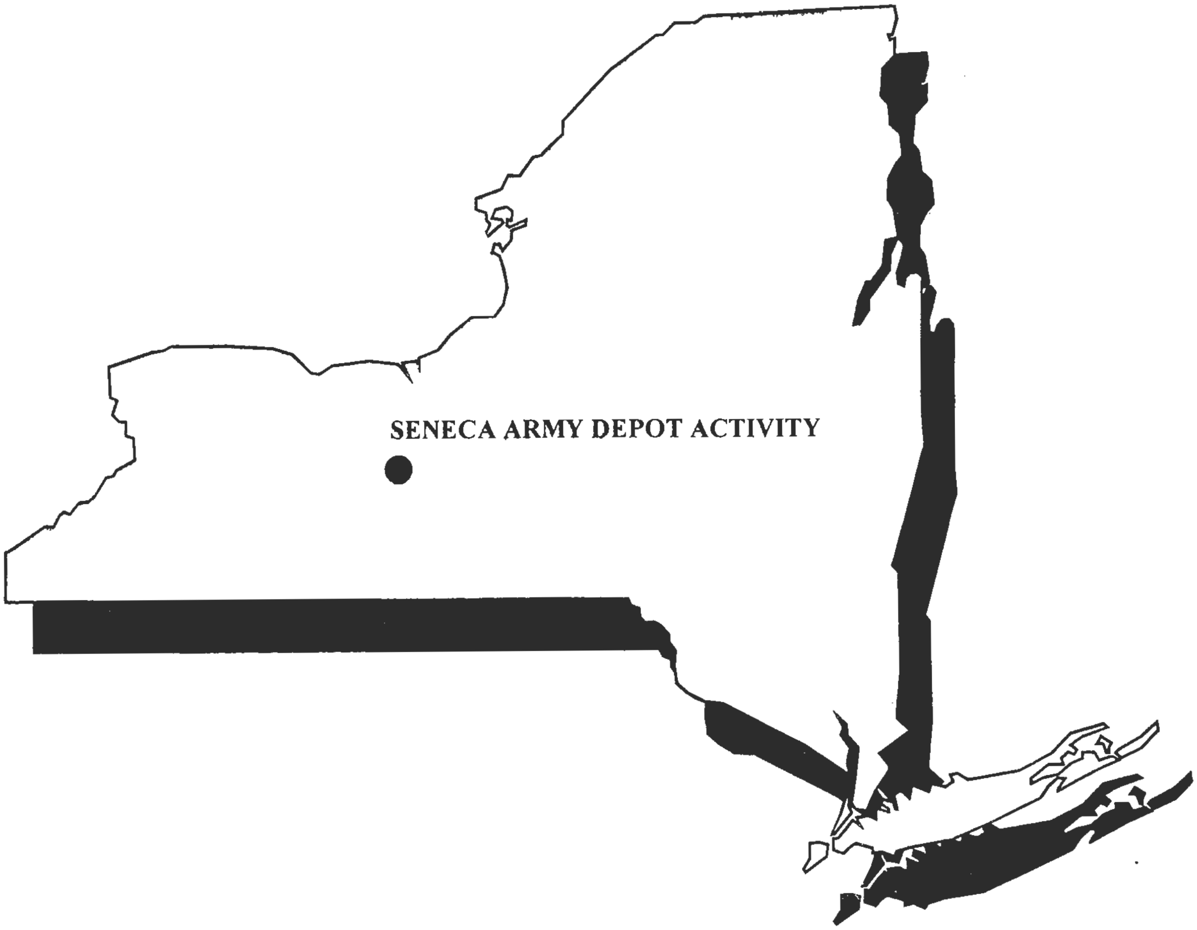

DRAFT

DECISION DOCUMENT FOR REMOVAL ACTIONS AT SWMUs SEAD-38, SEAD-39, SEAD-40, SEAD-41, AND SEAD-60 SENECA ARMY DEPOT ACTIVITY

CONTRACT NO. DACA87-95-D-0031
TASK ORDER N OF DELIVERY ORDER 14

MARCH 2001

PARSONS ENGINEERING SCIENCE, INC.

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March 30, 2001

Commander
U.S. Army Corps of Engineers
Engineering and Support Center, Hunstville
Attn: CEHNC-OE-DC (Major David Sheets)
4820 University Square
Huntsville, AL 35816-1822

SUBJECT: **Seneca Army Depot Activity, Draft Decision Document and Technical Specifications for Removal Actions at SWMUs SEAD-38, SEAD-39, SEAD-40, SEAD-41, and SEAD-60**

Dear Major Sheets:

Parsons Engineering Science (Parsons ES) is pleased to submit three copies of the Draft Decision Document and three copies of the draft Technical Specifications for Removal Actions at the Areas of Concern (AOC) listed above. These documents were originally submitted to the Army in 1995 and again in 1999. Revisions that have been made to update these documents include the addition of a health and safety plan, incorporation of new data from SEAD-60 to reflect work accomplished and modification of the scope of work required at SEAD-60 to reflect the fact that this removal action has already occurred. This work was performed in accordance with the Scope of Work (SOW) for Delivery Order 14, Annex N to the Parsons ES Contract DACA87-95-0031.

Parsons ES appreciates the opportunity to provide you with these documents. Should you have any questions, please do not hesitate to call me at (781) 401-2492 to discuss them.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Michael Duchesneau, P.E.
Project Manager

cc: S. Absolom, SEDA
R. Battaglia, CENAN
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C. Kim, USAEC
B. Wright, USAIOC

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DECISION DOCUMENT FOR REMOVAL ACTIONS AT SWMUs SEAD-38, SEAD-39, SEAD-40, SEAD-41, and SEAD-60 SENECA ARMY DEPOT ACTIVITY

Prepared for:

Seneca Army Depot Activity
Romulus, New York

Prepared by:

Parsons Engineering Science, Inc.
Canton, Massachusetts

Contract No. DACA87-95-D-0031
Task Order N of Delivery Order Order 14
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MARCH 2001

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1.0 DECISION DOCUMENT FOR REMEDIAL ACTION AT SEAD-38

1.1 EXECUTIVE SUMMARY

A limited sampling program performed at SEAD-38, the Building 2079 Boiler Blowdown Leach Pit, at Seneca Army Depot Activity (SEDA) in Romulus, NY demonstrated that a release of petroleum hydrocarbons has occurred. This decision document presents the proposed plan for conducting a time-critical removal action at SEAD-38 to eliminate contaminants that have been identified in the soil that represent a potential threat to the environment and neighboring populations. This removal action is considered time-critical because the historic military mission of the depot has been terminated and the depot has officially been closed by the Department of the Defense (DoD) and the US Army. In accordance with provisions of the DoD's Base Realignment and Closure (BRAC) process, the land and the facilities of the former depot have been surveyed and evaluated, and prospective beneficial uses of the facility have been identified. Portions of the depot are now being released to the public and private sectors for reuse under the BRAC process. As portions of the former depot are released for other beneficial uses, increased access is afforded to all portions of the former depot, resulting in an increased potential for exposure of populations to any residual chemicals that are present at former solid waste management units (SWMUs) remaining at the depot pending clean-up. Therefore, the goal of the proposed time-critical removal action at SEAD-38 is to eliminate and contain an identified source of residual chemical materials in the soil to remove or at least lessen the magnitude of the potential threat that it represents to surrounding populations and the environment.

This decision document presents the selected removal action that was developed in accordance with the Federal Facility Agreement and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan. Based upon the results of the ESI, it is recommended that the surface soil to the north and to the east of the Burning Pit be removed to a depth of six inches, contained, and disposed of at an off-site permitted waste landfill. This removal action is intended to be the final remedy for this site.

It is recommended that 15 cubic yards of soil be removed from the ditch and the field where blowdown liquids were discharged and that the excavated soil be transported to, and disposed at, an off-site facility. The extent of the area requiring excavation will be confirmed via sampling and analysis, and once completed, the excavation will be refilled with clean fill and re-contoured to match the existing terrain characteristics.

1.2 SITE BACKGROUND

1.2.1 Site Description

Building 2079 is an abandoned boiler plant located in the southwestern portion of SEDA. SEAD-38 is the blowdown leaching area that is located to the north-northwest of Building 2079 (**Figure 1**). Currently, the leach pit is not visible. A drainage pipe that originates in Building 2079 is suspected to have carried boiler blowdown liquids from the boiler plant to a roadside drainage ditch that is located approximately 100 feet to the northwest of Building 2079 and drains to the west. A second, smaller drainage ditch originates approximately 50 feet to the west of Building 2079 and drains to the northwest where it intercepts the larger roadside drainage ditch discussed previously. The area between the Building 2079 and the two drainage ditches is a relatively flat and level, grassy field.

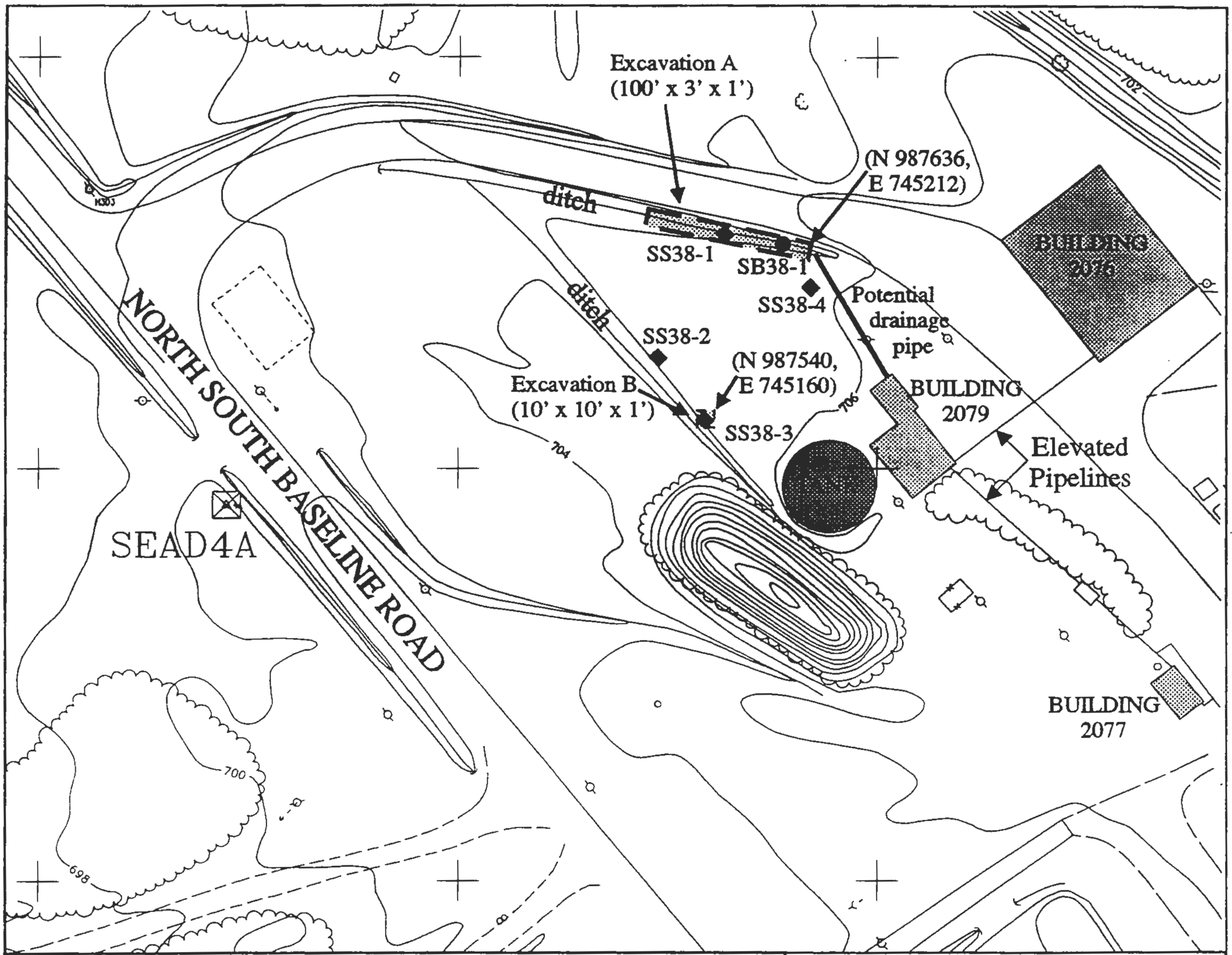
1.2.2 Site History

Between the time when the boilers were installed and 1979 – 1980, when all blowdown points were connected to the sanitary sewer system, the boilers discharged a total of 400 to 800 gallons per day. The discharge flow drained partly into nearby drainage ditches and partly into the ground. It is presumed that the boiler blowdown contained water, tannins, caustic soda (sodium hydroxide), and sodium phosphate.

1.3 PREVIOUS INVESTIGATIONS

1.3.1 Description of Sampling Program

A limited sampling program was performed in 1993 and 1994 to obtain evidence of a release. One soil boring (i.e., SB38-1) was advanced in the roadside drainage ditch north-northwest of the northeast corner of Building 2079. The soil boring was located at the discharge end of the drainage pipe that originates in Building 2079 and is suspected to have historically transmitted blowdown liquids from the boilers to the ditch. The boring was terminated in weathered bedrock at a depth of 6.3 feet below grade surface (bgs) due to spoon refusal. The water table was not encountered. No



LEGEND

● SOIL BORING LOCATION

◆ SURFACE SOIL SAMPLE

(N 987636, E 745212) NEW YORK STATE PLANE N/E COORDINATES

⊠ SURVEY MONUMENT

TELEPHONE POLE

N

PARSONS

PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY

DECISION DOCUMENT FOR REMOVAL ACTION
SEAD-38

DEPT. ENVIRONMENTAL ENGINEERING

DWG NO. 727023-01001

FIGURE 1

SAMPLE LOCATIONS AND APPROXIMATE AREA TO BE REMEDIATED

SCALE 1" = 100'

DATE AUGUST 1995

H:\ENG\SENECA\DECISION\VOLATILE\COMMENT\SEAD38A.CDR volatile organic compounds were detected with the field screening instrument, and no staining of the soil was observed, so the deepest sample recovered with sufficient sample volume (i.e., 2-4 ft bgs) was submitted to the laboratory for chemical analysis.

One surface soil sample (SS38-1, 0-2 in bgs) was collected from the base of the roadside drainage ditch downstream of the soil boring location and three surface soil samples (i.e., SS38-2 through 38-4, all 0-2 inches bgs) were collected from the grassy field between Building 2079 and the roadside drainage ditch. Chemical analyses completed on the recovered samples consisted of soil pH by Environmental Protection Agency (EPA) SW-846[1] Method 9045 and total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1[2]. The sample locations are shown in **Figure 1**.

1.3.2 Results of Sampling Program

The results of the limited soil sampling program are presented in **Table 1**. Petroleum hydrocarbons were detected in the subsurface soil sample and in each of the surface soil samples. Surface soil samples SS38-2 and SS38-4 contained 104 and 110 ppm of TRPH, respectively, and surface soil samples SS38-1 and SS38-3 contained significantly higher concentrations of 1840 and 1940 ppm, respectively. The subsurface soil sample SB38-1 contained 85 ppm TRPH. The pH of the soil samples ranged from 7.35 to 7.47 in the surface soil samples and was 8.93 in the subsurface soil sample.

The detection of petroleum hydrocarbons in all of the samples indicates that a release did occur. The low concentration of petroleum hydrocarbons in the subsurface sample suggests that the petroleum hydrocarbon impacts diminish with depth.

1.4 REMEDIAL ACTION OBJECTIVES

The objective of the proposed remedial action at SEAD-38 is to remediate soil located in the vicinity of the drainage ditches that has been contaminated by the release of total petroleum

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[1] US EPA Publication SW-846, "*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.*"

[2] EPA 600/4-79-020, "*Methods for Chemical Analysis of Water and Wastes*."

08/24/95

TABLE 1

SURFACE AND SUBSURFACE SOIL ANALYSIS RESULTS
SENECA ARMY DEPOT ACTIVITY
SEAD-38 LIMITED SAMPLING PROGRAM

Compound	Matrix Location Depth (ft) Date ES ID Lab ID Units	Maximum Result	NYSDEC TAGM #4046 value (2)	Number Above TAGM #4046 value	Soil SEAD-38 0-0.2 12/17/93 SB38-1 207135	Soil SEAD-38 0-0.2 12/17/93 SB38-2 207135	Soil SEAD-38 0-0.2 12/17/93 SB38-3 207135	Soil SEAD-38 0-0.2 12/17/93 SS38-4 207135	Soil SEAD-38 2-4 1/09/94 SB38-1 207135
Total Petroleum Hydrocarbons	mg/Kg	1940	NA	NA	1840	104	1940	110	85
pH	standard units	8.93	NA	NA	7.36	7.46	7.47	7.4	8.93
Total Solids	%W/W	88.8	NA	NA	60.2	79.8	80.1	86	88.8

NOTES :

(1) Laboratory results are from Sample Delivery Group (SDG) 41726.

(2) The New York State Department of Environmental Conservation's Technical and Administrative Guidance Memorandum HWR-94-4046 (or TAGM #4046) does not contain guidance values for these compounds.

hydrocarbons from the boilers and to demonstrate that the soil left surrounding the area of the excavation does not pose a significant threat to human health or the environment. The Army is proposing to perform a time-critical removal action to eliminate or lessen the magnitude of the potential threat that exists at SEAD-38. This decision document identifies and presents alternatives that have been considered to eliminate or lessen the magnitude of the potential threat. Due to the depot's change in status, and the current release of portions of the former depot for beneficial reuses by the public and private sectors, the proposed action is considered time-critical and the selected option will be implemented quickly to mitigate the potential threat.

It is currently anticipated that a limited amount of soil from the drainage ditch located to the north-northwest and to the west of Building 2079 will need to be remediated during the planned action. The current quantity of soil requiring treatment in the north-northwestern situated drainage ditch is currently estimated to cover an area that measures 100 feet long by 3 feet wide by 1 foot deep, while the extent of the soil requiring treatment in the western drainage ditch encompasses an area measuring roughly 10 feet long by 10 feet wide by 1 foot deep. Combined, the estimated volume of soil requiring treatment is approximately 15 cubic yards. The extent of the planned areas requiring treatment is displayed on **Figure 1**.

Verification of the acceptability of the surrounding soil quality will be demonstrated and documented by collecting and analyzing samples that will be analyzed for volatile organic and semivolatile organic compounds. Analytical results produced from the analysis of samples will be compared to soil cleanup levels that are tabulated in the New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Memorandum # 4046 "*Determination of Soil Cleanup Objectives and Cleanup Levels*". If the results from the confirmatory sampling indicate that all species are below allowable limits, the treatment process will be terminated, and the effected area will be backfilled (as needed if contaminated soil is excavated) and re-contoured; however, if the analytical results indicate that soil contains volatile and semivolatile organic compound concentrations in excess of TAGM #4046 levels the area of treatment will be expanded to remediate the identified contaminated soil.

1.5 TREATMENT/DISPOSAL ALTERNATIVES FOR EXCAVATED SOIL

A variety of treatment and disposal alternatives/technologies are available for the treatment of the excavated petroleum-impacted soils from SEAD-38. These include:

1. bioventing
2. vapor extraction
3. solidification/stabilization
4. land treatment or land farming
5. biopiles
6. soil washing
7. low temperature thermal desorption and
8. off-site disposal

A brief overview of these alternatives is provided below.

Bioventing

Bioventing is an in-situ treatment technology that promotes biodegradation of the identified volatile and semivolatile organic contaminants by the providing oxygen to the microorganisms that are resident in the affected soil. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be left in-place.

A typical bioventing system contains one or more air injection points that are manifold to a low-flow blower. A properly sized bioventing system provides only enough oxygen flow to sustain microbial activity. Optimal air flow rates maximize biodegradation as the vapors move slowly through biologically active soil while minimizing volatilization and release of the contaminants to the atmosphere.

Advantages of a bioventing system include factors such as:

1. in-situ treatment greatly reduces the expense and destruction associated with traditional combined excavation and treatment/disposal processes;
2. in-situ treatment often eliminates expensive off-gas treatment requirements that are typical of many soil vapor vacuum extraction procedures;
3. bioventing processes are mechanically simple, require minimal levels of maintenance, can be operated and maintained by relatively few people, and can be left unattended for extended periods of time; and,

4. biodegradation of volatile organic compounds can be achieved in periods of 1 to 5 years, while treatment times for semivolatile organic constituents can be achieved in 2 to 10 years.

Potential limitations of a bioventing system include:

1. bioventing is most practical for implementation at sites where large volumes of soil at depth are contaminated with degradable volatile and semivolatile organic compounds;
2. saturated soil lenses are difficult to aerate;
3. low-permeability soils are difficult to aerate;
4. soils with low moisture content tend to dry out during aeration, and thereby reduce the rate of biodegradation achieved;
5. water tables in close proximity to the ground's surface limits the vent well's radius of influence;
6. low nutrient levels (i.e., nitrogen and phosphorous) may affect and retard biodegradation; and,
7. low soil and ambient temperatures retard biodegradation.

Soil Vapor Extraction

Soil vapor extraction wells are drilled in and around the area where the soil contamination exists. A vacuum is then applied through the extraction well(s) that induces gas-phase volatiles to be removed from the soil and captured in the well(s). If contaminants are shallow, geomembrane covers are typically included to prevent short circuiting of air flow and to increase the radius of influence of the extraction wells. Ground water depression pumps may be needed to reduce upwelling that may result due to the application of the vacuum on the area of contamination. These wells may also be used to lower the local water table elevation, thereby thickening the vadose where this technology works best.

Principal advantages of this technology include:

1. it is an in-situ technology that thereby eliminates the need for excavation.
2. It is best applied to sites where large amounts of volatile and semivolatile organic contamination exists; and
3. relatively simple and inexpensive equipment is used in the system.

Potential limitations of this technology include:

1. soil that contains a high degree of fines and/or a high degree of saturation require higher vacuums which will increase the cost of the system or hamper the operational efficiency of the unit;
2. soil exhibiting highly variable stratigraphy or high permeability may be susceptible to uneven gas flow and therefore, contaminant removal;
3. soil containing high organic content or that is extremely dry has a high sorption capacity for VOCs which may result in reduced removal rates;
4. exhaust gases from the SVE system may require additional treatment prior to discharge to the atmosphere; and
5. entrained liquids resulting from the off-gas treatment system may require capture and treatment/disposal in ancillary systems.

Solidification/Stabilization

Solidification/stabilization technologies may be implemented in-situ or ex-situ. In either case, the objective of solidification technology is to physically bound or encapsulate the contamination within a stabilized mass, while stabilization technologies induce chemical reactions between stabilizing agents and the contaminants to reduce their mobility within the environment. The efficacy of the solidification/stabilization process is typically demonstrated by performing leachability tests to measure and document the immobilization of contaminants. Numerous forms of solidification and stabilization technologies have been demonstrated and include:

- bituminization
- emulsified asphalt
- modified sulfur cement
- polyethylene extrusion
- pozzolan/Portland cement
- radioactive waste solidification
- sludge stabilization soluble phosphates and
- vitrification/molten glass.

Key limitations or drawbacks of these technologies include:

1. Depth of contaminants may limit the application of some in-situ processes;
2. Environmental conditions may affect the long-term immobilization of the contaminants;
3. Certain types of wastes are incompatible with different processes and treatability studies are generally required to predict the efficacy of the treatment process;
4. Organic contaminants are frequently not encapsulated and immobilized by the processes;
5. Reagent/additive mixing are relatively difficult when applied in-situ;
6. Significant volume increases (e.g., up to double the original volume) may result from the process;
7. Confirmatory sampling for in-situ application is generally more difficult and costly that for ex-situ applications;
8. Cohesive soil and soil containing a large portion of coarse gravel and cobbles are unsuitable for this type of treatment; and
9. Solidified materials, if left in place, may hinder future site uses and conditions encountered.

Land Treatment or Land Farming

Land Treatment or Land Farming are generally comparable treatment technologies, the significant difference being Land Treatment is performed in-situ whereas Land Farming is performed ex-situ. In both cases, the contaminated soil is periodically tilled or turned over to aerate the waste and to promote degradation. During treatment, key conditions (e.g., moisture content, degree of aeration, pH and nutrient/additive levels, etc.) of the contaminated media are closely monitored and controlled to enhance the biodegradation process. Land Treatment or Land Farming technologies are both generally applied to enhance the degradation of heavier hydrocarbons, and are less likely to be used for the treatment of organic contamination containing volatile organic compounds. Volatile organic compound contamination is typically more effectively and quickly treated using technologies that take advantage of the lighter hydrocarbon species' volatility (e.g., soil vapor extraction, bioventing, etc.). Both technologies are considered to be medium to long-term approaches to remediating contaminated soils.

Land Treatment sites must be properly designed and managed to ensure that problems that could result in the ground water, surface water, sediment, air, and food chain contamination do not occur. Land Farming technologies, on the other hand, control these potential problems by moving the contaminated soil to a controlled test cell. During Land Farming the contaminated media is excavated and placed into lined beds or other systems that are designed to control and capture leaching or volatile contaminants. During placement of the contaminated media in the bed, lifts of up to 18 inches in height are constructed and these are maintained during the treatment process. Once the desired degree of biodegradation is achieved, the affected media is removed and replaced by other contaminated material. Frequently, fresh contaminated media is mixed with partially remediated material to inoculate the freshly added material with an actively degrading microbial culture, thereby enhancing degradation and shortening treatment times.

Contaminants that have been successfully treated in Land Treatment and Land Farming applications include diesel fuels, number 2 and 6 fuel oils, aviation fuels, oily sludges, wood preserving wastes, coke wastes and certain pesticides.

Key limitations to these treatment technologies include:

1. a large amount of space is required;
2. soil that is contaminated to extensive depths (e.g., greater than 1 to 2 feet) must be excavated and placed into land farming cells or spread out over extended areas;
3. conditions affecting the biological degradation of contaminants (e.g., temperature and rain fall) are largely uncontrolled which can lead to increased treatment times;
4. if volatile contaminants are present in the contaminated media, they must be pretreated because they would volatilize and cause releases to the atmosphere;
5. dust control provisions must be considered, especially during media tilling and handling operations;
6. runoff collection facilities must be constructed and monitored to control leachate release; and,
7. some waste constituents may be subject to land ban regulations and thus be prohibit from treatment via this technique.

Biopiles

Biopile treatment is a full-scale technology where excavated soils are mixed with soil additives, stockpiled in a fabricated treatment area, and remediated using forced aeration to promote natural biodegradation of the organic contaminants. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be recycled and placed back into the excavation.

A basic biopile system includes a treatment bed, which is typically comprised of a 60-mil high-density polyethylene (HDPE) base liner that sits atop a base of clean soil, an aeration system, an irrigation/nutrient addition system, a leachate collection system, and an over liner (20-mil HDPE). Moisture, heat, nutrients, oxygen, and pH are controlled to promote biodegradation. The irrigation/nutrient addition system is buried beneath the contaminated soil to facilitate the addition of air and if necessary, nutrients (e.g., water, phosphorous, nitrogen). The contaminated pile is typically covered to minimize run-off, evaporation and volatilization, and to promote solar heating. Volatile organic compounds liberated during the biodegradation may be captured in an optional air collection system where they are treated (e.g., passed through an activated carbon canister) prior to discharge to the atmosphere.

The advantages of soil treatment via biopiles include factors such as:

1. it is applicable to all types of petroleum, oil and lubricants;
2. final reaction products are relatively innocuous;
3. short treatment times (i.e., typically range from 3 to 6 months) are achievable; and,
4. treatment rate can be enhanced by the addition of simple, low-cost nutrients (i.e., water, nitrogen, phosphorous).

Limitations of treatment in biopiles include:

1. small size excavations (i.e., less than 250 cubic yards) may be more economically handled via off-site disposal;
2. a large amount of flat space is required for construction of the biopile; and,
3. increased content of clay and silt in the soil may retard or limit the extent of biodegradation.

Soil Washing

Soil washing is a treatment option applicable to soil contaminated with metals and semivolatile organic compounds (SVOCs). In the process, soil is slurried with water and subjected to intense scrubbings. To improve the efficiency of soil washing, the process may include the use of surfactants, detergents, chelating agents or pH adjustment. After contaminants are removed from the soil, the washing solutions can be treated in a wastewater treatment system. The washing fluid can then be recycled, continuing the soil washing process.

Certain site factors can limit the success of soil washing:

1. highly variable soil conditions;
2. high silt or clay content which will reduce percolation and leaching, and inhibit the solid-liquid separations following the soil washing;
3. chemical reactions with soil cation exchange and pH effects may decrease contaminant mobility; and,
4. if performed in-situ, the groundwater flow must be well defined in order to recapture washing solutions.

Low Temperature Thermal Desorption

Thermal desorption is a physical separation process that is intended to volatilize water and organic contaminants from the waste feedstock. A carrier gas transports the volatilized water and organic compounds into a gas treatment system where subsequent contaminant destruction or containment is accomplished. In low temperature thermal desorption (LTTD) processes, the contaminated media is heated to a temperature between 90 and 300 degrees Celsius (° C; or approximately 200 to 600 degrees Fahrenheit, ° F) using either direct-fired, indirect-fired, or indirect heated systems. In the direct-fired systems, fire is applied directly upon the surface of the contaminated media, and frequently some degree of thermal oxidation may result among the organic constituents. In the indirect-fired system, the flame heats the air stream that is then passed over and through the contaminated media to volatilize water and organic constituents. In an indirect-heated system, the waste is placed into an externally heated vessel where it is typically tumbled while the surrounding headspace is continuously swept with an inert carrier gas. If the LTTD system is operated at the lower end of its temperature range, the naturally occurring organic constituents of the soil are not damaged which enables the treated soil to support future biological activity.

Advantages of LTTD processes include:

1. it is effective at separating organic from complex waste streams (e.g., refinery wastes, coal tar wastes, paint wastes, etc.);
2. it can separate solvents, PCBs, pesticides, lubricants and fuels from soil;
3. equipment capable of handling 10 or more tons per hour is commercially available and it can be brought to the site;

4. LTTD processes require less fuel than other forms of treatment technologies; and,
5. treated soils can be used as backfill at the original excavation site or at other sites, if subsequent analyses indicate that organics are removed to permissible levels and metals enhancement does not occur.

Limitations of the LTTD technology include:

1. clay or silty soil that agglomerates and that has a high humic content typically increase reaction time or temperature requirements due to the binding of the organic contaminants within the soil matrix;
2. preprocessing of soil (e.g., dewatering, grinding or crushing) may be needed to achieve acceptable levels of moisture or particle size in the feed stock.;
3. soils containing heavy metals content may yield a treated soil residue that requires subsequent stabilization or treatment; and,
4. all thermal desorption systems require treatment of the off-gases to control particulates and emissions prior to discharge to the atmosphere.

Off-Site Disposal at a Landfill

Excavation of hazardous materials is performed extensively for site remediation. Excavation is usually accompanied by off-site treatment (several discussed above) or disposal in an off-site secured landfill. Excavation employs the use of earth moving equipment to physically remove soil and buried materials. There are no limitations to the types of waste that can be excavated and removed. Factors that must be considered include the mobility of the wastes, the feasibility of on-site containment, and the cost of disposing the waste or rendering it non-hazardous once it has been excavated. A frequent practice at hazardous waste sites is to excavate and remove contaminant "hot spots" and to use other remedial measures for less contaminated soil.

Advantages of excavation and off-site disposal include:

1. excavation and off-site disposal can be used to eliminate the source of contamination at a site;
2. excavation and off-site disposal reduces or eliminates the need for long-term monitoring at the original waste site; and,
3. time to achieve beneficial results at the original site is short relative to other remedial

alternatives.

Potential limitations of excavation and off-site disposal in a landfill include:

1. costs associated with off-site disposal are be high if the excavated material is classified as hazardous according to 40 CFR 261 Subpart C;
2. institutional aspects (e.g., barriers or fencing, dust suppression, etc.) can add significant delays to program implementation; and,
3. inappropriate post-excavation disposal can result in subsequent environmental liabilities at the off-site disposal site.

1.6 REMEDIAL ACTION COSTS

Bioventing

Bioventing does not require expensive equipment and can be completed by relatively few personnel who are responsible for the operation and continuing maintenance of the system. Factors that affect costs include the type of contaminant and its concentration, the permeability of the soil, well spacing and number, pumping rate and off-gas treatment requirements.

Based on data developed by the US Air Force Center for Environmental Excellence (AFCEE)[3], the estimated total costs of in-situ soil remediation via the application of bioventing technology is $10 to $60 per ton. At sites where more than 10,000 cubic yards of contaminated require treatment, costs of less than $10 per cubic yard have been achieved. At site where less than 500 cubic yards require treatment, costs of greater than $60 per cubic yard have been recorded.

Soil Vapor Extraction

The actual cost of in-situ soil vapor extraction is site-specific, highly dependant on the size of the contaminated site, the type of contaminant species that are present and their concentration, and the geologic and hydrogeologic setting of the site. Independently, these factors effect the number of extraction wells that may be required at the site, the level of vacuum that must be applied and the

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[3] Air Force Center of Environmental Excellence, Technology Transfer Division, "*Bioventing Performance and Cost Results from Multiple Air Force Test Sites*," Technology Demonstration, Final Technical Memorandum, Jun 1996, Hill AFB, Texas.

capacity of the extraction device needed, and the length of time that is necessary to achieve the desired clean-up goal. Additionally, off-gas treatment systems and systems that treat recovered liquid streams may also be needed to control releases to the air or receiving water bodies or sewer systems. Both of these ancillary systems will add to the ultimate cost of the soil vacuum extraction system.

Based on information reported by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via in-situ soil vapor extraction are estimated to be on the order of $10 to $40 per cubic yard of contaminated soil. An additional cost of between $10,000 and $100,000 may be required if pilot testing is required to demonstrate the efficacy of the technology for the contaminant.

In-Situ Solidification/Stabilization

Solidification/stabilization treatment is grouped into different categories according to the types of additives and processes used, and the cost of this treatment is ultimately dependent upon which process is utilized. Ex-situ processes are among the most mature of remediation technologies and data provided by Federal Remediation Technologies Roundtable[4] indicates that all forms of this technology can be applied for under $100 per ton of soil. In-situ treatment costs range from $40 to $60 per cubic yard for shallow applications of auger/caisson or reagent/injector head system processes, to $150 to $250 per cubic yard for deeper applications of the same technologies. Costs associated with the application of in-situ vitrification processes include $25,000 to $30,000 for treatability tests exclusive of analytical costs, plus equipment mobilization (i.e., $200,000 to $300,000 per event) fees, plus utilities (e.g., cost of electricity, water, etc.).

Land Treatment or Land Farming

Based on information provided by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via land treatment are estimated to be on the order of $25 to $50 per

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[4] Federal Remediation Technologies Roundtable, U.S. EPA, Chair, (5102G) 401 M Street, S.W., Washington, D.C. 20460, URL http://www.frtr.gov

cubic yard of contaminated soil. Comparable treatment costs via land farming procedures are estimated to be closer to $75 per cubic yard of soil treated. Additional costs associated that may be required for both technologies include laboratory study costs ($25,000 to $50,000 per event) and costs associated pilot tests or field demonstration (e.g., $100,000 to $500,000) if the efficacy of the technology for the contaminant is unknown.

Biopiles

Treatment costs using biopiles is dependant on the nature of the contaminant, the procedure to be used, the need for additional pre- or post-treatment, and the need for air emission control equipment. Information provided by the Federal Remediation Technologies Roundtable[4] indicates that typical treatment costs using a prepared bed and a liner range from $100 to $200 per cubic yard of contaminated soil.

Soil Washing

A large number of vendors provide soil washing services. The treatment processes used vary according to the scale of the operation, particle size being treated, and extraction agent used. Because the operation is unique for each site, it is difficult to arrive at a cost estimate. However, in an evaluation of fourteen companies offering soil washing treatment services, a general price range of $50 to $205 per ton was noted in EPA Engineering Bulletin EPA/540/2-90/017, September 1990. The average cost for use of this technology reported by the Federal Remediation Technologies Roundtable[4], including excavation costs, is $170 per ton.

Low Temperature Thermal Desorption

The Federal Remediation Technologies Roundtable[4] reports that costs associated with the remediation of petroleum hydrocarbon contaminated soil via low temperature thermal desorption systems range from $40 to $300 per ton of soil. Of the total cost, approximately $15 to $30 per ton is associated with direct operating costs, while unit transportation and set-up costs are estimated at $3.50 to $5.50 per ton (not typically exceeding a total of $200,000 per event). Costs associated with excavation of the contaminated soil and backfill of the treated soil is estimated in the range of $5 to $10 per ton.

Off-Site Disposal at a Landfill

The Federal Remediation Technologies Roundtable[4] estimates that costs associated with the excavation and disposal of soil range from $270 to $460 per ton of soil, depending on the nature of the hazardous materials and the methods of excavation. If the soil is not classified as hazardous, the cost to excavate and dispose of it in a landfill will more typically range between $50 and $100 per ton. If the soil can be classified as clean enough to serve for beneficial use as daily cover, the cost to excavate and dispose of it will drop and range between $25 and $50 per ton.

1.7 RECOMMENDATION

Remediation of petroleum hydrocarbon-impacted soil is recommended for the area of the north-northwestern roadside drainage ditch and for a small area at the end of the second drainage ditch that is located to the west of Building 2079. It is currently believed that a majority of the blowdown liquids was discharged into the north-northwestern drainage ditch; therefore, it is presumed that the soil in the bottom of this ditch will require the most attention. The projected amount of soil requiring remediation from this ditch is defined as 15 cubic yards. This estimate includes an area measuring 3 feet across the ditch and 100 feet in the downstream flow direction starting at the point where the underground pipe from Building 2079 first appears (at the location of SB38-1). The subsurface soil sample collected at this point shows that there is little vertical extent of the impacted soil, so the ditch should only be excavated to a depth of 1 foot.

Results from surface sample SS38-3 indicates that some soil in the field to the west of the boiler plant also needs to be remediated. Of the three shallow soil samples collected from the field, sample SS38-3 was the only one that showed a high (i.e., concentration greater than 1000 parts per million) petroleum hydrocarbon concentration. Because the extent of the elevated petroleum hydrocarbon-impacted soil is localized, a square measuring 10 feet on each side around sample location SS38-3 will be excavated to a depth of 1 foot. The locations of the areas to be remediated are shown in **Figure 1**.

The soil from the drainage ditch area and the soil from the SS38-3 sample location can be easily excavated with a backhoe and transported by truck to an off-site disposal area. Because of the limited volume of soil that requires remediation, clean fill from SEDA can be used to backfill the excavated area once the area has been shown to comply with the New York State Department of Environmental Conservation (NYSDEC) Petroleum-Contaminated Soil Guidance Policy.

1.8 JUSTIFICATION

The volume of petroleum hydrocarbon contaminated soil recommended for removal from SEAD-38 is approximately 15 cubic yards. Using a conservative estimated unit cost of $100 for the excavation and disposal of the contaminated soil, the total cost of the proposed removal action is approximately $ 1,500. Because the lateral and vertical extent of the petroleum hydrocarbon-impacted soil can be sufficiently removed by this method of remediation, and the cost is not prohibitive, excavation and off-site disposal are an effective and immediate way to remediate the soil at SEAD-38.

1.9 POST-REMOVAL VERIFICATION SAMPLING

Conformational sampling will be conducted at both excavation sites (i.e., north-northwestern drainage ditch and from the area of SS38-3) to verify that both "hot spots" of petroleum contaminated soil have been adequately removed. Six samples will be collected from the trench excavated at the drainage ditch while five samples will be collected from the pit excavated at sample location SS38-3. Each of these samples will be analyzed for volatile organic compounds and semivolatile organic compounds by EPA Methods SW-846 8021 and SW-846 8270, respectively. In the trench, one composite sample will be collected from each side-wall of the trench and one composite sample will be collected from each end of the floor of the trench. In the smaller pit, one composite sample will collected from each side-wall of the pit and one composite sample will be collected from the floor of the pit.

If these samples demonstrate that the concentrations of the contaminants are below the guidance values for the 1) protection of groundwater, 2) protection of human health, 3) protection of fish and wildlife, and 4) protection against objectionable nuisance characteristics, as stated in the NYSDEC Petroleum-Contaminated Soil Guidance Policy, then SEAD-38 will be considered to have been acceptably remediated.

2.0 DECISION DOCUMENT FOR REMOVAL ACTION AT SEAD-39

2.1 EXECUTIVE SUMMARY

A limited sampling program performed at SEAD-39, the Building 121 Boiler Blowdown Leach Pit, at Seneca Army Depot Activity (SEDA) in Romulus NY, demonstrated that a release of petroleum hydrocarbons has occurred. This decision document presents the proposed plan for conducting a time-critical removal action at SEAD-39 to eliminate contaminants that have been identified in the soil that represent a potential threat to the environment and neighboring populations. This removal action is considered time-critical because the historic military mission of the depot has been terminated and the depot has officially been closed by the Department of the Defense (DoD) and the US Army. In accordance with provisions of the DoD's Base Realignment and Closure (BRAC) process, the land and the facilities of the former depot have been surveyed and evaluated, and prospective beneficial uses of the facility have been identified. Portions of the depot are now being released to the public and private sectors for reuse under the BRAC process. As portions of the former depot are released for other beneficial uses, increased access is afforded to all portions of the former depot, resulting in an increased potential for exposure of populations to any residual chemicals that are present at former solid waste management units (SWMUs) remaining at the depot pending clean-up. Therefore, the goal of the proposed time-critical removal action at SEAD-39 is to eliminate and contain an identified source of residual chemical materials in the soil to remove or at least lessen the magnitude of the potential threat that it represents to surrounding populations and the environment.

This decision document presents the selected removal action that was developed in accordance with the Federal Facility Agreement and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan. Based upon the results of the ESI, it is recommended that the surface soil to the north and to the east of the Burning Pit be removed to a depth of six inches, contained, and disposed of at an off-site permitted waste landfill. This removal action is intended to be the final remedy for this site.

It is recommended that 18.5 cubic yards of soil be removed from the yard where the blowdown liquids were previously discharged and that the excavated soil be transported to, and disposed at, an off-site facility. The extent of the area requiring excavation will be confirmed via sampling and analysis, and once completed, the excavation will be backfilled with clean fill and re-graded and contoured to match the existing terrain characteristics.

2.2 SITE BACKGROUND

2.2.1 Site Description

Building 121 is an active boiler plant located in the administrative area (i.e., halfway along the eastern border) of the Seneca Army Depot Activity (SEDA). SEAD-39 is the historic blowdown leaching area that was located exterior to, and immediately north of, Building 121 (**Figure 1**). Use of the leaching area was terminated in approximately 1979 or 1980 when all boiler blowdown points were connected to the sanitary sewer. There is no depression or visible indication of where the historic leaching area was previously located. Center Street, which runs in an east-west direction, is located 50 feet to the north of Building 121 and the suspected location of the former leach pit. The land surface to the north of Building 121 is grass covered and is slightly mounded between the building and the street.

2.2.2 Site History

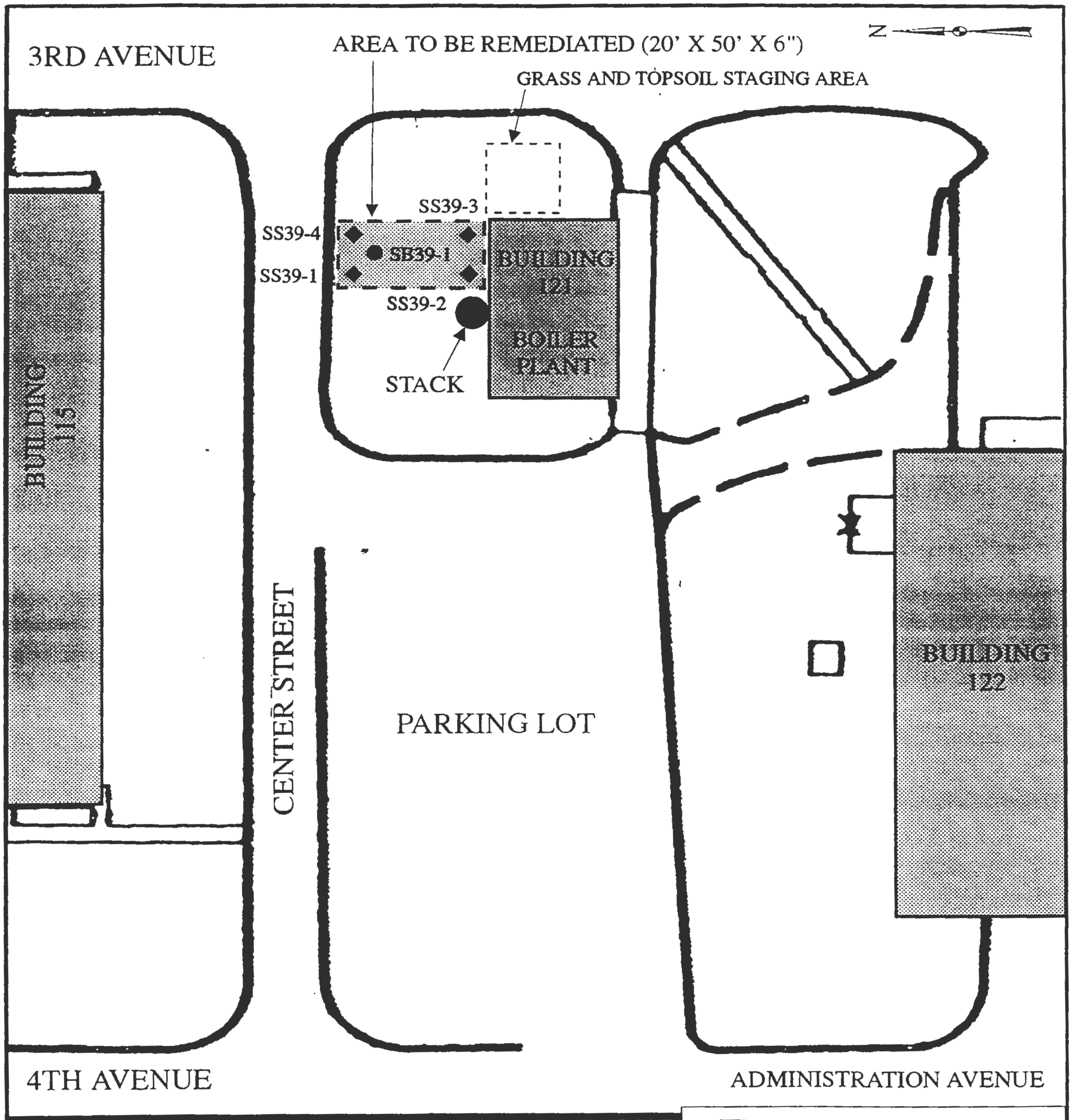
Between the time when the boilers were first installed and 1979 – 1980 when all blowdown points were connected to the sanitary sewer system, the boilers discharged between 400 and 800 gallons of blowdown liquids per day. Blowdown was released three times a day, and the discharged liquid was allowed to flow into the drainage system in the street and partly into the ground. The boiler blowdown is suspected to have contained water, tannins, caustic soda (sodium hydroxide), and sodium phosphate.

2.3 PREVIOUS INVESTIGATIONS

2.3.1 Description of Sampling Program

A limited sampling program was performed in 1993 and 1994 to obtain evidence of a release. One soil boring (i.e., SB39-1) was advanced to the north of the northeast corner of Building 121, part way between the building and the Center Street. The boring was terminated in weathered bedrock at split-spoon refusal, 5.7 feet below grade surface (bgs). The water table was encountered 5.2 feet bgs. Volatile organic compounds were not detected with the field-screening instrument, and no stained soil was observed. One sample, collected from a depth of 3-5 feet bgs, immediately above the local water table, was submitted to the lab for chemical analysis.

Physical characterization of the split-spoon samples collected from soil boring SB39-1 indicated that the top six inches of the ground is filled topsoil. This accounts for the mounding of the ground



LEGEND

◆ SURFACE SOIL SAMPLE

● SOIL BORING LOCATION

PARSONS

PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
DECISION DOCUMENT FOR REMOVAL ACTION
SEAD-39

DEPT ENVIRONMENTAL ENGINEERING

DWG NO 727023-01001

FIGURE 1

SAMPLE LOCATIONS AND APPROXIMATE AREA TO BE REMEDIATED

SCALE 1" = 50'

DATE AUGUST 1995

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surface that exists between Building 121 and Center Street. As this mounding makes the ground surface higher in elevation than the historic discharge point of the blowdown liquid, surface soil samples were not considered to be representative of the impacts caused by the release of the blowdown liquids. Therefore, four soil samples (SS39-1 through SS39-4) were collected by driving a split-spoon to a depth of 0-2 feet bgs at four corner locations surrounding the soil boring. One sample was collected from each sampling location and submitted for chemical analyses. Analytical determinations consisted of soil pH, analyzed by Environmental Protection Agency (EPA) SW-846[1] Method 9045 and total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1[2]. The sample locations are shown in **Figure 1**.

2.3.2 Results of Sampling Program

The results of the soil sampling program are presented in **Table 1**. Petroleum hydrocarbons were detected in all of the soil samples collected from SEAD-39. All of the soil samples, with the exception of SS39-1 contained TRPH concentrations of less than 100 parts per million (ppm). SS39-1 contained 118 ppm TRPH. The pH of the soil samples ranged from 7.9 to 8.9.

Detection of petroleum hydrocarbons in all of the samples indicates that a release did occur; however, the concentrations detected in each of the samples is low. The approximate area of soil that appears to be impacted is 20 feet by 50 feet. This area is outlined in **Figure 1**.

2.4 REMEDIAL ACTION OBJECTIVES

The objective of the proposed remedial action at SEAD-39 is to remediate soil located near historic blowdown leaching pit that has been contaminated by the release of total petroleum hydrocarbons from the boilers and to demonstrate that the soil left surrounding the area of the excavation does not pose a significant threat to human health or the environment. The Army is proposing to perform a time-critical removal action to eliminate or lessen the magnitude of the potential threat that exists at SEAD-39. This decision document identifies and presents alternatives that have been considered to eliminate or lessen the magnitude of the potential threat. Due to the depot's change in status, and the current release of portions of the former depot for beneficial reuses by

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[1] US EPA Publication SW-846, "*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.*"

[2] EPA 600/4-79-020, "*Methods for Chemical Analysis of Water and Wastes.*"

TABLE 1

SURFACE AND SUBSURFACE SOIL ANALYSIS RESULTS
SENECA ARMY DEPOT ACTIVITY
SEAD-39 LIMITED SAMPLING PROGRAM

Compound	Matrix Location Depth (ft) Date ES ID Lab ID QA/QC Units	Maximum Result	NYSDEC TAGM #4046 value (2)	Number Above TAGM #4046 value	Soil SEAD-39 0-0.2 1/12/94 SS39-1 208403	Soil SEAD-39 0-0.2 1/12/94 SS39-1 209343	Soil SEAD-39 0-0.2 1/24/94 SS39-5 209345 Dup. SS39-1	Soil SEAD-39 0-0.2 1/12/94 SS39-2 208404	Soil SEAD-39 0-0.2 1/12/94 SS39-3 208405	Soil SEAD-39 0-0.2 1/12/94 SS39-4 208406	Soil SEAD-39 3-5 12/16/93 SB39-1.1 207131	Soil SEAD-39 3-5 12/16/93 SB39-1.2 207133 Dup. SB39-1.1
Total Petroleum Hydrocarbons	mg/Kg	118	NA	NA	98	118	90	71	63	65	89	72
pH	standard units	8.9	NA	NA	7.9	7.91	8.18	8.9	8.34	8.03	7.2	7.39
Total Solids	%W/W	84.6	NA	NA	83.2	82.1	82.5	79.8	84.6	83.9	85.8	84.7

NOTES :

(1) Laboratory results are from Sample Delivery Group (SDG) 41726.
(2) The New York State Department of Environmental Conservation's Technical and Administrative Guidance Memorandum HWR-94-4046 (or TAGM #4046) does not contain guidance values for these compounds.

the public and private sectors, the proposed action is considered time-critical and the selected option will be implemented quickly to mitigate the potential threat.

It is currently anticipated that a limited amount of soil from the grassy area that is located to the north of Building 121 will need to be remediated during the planned action. The quantity of soil requiring treatment is estimated to cover an area that measures 50 feet long by 20 feet wide by 1 foot deep. This area extends from the edge of the building to the edge of Center Street. Combined, the estimated volume of soil requiring treatment is approximately 37 cubic yards. The extent of the area requiring treatment is displayed on **Figure 1**.

Verification of the acceptability of the surrounding soil quality will be demonstrated and documented by collecting and analyzing samples that will be analyzed for volatile organic and semivolatile organic compounds. Analytical results produced from the analysis of samples will be compared to soil cleanup levels that are tabulated in the New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Memorandum # 4046 "*Determination of Soil Cleanup Objectives and Cleanup Levels*". If the results from the confirmatory sampling indicate that all species are below allowable limits, the treatment process will be terminated, and the effected area will be backfilled (as needed if contaminated soil is excavated) and re-contoured; however, if the analytical results indicate that soil contains volatile and semivolatile organic compound concentrations in excess of TAGM #4046 levels the area of treatment will be expanded to remediate the identified contaminated soil.

2.5 TREATMENT/DISPOSAL ALTERNATIVES FOR CONTAMINATED SOIL

A variety of treatment and disposal alternatives/technologies are available for the petroleum-impacted soils from SEAD-39. These include:

1. bioventing
2. vapor extraction
3. solidification/stabilization
4. land treatment or land farming
5. biopiles
6. soil washing
7. low temperature thermal desorption and
8. off-site disposal

A brief overview of each of these alternatives is provided below.

Bioventing

Bioventing is an in-situ treatment technology that promotes biodegradation of the identified volatile and semivolatile organic contaminants by the providing oxygen to the microorganisms that are resident in the affected soil. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be left in-place.

A typical bioventing system contains one or more air injection points that are manifold to a low-flow blower. A properly sized bioventing system provides only enough oxygen flow to sustain microbial activity. Optimal air flow rates maximize biodegradation as the vapors move slowly through biologically active soil while minimizing volatilization and release of the contaminants to the atmosphere.

Advantages of a bioventing system include factors such as:

1. in-situ treatment greatly reduces the expense and destruction associated with traditional combined excavation and treatment/disposal processes;
2. in-situ treatment often eliminates expensive off-gas treatment requirements that are typical of many soil vapor vacuum extraction procedures;
3. bioventing processes are mechanically simple, require minimal levels of maintenance, can be operated and maintained by relatively few people, and can be left unattended for extended periods of time; and,
4. biodegradation of volatile organic compounds can be achieved in periods of 1 to 5 years, while treatment times for semivolatile organic constituents can be achieved in 2 to 10 years.

Potential limitations of a bioventing system include:

1. bioventing is most practical for implementation at sites where large volumes of soil at depth are contaminated with degradable volatile and semivolatile organic compounds;
2. saturated soil lenses are difficult to aerate;
3. low-permeability soils are difficult to aerate;
4. soils with low moisture content tend to dry out during aeration, and thereby reduce the rate of biodegradation achieved;
5. water tables in close proximity to the ground's surface limits the vent well's radius of influence;

6. low nutrient levels (i.e., nitrogen and phosphorous) may affect and retard biodegradation; and,
7. low soil and ambient temperatures retard biodegradation.

Soil Vapor Extraction

Soil vapor extraction wells are drilled in and around the area where the soil contamination exists. A vacuum is then applied through the extraction well(s) that induces gas-phase volatiles to be removed from the soil and captured in the well(s). If contaminants are shallow, geomembrane covers are typically included to prevent short circuiting of air flow and to increase the radius of influence of the extraction wells. Ground water depression pumps may be needed to reduce upwelling that may result due to the application of the vacuum on the area of contamination. These wells may also be used to lower the local water table elevation, thereby thickening the vadose where this technology works best.

Principal advantages of this technology include:

1. it is an in-situ technology that thereby eliminates the need for excavation.
2. it is best applied to sites where large amounts of volatile and semivolatile organic contamination exists; and
3. relatively simple and inexpensive equipment is used in the system.

Potential limitations of this technology include:

1. soil that contains a high degree of fines and/or a high degree of saturation require higher vacuums which will increase the cost of the system or hamper the operational efficiency of the unit;
2. soil exhibiting highly variable stratigraphy or high permeability may be susceptible to uneven gas flow and therefore, contaminant removal;
3. soil containing high organic content or that is extremely dry has a high sorption capacity for VOCs which may result in reduced removal rates;
4. exhaust gases from the SVE system may require additional treatment prior to discharge to the atmosphere; and
5. entrained liquids resulting from the off-gas treatment system may require capture and treatment/disposal in ancillary systems.

Solidification/Stabilization

Solidification/stabilization technologies may be implemented in-situ or ex-situ. In either case, the objective of solidification technology is to physically bound or encapsulate the contamination within a stabilized mass, while stabilization technologies induce chemical reactions between stabilizing agents and the contaminants to reduce their mobility within the environment. The efficacy of the solidification/stabilization process is typically demonstrated by performing leachability tests to measure and document the immobilization of contaminants. Numerous forms of solidification and stabilization technologies have been demonstrated and include:

- bituminization
- emulsified asphalt
- modified sulfur cement
- polyethylene extrusion
- pozzolan/Portland cement
- radioactive waste solidification
- sludge stabilization soluble phosphates and
- vitrification/molten glass.

Key limitations or drawbacks of these technologies include:

1. depth of contaminants may limit the application of some in-situ processes;
2. environmental conditions may affect the long-term immobilization of the contaminants;
3. certain types of wastes are incompatible with different processes and treatability studies are generally required to predict the efficacy of the treatment process;
4. organic contaminants are frequently not encapsulated and immobilized by the processes;
5. reagent/additive mixing are relatively difficult when applied in-situ;
6. significant volume increases (e.g., up to double the original volume) may result from the process;
7. confirmatory sampling for in-situ application is generally more difficult and costly that for ex-situ applications;
8. cohesive soil and soil containing a large portion of coarse gravel and cobbles are unsuitable for this type of treatment; and
9. solidified materials, if left in place, may hinder future site uses and conditions encountered.

Land Treatment or Land Farming

Land Treatment or Land Farming are generally comparable treatment technologies, the significant difference being Land Treatment is performed in-situ whereas Land Farming is performed ex-situ. In both cases, the contaminated soil is periodically tilled or turned over to aerate the waste and to promote degradation. During treatment, key conditions (e.g., moisture content, degree of aeration, pH and nutrient/additive levels, etc.) of the contaminated media are closely monitored and controlled to enhance the biodegradation process. Land Treatment or Land Farming technologies are both generally applied to enhance the degradation of heavier hydrocarbons, and are less likely to be used for the treatment of organic contamination containing volatile organic compounds. Volatile organic compound contamination is typically more effectively and quickly treated using technologies that take advantage of the lighter hydrocarbon species' volatility (e.g., soil vapor extraction, bioventing, etc.). Both technologies are considered to be medium to long-term approaches to remediating contaminated soils.

Land Treatment sites must be properly designed and managed to ensure that problems that could result in the ground water, surface water, sediment, air, and food chain contamination do not occur. Land Farming technologies, on the other hand, control these potential problems by moving the contaminated soil to a controlled test cell. During Land Farming the contaminated media is excavated and placed into lined beds or other systems that are designed to control and capture leaching or volatile contaminants. During placement of the contaminated media in the bed, lifts of up to 18 inches in height are constructed and these are maintained during the treatment process. Once the desired degree of biodegradation is achieved, the affected media is removed and replaced by other contaminated material. Frequently, fresh contaminated media is mixed with partially remediated material to inoculate the freshly added material with an actively degrading microbial culture, thereby enhancing degradation and shortening treatment times.

Contaminants that have been successfully treated in Land Treatment and Land Farming applications include diesel fuels, number 2 and 6 fuel oils, aviation fuels, oily sludges, wood preserving wastes, coke wastes and certain pesticides.

Limitations to these treatment technologies include:

1. a large amount of space is required;
2. soil that is contaminated to extensive depths (e.g., greater than 1 to 2 feet) must be excavated and placed into land farming cells or spread out over extended areas;

3. conditions affecting the biological degradation of contaminants (e.g., temperature and rain fall) are largely uncontrolled which can lead to increased treatment times;
4. if volatile contaminants are present in the contaminated media, they must be pretreated because they would volatilize and cause releases to the atmosphere;
5. dust control provisions must be considered, especially during media tilling and handling operations;
6. runoff collection facilities must be constructed and monitored to control leachate release; and,
7. some waste constituents may be subject to land ban regulations and thus be prohibit from treatment via this technique.

Biopiles

Biopile treatment is a full-scale technology where excavated soils are mixed with soil additives, stockpiled in a fabricated treatment area, and remediated using forced aeration to promote natural biodegradation of the organic contaminants. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be recycled and placed back into the excavation.

A basic biopile system includes a treatment bed, which is typically comprised of a 60-mil high-density polyethylene (HDPE) base liner that sits atop a base of clean soil, an aeration system, an irrigation/nutrient addition system, a leachate collection system, and an over liner (20-mil HDPE). Moisture, heat, nutrients, oxygen, and pH are controlled to promote biodegradation. The irrigation/nutrient addition system is buried beneath the contaminated soil to facilitate the addition of air and if necessary, nutrients (e.g., water, phosphorous, nitrogen). The contaminated pile is typically covered to minimize run-off, evaporation and volatilization, and to promote solar heating. Volatile organic compounds liberated during the biodegradation may be captured in an optional air collection system where they are treated (e.g., passed through an activated carbon canister) prior to discharge to the atmosphere.

The advantages of soil treatment via biopiles include factors such as:

1. it is applicable to all types of petroleum, oil and lubricants;
2. final reaction products are relatively innocuous;
3. short treatment times (i.e., typically range from 3 to 6 months) are achievable; and,
4. treatment rate can be enhanced by the addition of simple, low-cost nutrients (i.e., water, nitrogen, phosphorous).

Limitations of treatment in biopiles include:

1. small size excavations (i.e., less than 250 cubic yards) may be more economically handled via off-site disposal;
2. a large amount of flat space is required for construction of the biopile; and,
3. increased content of clay and silt in the soil may retard or limit the extent of biodegradation.

Soil Washing

Soil washing is a treatment option applicable to soil contaminated with metals and semivolatile organic compounds (SVOCs). In the process, soil is slurried with water and subjected to intense scrubbings. To improve the efficiency of soil washing, the process may include the use of surfactants, detergents, chelating agents or pH adjustment. After contaminants are removed from the soil, the washing solutions can be treated in a wastewater treatment system. The washing fluid can then be recycled, continuing the soil washing process.

Certain site factors can limit the success of soil washing:

1. highly variable soil conditions;
2. high silt or clay content which will reduce percolation and leaching, and inhibit the solid-liquid separations following the soil washing;
3. chemical reactions with soil cation exchange and pH effects may decrease contaminant mobility; and,
4. if performed in-situ, the groundwater flow must be well defined in order to recapture washing solutions.

Low Temperature Thermal Desorption

Thermal desorption is a physical separation process that is intended to volatilize water and organic contaminants from the waste feedstock. A carrier gas transports the volatilized water and organic compounds into a gas treatment system where subsequent contaminant destruction or containment is accomplished. In low temperature thermal desorption (LTTD) processes, the contaminated media is heated to a temperature between 90 and 300 degrees Celsius (^{O} C; or approximately 200 to 600 degrees Fahrenheit, ^{O}F) using either direct-fired, indirect-fired, or indirect heated systems. In the direct-fired systems, fire is applied directly upon the surface of the contaminated media, and frequently some degree of thermal oxidation may result among the organic constituents. In the indirect-fired system, the flame heats the air stream that is then passed over and through the contaminated media to volatilize water and organic constituents. In an indirect-heated system, the waste is placed into an externally heated vessel where it is typically tumbled while the surrounding headspace is continuously swept with an inert carrier gas. If the LTTD system is operated at the lower end of its temperature range, the naturally occurring organic constituents of the soil are not damaged which enables the treated soil to support future biological activity.

Advantages of LTTD processes include:

1. it is effective àt separating organic from complex waste streams (e.g., refinery wastes, coal tar wastes, paint wastes, etc.);
2. it can separate solvents, PCBs, pesticides, lubricants and fuels from soil;
3. equipment capable of handling 10 or more tons per hour is commercially available and it can be brought to the site;
4. LTTD processes require less fuel than other forms of treatment technologies; and,
5. treated soils can be used as backfill at the original excavation site or at other sites, if subsequent analyses indicate that organics are removed to permissible levels and metals enhancement does not occur.

Limitations of the LTTD technology include:

1. clay or silty soil that agglomerates and that has a high humic content typically increase reaction time or temperature requirements due to the binding of the organic contaminants within the soil matrix;
2. preprocessing of soil (e.g., dewatering, grinding or crushing) may be needed to achieve acceptable levels of moisture or particle size in the feed stock.;
3. soils containing heavy metals content may yield a treated soil residue that requires subsequent stabilization or treatment; and,
4. all thermal desorption systems require treatment of the off-gases to control particulates and emissions prior to discharge to the atmosphere.

Off-Site Disposal at a Landfill

Excavation of hazardous materials is performed extensively for site remediation. Excavation is usually accompanied by off-site treatment (several discussed above) or disposal in an off-site secured landfill. Excavation employs the use of earth moving equipment to physically remove soil and buried materials. There are no limitations to the types of waste that can be excavated and removed. Factors that must be considered include the mobility of the wastes, the feasibility of on-site containment, and the cost of disposing the waste or rendering it non-hazardous once it has been excavated. A frequent practice at hazardous waste sites is to excavate and remove contaminant "hot spots" and to use other remedial measures for less contaminated soil.

Advantages of excavation and off-site disposal include:

1. excavation and off-site disposal can be used to eliminate the source of contamination at a site;
2. excavation and off-site disposal reduces or eliminates the need for long-term monitoring at the original waste site; and,
3. time to achieve beneficial results at the original site is short relative to other remedial alternatives.

Potential limitations of excavation and off-site disposal in a landfill include:

1. costs associated with off-site disposal are be high if the excavated material is classified as hazardous according to 40 CFR 261 Subpart C;
2. institutional aspects (e.g., barriers or fencing, dust suppression, etc.) can add significant delays to program implementation; and,
3. inappropriate post-excavation disposal can result in subsequent environmental liabilities at the off-site disposal site.

2.6 REMEDIAL ACTION COSTS

Bioventing

Bioventing does not require expensive equipment and can be completed by relatively few personnel who are responsible for the operation and continuing maintenance of the system. Factors that affect costs include the type of contaminant and its concentration, the permeability of the soil, well spacing and number, pumping rate and off-gas treatment requirements.

Based on data developed by the US Air Force Center for Environmental Excellence (AFCEE)[3], the estimated total costs of in-situ soil remediation via the application of bioventing technology is $10 to $60 per ton. At sites where more than 10,000 cubic yards of contaminated require treatment, costs of less than $10 per cubic yard have been achieved. At site where less than 500 cubic yards require treatment, costs of greater than $60 per cubic yard have been recorded.

Soil Vapor Extraction

The actual cost of in-situ soil vapor extraction is site-specific, highly dependant on the size of the contaminated site, the type of contaminant species that are present and their concentration, and the geologic and hydrogeologic setting of the site. Independently, these factors effect the number of extraction wells that may be required at the site, the level of vacuum that must be applied and the capacity of the extraction device needed, and the length of time that is necessary to achieve the desired clean-up goal. Additionally, off-gas treatment systems and systems that treat recovered liquid streams may also be needed to control releases to the air or receiving water bodies or sewer systems. Both of these ancillary systems will add to the ultimate cost of the soil vacuum extraction system.

Based on information reported by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via in-situ soil vapor extraction are estimated to be on the order of $10 to $40 per cubic yard of contaminated soil. An additional cost of between $10,000 and $100,000 may be required if pilot testing is required to demonstrate the efficacy of the technology for the contaminant.

In-Situ Solidification/Stabilization

Solidification/stabilization treatment is grouped into different categories according to the types of additives and processes used, and the cost of this treatment is ultimately dependent upon which process is utilized. Ex-situ processes are among the most mature of remediation technologies and

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[3] Air Force Center of Environmental Excellence, Technology Transfer Division, "*Bioventing Performance and Cost Results from Multiple Air Force Test Sites*," Technology Demonstration, Final Technical Memorandum, Jun 1996, Hill AFB, Texas.

[4] Federal Remediation Technologies Roundtable, U.S. EPA, Chair, (5102G) 401 M Street, S.W., Washington, D.C. 20460, URL http://www.frtr.gov

data provided by Federal Remediation Technologies Roundtable[4] indicates that all forms of this technology can be applied for under $100 per ton of soil. In-situ treatment costs range from $40 to $60 per cubic yard for shallow applications of auger/caisson or reagent/injector head system processes, to $150 to $250 per cubic yard for deeper applications of the same technologies. Costs associated with the application of in-situ vitrification processes include $25,000 to $30,000 for treatability tests exclusive of analytical costs, plus equipment mobilization (i.e., $200-000 to $300,000 per event) fees, plus utilities (e.g., cost of electricity, water, etc.).

Land Treatment or Land Farming

Based on information provided by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via land treatment are estimated to be on the order of $25 to $50 per cubic yard of contaminated soil. Comparable treatment costs via land farming procedures are estimated to be closer to $75 per cubic yard of soil treated. Additional costs associated that may be required for both technologies include laboratory study costs ($25,000 to $50,000 per event) and costs associated pilot tests or field demonstration (e.g., $100,000 to $500,000) if the efficacy of the technology for the contaminant is unknown.

Biopiles

Treatment costs using biopiles is dependant on the nature of the contaminant, the procedure to be used, the need for additional pre- or post-treatment, and the need for air emission control equipment. Information provided by the Federal Remediation Technologies Roundtable[4] indicates that typical treatment costs using a prepared bed and a liner range from $100 to $200 per cubic yard of contaminated soil.

Soil Washing

A large number of vendors provide soil washing services. The treatment processes used vary according to the scale of the operation, particle size being treated, and extraction agent used. Because the operation is unique for each site, it is difficult to arrive at a cost estimate. However, in an evaluation of fourteen companies offering soil washing treatment services, a general price range of $50 to $205 per ton was noted in EPA Engineering Bulletin EPA/540/2-90/017, September 1990. The average cost for use of this technology reported by the Federal Remediation Technologies Roundtable[4], including excavation costs, is $170 per ton.

Low Temperature Thermal Desorption

The Federal Remediation Technologies Roundtable[4] reports that costs associated with the remediation of petroleum hydrocarbon contaminated soil via low temperature thermal desorption systems range from $40 to $300 per ton of soil. Of the total cost, approximately $15 to $30 per ton is associated with direct operating costs, while unit transportation and set-up costs are estimated at $3.50 to $5.50 per ton (not typically exceeding a total of $200,000 per event). Costs associated with excavation of the contaminated soil and backfill of the treated soil is estimated in the range of $5 to $10 per ton.

Off-Site Disposal at a Landfill

The Federal Remediation Technologies Roundtable[4] estimates that costs associated with the excavation and disposal of soil range from $270 to $460 per ton of soil, depending on the nature of the hazardous materials and the methods of excavation. If the soil is not classified as hazardous, the cost to excavate and dispose of it in a landfill will more typically range between $50 and $100 per ton. If the soil can be classified as clean enough to serve for beneficial use as daily cover, the cost to excavate and dispose of it will drop and range between $25 and $50 per ton.

2.7 RECOMMENDATION

To remove the petroleum-impacted soil at SEAD-39, a 20 by 50-foot area should be excavated down to a depth of one foot, as outlined in **Figure 1**. It is presumed that the top six inches of soil need not be remediated because it appears that this material lies above the elevation of the former blowdown leach pit, and thus is unlikely to be contaminated.

The soil can be excavated with a backhoe or bulldozer with the top six inches and the bottom six inches being segregated into two piles. Soil recovered from the six inches to one foot horizon can be loaded into trucks and transported off-site for disposal. Once confirmational samples and results have been obtained and shown to comply with the New York State Department of Environmental Conservation (NYSDEC) Petroleum-Contaminated Soil Guidance Policy, clean fill will be brought in and used as a base for the reclaimed upper soil. The existing grade will then be re-established using the untreated topsoil and sod.

2.8 JUSTIFICATION

The total volume of soil that is being recommended for remediation from SEAD-39 is approximately 18.5 cubic yards. Using a conservative estimated unit cost of $100 per cubic yard for the treatment of the soil, the total cost of remediating the soil is estimated as $1,850. Because the lateral and vertical extent of the petroleum-impacted soil can be sufficiently removed by this method of remediation, and the cost is not prohibitive, excavation and off-site disposal appears to be the most effective and immediate way to remediate the soil at SEAD-39.

2.9 POST-REMOVAL VERIFICATION SAMPLING

Conformational sampling will be conducted at the excavation site to verify that petroleum contaminated soil has been adequately removed. Six samples will be collected from area of the excavation. Each of these samples will be analyzed for volatile organic compounds and semivolatile organic compounds by EPA Methods SW-846 8021 and SW-846 8270, respectively. One composite sample will be collected from each side-wall of the excavated area and one composite sample will be collected from each end of the floor of the excavation.

If these samples demonstrate that the concentrations of the contaminants are below the guidance values for the 1) protection of groundwater, 2) protection of human health, 3) protection of fish and wildlife, and 4) protection against objectionable nuisance characteristics, as stated in the NYSDEC Petroleum-Contaminated Soil Guidance Policy, then SEAD-39 will be considered to have been acceptably remediated.

3.0 DECISION DOCUMENT FOR REMOVAL ACTION AT SEAD-40

3.1 EXECUTIVE SUMMARY

A limited sampling program performed at SEAD-40, the Building 319 Boiler Blowdown Leach Pit, at Seneca Army Depot Activity (SEDA) in Romulus, NY demonstrated that a release of petroleum hydrocarbons has occurred. This decision document presents the proposed plan for conducting a time-critical removal action at SEAD-40 to eliminate contaminants that have been identified in the soil that represent a potential threat to the environment and neighboring populations. This removal action is considered time-critical because the historic military mission of the depot has been terminated and the depot has officially been closed by the Department of the Defense (DoD) and the US Army. In accordance with provisions of the DoD's Base Realignment and Closure (BRAC) process, the land and the facilities of the former depot have been surveyed and evaluated, and prospective beneficial uses of the facility have been identified. Portions of the depot are now being released to the public and private sectors for reuse under the BRAC process. As portions of the former depot are released for other beneficial uses, increased access is afforded to all portions of the former depot, resulting in an increased potential for exposure of populations to any residual chemicals that are present at former solid waste management units (SWMUs) remaining at the depot pending clean-up. Therefore, the goal of the proposed time-critical removal action at SEAD-40 is to eliminate and contain an identified source of residual chemical materials in the soil to remove or at least lessen the magnitude of the potential threat that it represents to surrounding populations and the environment.

This decision document presents the selected removal action that was developed in accordance with the Federal Facility Agreement and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan. Based upon the results of the ESI, it is recommended that the surface soil to the north and to the east of the Burning Pit be removed to a depth of six inches, contained, and disposed of at an off-site permitted waste landfill. This removal action is intended to be the final remedy for this site.

It is recommended that 12.5 cubic yards be removed from the ditch where the blowdown liquids were discharged and that the excavated soil be transported to, and disposed at, an off-site facility. The extent of the area requiring excavation will be confirmed via sampling and analysis, and once completed, the excavation will be backfilled with clean fill and re-graded and contoured to match the existing terrain characteristics.

3.2 SITE BACKGROUND

3.2.1 Site Description

Building 319 is an active boiler plant located on First Street at the Seneca Army Depot Activity (SEDA). The historic blowdown leach pit that constitutes SEAD-40 was located in a drainage ditch that was next to the railroad tracks that are located north of Building 319 (**Figure 1**). Currently, evidence of the historic leach pit is not visible. A drainage pipe originating in Building 319 is suspected to have carried blowdown liquids to the drainage ditch, where they were released. The drainage ditch originates at the mouth of the drainage pipe approximately thirty feet northeast of Building 319. The drainage ditch continues for approximately 400 feet to the north where it eventually levels into a grassy field. The ground surface to the north of Building 319 and to the south of the drainage ditch is covered with asphalt.

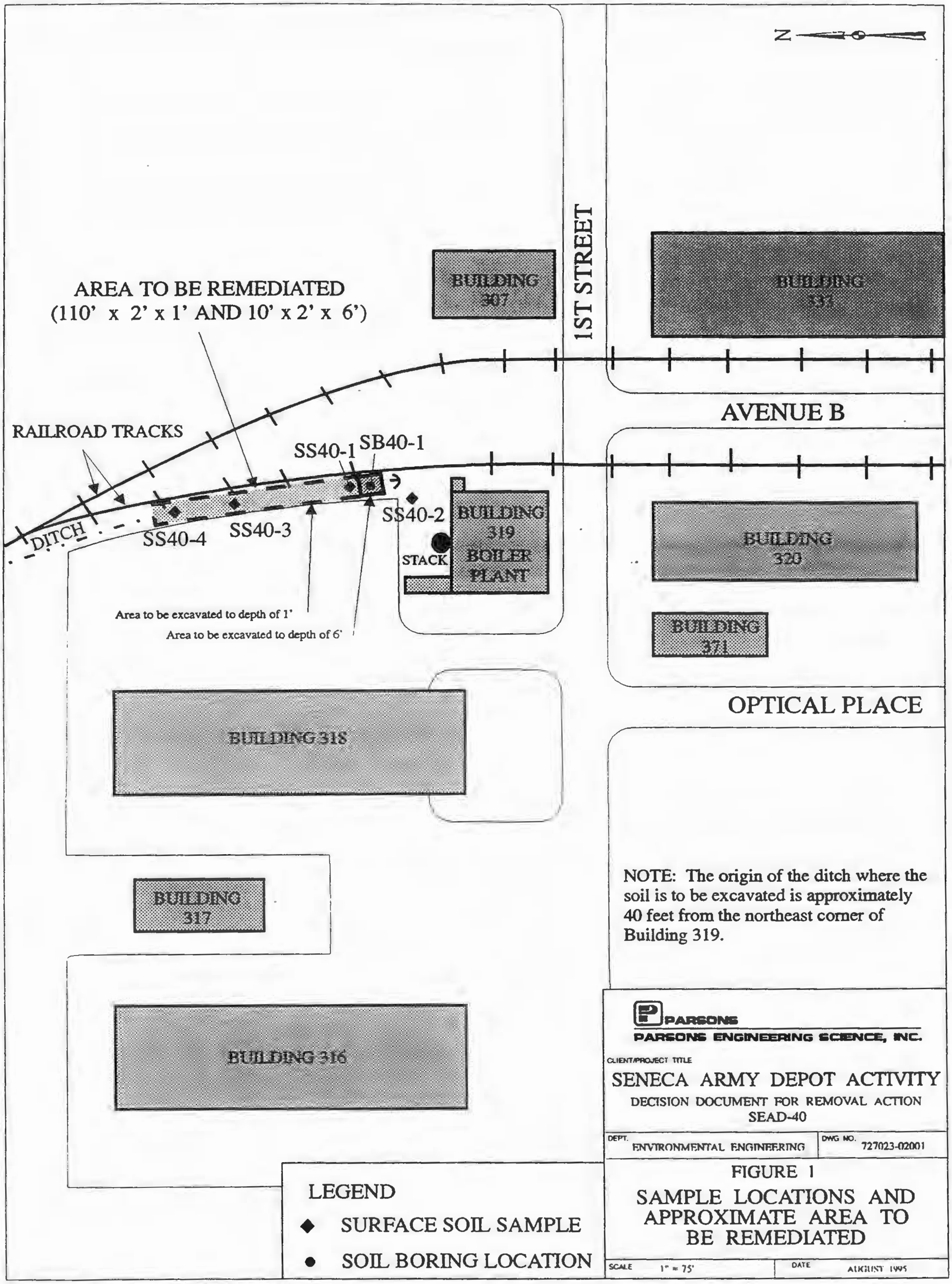
3.2.2 Site History

Between the time when the boilers were first installed and 1979 – 1980, when all blowdown points were connected to the sanitary sewer system, the boilers discharged blowdown three times every 24 hours. It is estimated that the average blowdown flow totaled 400 to 800 gallons per day. The blowdown flow drained partly into drainage ditch and partly into the ground. It is presumed that the boiler blowdown contained water, tannins, caustic soda (sodium hydroxide), and sodium phosphate.

3.3 PREVIOUS INVESTIGATION

3.3.1 Description of sampling program

A limited sampling program was performed in 1993 and 1994 to obtain evidence of a release. One soil boring was advanced in the ditch near the mouth of the drainage pipe. The boring was terminated in weathered bedrock at spoon-spoon refusal, 5.8 feet below grade surface. The water table was not encountered. Volatile organic compounds were not detected with the field-screening instrument, and no stained soil was observed. One sample, collected from a depth of 4-6 feet bgs



NOTE: The origin of the ditch where the soil is to be excavated is approximately 40 feet from the northeast corner of Building 319.

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
DECISION DOCUMENT FOR REMOVAL ACTION
SEAD-40

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 727023-02001

FIGURE 1
SAMPLE LOCATIONS AND APPROXIMATE AREA TO BE REMEDIATED

SCALE 1" = 75'
DATE AUGUST 1995

H:\ENG\SENECA\DECISION\VOLAT\SEAD40A.CDR was submitted to the lab for chemical analysis. Four surface samples (0-2 inches bgs) were also collected. One surface sample was collected at the mouth of the drainage pipe near SB40-1, another was collected between Building 319 and the drainage ditch, and the remaining two were collected in the drainage ditch approximately 50 an 100 feet downstream of the mouth of the discharge pipe. Chemical analyses consisted of pH analyzed by Environmental Protection Agency (EPA) SW-846[1] Method 9045 and total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1[2]. The sample locations are shown in **Figure 1**.

3.3.2 Results of Sampling Program

The results of the soil sampling program are presented in **Table 1**. Petroleum hydrocarbons were detected in all of the soil samples collected from SEAD-40. The subsurface sample SB40-1.1 and the surface soil sample SS40-3 contained 1,270 and 1,640 parts per million (ppm) petroleum hydrocarbons, respectively. The surface soil samples SS40-1, SS40-2, and SS40-4 contained 300, 420 and 680 ppm petroleum hydrocarbons, respectively. The pH of the soil samples ranged from 7.29 to 7.86.

The detection of petroleum hydrocarbons in all of the samples shows that a release did occur. The subsurface soil sample demonstrates that the petroleum impacts have penetrated to six feet near the mouth of the discharge pipe. The surface soil samples collected show that the petroleum impacts persists downstream of the point at which the blowdown liquids were discharged.

3.4 REMEDIAL ACTION OBJECTIVES

The objective of the proposed remedial action at SEAD-40 is to remediate soil located in the vicinity of the drainage ditch that has been contaminated by the release of total petroleum hydrocarbons from the boilers and to demonstrate that the soil left surrounding the area of the excavation does not pose a significant threat to human health or the environment. The Army is proposing to perform a time-critical removal action to eliminate or lessen the magnitude of the potential threat that exists at SEAD-40. This decision document identifies and presents alternatives that have been considered to eliminate or lessen the magnitude of the potential

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[1] US EPA Publication SW-846, "*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.*"

08/24/95

TABLE 1

SURFACE AND SUBSURFACE SOIL ANALYSIS RESULTS
SENECA ARMY DEPOT ACTIVITY
SEAD-40 LIMITED SAMPLING PROGRAM

Compound	Matrix Location Depth (ft) Date ES ID Lab ID QA/QC Units	Maximum Result	NYSDEC TAGM #4046 value (2)	Number Above TAGM #4046 value	Soil SEAD-40 4-6 12/16/93 SB40-1.1 207134	Soil SEAD-40 0-0.2 12/17/93 SS40-1 207139	Soil SEAD-40 2-4 12/17/93 SS40-5 207144 Dup.SS40-1	Soil SEAD-40 0-0.2 12/17/93 SS40-2 207141	Soil SEAD-40 0-0.2 12/17/93 SS40-3 207142	Soil SEAD-40 2-4 12/17/93 SS40-4 207143
Total Petroleum Hydrocarbons	mg/Kg	1640	NA	NA	1270	300	270	420	1640	680
pH	standard units	8.15	NA	NA	7.37	7.86	8.15	7.64	7.54	7.29
Total Solids	%W/W	91.8	NA	NA	85.4	90.8	91.8	89.2	81.1	69.99

NOTES :

(1) Laboratory results are from Sample Delivery Group (SDG) 41726.

(2) The New York State Department of Environmental Conservation's Technical and Administrative Guidance Memorandum HWR-94-4046 (or TAGM #4046) does not contain guidance values for these compounds.

H:\ENG\SENECA\DECISION\VOLATILE\SECTIONC\SWMUSOIL.WK3 threat. Due to the depot's change in status, and the current release of portions of the former depot for beneficial reuses by the public and private sectors, the proposed action is considered time-critical and the selected option will be implemented quickly to mitigate the potential threat.

It is currently anticipated that a limited amount of soil from the drainage ditch located to the north of Building 319 will need to be remediated during the planned action. The quantity of soil requiring treatment is currently estimated to include:

- an area that measures 10 feet long by 2 feet wide by 6 feet deep immediately at the end of the discharge pipe, near the location of SB40-1; and,
- an area that measures 110 feet long by 2 feet wide by 1 foot deep beyond (i.e., to the north of) the former deep excavation to remove the contamination that extends along the bottom of the drainage ditch.

Combined, the estimated volume of soil requiring treatment from SEAD-40 is approximately 12.5 cubic yards. The extent of the planned areas requiring treatment is displayed on **Figure 1**.

Verification of the acceptability of the surrounding soil quality will be demonstrated and documented by collecting and analyzing samples that will be analyzed for volatile organic and semivolatile organic compounds. Analytical results produced from the analysis of samples will be compared to soil cleanup levels that are tabulated in the New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Memorandum # 4046 "*Determination of Soil Cleanup Objectives and Cleanup Levels*". If the results from the confirmatory sampling indicate that all species are below allowable limits, the treatment process will be terminated, and the effected area will be backfilled (as needed if contaminated soil is excavated) and re-contoured; however, if the analytical results indicate that soil contains volatile and semivolatile organic compound concentrations in excess of TAGM #4046 levels the area of treatment will be expanded to remediate the identified contaminated soil.

3.5 TREATMENT/DISPOSAL ALTERNATIVES FOR CONTAMINATED SOIL

Varieties of treatment and disposal alternatives/technologies are available for the treatment of the excavated petroleum-impacted soils from SEAD-40. These include:

1. bioventing

2. vapor extraction
3. solidification/stabilization
4. land treatment or land farming
5. biopiles
6. soil washing
7. low temperature thermal desorption and
8. off-site disposal

A brief overview of these alternatives is provided below.

Bioventing

Bioventing is an in-situ treatment technology that promotes biodegradation of the identified volatile and semivolatile organic contaminants by the providing oxygen to the microorganisms that are resident in the affected soil. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be left in-place.

A typical bioventing system contains one or more air injection points that are manifold to a low-flow blower. A properly sized bioventing system provides only enough oxygen flow to sustain microbial activity. Optimal air flow rates maximize biodegradation as the vapors move slowly through biologically active soil while minimizing volatilization and release of the contaminants to the atmosphere.

Advantages of a bioventing system include factors such as:

1. in-situ treatment greatly reduces the expense and destruction associated with traditional combined excavation and treatment/disposal processes;
2. in-situ treatment often eliminates expensive off-gas treatment requirements that are typical of many soil vapor vacuum extraction procedures;
3. bioventing processes are mechanically simple, require minimal levels of maintenance, can be operated and maintained by relatively few people, and can be left unattended for extended periods of time; and,
4. biodegradation of volatile organic compounds can be achieved in periods of 1 to 5 years, while treatment times for semivolatile organic constituents can be achieved in 2 to 10 years.

Potential limitations of a bioventing system include:

1. bioventing is most practical for implementation at sites where large volumes of soil at depth are contaminated with degradable volatile and semivolatile organic compounds;
2. saturated soil lenses are difficult to aerate;
3. low-permeability soils are difficult to aerate;
4. soils with low moisture content tend to dry out during aeration, and thereby reduce the rate of biodegradation achieved;
5. water tables in close proximity to the ground's surface limits the vent well's radius of influence;
6. low nutrient levels (i.e., nitrogen and phosphorous) may affect and retard biodegradation; and,
7. low soil and ambient temperatures retard biodegradation.

Soil Vapor Extraction

Soil vapor extraction wells are drilled in and around the area where the soil contamination exists. A vacuum is then applied through the extraction well(s) that induces gas-phase volatiles to be removed from the soil and captured in the well(s). If contaminants are shallow, geomembrane covers are typically included to prevent short circuiting of air flow and to increase the radius of influence of the extraction wells. Ground water depression pumps may be needed to reduce upwelling that may result due to the application of the vacuum on the area of contamination. These wells may also be used to lower the local water table elevation, thereby thickening the vadose where this technology works best.

Principal advantages of this technology include:

1. it is an in-situ technology that thereby eliminates the need for excavation.
2. It is best applied to sites where large amounts of volatile and semivolatile organic contamination exists; and
3. relatively simple and inexpensive equipment is used in the system.

Potential limitations of this technology include:

1. soil that contains a high degree of fines and/or a high degree of saturation require higher vacuums which will increase the cost of the system or hamper the operational efficiency of the unit;
2. soil exhibiting highly variable stratigraphy or high permeability may be susceptible to uneven gas flow and therefore, contaminant removal;
3. soil containing high organic content or that is extremely dry has a high sorption capacity for VOCs which may result in reduced removal rates;
4. exhaust gases from the SVE system may require additional treatment prior to discharge to the atmosphere; and
5. entrained liquids resulting from the off-gas treatment system may require capture and treatment/disposal in ancillary systems.

Solidification/Stabilization

Solidification/stabilization technologies may be implemented in-situ or ex-situ. In either case, the objective of solidification technology is to physically bound or encapsulate the contamination within a stabilized mass, while stabilization technologies induce chemical reactions between stabilizing agents and the contaminants to reduce their mobility within the environment. The efficacy of the solidification/stabilization process is typically demonstrated by performing leachability tests to measure and document the immobilization of contaminants. Numerous forms of solidification and stabilization technologies have been demonstrated and include:

- bituminization
- emulsified asphalt
- modified sulfur cement
- polyethylene extrusion
- pozzolan/Portland cement
- radioactive waste solidification
- sludge stabilization soluble phosphates and
- vitrification/molten glass.

Key limitations or drawbacks of these technologies include:

1. Depth of contaminants may limit the application of some in-situ processes;
2. Environmental conditions may affect the long-term immobilization of the contaminants;

3. Certain types of wastes are incompatible with different processes and treatability studies are generally required to predict the efficacy of the treatment process;
4. Organic contaminants are frequently not encapsulated and immobilized by the processes;
5. Reagent/additive mixing are relatively difficult when applied in-situ;
6. Significant volume increases (e.g., up to double the original volume) may result from the process;
7. Confirmatory sampling for in-situ application is generally more difficult and costly that for ex-situ applications;
8. Cohesive soil and soil containing a large portion of coarse gravel and cobbles are unsuitable for this type of treatment; and
9. Solidified materials, if left in place, may hinder future site uses and conditions encountered.

Land Treatment or Land Farming

Land Treatment or Land Farming are generally comparable treatment technologies, the significant difference being Land Treatment is performed in-situ whereas Land Farming is performed ex-situ. In both cases, the contaminated soil is periodically tilled or turned over to aerate the waste and to promote degradation. During treatment, key conditions (e.g., moisture content, degree of aeration, pH and nutrient/additive levels, etc.) of the contaminated media are closely monitored and controlled to enhance the biodegradation process. Land Treatment or Land Farming technologies are both generally applied to enhance the degradation of heavier hydrocarbons, and are less likely to be used for the treatment of organic contamination containing volatile organic compounds. Volatile organic compound contamination is typically more effectively and quickly treated using technologies that take advantage of the lighter hydrocarbon species' volatility (e.g., soil vapor extraction, bioventing, etc.). Both technologies are considered to be medium to long-term approaches to remediating contaminated soils.

Land Treatment sites must be properly designed and managed to ensure that problems that could result in the ground water, surface water, sediment, air, and food chain contamination do not occur. Land Farming technologies, on the other hand, control these potential problems by moving the contaminated soil to a controlled test cell. During Land Farming the contaminated media is excavated and placed into lined beds or other systems that are designed to control and capture leaching or volatile contaminants. During placement of the contaminated media in the bed, lifts of up to 18 inches in height are constructed and these are maintained during the treatment process. Once the desired degree of biodegradation is achieved, the affected media is removed and replaced by other contaminated material. Frequently, fresh contaminated media is mixed with partially remediated material to inoculate the freshly added material with an actively degrading microbial culture, thereby enhancing degradation and shortening treatment times.

Contaminants that have been successfully treated in Land Treatment and Land Farming applications include diesel fuels, number 2 and 6 fuel oils, aviation fuels, oily sludges, wood preserving wastes, coke wastes and certain pesticides.

Key limitations to these treatment technologies include:

1. a large amount of space is required;
2. soil that is contaminated to extensive depths (e.g., greater than 1 to 2 feet) must be excavated and placed into land farming cells or spread out over extended areas;
3. conditions affecting the biological degradation of contaminants (e.g., temperature and rain fall) are largely uncontrolled which can lead to increased treatment times;
4. if volatile contaminants are present in the contaminated media, they must be pretreated because they would volatilize and cause releases to the atmosphere;
5. dust control provisions must be considered, especially during media tilling and handling operations;
6. runoff collection facilities must be constructed and monitored to control leachate release; and,
7. some waste constituents may be subject to land ban regulations and thus be prohibit from treatment via this technique.

Biopiles

Biopile treatment is a full-scale technology where excavated soils are mixed with soil additives, stockpiled in a fabricated treatment area, and remediated using forced aeration to promote natural biodegradation of the organic contaminants. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be recycled and placed back into the excavation.

A basic biopile system includes a treatment bed, which is typically comprised of a 60-mil high-density polyethylene (HDPE) base liner that sits atop a base of clean soil, an aeration system, an irrigation/nutrient addition system, a leachate collection system, and an over liner (20-mil HDPE).

Moisture, heat, nutrients, oxygen, and pH are controlled to promote biodegradation. The irrigation/nutrient addition system is buried beneath the contaminated soil to facilitate the addition of air and if necessary, nutrients (e.g., water, phosphorous, nitrogen). The contaminated pile is typically covered to minimize run-off, evaporation and volatilization, and to promote solar heating. Volatile organic compounds liberated during the biodegradation may be captured in an optional air collection system where they are treated (e.g., passed through an activated carbon canister) prior to discharge to the atmosphere.

The advantages of soil treatment via biopiles include factors such as:

1. it is applicable to all types of petroleum, oil and lubricants;
2. final reaction products are relatively innocuous;
3. short treatment times (i.e., typically range from 3 to 6 months) are achievable; and,
4. treatment rate can be enhanced by the addition of simple, low-cost nutrients (i.e., water, nitrogen, phosphorous).

Limitations of treatment in biopiles include:

1. small size excavations (i.e., less than 250 cubic yards) may be more economically handled via off-site disposal;
2. a large amount of flat space is required for construction of the biopile; and,
3. increased content of clay and silt in the soil may retard or limit the extent of biodegradation.

Soil Washing

Soil washing is a treatment option applicable to soil contaminated with metals and semivolatile organic compounds (SVOCs). In the process, soil is slurried with water and subjected to intense scrubbings. To improve the efficiency of soil washing, the process may include the use of surfactants, detergents, chelating agents or pH adjustment. After contaminants are removed from the soil, the washing solutions can be treated in a wastewater treatment system. The washing fluid can then be recycled, continuing the soil washing process.

Certain site factors can limit the success of soil washing:

1. highly variable soil conditions;
2. high silt or clay content which will reduce percolation and leaching, and inhibit the solid-liquid separations following the soil washing;
3. chemical reactions with soil cation exchange and pH effects may decrease contaminant mobility; and,
4. if performed in-situ, the groundwater flow must be well defined in order to recapture washing solutions.

Low Temperature Thermal Desorption

Thermal desorption is a physical separation process that is intended to volatilize water and organic contaminants from the waste feedstock. A carrier gas transports the volatilized water and organic compounds into a gas treatment system where subsequent contaminant destruction or containment is accomplished. In low temperature thermal desorption (LTTD) processes, the contaminated media is heated to a temperature between 90 and 300 degrees Celsius (^{O} C; or approximately 200 to 600 degrees Fahrenheit, ^{O}F) using either direct-fired, indirect-fired, or indirect heated systems. In the direct-fired systems, fire is applied directly upon the surface of the contaminated media, and frequently some degree of thermal oxidation may result among the organic constituents. In the indirect-fired system, the flame heats the air stream that is then passed over and through the contaminated media to volatilize water and organic constituents. In an indirect-heated system, the waste is placed into an externally heated vessel where it is typically tumbled while the surrounding headspace is continuously swept with an inert carrier gas. If the LTTD system is operated at the lower end of its temperature range, the naturally occurring organic constituents of the soil are not damaged which enables the treated soil to support future biological activity.

Advantages of LTTD processes include:

1. it is effective at separating organic from complex waste streams (e.g., refinery wastes, coal tar wastes, paint wastes, etc.);
2. it can separate solvents, PCBs, pesticides, lubricants and fuels from soil;
3. equipment capable of handling 10 or more tons per hour is commercially available and it can be brought to the site;
4. LTTD processes require less fuel than other forms of treatment technologies; and,
5. treated soils can be used as backfill at the original excavation site or at other sites, if subsequent analyses indicate that organics are removed to permissible levels and metals

enhancement does not occur.

Limitations of the LTTD technology include:

1. clay or silty soil that agglomerates and that has a high humic content typically increase reaction time or temperature requirements due to the binding of the organic contaminants within the soil matrix;
2. preprocessing of soil (e.g., dewatering, grinding or crushing) may be needed to achieve acceptable levels of moisture or particle size in the feed stock.;
3. soils containing heavy metals content may yield a treated soil residue that requires subsequent stabilization or treatment; and,
4. all thermal desorption systems require treatment of the off-gases to control particulates and emissions prior to discharge to the atmosphere.

Off-Site Disposal at a Landfill

Excavation of hazardous materials is performed extensively for site remediation. Excavation is usually accompanied by off-site treatment (several discussed above) or disposal in an off-site secured landfill. Excavation employs the use of earth moving equipment to physically remove soil and buried materials. There are no limitations to the types of waste that can be excavated and removed. Factors that must be considered include the mobility of the wastes, the feasibility of on-site containment, and the cost of disposing the waste or rendering it non-hazardous once it has been excavated. A frequent practice at hazardous waste sites is to excavate and remove contaminant "hot spots" and to use other remedial measures for less contaminated soil.

Advantages of excavation and off-site disposal include:

1. excavation and off-site disposal can be used to eliminate the source of contamination at a site;
2. excavation and off-site disposal reduces or eliminates the need for long-term monitoring at the original waste site; and,
3. time to achieve beneficial results at the original site is short relative to other remedial alternatives.

Potential limitations of excavation and off-site disposal in a landfill include:

1. costs associated with off-site disposal are be high if the excavated material is classified as hazardous according to 40 CFR 261 Subpart C;
2. institutional aspects (e.g., barriers or fencing, dust suppression, etc.) can add significant delays to program implementation; and,
3. inappropriate post-excavation disposal can result in subsequent environmental liabilities at the off-site disposal site.

3.6 REMEDIAL ACTION COSTS

Bioventing

Bioventing does not require expensive equipment and can be completed by relatively few personnel who are responsible for the operation and continuing maintenance of the system. Factors that affect costs include the type of contaminant and its concentration, the permeability of the soil, well spacing and number, pumping rate and off-gas treatment requirements.

Based on data developed by the US Air Force Center for Environmental Excellence (AFCEE)[3], the estimated total costs of in-situ soil remediation via the application of bioventing technology is $10 to $60 per ton. At sites where more than 10,000 cubic yards of contaminated require treatment, costs of less than $10 per cubic yard have been achieved. At site where less than 500 cubic yards require treatment, costs of greater than $60 per cubic yard have been recorded.

Soil Vapor Extraction

The actual cost of in-situ soil vapor extraction is site-specific, highly dependant on the size of the contaminated site, the type of contaminant species that are present and their concentration, and the geologic and hydrogeologic setting of the site. Independently, these factors effect the number of extraction wells that may be required at the site, the level of vacuum that must be applied and the capacity of the extraction device needed, and the length of time that is necessary to achieve the desired clean-up goal. Additionally, off-gas treatment systems and systems that treat recovered liquid streams may also be needed to control releases to the air or receiving water bodies or sewer systems. Both of these ancillary systems will add to the ultimate cost of the soil vacuum extraction system.

Based on information reported by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via in-situ soil vapor extraction are estimated to be on the order of $10 to $40 per cubic yard of contaminated soil. An additional cost of between $10,000 and $100,000 may be required if pilot testing is required to demonstrate the efficacy of the technology for the contaminant.

In-Situ Solidification/Stabilization

Solidification/stabilization treatment is grouped into different categories according to the types of additives and processes used, and the cost of this treatment is ultimately dependent upon which process is utilized. Ex-situ processes are among the most mature of remediation technologies and data provided by Federal Remediation Technologies Roundtable[4] indicates that all forms of this technology can be applied for under $100 per ton of soil. In-situ treatment costs range from $40 to $60 per cubic yard for shallow applications of auger/caisson or reagent/injector head system processes, to $150 to $250 per cubic yard for deeper applications of the same technologies. Costs associated with the application of in-situ vitrification processes include $25,000 to $30,000 for treatability tests exclusive of analytical costs, plus equipment mobilization (i.e., $200-000 to $300,000 per event) fees, plus utilities (e.g., cost of electricity, water, etc.).

Land Treatment or Land Farming

Based on information provided by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via land treatment are estimated to be on the order of $25 to $50 per cubic yard of contaminated soil. Comparable treatment costs via land farming procedures are

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[3] Air Force Center of Environmental Excellence, Technology Transfer Division, "*Bioventing Performance and Cost Results from Multiple Air Force Test Sites*," Technology Demonstration, Final Technical Memorandum, Jun 1996, Hill AFB, Texas.

[4] Federal Remediation Technologies Roundtable, U.S. EPA, Chair, (5102G) 401 M Street, S.W., Washington, D.C. 20460, URL http://www.frtr.gov

estimated to be closer to $75 per cubic yard of soil treated. Additional costs associated that may be required for both technologies include laboratory study costs ($25,000 to $50,000 per event) and costs associated pilot tests or field demonstration (e.g., $100,000 to $500,000) if the efficacy of the technology for the contaminant is unknown.

Biopiles

Treatment costs using biopiles is dependant on the nature of the contaminant, the procedure to be used, the need for additional pre- or post-treatment, and the need for air emission control equipment. Information provided by the Federal Remediation Technologies Roundtable[4] indicates that typical treatment costs using a prepared bed and a liner range from $100 to $200 per cubic yard of contaminated soil.

Soil Washing

A large number of vendors provide soil washing services. The treatment processes used vary according to the scale of the operation, particle size being treated, and extraction agent used. Because the operation is unique for each site, it is difficult to arrive at a cost estimate. However, in an evaluation of fourteen companies offering soil washing treatment services, a general price range of $50 to $205 per ton was noted in EPA Engineering Bulletin EPA/540/2-90/017, September 1990. The average cost for use of this technology reported by the Federal Remediation Technologies Roundtable[4], including excavation costs, is $170 per ton.

Low Temperature Thermal Desorption

The Federal Remediation Technologies Roundtable[4] reports that costs associated with the remediation of petroleum hydrocarbon contaminated soil via low temperature thermal desorption systems range from $40 to $300 per ton of soil. Of the total cost, approximately $15 to $30 per ton is associated with direct operating costs, while unit transportation and set-up costs are estimated at $3.50 to $5.50 per ton (not typically exceeding a total of $200,000 per event). Costs associated with excavation of the contaminated soil and backfill of the treated soil is estimated in the range of $5 to $10 per ton.

Off-Site Disposal at a Landfill

The Federal Remediation Technologies Roundtable[4] estimates that costs associated with the excavation and disposal of soil range from $270 to $460 per ton of soil, depending on the nature of the hazardous materials and the methods of excavation. If the soil is not classified as hazardous, the cost to excavate and dispose of it in a landfill will more typically range between $50 and $100 per ton. If the soil can be classified as clean enough to serve for beneficial use as daily cover, the cost to excavate and dispose of it will drop and range between $25 and $50 per ton.

3.7 RECOMMENDATIONS

Remediation of petroleum hydrocarbon-impacted soil located in the drainage ditch to the north of Building 319 is recommended. It is currently believed that a majority of the blowdown liquids was discharged into the northern drainage ditch; therefore, it is presumed that the soil in the bottom of this ditch will require the most attention. The projected amount of soil requiring remediation from this ditch is defined as 12.5 cubic yards. This estimate includes an area measuring 2 feet across the ditch and extending 120 to the north in the downstream flow direction starting at the point where the underground pipe from Building 319 first appears (at the location of SB40-1). The subsurface soil sample, SB40-1, collected at this point shows that the petroleum hydrocarbon contamination has penetrated throughout the vadose zone, so all soil located above the weathered bedrock in this area should be treated or removed. Downstream of this location, the petroleum hydrocarbon contamination appears to be located in the shallow soil, so it is recommended that the initial treatment/removal focus on the top one foot of the soil. Details of the areas to be remediated are shown in **Figure 1**.

The soil from the drainage ditch area can be easily excavated with a backhoe and transported by truck to an off-site disposal area. Because of the limited volume of soil that requires remediation, clean fill from SEDA can be used to backfill the excavated area once the area has been shown to comply with the New York State Department of Environmental Conservation (NYSDEC) Petroleum-Contaminated Soil Guidance Policy.

3.8 JUSTIFICATION

The volume of petroleum hydrocarbon contaminated soil recommended for removal from SEAD-40 is approximately 12.5 cubic yards. Using a conservative estimated unit cost of $100 for the excavation, backfill and disposal of the contaminated soil, the total cost of the proposed removal action is approximately $1,250. Because the lateral and vertical extent of the petroleum hydrocarbon-impacted soil can be sufficiently removed by this method of remediation, and the cost is not prohibitive, excavation and off-site disposal are an effective and immediate way to remediate the soil at SEAD-40.

3.9 POST-REMOVAL VERIFICATION SAMPLING

Conformational sampling will be conducted at the excavation site to verify that the petroleum contaminated soil has been adequately removed. Five samples (one from each side wall, and from the base of the pit) will be collected from the deeper portion of the excavation (i.e., at the drainage pipe end near SB40-1). These samples will be collected as composites from each of the side-walls of the trench and from the base of the excavation. An additional five samples will be collected from the shallow, extended portion of the trench (i.e., between SS40-1 and SS40-4). In this instance, one composite sample will be collected from the northerly, easterly and westerly situated side wall of the trench, while two additional samples will be collected from the base of the excavation, one from either end. Each of these samples will be analyzed for volatile organic compounds and semivolatile organic compounds by EPA Methods SW-846[1] 8021 and SW-846[1] 8270, respectively.

If these samples demonstrate that the concentrations of the contaminants are below the guidance values for the: 1) protection of groundwater, 2) protection of human health, 3)protection of fish and wildlife, and 4) protection against objectionable nuisance characteristics, as stated in the NYSDEC Petroleum-Contaminated Soil Guidance Policy, then SEAD-38 will be considered to have been acceptably remediated.

4.0 DECISION DOCUMENT FOR REMOVAL ACTION AT SEAD-41

4.1 EXECUTIVE SUMMARY

A limited sampling program performed at SEAD-41, the Building 718 Boiler Blowdown Leach Pit, at Seneca Army Depot Activity (SEDA) in Romulus, NY demonstrated that a release of petroleum hydrocarbons has occurred. This decision document presents the proposed plan for conducting a time-critical removal action at SEAD-41 to eliminate contaminants that have been identified in the soil that represent a potential threat to the environment and neighboring populations. This removal action is considered time-critical because the historic military mission of the depot has been terminated and the depot has officially been closed by the Department of the Defense (DoD) and the US Army. In accordance with provisions of the DoD's Base Realignment and Closure (BRAC) process, the land and the facilities of the former depot have been surveyed and evaluated, and prospective beneficial uses of the facility have been identified. Portions of the depot are now being released to the public and private sectors for reuse under the BRAC process. As portions of the former depot are released for other beneficial uses, increased access is afforded to all portions of the former depot, resulting in an increased potential for exposure of populations to any residual chemicals that are present at former solid waste management units (SWMUs) remaining at the depot pending clean-up. Therefore, the goal of the proposed time-critical removal action at SEAD-41 is to eliminate and contain an identified source of residual chemical materials in the soil to remove or at least lessen the magnitude of the potential threat that it represents to surrounding populations and the environment.

This decision document presents the selected removal action that was developed in accordance with the Federal Facility Agreement and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan. Based upon the results of the ESI, it is recommended that the surface soil to the north and to the east of the Burning Pit be removed to a depth of six inches, contained, and disposed of at an off-site permitted waste landfill. This removal action is intended to be the final remedy for this site.

It is recommended that 4.5 cubic yards of soil be removed from the ditch where blowdown liquids were discharged and that the excavated soil is transported to, and disposed at, an off-site facility. The extent of the area requiring excavation will be confirmed via sampling and analysis, and once completed, the excavation will be refilled with clean fill and re-contoured to match the existing terrain characteristics.

4.2 SITE BACKGROUND

4.2.1 Site Description

Building 718 is an abandoned boiler plant located in the northern end of SEDA. SEAD-41 is the blowdown leaching area that is suspected to have existed in the drainage ditch that is located approximately 40 west of Building 718 (**Figure 1**). All surface discharge originating along the west side of Building 718 would flow into this ditch. Thirty feet to the north of Building 718 is a street that runs east west. The drainage ditch is relatively steep-sided near the building and primarily drains to the north where it joins a roadside drainage ditch. Some runoff in the ditch would flow to the southwest where the drainage ditch is cut off by a crushed gravel road leading southwest away from Building 718.

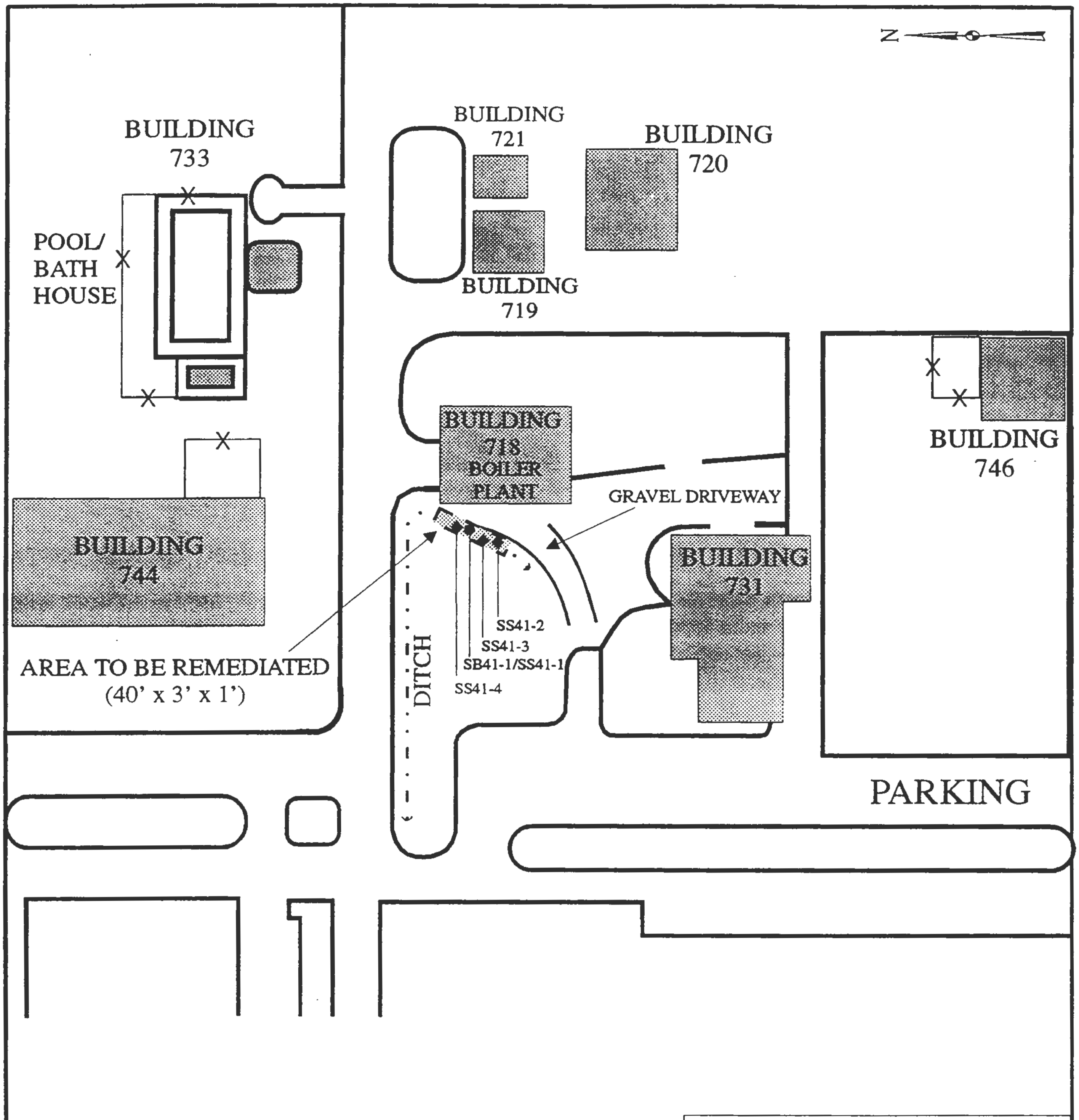
4.2.2 Site History

Between the time when the boilers were installed and 1979 – 1980, when all blowdown points were connected to the sanitary sewer system, the boilers discharged a total of 400 to 800 gallons per day. The discharge flow drained partly into nearby drainage ditches and partly into the ground. It is unknown whether the blowdown liquid was discharged directly into the ditch to the west of Building 718, or whether it was discharged next to the building and flowed over the ground into the ditch. It is presumed that the boiler blowdown contained water, tannins, caustic soda (sodium hydroxide), and sodium phosphate.

4.3 PREVIOUS INVESTIGATIONS

4.3.1 Description of Sampling Program

A limited sampling program was performed in 1993 and 1994 to obtain evidence of a release. One soil boring was advanced in the drainage ditch immediately to the west of the location where blowdown liquids were suspected to have been discharged from Building 718. The boring was terminated in weathered bedrock at split-spoon refusal, 6.3 feet below grade surface (bgs). The water table was encountered 4.0 feet bgs. No volatile organic compounds were detected with the



LEGEND

◆ SURFACE SOIL SAMPLE

● SOIL BORING LOCATION

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
DECISION DOCUMENT FOR REMOVAL ACTION
SEAD-41

DEPT. ENVIRONMENTAL ENGINEERING	DWG NO 727023-02001

FIGURE 1
SAMPLE LOCATIONS AND APPROXIMATE AREA TO BE REMEDIATED

SCALE 1" = 100'	DATE AUGUST 1995

H:\ENG\SENECA\DECISION\VOLATILE\SEAD41.CDR field screening instrument, and no stained soil was observed, so the sample collected from immediately above the water table (2-4 feet bgs) was submitted to the lab for chemical analysis. A second soil sample (SS41-1) collected from the 0-2 foot bgs interval at the same location was also submitted for analyses. Three additional shallow soil samples were also collected from the interval of 0 to 2 feet bgs using a split-spoon at other locations along the base of the drainage ditch. One sample was collected from each split-spoon sample. Chemical analyses completed on the recovered samples consisted of soil pH by Environmental Protection Agency (EPA) SW-846[1] Method 9045 and total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1[2]. The sample locations are shown in **Figure 1**.

4.3.2 Results of Sampling Program

The results of the soil sampling program are presented in **Table 1**. Petroleum hydrocarbons were detected in all of the soil samples collected from SEAD-41. The surface soil samples SS41-1 and SS41-3 contained 144 and 300 ppm of TRPH, respectively. The surface soil samples SS41-2 and SS41-4 contained significantly less at 40 and 70 ppm TRPH, respectively. The subsurface soil sample SB41-1 contained 66 ppm TRPH. The pH of the soil samples ranged from 8.19 to 8.74.

The detection of petroleum hydrocarbons in all of the samples shows that a release did occur. The surface samples collected nearest the point where the blowdown liquids are suspected of being discharged contained the greatest concentration of petroleum hydrocarbons. Since the sample collected at depth from location SB41-1 and the two surface soil samples collected up- and down-gradient of the presumed release point contained lower concentrations of petroleum hydrocarbons, it appears that the extent petroleum-impacted soil is localized to the suspected point of release of the blowdown liquids. This area is outlined in **Figure 1**.

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[1] US EPA Publication SW-846, *"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods."*

[2] EPA 600/4-79-020, *"Methods for Chemical Analysis of Water and Wastes."*

TABLE 1

SURFACE AND SUBSURFACE SOIL ANALYSIS RESULTS
SENECA ARMY DEPOT ACTIVITY
SEAD-41 LIMITED SAMPLING PROGRAM

Compound	Matrix Location Depth (ft) Date ES ID Lab ID Units	Maximum Result	NYSDEC TAGM #4046 value (2)	Number Above TAGM #4046 value	Soil SEAD-41 0-0.2 1/11/94 SS41-1 208407	Soil SEAD-41 0-0.2 1/11/94 SS41-2 208408	Soil SEAD-41 0-0.2 1/11/94 SB41-3 208409	Soil SEAD-41 0-0.2 1/12/94 SS41-4 208410	Soil SEAD-41 2-4 1/11/94 SB41-1 208402
Total Petroleum Hydrocarbons	mg/Kg	300	NA	NA	144	40	300	70	66
pH	standard units	8.74	NA	NA	8.74	8.57	8.49	8.19	8.64
Total Solids	%W/W	88.3	NA	NA	88.3	86.5	84.4	84	85.1

NOTES :

(1) Laboratory results are from Sample Delivery Group (SDG) 41726.

(2) The New York State Department of Environmental Conservation's Technical and Administrative Guidance Memorandum HWR-94-4046 (or TAGM #4046) does not contain guidance values for these compounds.

4.4 REMEDIAL ACTION OBJECTIVES

The objective of the proposed remedial action at SEAD-41 is to remediate soil located in the vicinity of the drainage ditch that has been contaminated by the release of total petroleum hydrocarbons from the boilers and to demonstrate that the soil left surrounding the area of the excavation does not pose a significant threat to human health or the environment. The Army is proposing to perform a time-critical removal action to eliminate or lessen the magnitude of the potential threat that exists at SEAD-41. This decision document identifies and presents alternatives that have been considered to eliminate or lessen the magnitude of the potential threat. Due to the depot's change in status, and the current release of portions of the former depot for beneficial reuses by the public and private sectors, the proposed action is considered time-critical and the selected option will be implemented quickly to mitigate the potential threat.

It is currently anticipated that a limited amount of soil from the drainage ditch located to the west of Building 718 will need to be remediated during the planned action. The current quantity of soil requiring treatment in the drainage ditch is currently estimated to cover an area that measures 40 feet long by 3 feet wide by 1 foot deep. Combined, the estimated volume of soil requiring treatment is approximately 4.5 cubic yards. The extent area requiring treatment is displayed on **Figure 1**.

Verification of the acceptability of the surrounding soil quality will be demonstrated and documented by collecting and analyzing samples that will be analyzed for volatile organic and semivolatile organic compounds. Analytical results produced from the analysis of samples will be compared to soil cleanup levels that are tabulated in the New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Memorandum (TAGM) # 4046 "*Determination of Soil Cleanup Objectives and Cleanup Levels*". If the results from the confirmatory sampling indicate that all species are below allowable limits, the treatment process will be terminated, and the effected area will be backfilled (as needed if contaminated soil is excavated) and re-contoured; however, if the analytical results indicate that soil contains volatile and semivolatile organic compound concentrations in excess of TAGM #4046 levels the area of treatment will be expanded to remediate the identified contaminated soil.

4.5 TREATMENT/DISPOSAL ALTERNATIVES FOR CONTAMINATED SOIL

Varieties of treatment and disposal alternatives/technologies are available for the treatment of the excavated petroleum-impacted soils from SEAD-41. These include:

1. bioventing
2. vapor extraction
3. solidification/stabilization
4. land treatment or land farming
5. biopiles
6. soil washing
7. low temperature thermal desorption and
8. off-site disposal

A brief overview of these alternatives is provided below.

Bioventing

Bioventing is an in-situ treatment technology that promotes biodegradation of the identified volatile and semivolatile organic contaminants by the providing oxygen to the microorganisms that are resident in the affected soil. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be left in-place.

A typical bioventing system contains one or more air injection points that are manifold to a low-flow blower. A properly sized bioventing system provides only enough oxygen flow to sustain microbial activity. Optimal air flow rates maximize biodegradation as the vapors move slowly through biologically active soil while minimizing volatilization and release of the contaminants to the atmosphere.

Advantages of a bioventing system include factors such as:

1. in-situ treatment greatly reduces the expense and destruction associated with traditional combined excavation and treatment/disposal processes;
2. in-situ treatment often eliminates expensive off-gas treatment requirements that are typical of many soil vapor vacuum extraction procedures;

3. bioventing processes are mechanically simple, require minimal levels of maintenance, can be operated and maintained by relatively few people, and can be left unattended for extended periods of time; and,
4. biodegradation of volatile organic compounds can be achieved in periods of 1 to 5 years, while treatment times for semivolatile organic constituents can be achieved in 2 to 10 years.

Potential limitations of a bioventing system include:

1. bioventing is most practical for implementation at sites where large volumes of soil at depth are contaminated with degradable volatile and semivolatile organic compounds;
2. saturated soil lenses are difficult to aerate;
3. low-permeability soils are difficult to aerate;
4. soils with low moisture content tend to dry out during aeration, and thereby reduce the rate of biodegradation achieved;
5. water tables in close proximity to the ground's surface limits the vent well's radius of influence;
6. low nutrient levels (i.e., nitrogen and phosphorous) may affect and retard biodegradation; and,
7. low soil and ambient temperatures retard biodegradation.

Soil Vapor Extraction

Soil vapor extraction wells are drilled in and around the area where the soil contamination exists. A vacuum is then applied through the extraction well(s) that induces gas-phase volatiles to be removed from the soil and captured in the well(s). If contaminants are shallow, geomembrane covers are typically included to prevent short circuiting of air flow and to increase the radius of influence of the extraction wells. Ground water depression pumps may be needed to reduce upwelling that may result due to the application of the vacuum on the area of contamination. These wells may also be used to lower the local water table elevation, thereby thickening the vadose where this technology works best.

Principal advantages of this technology include:

1. it is an in-situ technology that thereby eliminates the need for excavation.

2. It is best applied to sites where large amounts of volatile and semivolatile organic contamination exists; and
3. relatively simple and inexpensive equipment is used in the system.

Potential limitations of this technology include:

1. soil that contains a high degree of fines and/or a high degree of saturation require higher vacuums which will increase the cost of the system or hamper the operational efficiency of the unit;
2. soil exhibiting highly variable stratigraphy or high permeability may be susceptible to uneven gas flow and therefore, contaminant removal;
3. soil containing high organic content or that is extremely dry has a high sorption capacity for VOCs which may result in reduced removal rates;
4. exhaust gases from the SVE system may require additional treatment prior to discharge to the atmosphere; and
5. entrained liquids resulting from the off-gas treatment system may require capture and treatment/disposal in ancillary systems.

Solidification/Stabilization

Solidification/stabilization technologies may be implemented in-situ or ex-situ. In either case, the objective of solidification technology is to physically bound or encapsulate the contamination within a stabilized mass, while stabilization technologies induce chemical reactions between stabilizing agents and the contaminants to reduce their mobility within the environment. The efficacy of the solidification/stabilization process is typically demonstrated by performing leachability tests to measure and document the immobilization of contaminants. Numerous forms of solidification and stabilization technologies have been demonstrated and include:

- bituminization
- emulsified asphalt
- modified sulfur cement
- polyethylene extrusion
- pozzolan/Portland cement
- radioactive waste solidification
- sludge stabilization soluble phosphates and

- vitrification/molten glass.

Key limitations or drawbacks of these technologies include:

1. Depth of contaminants may limit the application of some in-situ processes;
2. Environmental conditions may affect the long-term immobilization of the contaminants;
3. Certain types of wastes are incompatible with different processes and treatability studies are generally required to predict the efficacy of the treatment process;
4. Organic contaminants are frequently not encapsulated and immobilized by the processes;
5. Reagent/additive mixing are relatively difficult when applied in-situ;
6. Significant volume increases (e.g., up to double the original volume) may result from the process;
7. Confirmatory sampling for in-situ application is generally more difficult and costly that for ex-situ applications;
8. Cohesive soil and soil containing a large portion of coarse gravel and cobbles are unsuitable for this type of treatment; and
9. Solidified materials, if left in place, may hinder future site uses and conditions encountered.

Land Treatment or Land Farming

Land Treatment or Land Farming are generally comparable treatment technologies, the significant difference being Land Treatment is performed in-situ whereas Land Farming is performed ex-situ. In both cases, the contaminated soil is periodically tilled or turned over to aerate the waste and to promote degradation. During treatment, key conditions (e.g., moisture content, degree of aeration, pH and nutrient/additive levels, etc.) of the contaminated media are closely monitored and controlled to enhance the biodegradation process. Land Treatment or Land Farming technologies are both generally applied to enhance the degradation of heavier hydrocarbons, and are less likely to be used for the treatment of organic contamination containing volatile organic compounds. Volatile organic compound contamination is typically more effectively and quickly treated using technologies that take advantage of the lighter hydrocarbon species' volatility (e.g., soil vapor extraction, bioventing, etc.). Both technologies are considered to be medium to long-term approaches to remediating contaminated soils.

Land Treatment sites must be properly designed and managed to ensure that problems that could result in the ground water, surface water, sediment, air, and food chain contamination do not occur.

Land Farming technologies, on the other hand, control these potential problems by moving the contaminated soil to a controlled test cell. During Land Farming the contaminated media is excavated and placed into lined beds or other systems that are designed to control and capture leaching or volatile contaminants. During placement of the contaminated media in the bed, lifts of up to 18 inches in height are constructed and these are maintained during the treatment process. Once the desired degree of biodegradation is achieved, the affected media is removed and replaced by other contaminated material. Frequently, fresh contaminated media is mixed with partially remediated material to inoculate the freshly added material with an actively degrading microbial culture, thereby enhancing degradation and shortening treatment times.

Contaminants that have been successfully treated in Land Treatment and Land Farming applications include diesel fuels, number 2 and 6 fuel oils, aviation fuels, oily sludges, wood preserving wastes, coke wastes and certain pesticides.

Limitations to these treatment technologies include:

1. a large amount of space is required;
2. soil that is contaminated to extensive depths (e.g., greater than 1 to 2 feet) must be excavated and placed into land farming cells or spread out over extended areas;
3. conditions affecting the biological degradation of contaminants (e.g., temperature and rain fall) are largely uncontrolled which can lead to increased treatment times;
4. if volatile contaminants are present in the contaminated media, they must be pretreated because they would volatilize and cause releases to the atmosphere;
5. dust control provisions must be considered, especially during media tilling and handling operations;
6. runoff collection facilities must be constructed and monitored to control leachate release; and,
7. some waste constituents may be subject to land ban regulations and thus be prohibit from treatment via this technique.

Biopiles

Biopile treatment is a full-scale technology where excavated soils are mixed with soil additives, stockpiled in a fabricated treatment area, and remediated using forced aeration to promote natural biodegradation of the organic contaminants. If the treatment is successful, the contaminants are reduced to carbon dioxide and water, and the soil can be recycled and placed back into the excavation.

A basic biopile system includes a treatment bed, which is typically comprised of a 60-mil high-density polyethylene (HDPE) base liner that sits atop a base of clean soil, an aeration system, an irrigation/nutrient addition system, a leachate collection system, and an over liner (20-mil HDPE). Moisture, heat, nutrients, oxygen, and pH are controlled to promote biodegradation. The irrigation/nutrient addition system is buried beneath the contaminated soil to facilitate the addition of air and if necessary, nutrients (e.g., water, phosphorous, nitrogen). The contaminated pile is typically covered to minimize run-off, evaporation and volatilization, and to promote solar heating. Volatile organic compounds liberated during the biodegradation may be captured in an optional air collection system where they are treated (e.g., passed through an activated carbon canister) prior to discharge to the atmosphere.

The advantages of soil treatment via biopiles include factors such as:

1. it is applicable to all types of petroleum, oil and lubricants;
2. final reaction products are relatively innocuous;
3. short treatment times (i.e., typically range from 3 to 6 months) are achievable; and,
4. treatment rate can be enhanced by the addition of simple, low-cost nutrients (i.e., water, nitrogen, phosphorous).

Limitations of treatment in biopiles include:

1. small size excavations (i.e., less than 250 cubic yards) may be more economically handled via off-site disposal;
2. a large amount of flat space is required for construction of the biopile; and,
3. increased content of clay and silt in the soil may retard or limit the extent of biodegradation.

Soil Washing

Soil washing is a treatment option applicable to soil contaminated with metals and semivolatile organic compounds (SVOCs). In the process, soil is slurried with water and subjected to intense scrubbings. To improve the efficiency of soil washing, the process may include the use of surfactants, detergents, chelating agents or pH adjustment. After contaminants are removed from the soil, the washing solutions can be treated in a wastewater treatment system. The washing fluid can then be recycled, continuing the soil washing process.

Certain site factors can limit the success of soil washing:

1. highly variable soil conditions;
2. high silt or clay content which will reduce percolation and leaching, and inhibit the solid-liquid separations following the soil washing;
3. chemical reactions with soil cation exchange and pH effects may decrease contaminant mobility; and,
4. if performed in-situ, the groundwater flow must be well defined in order to recapture washing solutions.

Low Temperature Thermal Desorption

Thermal desorption is a physical separation process that is intended to volatilize water and organic contaminants from the waste feedstock. A carrier gas transports the volatilized water and organic compounds into a gas treatment system where subsequent contaminant destruction or containment is accomplished. In low temperature thermal desorption (LTTD) processes, the contaminated media is heated to a temperature between 90 and 300 degrees Celsius (^{O} C; or approximately 200 to 600 degrees Fahrenheit, ^{O}F) using either direct-fired, indirect-fired, or indirect heated systems. In the direct-fired systems, fire is applied directly upon the surface of the contaminated media, and frequently some degree of thermal oxidation may result among the organic constituents. In the indirect-fired system, the flame heats the air stream that is then passed over and through the contaminated media to volatilize water and organic constituents. In an indirect-heated system, the waste is placed into an externally heated vessel where it is typically tumbled while the surrounding headspace is continuously swept with an inert carrier gas. If the LTTD system is operated at the lower end of its temperature range, the naturally occurring organic constituents of the soil are not damaged which enables the treated soil to support future biological activity.

Advantages of LTTD processes include:

1. it is effective at separating organic from complex waste streams (e.g., refinery wastes, coal tar wastes, paint wastes, etc.);

2. it can separate solvents, PCBs, pesticides, lubricants and fuels from soil;
3. equipment capable of handling 10 or more tons per hour is commercially available and it can be brought to the site;
4. LTTD processes require less fuel than other forms of treatment technologies; and,
5. treated soils can be used as backfill at the original excavation site or at other sites, if subsequent analyses indicate that organics are removed to permissible levels and metals enhancement does not occur.

Limitations of the LTTD technology include:

1. clay or silty soil that agglomerates and that has a high humic content typically increase reaction time or temperature requirements due to the binding of the organic contaminants within the soil matrix;
2. preprocessing of soil (e.g., dewatering, grinding or crushing) may be needed to achieve acceptable levels of moisture or particle size in the feed stock.;
3. soils containing heavy metals content may yield a treated soil residue that requires subsequent stabilization or treatment; and,
4. all thermal desorption systems require treatment of the off-gases to control particulates and emissions prior to discharge to the atmosphere.

Off-Site Disposal at a Landfill

Excavation of hazardous materials is performed extensively for site remediation. Excavation is usually accompanied by off-site treatment (several discussed above) or disposal in an off-site secured landfill. Excavation employs the use of earth moving equipment to physically remove soil and buried materials. There are no limitations to the types of waste that can be excavated and removed. Factors that must be considered include the mobility of the wastes, the feasibility of on-site containment, and the cost of disposing the waste or rendering it non-hazardous once it has been excavated. A frequent practice at hazardous waste sites is to excavate and remove contaminant "hot spots" and to use other remedial measures for less contaminated soil.

Advantages of excavation and off-site disposal include:

1. excavation and off-site disposal can be used to eliminate the source of contamination at a site;

2. excavation and off-site disposal reduces or eliminates the need for long-term monitoring at the original waste site; and,
3. time to achieve beneficial results at the original site is short relative to other remedial alternatives.

Potential limitations of excavation and off-site disposal in a landfill include:

1. costs associated with off-site disposal are be high if the excavated material is classified as hazardous according to 40 CFR 261 Subpart C;
2. institutional aspects (e.g., barriers or fencing, dust suppression, etc.) can add significant delays to program implementation; and,
3. inappropriate post-excavation disposal can result in subsequent environmental liabilities at the off-site disposal site.

4.6 REMEDIAL ACTION COSTS

Bioventing

Bioventing does not require expensive equipment and can be completed by relatively few personnel who are responsible for the operation and continuing maintenance of the system. Factors that affect costs include the type of contaminant and its concentration, the permeability of the soil, well spacing and number, pumping rate and off-gas treatment requirements.

Based on data developed by the US Air Force Center for Environmental Excellence (AFCEE)[3], the estimated total costs of in-situ soil remediation via the application of bioventing technology is $10 to $60 per ton. At sites where more than 10,000 cubic yards of contaminated require treatment, costs of less than $10 per cubic yard have been achieved. At site where less than 500 cubic yards require treatment, costs of greater than $60 per cubic yard have been recorded.

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[3] Air Force Center of Environmental Excellence, Technology Transfer Division, "*Bioventing Performance and Cost Results from Multiple Air Force Test Sites*," Technology Demonstration, Final Technical Memorandum, Jun 1996, Hill AFB, Texas.

Soil Vapor Extraction

The actual cost of in-situ soil vapor extraction is site-specific, highly dependant on the size of the contaminated site, the type of contaminant species that are present and their concentration, and the geologic and hydrogeologic setting of the site. Independently, these factors effect the number of extraction wells that may be required at the site, the level of vacuum that must be applied and the capacity of the extraction device needed, and the length of time that is necessary to achieve the desired clean-up goal. Additionally, off-gas treatment systems and systems that treat recovered liquid streams may also be needed to control releases to the air or receiving water bodies or sewer systems. Both of these ancillary systems will add to the ultimate cost of the soil vacuum extraction system.

Based on information reported by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via in-situ soil vapor extraction are estimated to be on the order of $10 to $40 per cubic yard of contaminated soil. An additional cost of between $10,000 and $100,000 may be required if pilot testing is required to demonstrate the efficacy of the technology for the contaminant.

In-Situ Solidification/Stabilization

Solidification/stabilization treatment is grouped into different categories according to the types of additives and processes used, and the cost of this treatment is ultimately dependent upon which process is utilized. Ex-situ processes are among the most mature of remediation technologies and data provided by Federal Remediation Technologies Roundtable[4] indicates that all forms of this technology can be applied for under $100 per ton of soil. In-situ treatment costs range from $40 to $60 per cubic yard for shallow applications of auger/caisson or reagent/injector head system processes, to $150 to $250 per cubic yard for deeper applications of the same technologies. Costs associated with the application of in-situ vitrification processes include $25,000 to $30,000 for treatability tests exclusive of analytical costs, plus equipment mobilization (i.e., $200-000 to $300,000 per event) fees, plus utilities (e.g., cost of electricity, water, etc.).

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[4] Federal Remediation Technologies Roundtable, U.S. EPA, Chair, (5102G) 401 M Street, S.W., Washington, D.C. 20460, URL http://www.frtr.gov

Land Treatment or Land Farming

Based on information provided by the Federal Remediation Technologies Roundtable[4], costs to treat contaminated soil via land treatment are estimated to be on the order of \$25 to \$50 per cubic yard of contaminated soil. Comparable treatment costs via land farming procedures are estimated to be closer to \$75 per cubic yard of soil treated. Additional costs associated that may be required for both technologies include laboratory study costs (\$25,000 to \$50,000 per event) and costs associated pilot tests or field demonstration (e.g., \$100,000 to \$500,000) if the efficacy of the technology for the contaminant is unknown.

Biopiles

Treatment costs using biopiles is dependant on the nature of the contaminant, the procedure to be used, the need for additional pre- or post-treatment, and the need for air emission control equipment. Information provided by the Federal Remediation Technologies Roundtable[4] indicates that typical treatment costs using a prepared bed and a liner range from \$100 to \$200 per cubic yard of contaminated soil.

Soil Washing

A large number of vendors provide soil washing services. The treatment processes used vary according to the scale of the operation, particle size being treated, and extraction agent used. Because the operation is unique for each site, it is difficult to arrive at a cost estimate. However, in an evaluation of fourteen companies offering soil washing treatment services, a general price range of \$50 to \$205 per ton was noted in EPA Engineering Bulletin EPA/540/2-90/017, September 1990. The average cost for use of this technology reported by the Federal Remediation Technologies Roundtable[4], including excavation costs, is \$170 per ton.

Low Temperature Thermal Desorption

The Federal Remediation Technologies Roundtable[4] reports that costs associated with the remediation of petroleum hydrocarbon contaminated soil via low temperature thermal desorption systems range from \$40 to \$300 per ton of soil. Of the total cost, approximately \$15 to \$30 per ton is associated with direct operating costs, while unit transportation and set-up costs are estimated at \$3.50 to \$5.50 per ton (not typically exceeding a total of \$200,000 per event). Costs associated with excavation of the contaminated soil and backfill of the treated soil is estimated in the range of $5 to $10 per ton.

Off-Site Disposal at a Landfill

The Federal Remediation Technologies Roundtable[4] estimates that costs associated with the excavation and disposal of soil range from $270 to $460 per ton of soil, depending on the nature of the hazardous materials and the methods of excavation. If the soil is not classified as hazardous, the cost to excavate and dispose of it in a landfill will more typically range between $50 and $100 per ton. If the soil can be classified as clean enough to serve for beneficial use as daily cover, the cost to excavate and dispose of it will drop and range between $25 and $50 per ton.

4.7 RECOMMENDATION

Remediation of petroleum hydrocarbon-impacted soil is recommended for the area of the roadside drainage ditch that is located to the west of Building 718. It is currently believed that the blowdown liquids were discharged near the center of this ditch and pooled in this area. The projected amount of soil requiring remediation from this ditch is defined as 4.5 cubic yards. This estimate includes an area measuring 1 foot deep by 3 feet across the ditch by 20 feet each in the up- and down-stream flow directions from the point where the blowdown is suspected to have been released. The subsurface soil sample collected beneath the center of the ditch and up- and down-stream of the release point shows that there is little extent to the impacted soil.

The soil from the drainage ditch can be easily excavated with a backhoe and transported by truck to an off-site disposal area. Because of the limited volume of soil that requires remediation, clean fill from SEDA can be used to backfill the excavated area once the area has been shown to comply with the New York State Department of Environmental Conservation (NYSDEC) Petroleum-Contaminated Soil Guidance Policy.

4.8 JUSTIFICATION

The volume of petroleum hydrocarbon contaminated soil recommended for removal from SEAD-41 is approximately 4.5 cubic yards. Using a conservative estimated unit cost of $100 for the excavation and disposal of the contaminated soil, the total cost of the proposed removal action is approximately $450. Because the lateral and vertical extent of the petroleum hydrocarbon-impacted soil can be sufficiently removed by this method of remediation, and the cost is not prohibitive, excavation and off-site disposal are an effective and immediate way to remediate the soil at SEAD-41.

4.9 POST-REMOVAL VERIFICATION SAMPLING

Conformational sampling will be conducted at the excavation site to verify that the "hot spot" of petroleum contaminated soil has been adequately removed. Six samples will be collected from the trench excavated at the drainage ditch. Each of these samples will be analyzed for volatile organic compounds and semivolatile organic compounds by EPA Methods SW-846 8021 and SW-846 8270, respectively. One composite sample will be collected from each side-wall of the trench and one composite sample will be collected from each end of the floor of the trench.

If these samples demonstrate that the concentrations of the contaminants are below the guidance values for the 1) protection of groundwater, 2) protection of human health, 3) protection of fish and wildlife, and 4) protection against objectionable nuisance characteristics, as stated in the NYSDEC Petroleum-Contaminated Soil Guidance Policy, then SEAD-41 will be considered to have been acceptably remediated.

5.0 DECISION DOCUMENT FOR REMOVAL ACTION AT SEAD-60

5.1 EXECUTIVE SUMMARY

An Expanded Site Inspection performed at SEAD-60, the Oil Discharge Area adjacent to Building 609, at Seneca Army Depot Activity (SEDA) in Romulus, NY demonstrated that a release of petroleum hydrocarbons has occurred. During May/June of 1999, approximately 195 cubic yards of petroleum hydrocarbon contaminated soil and sediment was excavated from the area of SEAD-60 as part of a NYSDEC Region 8 Spill Prevention and Response Unit clean-up. This material was transported to SEAD-17 where it was staged for use as the feed stock for a treatability study at the former deactivation furnace. This removal action was a time-critical removal action, completed by the Army with the intent of eliminating a known source of contamination that could pose a threat to the environment and surrounding populations.

SEDA's historic military mission has been terminated and the depot has officially been closed by the Department of the Defense (DoD) and the US Army. In accordance with provisions of the DoD's Base Realignment and Closure (BRAC) process, the land and the facilities of the former depot have been surveyed and evaluated, and prospective beneficial uses of the facility have been identified. Portions of the depot, including the area immediately surrounding SEAD-60, are now being released to the public and private sectors for reuse under the BRAC process. As portions of the former depot are released for other beneficial uses, increased access is afforded to all portions of the former depot, resulting in an increased potential for exposure of populations to any residual chemicals that are present at former solid waste management units (SWMUs) remaining at the depot pending clean-up.

Therefore, the goal of the removal action at SEAD-60 was to eliminate an identified source of residual chemical materials in the soil and sediment. This goal was achieved by the removal action that was conducted.

This decision document presents details of the removal action conducted at SEAD-60 that was developed in accordance with the Federal Facility Agreement and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan.

5.2 SITE BACKGROUND

5.2.1 Site Description

SEAD-60 is located in the southeastern portion of SEDA and represents an area of oil stained soil adjacent to the southwest corner of Building 609. SEAD-52 is adjacent to the southern boundary of the SWMU area, and SEAD-62 is located to the east. The site is located within the ammunition storage area and access to the site is restricted. The site plan is shown in **Figure 1**.

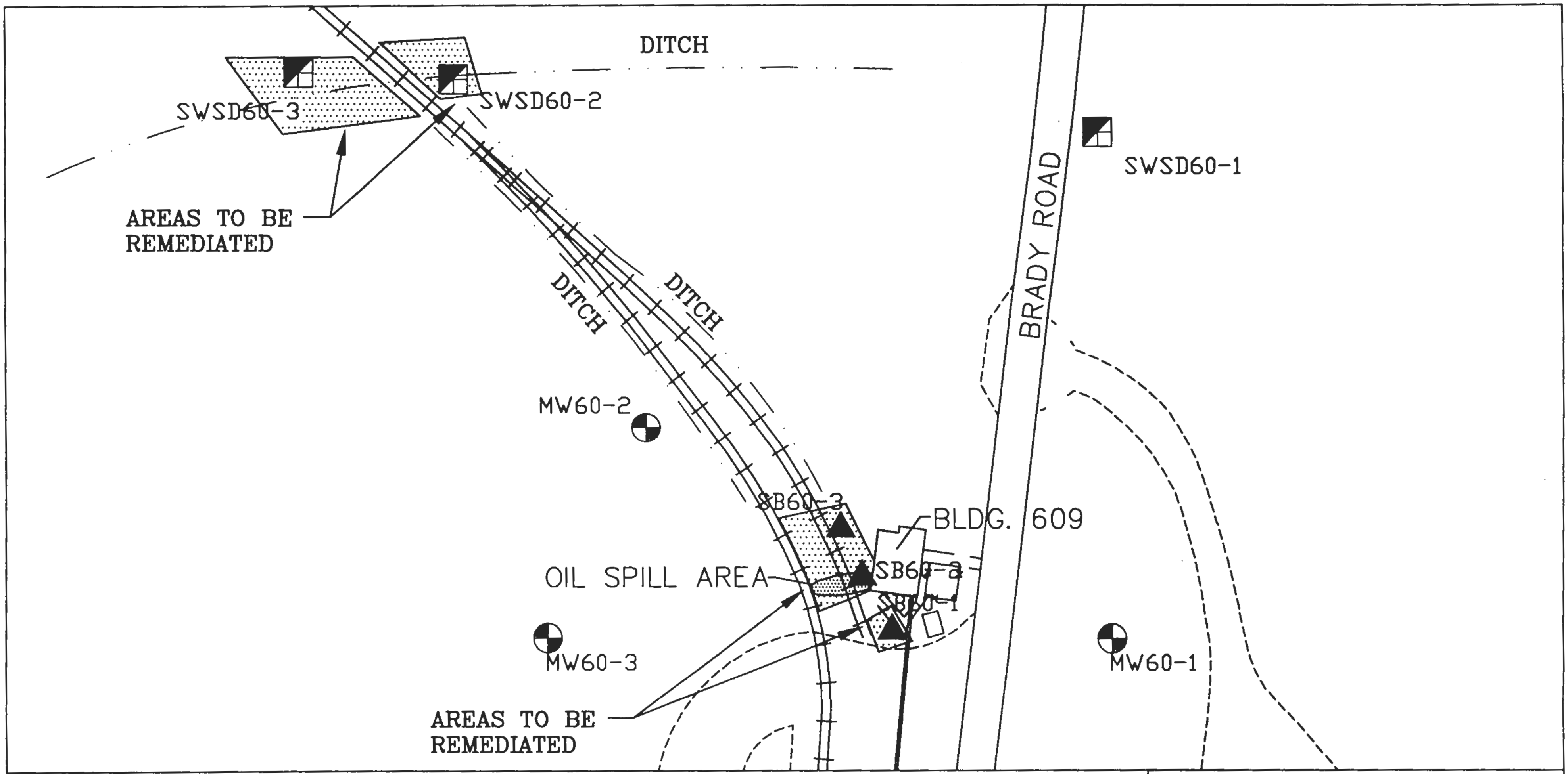
The surrounding areas are characterized by developed and undeveloped land. The developed areas consist of Building 609, which is located immediately west of Brady Road, and two SEDA railroad spurs. A single railroad track enters the developed area from the northwest and splits into two spur lines approximately 300 feet northwest of Building 609. The two spurs transect the site to the west of Building 609. The eastern spur line passes within a few feet of Building 609 and ends just south of Building 609. The western spur ends at the northern side of Building 612 that is south of Building 609.

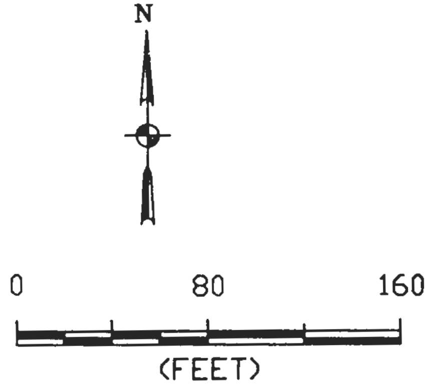
The undeveloped areas are located north, west and east of SEAD-60, and consist of grassy fields with sparse brush. A grassy mounded area is also located north-northwest of the site.

Building 612, which is part of SEAD-52, is located approximately 120 feet south of the site of SEAD-60. Building 609 is the boiler house for Building 612. Elevated pipes, which include steam pipes, run parallel to Brady Road and connect Buildings 609 and 612. A tall emissions stack protrudes from the southeastern corner of Building 609. A paved driveway is located immediately south of Building 609 and provides vehicular access to the western portion of the site from Brady Road. There are also paved access routes on the eastern and northern sides of the building.

The spill area, which is evidenced by visibly stained soils and which measures approximately 6 feet by 30 feet in size, extends west of the easternmost railroad spur. No vegetation is present in the visibly stained soil area.

The topography in the immediate vicinity of the Building 609 is variable but the most notable feature is a low-lying area that is defined by the western wall of Building 609 and the easement of the easternmost railroad spur. The local topography within an approximately 50-foot radius





LEGEND:

▲ SB60-3	SOIL BORING
◩ SWSD60-1	SURFACE WATER/ SEDIMENT SAMPLE
◕ MW60-1	MONITORING WELL WITH WATER TABLE ELEVATION
— · —	DITCH

R:\SENECA\SEAD60\SOILSD60.DWG

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
DECISION DOCUMENT FOR REMOVAL ACTION
SEAD-60

DEPT. ENVIRONMENTAL ENGINEERING
Dwg. No. 734605-01001

FIGURE 1
SAMPLE LOCATIONS AND APPROXIMATE AREA TO BE REMEDIATED

SCALE AS NOTED
DATE FEBRUARY 1999
REV A

slopes toward this area while the regional topography slopes to the west. In the northern portion of the site, the topography slopes toward an east-west trending intermittent stream that flows to the west. Drainage swales, which parallel each side of the railroad spurs, flow north intersecting the intermittent stream approximately 300 feet northwest of Building 609.

Surface water flow resulting from precipitation events at SEAD-60 is controlled by the local topography. Surface water flows primarily westward following the regional topographic slope in this area. There are no sustained surface water bodies present at SEAD-60, although intermittent drainage ditches are present to the north, northwest and west of the site. The two drainage ditches, which flow to the northwest along the railroad spurs, originate near the oil spill area.

Three monitoring wells were installed at SEAD-60 as part of the ESI program,. Groundwater elevations were measured in the three monitoring wells and the results are presented in the referenced ESI Report. Based on these data, the groundwater flow direction is primarily west across SEAD-60.

5.2.2 Site History

Most of the historical information for SEAD-60 is related to a release of oil on the site. Building 609 has historically been a boiler house for Building 612, which is located south of Building 609. It is believed that overflow from an aboveground storage tank located in Building 609 was discharged from a pipe in the wall of Building 609 resulting in a spill adjacent to the southwest corner of the building. According to SEDA personnel, the aboveground storage tank contains No. 2 fuel oil. No information is available on the date of the spill or the volume of oil released.

5.3 PREVIOUS INVESTIGATIONS

5.3.1 Description of Sampling Program

Soil, surface water, sediment and groundwater were sampled as part of the ESI conducted at SEAD-60 in 1994. Sampling and analyses were based upon historical information of an oil release on site. The results of this investigation were detailed in the draft ESI Seven Low Priority SWMUs report (Parsons ES, April 1995).

Three surface and six subsurface soil samples were collected at SEAD-60 in the immediate vicinity of the oil-stained soil. Three collocated surface water and sediment samples were collected from drainage ditches north of SEAD-60. Two of the selected surface water and sediment locations are suspected to receive surface water runoff from SEAD-60, while the last sample location (SWSD60-1) is an upstream sample. Three monitoring wells were also installed and sampled as part of this investigation. The following sections describe the nature and extent of contamination identified at SEAD-60. The sample locations are shown in **Figure 1**.

5.3.2 Results of Sampling Program

The ESI conducted at SEAD-60 identified an area that had been impacted by a release of fuel oil to the ground surface immediately west of Building 609. The results of the soil sampling program are presented in **Tables 1** through **4**. The surface soils in this area have been impacted primarily by petroleum hydrocarbons and PAHs, and to a lesser extent by PCB compounds. At the location of the oil release, surface soils (0 to 0.2 feet below grade surface) are the most significantly impacted media. TPH concentrations of 218,000 mg/kg and 50,900 mg/kg were found in the area of the oil-stained soil. Concentrations of PAHs (up to 27,000 mg/kg) correlated spatially with the elevated TPH concentrations in the surface soils. Measured concentrations of PAHs in excess of NYSDEC TAGM levels were most numerous in the surface soil samples where eight concentrations reported for benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, and dibenz(a,h)anthracene were in excess of defined state soil guidance limits were found. Only a single concentration (i.e., 27 J ug/Kg) of dibenz(a,h)anthracene was found at a level in excess of its NYSDEC TAGM value in deeper soils (i.e., SB60-2-04, 6 to 8 feet bgs).

While the concentrations of volatile organic compounds, pesticides, and PCBs present in the two surface soil samples from the release area were generally below TAGM values, two PCBs (Aroclor 1248 and Aroclor 1260) were found at concentrations above their respective TAGM values. Both of these high PCB concentrations were recorded in the shallow soil sample (i.e., SB60-2-00) that also indicated the highest concentration of TPH. Heavy metals concentrations above TAGM values were present in all of the samples. While the surface soil samples from the two soil borings located near the oil release area generally had more TAGM exceedences for heavy metals; no consistent pattern in the spacial distribution of these exceedences was evident.

Sediment downgradient of SEAD-60 has also been impacted by the release of the fuel oil. Concentrations of semivolatile organic compounds, primarily including PAHs were reported in the analytical results of the two sediment samples collected downgradient of the oil-stained soil. The

TABLE 1

SENECA ARMY DEPOT ACTIVITY
SEAD-60
SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND		MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM					
	MATRIX					SOIL	SOIL	SOIL	SOIL	SOIL
	LOCATION					SEAD-60	SEAD-60	SEAD-60	SEAD-60	SEAD-60
	DEPTH (FEET)					0-0 2	0-2	2-4	0-0.2	2-4
	SAMPLE DATE					05/27/94	02/28/94	02/28/94	06/07/94	06/08/94
	ES ID					SB60-1-00	SB60-1 01	SB60-1.02	SB60-2-00	SB60-2-02
	LAB ID					222473	212883	212884	223339	223513
	SDG NUMBER					44410	42510	42510	44410	44694
	UNITS									
VOLATILE ORGANICS										
Methylene Chloride	ug/Kg	54	56%	100	0	12 U	11 U	11 U	27 J	11 U
Acetone	ug/Kg	170	11%	200	0	12 U	11 U	11 U	170 J	11 U
Carbon Disulfide	ug/Kg	2	22%	2700	0	12 U	11 U	11 U	1 J	11 U
2-Butanone	ug/Kg	26	11%	300	0	12 U	11 U	11 U	26 J	11 U
2-Hexanone	ug/Kg	1	11%	NA	NA	12 U	11 U	1 J	11 UJ	11 U
Tetrachloroethene	ug/Kg	3	11%	1400	0	12 U	11 U	11 U	11 UJ	11 U
Toluene	ug/Kg	13	33%	1500	0	12 U	11 U	11 U	13 J	2 J
Ethylbenzene	ug/Kg	4	11%	5500	0	12 U	11 U	11 U	4 J	11 U
Xylene (total)	ug/Kg	9	11%	1200	0	12 U	11 U	11 U	9 J	11 U
SEMIVOLATILE ORGANICS										
Naphthalene	ug/Kg	38	11%	13000	0	38 J	370 U	370 U	18000 U	360 U
2-Methylnaphthalene	ug/Kg	1100	11%	36400	0	390 U	370 U	370 U	1100 J	360 U
Acenaphthene	ug/Kg	1400	33%	50000*	0	59 J	370 U	370 U	1400 J	360 U
Dibenzofuran	ug/Kg	29	11%	6200	0	29 J	370 U	370 U	18000 U	360 U
Fluorene	ug/Kg	1300	22%	50000*	0	48 J	370 U	370 U	1300 J	360 U
Phenanthrene	ug/Kg	8900	44%	50000*	0	570 J	25 J	370 U	8900 J	360 U
Anthracene	ug/Kg	2000	22%	50000*	0	98 J	370 U	370 U	2000 J	360 U
Carbazole	ug/Kg	79	11%	50000*	0	79 J	370 U	370 U	18000 U	360 U
Di-n-butylphthalate	ug/Kg	1500	33%	8100	0	390 U	370 U	370 U	1500 J	360 U
Fluoranthene	ug/Kg	14000	67%	50000*	0	1100 J	33 J	370 U	14000 J	27 J
Pyrene	ug/Kg	27000	78%	50000*	0	700 J	31 J	37 J	27000 J	27 J
Benzo(a)anthracene	ug/Kg	340	11%	220	1	340 J	370 U	370 U	18000 U	360 U
Chrysene	ug/Kg	17000	44%	400	2	400	370 U	370 U	17000 J	18 J
bis(2-Ethylhexyl)phthalate	ug/Kg	380	44%	50000*	0	54 J	370 U	380 J	18000 U	360 U
Benzo(b)fluoranthene	ug/Kg	16000	33%	1100	2	730 J	370 U	370 U	16000 J	360 U
Benzo(k)fluoranthene	ug/Kg	190	11%	1100	0	190 J	370 U	370 U	18000 U	360 U
Benzo(a)pyrene	ug/Kg	350	11%	61	1	350 J	370 U	370 U	18000 U	360 U
Indeno(1,2,3-cd)pyrene	ug/Kg	1100	33%	3200	0	220 J	370 U	370 U	18000 U	360 U
Dibenz(a,h)anthracene	ug/Kg	1100	33%	14	3	110 J	370 U	370 U	18000 U	360 U
Benzo(g,h,i)perylene	ug/Kg	1600	33%	50000*	0	220 J	370 U	370 U	18000 U	360 U

TABLE 1

SENECA ARMY DEPOT ACTIVITY
SEAD-60
SOIL ANALYSIS RESULTS FROM THE ESI

	MATRIX					SOIL	SOIL	SOIL	SOIL	SOIL
	LOCATION					SEAD-60	SEAD-60	SEAD-60	SEAD-60	SEAD-60
	DEPTH (FEET)					0-0.2	0-2	2-4	0-0.2	2-4
	SAMPLE DATE					05/27/94	02/28/94	02/28/94	06/07/94	06/08/94
	ES ID		FREQUENCY		NUMBER	SB60-1-00	SB60-1.01	SB60-1.02	SB60-2-00	SB60-2-02
	LAB ID		OF		ABOVE	222473	212883	212884	223339	223513
	SDG NUMBER	MAXIMUM	DETECTION	TAGM	TAGM	44410	42510	42510	44410	44694
COMPOUND	UNITS									
PESTICIDES/PCB										
alpha-BHC	ug/Kg	5	11%	110	0	4 UJ	1.9 U	1.9 U	5 J	1.8 U
Aldrin	ug/Kg	16	11%	41	0	4 UJ	1.9 U	1.9 U	16 J	1.8 U
Endosulfan I	ug/Kg	34	33%	900	0	3.2 J	1.9 U	1.9 U	34 J	1.8 U
4,4'-DDE	ug/Kg	110	44%	2100	0	110 J	2.7 J	3.7 U	31 J	3.6 U
4,4'-DDD	ug/Kg	100	22%	2900	0	7.8 UJ	3.7 U	3.7 U	55 J	3.6 U
4,4'-DDT	ug/Kg	130	22%	2100	0	84 J	3.7 U	3.7 U	130 J	3.6 U
Endrin ketone	ug/Kg	14	11%	NA	NA	7.8 UJ	3.7 U	3.7 U	14 J	3.6 U
alpha-Chlordane	ug/Kg	27	22%	540	0	4 UJ	1.9 U	1.9 U	27 J	1.8 U
gamma-Chlordane	ug/Kg	10	11%	540	0	4 UJ	1.9 U	1.9 U	10 J	1.8 U
Aroclor-1242	ug/Kg	970	11%	1000/10000(a)	0	78 UJ	37 U	37 U	970 J	36 U
Aroclor-1248	ug/Kg	2100	11%	1000/10000(a)	1	78 UJ	37 U	37 U	2100 J	36 U
Aroclor-1260	ug/Kg	4400	22%	1000/10000(a)	1	78 UJ	37 U	37 U	4400 J	36 U
METALS										
Aluminum	mg/Kg	14100	100%	14593	0	10800	8440	13300	9420	6850 J
Antimony	mg/Kg	1.8	78%	3.59	0	0.28 J	0.43 J	0.36 J	1.8 J	0.29 J
Arsenic	mg/Kg	8.1	100%	7.5	1	5.3	4.1 J	6.2 J	8.1	4.6
Barium	mg/Kg	679	100%	300	2	77.6	98.3	85.8	679	71.7 J
Beryllium	mg/Kg	0.67	100%	1	0	0.47 J	0.43 J	0.67 J	0.42 J	0.26 J
Cadmium	mg/Kg	2	100%	1	2	0.58 J	0.36 J	0.27 J	2	0.32 J
Calcium	mg/Kg	102000	100%	101904	1	65800	75100	64000	56200	90900 J
Chromium	mg/Kg	23.3	100%	22	2	18.3	14.2	19.4	18.8	12 J
Cobalt	mg/Kg	13.1	100%	30	0	9.6	8.3 J	10.8	9.5 J	8.1 J
Copper	mg/Kg	190	100%	25	3	24.9	21.3	21.7	190	16.6 J
Iron	mg/Kg	32100	100%	26627	1	22800	18900	23900	22800	15600 J
Lead	mg/Kg	66.7	100%	30	3	17.1	47.5 J	12.6 J	66.7	7.2
Magnesium	mg/Kg	25400	100%	12222	5	13300	11300	17200	12200	25400 J
Manganese	mg/Kg	536	100%	669	0	422	333	431	317	536 J
Mercury	mg/Kg	0.08	89%	0.1	0	0.06 J	0.08 J	0.03 J	0.03 J	0.03 J
Nickel	mg/Kg	44.3	100%	34	1	30.9	23.5	29.1	29.5	23.5 J
Potassium	mg/Kg	1920	100%	1762	7	1920 J	1470	1820	1870 J	1860
Selenium	mg/Kg	1.5	33%	2	0	0.43 U	0.32 U	0.31 U	1.5 J	0.54 U
Sodium	mg/Kg	140	100%	104	8	105 J	75 J	129 J	127 J	119 J
Vanadium	mg/Kg	26.2	100%	150	0	18.6	14.8	21.9	21.2	13.7 J
Zinc	mg/Kg	569	100%	83	5	85	58.6	101	569	43.7 J
OTHER ANALYSES										
Total Petroleum Hydrocarbons	mg/Kg	218000	89%	NA	NA	87 J	29 U	87 J	218000	283
Total Solids	%W/W					85.4	88.4	87.7	90.1	91.8

TABLE 1

SENECA ARMY DEPOT ACTIVITY
SEAD-60
SOIL ANALYSIS RESULTS FROM THE ESI

	MATRIX					SOIL	SOIL	SOIL	SOIL
	LOCATION					SEAD-60	SEAD-60	SEAD-60	SEAD-60
	DEPTH (FEET)					6-8	0-0.2	4-6	6-8
	SAMPLE DATE					06/07/94	06/08/94	06/08/94	06/08/94
	ES ID					SB60-2-04	SB60-3.00	SB60-3.03	SB60-3.04
	LAB ID					223340	223499	223500	223501
	SDG NUMBER	MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM	44665	44665	44665	44665
COMPOUND	UNITS								
VOLATILE ORGANICS									
Methylene Chloride	ug/Kg	54	56%	100	0	3 J	21	54	1 J
Acetone	ug/Kg	170	11%	200	0	11 U R	14 U	11 U	11 U
Carbon Disulfide	ug/Kg	2	22%	2700	0	11 U R	14 U	11 U	2 J
2-Butanone	ug/Kg	26	11%	300	0	11 U R	14 U	11 U	11 U
2-Hexanone	ug/Kg	1	11%	NA	NA	11 U R	14 U	11 U	11 U
Tetrachloroethene	ug/Kg	3	11%	1400	0	3 J	14 U	11 U	11 U
Toluene	ug/Kg	13	33%	1500	0	2 J	14 U	11 U	11 U
Ethylbenzene	ug/Kg	4	11%	5500	0	11 U R	14 U	11 U	11 U
Xylene (total)	ug/Kg	9	11%	1200	0	11 U R	14 U	11 U	11 U
SEMIVOLATILE ORGANICS									
Naphthalene	ug/Kg	38	11%	13000	0	350 U	2200 U	350 U	350 U
2-Methylnaphthalene	ug/Kg	1100	11%	36400	0	350 U	2200 U	350 U	350 U
Acenaphthene	ug/Kg	1400	33%	50000*	0	32 J	2200 U	350 U	350 U
Dibenzofuran	ug/Kg	29	11%	6200	0	350 U	2200 U	350 U	350 U
Fluorene	ug/Kg	1300	22%	50000*	0	350 U	2200 U	350 U	350 U
Phenanthrene	ug/Kg	8900	44%	50000*	0	350 U	680 J	350 U	350 U
Anthracene	ug/Kg	2000	22%	50000*	0	350 U	2200 U	350 U	350 U
Carbazole	ug/Kg	79	11%	50000*	0	350 U	2200 U	350 U	350 U
Di-n-butylphthalate	ug/Kg	1500	33%	8100	0	350 U	2200 U	81 J	94 J
Fluoranthene	ug/Kg	14000	67%	50000*	0	29 J	1300 J	350 U	350 U
Pyrene	ug/Kg	27000	78%	50000*	0	62 J	2000 J	350 U	350 U
Benzo(a)anthracene	ug/Kg	340	11%	220	1	350 U	2200 U	350 U	350 U
Chrysene	ug/Kg	17000	44%	400	2	350 U	1100 J	350 U	350 U
bis(2-Ethylhexyl)phthalate	ug/Kg	380	44%	50000*	0	43 J	2200 U	350 U	160 J
Benzo(b)fluoranthene	ug/Kg	16000	33%	1100	2	350 U	1500 J	350 U	350 U
Benzo(k)fluoranthene	ug/Kg	190	11%	1100	0	350 U	2200 UJ	350 U	350 U
Benzo(a)pyrene	ug/Kg	350	11%	61	1	350 U	2200 U	350 U	350 U
Indeno(1,2,3-cd)pyrene	ug/Kg	1100	33%	3200	0	46 J	1100 J	350 U	350 U
Dibenz(a,h)anthracene	ug/Kg	1100	33%	14	3	27 J	1100 J	350 U	350 U
Benzo(g,h,i)perylene	ug/Kg	1600	33%	50000*	0	43 J	1600 J	350 U	350 U

TABLE 1

SENECA ARMY DEPOT ACTIVITY
SEAD-60
SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE ES ID LAB ID SDG NUMBER UNITS	MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM	SOIL SEAD-60 6-8 06/07/94 SB60-2-04 223340 44665	SOIL SEAD-60 0-0.2 06/08/94 SB60-3 00 223499 44665	SOIL SEAD-60 4-6 06/08/94 SB60-3 03 223500 44665	SOIL SEAD-60 6-8 06/08/94 SB60-3.04 223501 44665
PESTICIDES/PCB									
alpha-BHC	ug/Kg	5	11%	110	0	1.8 U	2.9 UJ	1.8 U	1.8 U
Aldrin	ug/Kg	16	11%	41	0	1.8 U	2.9 UJ	1.8 U	1.8 U
Endosulfan I	ug/Kg	34	33%	900	0	1.8 U	6.3 J	1.8 U	1.8 U
4,4'-DDE	ug/Kg	110	44%	2100	0	3.5 U	28 J	3.5 U	3.5 U
4,4'-DDD	ug/Kg	100	22%	2900	0	3.5 U	100 J	3.5 U	3.5 U
4,4'-DDT	ug/Kg	130	22%	2100	0	3.5 U	5.6 UJ	3.5 U	3.5 U
Endrin ketone	ug/Kg	14	11%	NA	NA	3.5 U	5.6 UJ	3.5 U	3.5 U
alpha-Chlordane	ug/Kg	27	22%	540	0	1.8 U	3 J	1.8 U	1.8 U
gamma-Chlordane	ug/Kg	10	11%	540	0	1.8 U	2.9 UJ	1.8 U	1.8 U
Aroclor-1242	ug/Kg	970	11%	1000/10000(a)	0	35 U	56 UJ	35 U	35 U
Aroclor-1248	ug/Kg	2100	11%	1000/10000(a)	1	35 U	56 UJ	35 U	35 U
Aroclor-1260	ug/Kg	4400	22%	1000/10000(a)	1	35 U	220 J	35 U	35 U
METALS									
Aluminum	mg/Kg	14100	100%	14593	0	8320	14100	6980	13200
Antimony	mg/Kg	1.8	78%	3.59	0	0.22 UJ	0.49 J	0.26 J	0.18 UJ
Arsenic	mg/Kg	8.1	100%	7.5	1	3.8	7	4	5.6
Barium	mg/Kg	679	100%	300	2	90.1	416	64	50.1
Beryllium	mg/Kg	0.67	100%	1	0	0.38 J	0.66 J	0.35 J	0.63 J
Cadmium	mg/Kg	2	100%	1	2	0.33 J	1.5 J	0.35 J	0.72
Calcium	mg/Kg	102000	100%	101904	1	72300 J	23700 J	102000 J	50600 J
Chromium	mg/Kg	23.3	100%	22	2	14.1	23.3	12	22.7
Cobalt	mg/Kg	13.1	100%	30	0	7.9 J	13.1 J	8.2	12.7
Copper	mg/Kg	190	100%	25	3	20.5	74.1	19.8	30.6
Iron	mg/Kg	32100	100%	26627	1	17700	25700	15500	32100
Lead	mg/Kg	66.7	100%	30	3	9.5	50.6	8.2	15.3
Magnesium	mg/Kg	25400	100%	12222	5	19000	8570	18000	11400
Manganese	mg/Kg	536	100%	669	0	368	443	417	378
Mercury	mg/Kg	0.08	89%	0.1	0	0.07 J	0.02 U	0.02 J	0.01 J
Nickel	mg/Kg	44.3	100%	34	1	23.6	31.3	22.9	44.3
Potassium	mg/Kg	1920	100%	1762	7	1820 J	1820 J	1690 J	1920 J
Selenium	mg/Kg	1.5	33%	2	0	0.47 U	1.2 J	0.43 U	0.65 J
Sodium	mg/Kg	140	100%	104	8	119 J	118 J	113 J	140 J
Vanadium	mg/Kg	26.2	100%	150	0	14.5	26.2	12.9	19.3
Zinc	mg/Kg	569	100%	83	5	64.4	314	56.3	266
OTHER ANALYSES									
Total Petroleum Hydrocarbons	mg/Kg	218000	89%	NA	NA	332	50900	57	34
Total Solids	%W/W					94.2	59.1	93.1	93.8

NOTES
- a) The TAGM value for PCBs is 1000ug/Kg for surface soils and 10,000 ug/Kg for subsurface soils.
- b) * = As per proposed TAGM, total VOCs < 10 ppm, total SVOs < 500 ppm, and individual SVOs < 50 ppm
- c) NA = Not Available.
- d) U = The compound was not detected below this concentration.
- e) J = The reported value is an estimated concentration.
- f) UJ = The compound may have been present above this concentration, but was not detected due to problems with t
- g) R = The data was rejected during the data validation process

TABLE 2

SENECA ARMY DEPOT ACTIVITY
SEAD-60
GROUNDWATER ANALYSIS RESULTS FROM THE ESI

	MATRIX	MAXIMUM	FREQUENCY OF DETECTION	FEDERAL DRINKING WATER MCL (h)	NY AWQS CLASS GA (a)	NUMBER ABOVE LOWEST CRITERIA	WATER	WATER	WATER
	LOCATION						SEAD-60	SEAD-60	SEAD-60
	SAMPLE DATE						07/07/94	07/07/94	03/29/94
	ES ID						MW60-1	MW60-2	MW60-3
	LAB ID						226301	226302	215838
	SDG NUMBER						45257	45257	43179
COMPOUND	UNITS								
VOLATILE ORGANICS									
Acetone	ug/L	77	67%	NA	NA	NA	48	77 J	10 U
Benzene	ug/L	1	33%	5	0.7	1	1 J	10 U	10 U
PESTICIDES/PCB									
beta-BHC	ug/L	0.049	33%	NA	5	0	0.051 U	0.051 U	0.049 J
METALS									
Aluminum	ug/L	376	100%	50-100*	NA	3	348	58 J	376
Barium	ug/L	88.7	100%	2000	1000	0	88.7 J	45 J	34 J
Calcium	ug/L	113000	100%	NA	NA	NA	95100	112000	113000
Chromium	ug/L	0.56	67%	100	50	0	0.56 J	0.4 U	0.51 J
Cobalt	ug/L	0.72	33%	NA	NA	NA	0.5 U	0.5 U	0.72 J
Copper	ug/L	0.99	33%	1000*	200	0	0.5 U	0.5 U	0.99 J
Iron	ug/L	1440	100%	300	300	3	1290	1340	1440
Magnesium	ug/L	55100	100%	NA	NA	NA	31100	55100	52600
Manganese	ug/L	377	100%	50*	300	3	377	125	166
Mercury	ug/L	0.05	67%	2	2	0	0.05 J	0.05 J	0.03 U
Nickel	ug/L	1.6	33%	100	NA	NA	0.7 U	0.7 U	1.6 J
Potassium	ug/L	8760	100%	NA	NA	NA	8760	4530 J	4510 J
Sodium	ug/L	59400	100%	NA	20000	1	59400	12300	11400
Thallium	ug/L	1.8	33%	2	NA	0	1.9 U	1.9 U	1.8 J
Vanadium	ug/L	1.5	67%	NA	NA	NA	1 J	0.5 U	1.5 J
Zinc	ug/L	6.9	100%	5000*	300	0	6.9 J	3.2 J	4.8 J
OTHER ANALYSES									
Total Petroleum Hydrocarbons	mg/L	2.2	66%		NA	NA	2.2	1.22	0.4 U
pH	Standard Units						7.4	7.3	7.6
Conductivity	umhos/cm						1010	700	615
Temperature	°C						11.7	11.5	8.2
Turbidity	NTU						104	8.6	5.8

NOTES:
a) NY State Class GA Groundwater Regulations
b) NA = Not Available
d) U = The compound was not detected below this concentration.
e) J = The reported value is an estimated concentration.
f) UJ = The compound may have been present above this concentration,
but was not detected due to problems with the analysis.
g) R = The data was rejected during the data validation process.
h) Federal Primary and Secondary (*) Drinking Water Maximum Contaminant Levels
(40 CRF 141.61-62 and 40 CRF 143.3)

TABLE 3

SENECA ARMY DEPOT ACTIVITY
SEAD-60
SURFACE WATER ANALYSIS RESULTS FROM THE ESI

	MATRIX					WATER	WATER	WATER
	LOCATION					SEAD-60	SEAD-60	SEAD-60
	SAMPLE DATE					04/27/94	04/20/94	04/20/94
	ES ID		FREQUENCY	NYS	NUMBER	SW60-1	SW60-2	SW60-3
	LAB ID		OF	GUIDELINES	ABOVE	219531	218496	218497
	SDG NUMBER	MAXIMUM	DETECTION	CLASS D	CRITERIA	43626	43626	43626
COMPOUND	UNITS			(a,c)				
METALS								
Aluminum	ug/L	259	100%	NA	NA	35.7 J	259	93.5 J
Arsenic	ug/L	1.6	33%	360	0	1.5 U	1.6 J	1.5 U
Barium	ug/L	49.4	100%	NA	NA	28.7 J	49.4 J	22.4 J
Calcium	ug/L	89000	100%	360	NA	42300	89000	42200
Chromium	ug/L	0.68	67%	3275	0	0.56 J	0.68 J	0.4 U
Copper	ug/L	2	100%	36.8	0	1.7 J	2 J	1.1 J
Iron	ug/L	453	100%	300	1	78 J	453	121
Magnesium	ug/L	22000	100%	NA	NA	8260	22000	8390
Manganese	ug/L	28.5	100%	NA	NA	12.5 J	28.5	4.5 J
Nickel	ug/L	1.8	100%	50562	0	0.98 J	1.8 J	0.83 J
Potassium	ug/L	1430	100%	NA	NA	1060 J	1430 J	649 J
Sodium	ug/L	53800	100%	NA	NA	2030 J	53800	2340 J
Vanadium	ug/L	0.85	33%	190	0	0.7 U	0.85 J	0.69 U
Zinc	ug/L	9.6	100%	611	0	3 J	3.4 J	9.6 J
OTHER ANALYSES								
pH	Standard Units					8.4	8.7	9.1
Conductivity	umhos/cm					232	675	180
Temperature	°C					23.3	16	10
Turbidity	NTU					2.2	5.7	2.4

NOTES:

a) The New York State Ambient Water Quality standards and guidelines for Class D surface water.
b) Hardness dependent values assume a hardness of 217 mg/L.
c) NA = Not Available
d) U = The compound was not detected below this concentration.
e) J = The reported value is an estimated concentration.
f) UJ = The compound may have been present above this concentration, but was not detected due to problems with the analysis.

TABLE 4

SENECA ARMY DEPOT
SEAD-60
SEDIMENT ANALYSIS RESULTS FROM THE ESI

	MATRIX								SOIL		SOIL		SOIL	
	LOCATION								SEAD-60		SEAD-60		SEAD-60	
	DEPTH (FEET)								0-0 2		0-0.2		0-0.2	
	SAMPLE DATE								04/27/94		04/20/94		04/20/94	
	ES ID								SD60-1		SD60-2		SD60-3	
	LAB ID								219550		218490		218491	
	SDG NUMBER								43663		43663		43663	
COMPOUND	UNITS	MAXIMUM	FREQUENCY OF DETECTION	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (a)	NYSDEC SEDIMENT CRITERIA FOR HUMAN HEALTH (a)	NYSDEC SEDIMENT CRITERIA FOR WILDLIFE (a)	LOT (b)	NUMBER ABOVE CRITERIA						
VOLATILE ORGANICS														
Chloroform	ug/Kg	3	33%	NA	NA	NA	NA	NA	16	U	3	J	16	U
SEMIVOLATILE ORGANICS														
Phenanthrene	ug/Kg	70	67%	1390	NA	NA	NA	0	580	U	63	J	70	J
Fluoranthene	ug/Kg	200	67%	NA	NA	NA	NA	NA	580	U	160	J	200	J
Pyrene	ug/Kg	250	67%	NA	NA	NA	NA	NA	580	U	190	J	250	J
Benzo(a)anthracene	ug/Kg	68	67%	NA	13	NA	NA	2	580	U	56	J	68	J
Chrysene	ug/Kg	160	67%	NA	13	NA	NA	2	580	U	130	J	160	J
bis(2-Ethylhexyl)phthalate	ug/Kg	1100	100%	1197 (c)	NA	NA	NA	0	110	J	1100		75	J
Benzo(b)fluoranthene	ug/Kg	120	67%	NA	13	NA	NA	2	580	U	120	J	120	J
Benzo(k)fluoranthene	ug/Kg	97	67%	NA	13	NA	NA	2	580	U	87	J	97	J
Benzo(a)pyrene	ug/Kg	79	67%	NA	13	NA	NA	2	580	U	79	J	64	J
Indeno(1,2,3-cd)pyrene	ug/Kg	68	67%	NA	13	NA	NA	2	580	U	68	J	57	J
Benzo(g,h,i)perylene	ug/Kg	93	67%	NA	NA	NA	NA	NA	580	U	93	J	67	J
PESTICIDES/PCB														
Endosulfan I	ug/Kg	2.1	33%	0 3	NA	NA	NA	1	3	U	3.3	U	2.1	J
4,4'-DDE	ug/Kg	5.4	33%	500	0 1	10	NA	1	5 8	U	6.5	U	5.4	J
4,4'-DDT	ug/Kg	3.4	33%	NA	NA	10	NA	0	5 8	U	6.5	U	3.4	J
alpha-Chlordane	ug/Kg	1 9	33%	0.06	0.01	0.06	NA	1	3	U	3.3	U	1.9	J
METALS														
Aluminum	mg/Kg	12700	100%	NA	NA	NA	NA	NA	12700		10700		5470	
Arsenic	mg/Kg	4 8	100%	5	NA	NA	33	0	4.8		3.6		3.7	
Barium	mg/Kg	97.6	100%	NA	NA	NA	NA	NA	97.6		80.3		46.5	J
Beryllium	mg/Kg	0.62	100%	NA	NA	NA	NA	NA	0.62	J	0.54	J	0.35	J
Cadmium	mg/Kg	0.44	100%	0 8	NA	NA	10	0	0.34	J	0.44	J	0.25	J
Calcium	mg/Kg	227000	100%	NA	NA	NA	NA	NA	3760		21300		227000	
Chromium	mg/Kg	19.5	100%	26	NA	NA	111	0	19.5		17.5		9	
Cobalt	mg/Kg	9.6	100%	NA	NA	NA	NA	NA	9.6	J	8.2	J	6.7	J
Copper	mg/Kg	21 1	100%	19	NA	NA	114	1	14.2		21.1		12.5	
Iron	mg/Kg	25000	100%	24000	NA	NA	40000	1	25000		22000		12700	
Lead	mg/Kg	24.6	100%	27	NA	NA	250	0	13.9		24.6		9.1	
Magnesium	mg/Kg	8380	100%	NA	NA	NA	NA	NA	4370		7490		8380	
Manganese	mg/Kg	509	100%	428	NA	NA	1100	2	467	J	282	J	509	J
Mercury	mg/Kg	0 03	33%	0 11	NA	NA	2	0	0 05	J R	0.04	J R	0.03	J
Nickel	mg/Kg	27.2	100%	22	NA	NA	90	2	27.2		26.7		16.2	
Potassium	mg/Kg	1610	100%	NA	NA	NA	NA	NA	1610		1190	J	988	J
Sodium	mg/Kg	134	67%	NA	NA	NA	NA	NA	45	U	134	J	91	J
Thallium	mg/Kg	0 55	33%	NA	NA	NA	NA	NA	0.45	U	0.55	J	0.46	U
Vanadium	mg/Kg	23.9	100%	NA	NA	NA	NA	NA	23 9		19.2		11 1	J
Zinc	mg/Kg	101	100%	85	NA	NA	800	3	93 5		88.1		101	
Cyanide	mg/Kg	3 3	33%	NA	NA	NA	NA	NA	0 83	U	0.94	U	3.3	
OTHER ANALYSES														
Total Petroleum Hydrocarbons	mg/Kg	149	33%						40	U	149		44	U
Total Solids	%W/W								56 8		50.7		60.5	

NOTES.

a) NYSDEC Sediment Criteria - 1989
b) LOT = Limit of Tolerance Represents point at which significant effects on benthic species occur.
c) NYSDEC 1969 guideline for phthalates.
d) NA = Not Available.
e) U = The compound was not detected below this concentration.
f) J = The reported value is an estimated concentration
g) UJ = The compound may have been present above this concentration, but was not detected due to problems with the analysis.
h) R = The data was rejected during the data validation process.

concentrations of several of these semivolatile organic compounds exceed their respective TAGMs. TPH was also reported in one of the two, downgradient sediment samples at a level of 149 mg/Kg.

The analytical results also indicate that TPH has impacted the groundwater beneath the oil release area, even though the concentrations of TPH found in soil were dramatically reduced at depth. A TPH concentration of 1.22 mg/L was detected in the monitoring well (MW60-2) located hydraulically downgradient of the oil release area.

Monitoring well MW60-1, which is located hydraulically upgradient of the known oil release area and approximately 130 feet east of the Building 609, contained TPH at a higher concentration (i.e., 2.2 mg/L) than that was found in the downgradient well (i.e., MW60-2). Concentrations exceeding TAGM and Federal Drinking Water criteria were also reported for four metals (aluminum, iron, manganese, and sodium) in groundwater samples; all of the listed metals exceeded criteria values in the upgradient well, and the first three contaminants were also found at high levels in the two downgradient wells.

Surface water at the site has not been significantly impacted by any of the constituents that were analyzed for during the investigation.

These results indicate that a release of TPH and PAHs in the near surface soils has occurred at SEAD-60.

5.3.3 Results of Treatability Tests

The treatability study at the former deactivation furnace (i.e., APE 1236 deactivation furnace, SEAD-17) was conducted in August and September 2000. Treatability study conditions included the operation of the furnace at two soil/sediment feed rates (i.e., 2 and 5 tons per hour) while the temperature of the kiln and afterburner (i.e., approximately 600 and 1600 ^{O}F, respectively) and the residence time of the soil in the kiln were held constant. Samples of the soil feed, the kiln bottom ash (i.e., the treated soil) and the flyash were collected and characterized for total petroleum hydrocarbons (EPA Method 418.1), semivolatile organic compounds (SW-846 Method 8270), pesticides and PCBs (SW-846 Method 8081) and metals (SW-846 Method 6010 et. al.). Results of the chemical analyses are summarized in **Tables 5** through **7** for the soil feed, the treated soil and the flyash, respectively. **Table 8** presents a summary of the removal efficiency measured for the TPH and semivolatile organic compounds originally contained in the soil/sediment from SEAD-60

Table 5
SOIL FEED ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

STUDY ID:	LTTD	LTTD	NONE	LTTD	LTTD
SDG:	79605	79605	79605	79890	79890
LOC ID:	LTTDW	LTTDW	NONE	LTTDW	LTTDW
SAMP_ID:	LT4000	LT4006	LT4006RE	LT4012	LT4013
FIELD QC CODE:	SA	SA	NONE	SA	DU
SAMP. DEPTH TOP:	0	0	NONE	0	0
SAMP. DEPTH BOT:	0	0	NONE	0	0
MATRIX:	SOIL	SOIL	NONE	SOIL	SOIL
SAMP. DATE:	30-Aug-00	01-Sep-00		20-Sep-00	20-Sep-00

Parameter	Units	Maximum Concentration	Average Concentration	Frequency of Detection	TAGM Value (1)	Number Exceeding TAGM	Number of Times Detected	Number of Analyses	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Semivolatile Organic Compounds													
2-Methylnaphthalene	UG/KG	29	120	40.0%	36,400	0	4	10	29. J	28. J	29. J	360. U	380. U
Acenaphthene	UG/KG	56	123.4	50.0%	50,000	0	5	10	360. U	22. J	24. J	360. U	17. J
Anthracene	UG/KG	91	61.1	90.0%	50,000	0	9	10	21. J	55. J	57. J	360. U	23. J
Benzo(a)anthracene	UG/KG	300	171	100.0%	224	1	10	10	100. J	170. J	180. J	120. J	130. J
Benzo(a)pyrene	UG/KG	360	213	100.0%	61	10	10	10	**150.** J	**220.** J	**230.** J	**160.** J	**170.** J
Benzo(b)fluoranthene	UG/KG	490	265	100.0%	1,100	0	10	10	170. J	320. J	300. J	140. J	180. J
Benzo(ghi)perylene	UG/KG	430	235	100.0%	50,000	0	10	10	160. J	250. J	250. J	160. J	180. J
Benzo(k)fluoranthene	UG/KG	440	246	100.0%	1,100	0	10	10	140. J	270. J	290. J	190. J	230. J
Bis(2-Ethylhexyl)phthalate	UG/KG	220	166	50.0%	50,000	0	5	10	360. U	220. JB	220. JB	36. JB	380. U
Carbazole	UG/KG	73	118.9	60.0%		0	6	10	360. U	51. J	34. J	360. U	380. U
Chrysene	UG/KG	440	282	100.0%	400	1	10	10	170. J	340. J	350. J	180. J	230. J
Dibenz(a,h)anthracene	UG/KG	140	76.2	100.0%	14	10	10	10	**60.** J	**89.** J	**110.** J	**55.** J	**48.** J
Dibenzofuran	UG/KG	36	102.2	50.0%	6,200	0	5	10	18. J	20. J	21. J	360. U	380. U
Fluoranthene	UG/KG	600	318	100.0%	50,000	0	10	10	170. J	270. J	300. J	180. J	180. J
Fluorene	UG/KG	55	90.7	60.0%	50,000	0	6	10	21. J	25. J	28. J	360. U	380. U
Indeno(1,2,3-cd)pyrene	UG/KG	380	193.8	100.0%	3,200	0	10	10	120. J	200. J	190. J	120. J	160. J
Naphthalene	UG/KG	42	88.5	60.0%	13,000	0	6	10	23. J	28. J	29. J	360. U	380. U
Phenanthrene	UG/KG	440	203.2	100.0%	50,000	0	10	10	120. J	170. J	170. J	72. J	110. J
Pyrene	UG/KG	680	380	100.0%	50,000	0	10	10	210. J	330. J	370.	250. J	310. J
Total Petroleum Hydrocarbons													
Diesel Oil	MG/KG	140	75.75	100.0%		0	8	8	92 Y	140 Y		43	68
Motor Oil	MG/KG	720	379.2	100.0%		0	8	8	420 Y	630 Y		5.3	480
PCBs													
Aroclor-1254	UG/KG	26	18.5	75.0%	10,000	0	6	8	19.	18. U		18.	18. J
Aroclor-1260	UG/KG	41	27.125	87.5%	10,000	0	7	8	23.	21.		27.	24.
Metals													
Aluminum	MG/KG	12000	10436.25	100.0%	19,300	0	8	8	9,710.	10,100.		8,600. E*	12,000. E*
Antimony	MG/KG	2.7	1.47375	75.0%	6	0	6	8	.93 UN	.99 UN		1.4 BN	1.1 BN
Arsenic	MG/KG	4.6	3.7	100.0%	8	0	8	8	4. N	4.6 N		2.9 *	3.5 *
Barium	MG/KG	113	91.425	100.0%	300	0	8	8	85. *	79.6 *		78.6 *	113. *
Beryllium	MG/KG	0.78	0.6975	100.0%	1	0	8	8	.73	.73		.62	.78
Cadmium	MG/KG	2.3	0.689375	100.0%	2	0	7	7	.38 B*	.47 *		.22 B	2.3
Calcium	MG/KG	104000	77025	100.0%	121,000	0	8	8	69,500.	75,500.		104,000. *	83,200. *
Chromium	MG/KG	21.4	18.8	100.0%	30	0	8	8	17. N*	18.9 N*		15.7 E*	20.9 E*
Cobalt	MG/KG	11.2	9.9125	100.0%	30	0	8	8	10.	9.7		8.4	10.5
Copper	MG/KG	77	49.2375	100.0%	33	6	8	8	31.8 N	**41.8** N		**39.3** EN	**51.1** EN
Iron	MG/KG	23800	21287.5	100.0%	36,500	0	8	8	20,100. *	20,300. *		17,000. E*	23,800. E*

Table 5
SOIL FEED ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD	LTTD	NONE	LTTD	LTTD
								SDG:	79605	79605	79605	79890	79890
								LOC ID:	LTTDW	LTTDW	NONE	LTTDW	LTTDW
								SAMP_ID:	LT4000	LT4006	LT4006RE	LT4012	LT4013
								FIELD QC CODE:	SA	SA	NONE	SA	DU
								SAMP. DEPTH TOP:	0	0	NONE	0	0
								SAMP. DEPTH BOT:	0	0	NONE	0	0
								MATRIX:	SOIL	SOIL	NONE	SOIL	SOIL
								SAMP. DATE:	30-Aug-00	01-Sep-00		20-Sep-00	20-Sep-00
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Lead	MG/KG	257	157.1625	100.0%	25	8	8	8	**61.6** E*	**105.** E*		**165.** E	**171.** E
Magnesium	MG/KG	16700	14375	100.0%	21,500	0	8	8	12,400. *	14,300. *		12,100. *	14,400. *
Manganese	MG/KG	554	489.25	100.0%	1,060	0	8	8	484. *	497. *		466.	554.
Mercury	MG/KG	0.03	0.02125	50.0%	0	0	4	8	.02 U	.02 U		.03 B	.03 B
Nickel	MG/KG	33.4	30.3	100.0%	49	0	8	8	30.5 E	30. E		25.1 *	33.4 *
Potassium	MG/KG	2190	1871.25	100.0%	2,380	0	8	8	1,530. *	1,610. *		1,840.	1,970.
Selenium	MG/KG	0.28	0.17375	12.5%	2	0	1	8	.23 UN	.25 UN		.22 U	.24 U
Silver	MG/KG	0.36	0.2475	75.0%	1	0	6	8	.16 UN	.18 UN		.32 BN	.25 BN
Sodium	MG/KG	135	112.0875	100.0%	172	0	8	8	133. B	135. B		104. B	121. B
Thallium	MG/KG	3.1	2.4875	100.0%	1	8	8	8	**2.3**	**2.3**		**2.3**	**2.9**
Vanadium	MG/KG	27.7	19.9625	100.0%	150	0	8	8	15.7 *	16.2 *		20.2 E*	27.7 E*
Zinc	MG/KG	175	116.3125	100.0%	110	4	8	8	102. N*	98.2 N*		101. EN	**175.** EN

1. NYSDEC Technical and Administrative Guidance Memorandum #4046, January 24, 1994

Table 5
SOIL FEED ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD	NONE	LTTD	LTTD	LTTD
								SDG:	79890	79890	79894	79890	79890
								LOC ID:	LTTDW	NONE	LTTDW	LTTDW	LTTDW
								SAMP_ID:	LT4020	LT4020RE	LT4028	LT4029	LT4036
								FIELD QC CODE:	SA	NONE	SA	DU	SA
								SAMP. DEPTH TOP:	0	NONE	0	0	0
								SAMP. DEPTH BOT:	0	NONE	0	0	0
								MATRIX:	SOIL	NONE	SOIL	SOIL	SOIL
								SAMP. DATE:	21-Sep-00		22-Sep-00	22-Sep-00	23-Sep-00
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Semivolatile Organic Compounds													
2-Methylnaphthalene	UG/KG	29	120	40.0%	36,400	0	4	10	360. U	360. U	360. U	24. J	360. U
Acenaphthene	UG/KG	56	123.4	50.0%	50,000	0	5	10	360. U	360. U	35. J	56. J	360. U
Anthracene	UG/KG	91	61.1	90.0%	50,000	0	9	10	43. J	41. J	64. J	91. J	36. J
Benzo(a)anthracene	UG/KG	300	171	100.0%	224	1	10	10	180. J	200. J	210. J	**300.** J	120. J
Benzo(a)pyrene	UG/KG	360	213	100.0%	61	10	10	10	**250.** J	**250.** J	**220.** J	**360.** J	**120.** J
Benzo(b)fluoranthene	UG/KG	490	265	100.0%	1,100	0	10	10	310. J	320. J	290. J	490.	130. J
Benzo(ghi)perylene	UG/KG	430	235	100.0%	50,000	0	10	10	280. J	320. J	210. J	430.	110. J
Benzo(k)fluoranthene	UG/KG	440	246	100.0%	1,100	0	10	10	270. J	290. J	210. J	440.	130. J
Bis(2-Ethylhexyl)phthalate	UG/KG	220	166	50.0%	50,000	0	5	10	47. J	47. J	360. U	360. U	360. U
Carbazole	UG/KG	73	118.9	60.0%		0	6	10	36. J	43. J	42. J	73. J	360. U
Chrysene	UG/KG	440	282	100.0%	400	1	10	10	320. J	340. J	300. J	**440.**	150. J
Dibenz(a,h)anthracene	UG/KG	140	76.2	100.0%	14	10	10	10	**85.** J	**91.** J	**45.** J	**140.** J	**39.** J
Dibenzofuran	UG/KG	36	102.2	50.0%	6,200	0	5	10	360. U	360. U	17. J	36. J	360. U
Fluoranthene	UG/KG	600	318	100.0%	50,000	0	10	10	360.	350. J	470.	600.	300. J
Fluorene	UG/KG	55	90.7	60.0%	50,000	0	6	10	360. U	20. J	28. J	55. J	360. U
Indeno(1,2,3-cd)pyrene	UG/KG	380	193.8	100.0%	3,200	0	10	10	230. J	260. J	180. J	380.	98. J
Naphthalene	UG/KG	42	88.5	60.0%	13,000	0	6	10	16. J	17. J	360. U	42. J	360. U
Phenanthrene	UG/KG	440	203.2	100.0%	50,000	0	10	10	210. J	220. J	310. J	440.	210. J
Pyrene	UG/KG	680	380	100.0%	50,000	0	10	10	420.	450.	480.	680.	300. J
Total Petroleum Hydrocarbons													
Diesel Oil	MG/KG	140	75.75	100.0%		0	8	8	80		84	81	18
Motor Oil	MG/KG	720	379.2	100.0%		0	8	8	680		5.3	720	93
PCBs													
Aroclor-1254	UG/KG	26	18.5	75.0%	10,000	0	6	8	25.		26.	24.	18. U
Aroclor-1260	UG/KG	41	27.125	87.5%	10,000	0	7	8	41.		38.	34.	18. U
Metals													
Aluminum	MG/KG	12000	10436.25	100.0%	19,300	0	8	8	9,980. E*		10,400. E	11,600. E*	11,100. E*
Antimony	MG/KG	2.7	1.47375	75.0%	6	0	6	8	2. BN		2.7 BN	2.1 BN	.57 BN
Arsenic	MG/KG	4.6	3.7	100.0%	8	0	8	8	3.4 *		3.9	3.4 *	3.9 *
Barium	MG/KG	113	91.425	100.0%	300	0	8	8	99.9 *		105.	98.1 *	72.2 *
Beryllium	MG/KG	0.78	0.6975	100.0%	1	0	8	8	.68		.55	.76	.73
Cadmium	MG/KG	2.3	0.689375	100.0%	2	0	7	7	.37 B		1.5	.26 B	.03 U
Calcium	MG/KG	104000	77025	100.0%	121,000	0	8	8	102,000. *		58,000. E*	62,600. *	61,400. *
Chromium	MG/KG	21.4	18.8	100.0%	30	0	8	8	17.7 E*		18.2	20.6 E*	21.4 E*
Cobalt	MG/KG	11.2	9.9125	100.0%	30	0	8	8	9.5		9.4	10.6	11.2
Copper	MG/KG	77	49.2375	100.0%	33	6	8	8	**53.7** EN		**77.** N*	**67.2** EN	32. EN
Iron	MG/KG	23800	21287.5	100.0%	36,500	0	8	8	19,700. E*		22,900. E	22,700. E*	23,800. E*

Table 5
SOIL FEED ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD	NONE	LTTD	LTTD	LTTD
								SDG:	79890	79890	79894	79890	79890
								LOC ID:	LTTDW	NONE	LTTDW	LTTDW	LTTDW
								SAMP_ID:	LT4020	LT4020RE	LT4028	LT4029	LT4036
								FIELD QC CODE:	SA	NONE	SA	DU	SA
								SAMP. DEPTH TOP:	0	NONE	0	0	0
								SAMP. DEPTH BOT:	0	NONE	0	0	0
								MATRIX:	SOIL	NONE	SOIL	SOIL	SOIL
								SAMP. DATE:	21-Sep-00		22-Sep-00	22-Sep-00	23-Sep-00
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Lead	MG/KG	257	157.1625	100.0%	25	8	8	8	**243.** E		**222.** E	**257.** E	**32.7** E
Magnesium	MG/KG	16700	14375	100.0%	21,500	0	8	8	15,700. *		14,100. E*	16,700. *	15,300. *
Manganese	MG/KG	554	489.25	100.0%	1,060	0	8	8	451.		428. E	506.	528.
Mercury	MG/KG	0.03	0.02125	50.0%	0	0	4	8	.03 B		.02 U	.03 B	.02 U
Nickel	MG/KG	33.4	30.3	100.0%	49	0	8	8	29. *		31. E	32.9 *	30.5 *
Potassium	MG/KG	2190	1871.25	100.0%	2,380	0	8	8	2,120.		1,950. E	2,190.	1,760.
Selenium	MG/KG	0.28	0.17375	12.5%	2	0	1	8	.25 U		.27 U	.28 U	.28 B
Silver	MG/KG	0.36	0.2475	75.0%	1	0	6	8	.25 BN		.36 BN	.29 BN	.17 BN
Sodium	MG/KG	135	112.0875	100.0%	172	0	8	8	127. B		88.3 B	97.1 B	91.3 B
Thallium	MG/KG	3.1	2.4875	100.0%	1	8	8	8	**2.3**		**3.1**	**2.2**	**2.5**
Vanadium	MG/KG	27.7	19.9625	100.0%	150	0	8	8	21.4 E*		16.8	21.6 E*	20.1 E*
Zinc	MG/KG	175	116.3125	100.0%	110	4	8	8	**119.** EN		**129.** EN	**139.** EN	67.3 EN

1. NYSDEC Technical and Administrative Guidance Memorandum #4046, January 24, 1994

Table 6
TREATED SOIL ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD		LTTD		LTTD		LTTD		LTTD		LTTD		LTTD	
								SDG:	79605		79605		79605		79890		79890		79890		79890	
								LOC ID:	LTTDK		LTTDK		LTTDK		LTTDK		LTTDK		LTTDK		LTTDK	
								SAMP_ID:	LT4001		LT4007		LT0000		LT4014		LT4021		LT4030		LT4037	
								FIELD QC CODE:	SA		SA		DU		SA		SA		SA		SA	
								SAMP DEPTH TOP:	0		0		0		0		0		0		0	
								SAMP DEPTH BOT:	0		0		0		0		0		0		0	
								MATRIX:	SOIL		SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
								SAMP. DATE:	30-Aug-00		01-Sep-00		01-Sep-00		20-Sep-00		21-Sep-00		22-Sep-00		23-Sep-00	
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Semivolatile Organic Compounds																						
2-Methylnaphthalene	UG/KG	18	154.7	28.6%	36,400.00	0	2	7	18.	J	330.	U	390.	U	330.	U	15.	J	330.	U	330.	U
Anthracene	UG/KG	65	130.7	28.6%	50,000.00	0	2	7	65.	J	330.	U	25.	J	330.	U	330.	U	330.	U	330.	U
Benzo(a)anthracene	UG/KG	480	136.7	71.4%	224	1	5	7	**480.**		330.	U	40.	J	16.	J	25.	J	66.	J	330.	U
Benzo(a)pyrene	UG/KG	560	148.1	71.4%	61	2	5	7	**560.**		330.	U	32.	J	17.	J	25.	J	**73.**	J	330	U
Benzo(b)fluoranthene	UG/KG	660	194.	71.4%	1,100.00	0	5	7	660.		330.	U	36.	J	55.	JY	77.	JY	200.	JY	330.	U
Benzo(ghi)perylene	UG/KG	380	132.9	71.4%	50,000.00	0	5	7	380.		330.	U	27.	J	32.	J	41.	J	120.	J	330.	U
Benzo(k)fluoranthene	UG/KG	650	217.6	28.6%	1,100.00	0	2	7	650.		330.	U	48.	J	330.	U	330.	U	330	U	330.	U
Benzoic Acid	UG/KG	320	285.7	71.4%	2,700.00	0	5	7	320.	J	830.	U	310.	J	120.	J	190.	J	230.	J	830.	U
Bis(2-Ethylhexyl)phthalate	UG/KG	44	147.7	14.3%	50,000 00	0	1	7	330.	U	330.	U	44.	JB	330.	U	330.	U	330.	U	330.	U
Butylbenzylphthalate	UG/KG	34	146.3	14.3%	50,000.00	0	1	7	330.	U	330.	U	34.	J	330.	U	330.	U	330.	U	330.	U
Carbazole	UG/KG	35	127.4	28.6%		0	2	7	35.	J	330.	U	32.	J	330.	U	330.	U	330.	U	330.	U
Chrysene	UG/KG	660	129.1	71.4%	400	1	5	7	**660.**		330.	U	47.	J	36.	J	51.	J	110.	J	330.	U
Dibenz(a,h)anthracene	UG/KG	130	124.	42.9%	14	3	3	7	**130.**	J	330.	U	**28.**	J	330.	U	330.	U	**50.**	J	330.	U
Dibenzofuran	UG/KG	17	176.	14.3%	6,200.00	0	1	7	17	J	330.	U	390.	U	330.	U	330.	U	330.	U	330.	U
Diethyl phthalate	UG/KG	26	145.1	14.3%	7,100.00	0	1	7	330.	U	330.	U	26.	J	330.	U	330.	U	330.	U	330.	U
Di-n-butylphthalate	UG/KG	43	147.6	14.3%	8,100.00	0	1	7	330.	U	330.	U	43.	J	330.	U	330.	U	330	U	330.	U
Di-n-octylphthalate	UG/KG	38	146.9	14.3%	50,000.00	0	1	7	330.	U	330.	U	38.	J	330.	U	330.	U	330.	U	330.	U
Fluoranthene	UG/KG	640	182.	71.4%	50,000.00	0	5	7	640.		330.	U	41.	J	50.	J	73.	J	140.	J	330.	U
Indeno(1,2,3-cd)pyrene	UG/KG	370	126.7	71.4%	3,200.00	0	5	7	370.		330	U	29.	J	24.	J	34.	J	100.	J	330.	U
Phenanthrene	UG/KG	410	133.6	71.4%	50,000.00	0	5	7	410.		330.	U	33.	J	28.	J	46.	J	88.	J	330.	U
Phenol	UG/KG	25	145.	14.3%	30	0	1	7	330.	U	330.	U	25.	J	330.	U	330.	U	330.	U	330.	U
Pyrene	UG/KG	570	163.1	71.4%	50,000.00	0	5	7	570.		330.	U	39.	J	31.	J	52.	J	120.	J	330.	U
Total Petroleum Hydrocarbons																						
Diesel Oil	MG/KG	29	13.1	71.4%		0	5	7	29	Y	14	Y	7.8	U	5.7	J	13		19	J	6.6	U
Motor Oil	MG/KG	360	107.9	85.7%		0	6	7	120	Y	60	Y	22	Y	90		100		360		6.6	U
Metals																						
Aluminum	MG/KG	12200	10,685.7	100.0%	19,300.00	0	7	7	8,370.		9,630.		12,200.		11,700.	E*	10,600.	E*	10,800.	E*	11,500.	E*
Antimony	MG/KG	4.8	2.9	100.0%	5.9	0	7	7	1.2	BN	2.4	BN	4.1	BN	4.8	BN	1.8	BN	3.7	BN	2.4	BN
Arsenic	MG/KG	5.7	4.	100.0%	8.2	0	7	7	4.3	N	4.1	N	5.7	N	3.7	*	3.3	*	3.6	*	3.5	*
Barium	MG/KG	109	92.	100.0%	300	0	7	7	75.8	*	87.2	*	103.	*	98.5	*	93.9	*	109.	*	76.4	*
Beryllium	MG/KG	0.9	0.7	100.0%	1.1	0	7	7	.66		.73		.9		.77		.73		.71		.73	
Cadmium	MG/KG	5.9	1.5	100.0%	2.3	1	7	7	1.5	*	.69	*	1.3	*	.38	B	.16	B	.39		**5.9**	
Calcium	MG/KG	116000	71,298.6	100 0%	121,000.00	0	7	7	116,000.		78,300.		9,190.		69,900.	*	92,500.	*	65,200.	*	68,000.	*
Chromium	MG/KG	24.8	21.2	100.0%	29.6	0	7	7	15.6	N*	19.8	N*	24.8	N*	22.9	E*	19.1	E*	24.3	E*	22.1	E*
Cobalt	MG/KG	11.5	9.9	100.0%	30	0	7	7	7.9		9.2		11.5		10.3		9.7		9.7		11.2	
Copper	MG/KG	72.3	52.8	100.0%	33	7	7	7	**37.3**	N	**53.3**	N	**53.4**	N	**60.6**	EN	**49.7**	EN	**72.3**	EN	**42.9**	EN
Iron	MG/KG	26500	21,600.	100.0%	36,500.00	0	7	7	18,300.	*	20,400.	*	26,500.	*	22,900.	E*	20,700.	E*	20,900.	E*	21,500.	E*
Lead	MG/KG	1120	369.9	100.0%	24.8	7	7	7	**152.**	E*	**185.**	E*	**315.**	E*	**1,120.**	E	**227.**	E	**320.**	E	**270.**	E
Magnesium	MG/KG	18700	15,000.	100.0%	21,500.00	0	7	7	14,100.	*	12,200.	*	15,100.	*	16,900.	*	13,800.	*	18,700.	*	14,200.	*
Manganese	MG/KG	573	473.9	100.0%	1,060.00	0	7	7	396.	*	443.	*	573.	*	500.		471.		468.		466.	
Nickel	MG/KG	39.6	31.7	100.0%	49	0	7	7	27.7	E	31.8	E	39.6	E	33.4	*	30.2	*	29.4	*	29.5	*
Potassium	MG/KG	2600	2,035.7	100.0%	2,380.00	1	7	7	1,280.	*	1,540.	*	2,030.	*	2,250.		2,350.		2,200.		**2,600.**	
Silver	MG/KG	1.3	0.5	85 7%	0.75	1	6	7	.34	BN	.15	UN	.36	BN	.33	BN	.38	BN	.32	BN	**1.3**	N
Sodium	MG/KG	185	151.9	100.0%	172	2	7	7	140.	B	135.	B	166.	B	93.1	B	**181.**	B	163.	B	**185.**	B
Thallium	MG/KG	2.5	2.3	100.0%	0.7	7	7	7	**1.9**		**2.3**		**2.4**		**2.2**		**2.5**		**2.3**		**2.3**	
Vanadium	MG/KG	25	19.8	100.0%	150	0	7	7	12.9	*	15.7	*	21.1	*	25.	E*	21.8	E*	21.6	E*	20.5	E*
Zinc	MG/KG	135	111.7	100.0%	110	4	7	7	93.7	N*	105.	N*	**135.**	N*	**130.**	EN	**122.**	EN	**125.**	EN	71.3	EN

1. NYSDEC Technical and Administrative Guidance Memorandum #4046, January 24, 1994

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD	LTTD	LTTD	LTTD	LTTD
								SDG:	79605	79605	79605	79605	79890
								LOC ID:	LTTDL	LTTDH	LTTDL	LTTDH	LTTDB
								SAMP_ID:	LT4004	LT4005	LT4010	LT4011	LT4016
								FIELD QC CODE:	SA	SA	SA	SA	SA
								SAMP. DEPTH TOP:	0	0	0	0	0
								SAMP. DEPTH BOT:	0	0	0	0	0
								MATRIX:	SOIL	SOIL	SOIL	SOIL	SOIL
								SAMP. DATE:	30-Aug-00	30-Aug-00	01-Sep-00	01-Sep-00	20-Sep-00
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Semivolatile Organic Compounds													
2-Methylnaphthalene	UG/KG	110	121.4	36.8%	36,400.00	0	7	19	41. J	350. U	110. J	350. U	39. J
Acenaphthylene	UG/KG	84	164.2	5.3%	41,000.00	0	1	19	340. U	350. U	370. U	350. U	84. J
Anthracene	UG/KG	24	161.	5.3%	50,000.00	0	1	19	340. U	350. U	370. U	350. U	24. J
Benzidine	UG/KG	69	404.2	5.3%		0	1	19	69. J	880. U	930. U	870. U	840. U
Benzo(a)anthracene	UG/KG	72	147.1	15.8%	224	0	3	19	340. U	350. U	17. J	350. U	72. J
Benzo(a)pyrene	UG/KG	120	150.5	15.8%	61	1	3	19	18. J	350. U	41. J	350. U	**120.** J
Benzo(b)fluoranthene	UG/KG	260	155.5	21.1%	1,100.00	0	4	19	340. U	350. U	30. J	350. U	260. JY
Benzo(ghi)perylene	UG/KG	710	190.2	26.3%	50,000.00	0	5	19	77. J	350. U	270. J	350. U	710.
Benzo(k)fluoranthene	UG/KG	21	159.8	5.3%	1,100.00	0	1	19	340. U	350. U	21. J	350. U	330. U
Bis(2-Ethylhexyl)phthalate	UG/KG	230	144.1	26.3%	50,000.00	0	5	19	28. J	350. U	370. U	350. U	46. J
Carbazole	UG/KG	45	162.1	5.3%		0	1	19	340. U	350. U	370. U	350. U	330. U
Chrysene	UG/KG	140	147.2	21.1%	400	0	4	19	340. U	350. U	36. J	350. U	140. J
Dibenzofuran	UG/KG	140	129.1	31.6%	6,200.00	0	6	19	41. J	350. U	140. J	350. U	27. J
Fluoranthene	UG/KG	610	187.9	47.4%	50,000.00	0	9	19	140. J	350. U	420.	350. U	610.
Fluorene	UG/KG	52	147.	15.8%	50,000.00	0	3	19	20. J	350. U	52. J	350. U	41. J
Indeno(1,2,3-cd)pyrene	UG/KG	250	151.4	21.1%	3,200.00	0	4	19	340. U	350. U	37. J	350. U	250. J
Naphthalene	UG/KG	41	145.9	15.8%	13,000.00	0	3	19	16. J	350. U	41. J	350. U	35. J
Phenanthrene	UG/KG	740	211.9	68.4%	50,000.00	0	13	19	300. J	350. U	740.	350. U	570.
Phenol	UG/KG	63	163.1	5.3%	30	1	1	19	340. U	350. U	370. U	350. U	**63.** J
Pyrene	UG/KG	900	209.9	47.4%	50,000.00	0	9	19	270. J	350. U	540.	350. U	900.
Total Petroleum Hydrocarbons													
Diesel Oil	MG/KG	120.	26.2	76.5%		0	13	17	88. Y	12. Y	120. Y	9.3 Y	24.
Motor Oil	MG/KG	95.	28.8	76.5%		0	13	17	72. Y	7.1 U	65. Y	14. Y	95.
Metals													
Aluminum	MG/KG	43200	27,417.6	100.0%	19,300.00	15	17	17	1,850.	**27,600.**	3,750.	**32,200.**	**42,900.** E*
Antimony	MG/KG	39.5	14.1	100.0%	5.9	16	17	17	**30.3** N	**16.7** N	**39.5** N	**8.6** N	**13.6** N
Arsenic	MG/KG	19.3	8.4	100.0%	8.2	6	17	17	**16.3** N	5.9 N	**19.3** N	5.9 N	**16.8** *
Barium	MG/KG	391	296.4	100.0%	300	7	17	17	214. *	269. *	**343.** *	284. *	**391.** *
Beryllium	MG/KG	1.7	1.2	100.0%	1.1	10	17	17	.66	**1.2**	.63	**1.4**	**1.7**
Cadmium	MG/KG	13.8	5.	82.4%	2.3	12	14	17	**5.1** *	**4.2** *	**7.3** *	**2.5** *	**13.8**
Calcium	MG/KG	100000	52,438.9	100.0%	121,000.00	0	17	17	5,980.	50,500.	10,000.	59,900.	89,200. *
Chromium	MG/KG	214	95.3	100.0%	29.6	17	17	17	**214.** N*	**87.7** N*	**197.** N*	**52.6** N*	**88.5** E*
Cobalt	MG/KG	23.5	14.4	100.0%	30	0	17	17	21.5	10.7	23.5	11.3	14.6
Copper	MG/KG	8710	2,378.6	100.0%	33	17	17	17	**3,500.** N	**3,980.** N	**3,600.** N	**8,710.** N	**152.** EN
Iron	MG/KG	591000	140,070.6	100.0%	36,500.00	8	17	17	**515,000.** *	26,500. *	**591,000.** *	26,900. *	33,500. E*
Lead	MG/KG	1670	690.3	100.0%	24.8	17	17	17	**384.** E*	**816.** E*	**657.** E*	**527.** E*	**1,670.** E
Magnesium	MG/KG	26100	13,146.5	100.0%	21,500.00	3	17	17	1,630. *	11,800. *	2,270. *	14,100. *	20,000. *
Manganese	MG/KG	2280	910.	100.0%	1,060.00	4	17	17	**2,280.** *	553. *	**2,030.** *	603. *	667.
Mercury	MG/KG	0.48	0.1	58.8%	0.1	5	10	17	.02 U	.02 U	.03 B	.02 U	**.37**
Nickel	MG/KG	192	80.6	100.0%	49	15	17	17	**192.** E	**137.** E	**106.** E	**67.** E	**58.7** *

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD	LTTD	LTTD	LTTD	LTTD
								SDG:	79605	79605	79605	79605	79890
								LOC ID:	LTTDL	LTTDH	LTTDL	LTTDH	LTTDB
								SAMP_ID:	LT4004	LT4005	LT4010	LT4011	LT4016
								FIELD QC CODE:	SA	SA	SA	SA	SA
								SAMP. DEPTH TOP:	0	0	0	0	0
								SAMP. DEPTH BOT:	0	0	0	0	0
								MATRIX:	SOIL	SOIL	SOIL	SOIL	SOIL
								SAMP. DATE:	30-Aug-00	30-Aug-00	01-Sep-00	01-Sep-00	20-Sep-00
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Potassium	MG/KG	20900	9,588.1	100.0%	2,380.00	14	17	17	664. *	9,140. *	1,270. *	10,200. *	20,600.
Selenium	MG/KG	14	3.1	70.6%	2	8	12	17	10.3 N	.26 UN	14. N	.28 UN	2.
Silver	MG/KG	2.5	1.3	100.0%	0.75	14	17	17	1.1 N	1. N	1.9 N	.78 BN	2.5 N
Sodium	MG/KG	1510	858.6	100.0%	172	16	17	17	466. B	820.	431. B	894.	1,440.
Thallium	MG/KG	41.6	10.3	100.0%	0.7	17	17	17	37.5	2.7	41.6	2.8	4.4
Vanadium	MG/KG	102	61.3	100.0%	150	0	17	17	22.9 *	54. *	29.9 *	63.1 *	102. E*
Zinc	MG/KG	874	333.7	100.0%	110	17	17	17	645. N*	167. N*	874. N*	160. N*	403. EN

1. NYSDEC Technical and Administrative Guidance Memorandum #4046, January 24, 1994

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

Parameter	Units	Maximum Concentration	Average Concentration	Frequency of Detection	TAGM Value (1)	Number Exceeding TAGM	Number of Times Detected	Number of Analyses	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
STUDY ID:									LTTD	LTTD	LTTD	LTTD	NONE
SDG:									79890	79890	79890	79890	79890
LOC ID:									LTTDL	LTTDH	LTTDB	LTTDL	NONE
SAMP_ID:									LT4018	LT4019	LT4022	LT4026	LT4026RE
FIELD QC CODE:									SA	SA	SA	SA	NONE
SAMP. DEPTH TOP:									0	0	0	0	NONE
SAMP. DEPTH BOT:									0	0	0	0	NONE
MATRIX:									SOIL	SOIL	SOIL	SOIL	NONE
SAMP. DATE:									20-Sep-00	20-Sep-00	21-Sep-00	21-Sep-00	
Semivolatile Organic Compounds													
2-Methylnaphthalene	UG/KG	110	121.4	36.8%	36,400.00	0	7	19	38. J	330. U	330. U	31. J	15. J
Acenaphthylene	UG/KG	84	164.2	5.3%	41,000.00	0	1	19	330. U	330. U	330. U	340. U	340. U
Anthracene	UG/KG	24	161.	5.3%	50,000.00	0	1	19	330. U	330. U	330. U	340. U	340. U
Benzidine	UG/KG	69	404.2	5.3%		0	1	19	840. U	830. U	830. U	850. U	850. U
Benzo(a)anthracene	UG/KG	72	147.1	15.8%	224	0	3	19	330. U	330. U	21. J	340. U	340. U
Benzo(a)pyrene	UG/KG	120	150.5	15.8%	61	1	3	19	330. U	330. U	330. U	340. U	340. U
Benzo(b)fluoranthene	UG/KG	260	155.5	21.1%	1,100.00	0	4	19	330. U	330. U	87. JY	340. U	340. U
Benzo(ghi)perylene	UG/KG	710	190.2	26.3%	50,000.00	0	5	19	330. U	330. U	150. J	340. U	340. U
Benzo(k)fluoranthene	UG/KG	21	159.8	5.3%	1,100.00	0	1	19	330. U	330. U	330. U	340. U	340. U
Bis(2-Ethylhexyl)phthalate	UG/KG	230	144.1	26.3%	50,000.00	0	5	19	330. U	330. U	27. J	340. U	340. U
Carbazole	UG/KG	45	162.1	5.3%		0	1	19	330. U	330. U	330. U	340. U	340. U
Chrysene	UG/KG	140	147.2	21.1%	400	0	4	19	330. U	330. U	62. J	340. U	340. U
Dibenzofuran	UG/KG	140	129.1	31.6%	6,200.00	0	6	19	28. J	330. U	330. U	21. J	340. U
Fluoranthene	UG/KG	610	187.9	47.4%	50,000.00	0	9	19	59. J	330. U	290. J	98. J	340. U
Fluorene	UG/KG	52	147.	15.8%	50,000.00	0	3	19	330. U	330. U	330. U	340. U	340. U
Indeno(1,2,3-cd)pyrene	UG/KG	250	151.4	21.1%	3,200.00	0	4	19	330. U	330. U	50. J	340. U	340. U
Naphthalene	UG/KG	41	145.9	15.8%	13,000.00	0	3	19	330. U	330. U	330. U	340. U	340. U
Phenanthrene	UG/KG	740	211.9	68.4%	50,000.00	0	13	19	330. J	330. U	150. J	230. J	140. J
Phenol	UG/KG	63	163.1	5.3%	30	1	1	19	330. U	330. U	330. U	340. U	340. U
Pyrene	UG/KG	900	209.9	47.4%	50,000.00	0	9	19	46. J	330. U	280. J	69. J	340. U
Total Petroleum Hydrocarbons													
Diesel Oil	MG/KG	120.	26.2	76.5%		0	13	17	68.	6.7 U	9.6	35.	
Motor Oil	MG/KG	95.	28.8	76.5%		0	13	17	47.	6.7 U	40.	20.	
Metals													
Aluminum	MG/KG	43200	27,417.6	100.0%	19,300.00	15	17	17	19,600. E*	28,400. E*	43,200. E*	22,700. E*	
Antimony	MG/KG	39.5	14.1	100.0%	5.9	16	17	17	15.4 N	12.3 N	10.5 N	13.6 N	
Arsenic	MG/KG	19.3	8.4	100.0%	8.2	6	17	17	1.3 *	3.8 *	16.1 *	4.9 *	
Barium	MG/KG	391	296.4	100.0%	300	7	17	17	237. *	283. *	386. *	273. *	
Beryllium	MG/KG	1.7	1.2	100.0%	1.1	10	17	17	.98	1.2	1.7	1.1	
Cadmium	MG/KG	13.8	5.	82.4%	2.3	12	14	17	.03 U	3.2	10.4	.04 U	
Calcium	MG/KG	100000	52,438.9	100.0%	121,000.00	0	17	17	35,300. *	55,000. *	93,800. *	45,000. *	
Chromium	MG/KG	214	95.3	100.0%	29.6	17	17	17	90.7 E*	97.5 E*	86.3 E*	100. E*	
Cobalt	MG/KG	23.5	14.4	100.0%	30	0	17	17	17.2	13.2	14.3	17.2	
Copper	MG/KG	8710	2,378.6	100.0%	33	17	17	17	663. EN	2,430. EN	140. EN	1,050. EN	
Iron	MG/KG	591000	140,070.6	100.0%	36,500.00	8	17	17	316,000. E*	77,400. E*	30,700. E*	222,000. E*	
Lead	MG/KG	1670	690.3	100.0%	24.8	17	17	17	479. E	80.3 E	1,410. E	527. E	
Magnesium	MG/KG	26100	13,146.5	100.0%	21,500.00	3	17	17	6,960. *	13,200. *	21,900. *	9,530. *	
Manganese	MG/KG	2280	910.	100.0%	1,060.00	4	17	17	1,340.	718.	635.	1,160.	
Mercury	MG/KG	0.48	0.1	58.8%	0.1	5	10	17	.09	.02 U	.47	.07	
Nickel	MG/KG	192	80.6	100.0%	49	15	17	17	62.2 *	103. *	54.3 *	82.9 *	

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

STUDY ID:	LTTD	LTTD	LTTD	LTTD	NONE
SDG:	79890	79890	79890	79890	79890
LOC ID:	LTTDL	LTTDH	LTTDB	LTTDL	NONE
SAMP_ID:	LT4018	LT4019	LT4022	LT4026	LT4026RE
FIELD QC CODE:	SA	SA	SA	SA	NONE
SAMP. DEPTH TOP:	0	0	0	0	NONE
SAMP. DEPTH BOT:	0	0	0	0	NONE
MATRIX:	SOIL	SOIL	SOIL	SOIL	NONE
SAMP. DATE:	20-Sep-00	20-Sep-00	21-Sep-00	21-Sep-00	

Parameter	Units	Maximum Concentration	Average Concentration	Frequency of Detection	TAGM Value (1)	Number Exceeding TAGM	Number of Times Detected	Number of Analyses	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Potassium	MG/KG	20900	9,588.1	100.0%	2,380.00	14	17	17	**6,210.**	**11,200.**	**20,900.**	**7,080.**	
Selenium	MG/KG	14	3.1	70.6%	2	8	12	17	**6.5**	.22 U	**2.6**	**3.1**	
Silver	MG/KG	2.5	1.3	100.0%	0.75	14	17	17	**1.1** N	**1.2** N	**2.1** N	**1.9** N	
Sodium	MG/KG	1510	858.6	100.0%	172	16	17	17	78. B	**790.**	**1,440.**	**372.** B	
Thallium	MG/KG	41.6	10.3	100.0%	0.7	17	17	17	**19.4**	**5.6**	**3.6**	**13.2**	
Vanadium	MG/KG	102	61.3	100.0%	150	0	17	17	51.1 E*	63.1 E*	99.5 E*	52.7 E*	
Zinc	MG/KG	874	333.7	100.0%	110	17	17	17	**481.** EN	**214.** EN	**368.** EN	**412.** EN	

1. NYSDEC Technical and Administrative Guidance Memorandum #4046, January 24, 1994

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD	LTTD	LTTD	LTTD	LTTD
								SDG:	79890	79890	79890	79890	79890
								LOC ID:	LTTDH	LTTDB	LTTDL	LTTDH	LTTDB
								SAMP_ID:	LT4027	LT4032	LT4034	LT4035	LT4038
								FIELD QC CODE:	SA	SA	SA	SA	SA
								SAMP. DEPTH TOP:	0	0	0	0	0
								SAMP. DEPTH BOT:	0	0	0	0	0
								MATRIX:	SOIL	SOIL	SOIL	SOIL	SOIL
								SAMP. DATE:	21-Sep-00	22-Sep-00	22-Sep-00	22-Sep-00	23-Sep-00
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Semivolatile Organic Compounds													
2-Methylnaphthalene	UG/KG	110	121.4	36.8%	36,400.00	0	7	19	330. U	330. U	330. U	330. U	340. U
Acenaphthylene	UG/KG	84	164.2	5.3%	41,000.00	0	1	19	330. U	330. U	330. U	330. U	340. U
Anthracene	UG/KG	24	161.	5.3%	50,000.00	0	1	19	330. U	330. U	330. U	330. U	340. U
Benzidine	UG/KG	69	404.2	5.3%		0	1	19	820. U	830. U	830. U	830. U	850. U
Benzo(a)anthracene	UG/KG	72	147.1	15.8%	224	0	3	19	330. U	330. U	330. U	330. U	340. U
Benzo(a)pyrene	UG/KG	120	150.5	15.8%	61	1	3	19	330. U	330. U	330. U	330. U	340. U
Benzo(b)fluoranthene	UG/KG	260	155.5	21.1%	1,100.00	0	4	19	330. U	57. JY	330. U	330. U	340. U
Benzo(ghi)perylene	UG/KG	710	190.2	26.3%	50,000.00	0	5	19	330. U	57. J	330. U	330. U	340. U
Benzo(k)fluoranthene	UG/KG	21	159.8	5.3%	1,100.00	0	1	19	330. U	330. U	330. U	330. U	340. U
Bis(2-Ethylhexyl)phthalate	UG/KG	230	144.1	26.3%	50,000.00	0	5	19	330. U	37. J	330. U	330. U	340. U
Carbazole	UG/KG	45	162.1	5.3%		0	1	19	330. U	330. U	330. U	330. U	340. U
Chrysene	UG/KG	140	147.2	21.1%	400	0	4	19	330. U	39. J	330. U	330. U	340. U
Dibenzofuran	UG/KG	140	129.1	31.6%	6,200.00	0	6	19	330. U	330. U	330. U	330. U	340. U
Fluoranthene	UG/KG	610	187.9	47.4%	50,000.00	0	9	19	330. U	180. J	330. U	330. U	340. U
Fluorene	UG/KG	52	147.	15.8%	50,000.00	0	3	19	330. U	330. U	330. U	330. U	340. U
Indeno(1,2,3-cd)pyrene	UG/KG	250	151.4	21.1%	3,200.00	0	4	19	330. U	20. J	330. U	330. U	340. U
Naphthalene	UG/KG	41	145.9	15.8%	13,000.00	0	3	19	330. U	330. U	330. U	330. U	340. U
Phenanthrene	UG/KG	740	211.9	68.4%	50,000.00	0	13	19	330. U	97. J	100. J	330. U	40. J
Phenol	UG/KG	63	163.1	5.3%	30	1	1	19	330. U	330. U	330. U	330. U	340. U
Pyrene	UG/KG	900	209.9	47.4%	50,000.00	0	9	19	330. U	130. J	330. U	330. U	340. U
Total Petroleum Hydrocarbons													
Diesel Oil	MG/KG	120.	26.2	76.5%		0	13	17	6.7 U	6.2 J	12.	6.6 U	8.6
Motor Oil	MG/KG	95.	28.8	76.5%		0	13	17	6.7 U	52.	7.5	6.6 U	32.
Metals													
Aluminum	MG/KG	43200	27,417.6	100.0%	19,300.00	15	17	17	**26,600.** E*	**40,300.** E*	**25,800.** E*	**30,400.** E*	**41,300.** E*
Antimony	MG/KG	39.5	14.1	100.0%	5.9	16	17	17	**8.2** N	**11.4** N	**9.8** N	5.8 N	**8.8** N
Arsenic	MG/KG	19.3	8.4	100.0%	8.2	6	17	17	4.1 *	**13.8** *	3.2 *	4.3 *	**13.7** *
Barium	MG/KG	391	296.4	100.0%	300	7	17	17	255. *	**358.** *	**355.** *	251. *	**357.** *
Beryllium	MG/KG	1.7	1.2	100.0%	1.1	10	17	17	**1.2**	**1.6**	1.1	**1.3**	**1.7**
Cadmium	MG/KG	13.8	5.	82.4%	2.3	12	14	17	1.5	**11.6**	.03 U	.82	**9.6**
Calcium	MG/KG	100000	52,438.9	100.0%	121,000.00	0	17	17	62,100. *	85,000. *	54,200. *	62,200. *	100,000. *
Chromium	MG/KG	214	95.3	100.0%	29.6	17	17	17	**68.7** E*	**83.4** E*	**106.** E*	**53.9** E*	**85.** E*
Cobalt	MG/KG	23.5	14.4	100.0%	30	0	17	17	12.8	13.5	15.5	12.9	13.8
Copper	MG/KG	8710	2,378.6	100.0%	33	17	17	17	**3,150.** EN	**136.** EN	**853.** EN	**4,720.** EN	**113.** EN
Iron	MG/KG	591000	140,070.6	100.0%	36,500.00	8	17	17	30,500. E*	29,800. E*	**152,000.** E*	34,100. E*	27,800. E*
Lead	MG/KG	1670	690.3	100.0%	24.8	17	17	17	**665.** E	**1,310.** E	**53.9** E	**40.2** E	**1,230.** E
Magnesium	MG/KG	26100	13,146.5	100.0%	21,500.00	3	17	17	13,100. *	**22,400.** *	10,700. *	12,800. *	**26,100.** *
Manganese	MG/KG	2280	910.	100.0%	1,060.00	4	17	17	589.	602.	932.	607.	682.
Mercury	MG/KG	0.48	0.1	58.8%	0.1	5	10	17	.02 U	**.48**	.06	.02 U	**.21**
Nickel	MG/KG	192	80.6	100.0%	49	15	17	17	**85.2** *	**50.4** *	**67.2** *	**60.6** *	45.6 *

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

								STUDY ID:	LTTD	LTTD	LTTD	LTTD	LTTD
								SDG:	79890	79890	79890	79890	79890
								LOC ID:	LTTDH	LTTDB	LTTDL	LTTDH	LTTDB
								SAMP_ID:	LT4027	LT4032	LT4034	LT4035	LT4038
								FIELD QC CODE:	SA	SA	SA	SA	SA
								SAMP. DEPTH TOP:	0	0	0	0	0
								SAMP. DEPTH BOT:	0	0	0	0	0
								MATRIX:	SOIL	SOIL	SOIL	SOIL	SOIL
								SAMP. DATE:	21-Sep-00	22-Sep-00	22-Sep-00	22-Sep-00	23-Sep-00
Parameter	**Units**	**Maximum Concentration**	**Average Concentration**	**Frequency of Detection**	**TAGM Value (1)**	**Number Exceeding TAGM**	**Number of Times Detected**	**Number of Analyses**	Value (Q)	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Potassium	MG/KG	20900	9,588.1	100.0%	2,380.00	14	17	17	**8,010.**	**18,000.**	**7,480.**	**9,050.**	**18,900.**
Selenium	MG/KG	14	3.1	70.6%	2	8	12	17	.24 U	**2.8**	1.4	.25 U	**3.3**
Silver	MG/KG	2.5	1.3	100.0%	0.75	14	17	17	.61 BN	**2.4** N	**.83** N	.49 BN	**1.9** N
Sodium	MG/KG	1510	858.6	100.0%	172	16	17	17	**837.**	**1,310.**	**668.**	**927.**	**1,510.**
Thallium	MG/KG	41.6	10.3	100.0%	0.7	17	17	17	**3.**	**3.1**	**9.5**	**3.7**	**4.3**
Vanadium	MG/KG	102	61.3	100.0%	150	0	17	17	54.8 E*	91.1 E*	56.7 E*	62.3 E*	92.2 E*
Zinc	MG/KG	874	333.7	100.0%	110	17	17	17	**198.** EN	**340.** EN	**336.** EN	**150.** EN	**262.** EN

1. NYSDEC Technical and Administrative Guidance Memorandum #4046, January 24, 1994

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

STUDY ID:	NONE	LTTD	LTTD	LTTD
SDG:	79890	79890	79894	79894
LOC ID:	NONE	LTTDC	LTTDL	LTTDH
SAMP_ID:	LT4038RE	LT4039	LT4040	LT4041
FIELD QC CODE:	NONE	SA	SA	SA
SAMP. DEPTH TOP:	NONE	0	0	0
SAMP. DEPTH BOT:	NONE	0	0	0
MATRIX:	NONE	SOIL	SOIL	SOIL
SAMP. DATE:		23-Sep-00	23-Sep-00	23-Sep-00

Parameter	Units	Maximum Concentration	Average Concentration	Frequency of Detection	TAGM Value (1)	Number Exceeding TAGM	Number of Times Detected	Number of Analyses	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Semivolatile Organic Compounds												
2-Methylnaphthalene	UG/KG	110	121.4	36.8%	36,400.00	0	7	19	340. U	330. U	22. J	330. U
Acenaphthylene	UG/KG	84	164.2	5.3%	41,000.00	0	1	19	340. U	330. U	330. U	330. U
Anthracene	UG/KG	24	161.	5.3%	50,000.00	0	1	19	340. U	330. U	330. U	330. U
Benzidine	UG/KG	69	404.2	5.3%		0	1	19	850. U	820. U	830. U	840. U
Benzo(a)anthracene	UG/KG	72	147.1	15.8%	224	0	3	19	340. U	330. U	330. U	330. U
Benzo(a)pyrene	UG/KG	120	150.5	15.8%	61	1	3	19	340. U	330. U	330. U	330. U
Benzo(b)fluoranthene	UG/KG	260	155.5	21.1%	1,100.00	0	4	19	340. U	330. U	330. U	330. U
Benzo(ghi)perylene	UG/KG	710	190.2	26.3%	50,000.00	0	5	19	340. U	330. U	330. U	330. U
Benzo(k)fluoranthene	UG/KG	21	159.8	5.3%	1,100.00	0	1	19	340. U	330. U	330. U	330. U
Bis(2-Ethylhexyl)phthalate	UG/KG	230	144.1	26.3%	50,000.00	0	5	19	340. U	330. U	330. U	230. J
Carbazole	UG/KG	45	162.1	5.3%		0	1	19	340. U	45. J	330. U	330. U
Chrysene	UG/KG	140	147.2	21.1%	400	0	4	19	340. U	330. U	330. U	330. U
Dibenzofuran	UG/KG	140	129.1	31.6%	6,200.00	0	6	19	340. U	330. U	16. J	330. U
Fluoranthene	UG/KG	610	187.9	47.4%	50,000.00	0	9	19	340. U	53. J	36. J	330. U
Fluorene	UG/KG	52	147.	15.8%	50,000.00	0	3	19	340. U	330. U	330. U	330. U
Indeno(1,2,3-cd)pyrene	UG/KG	250	151.4	21.1%	3,200.00	0	4	19	340. U	330. U	330. U	330. U
Naphthalene	UG/KG	41	145.9	15.8%	13,000.00	0	3	19	340. U	330. U	330. U	330. U
Phenanthrene	UG/KG	740	211.9	68.4%	50,000.00	0	13	19	39. J	140. J	140. J	330. U
Phenol	UG/KG	63	163.1	5.3%	30	1	1	19	340. U	330. U	330. U	330. U
Pyrene	UG/KG	900	209.9	47.4%	50,000.00	0	9	19	340. U	48. J	21. J	330. U
Total Petroleum Hydrocarbons												
Diesel Oil	MG/KG	120.	26.2	76.5%		0	13	17		23.	16.	6.7 U
Motor Oil	MG/KG	95.	28.8	76.5%		0	13	17		16.	12.	6.7 U
Metals												
Aluminum	MG/KG	43200	27,417.6	100.0%	19,300.00	15	17	17		**35,700.** E*	**22,300.** E	**21,500.** E
Antimony	MG/KG	39.5	14.1	100.0%	5.9	16	17	17		**8.9** N	**13.5** N	**12.1** N
Arsenic	MG/KG	19.3	8.4	100.0%	8.2	6	17	17		3.9 *	4.9	4.2
Barium	MG/KG	391	296.4	100.0%	300	7	17	17		**343.** *	247.	192.
Beryllium	MG/KG	1.7	1.2	100.0%	1.1	10	17	17		**1.4**	.76	.77
Cadmium	MG/KG	13.8	5.	82.4%	2.3	12	14	17		**4.1**	**7.**	**4.5**
Calcium	MG/KG	100000	52,438.9	100.0%	121,000.00	0	17	17		981. *	38,200. E*	44,100. E*
Chromium	MG/KG	214	95.3	100.0%	29.6	17	17	17		**48.9** E*	**111.**	**49.4**
Cobalt	MG/KG	23.5	14.4	100.0%	30	0	17	17		13.8	11.	7.9
Copper	MG/KG	8710	2,378.6	100.0%	33	17	17	17		**150.** EN	**1,180.** N*	**5,910.** N*
Iron	MG/KG	591000	140,070.6	100.0%	36,500.00	8	17	17		**60,000.** E*	**176,000.** E	32,000. E
Lead	MG/KG	1670	690.3	100.0%	24.8	17	17	17		**855.** E	**449.** E	**582.** E
Magnesium	MG/KG	26100	13,146.5	100.0%	21,500.00	3	17	17		17,700. *	9,000. E*	10,300. E*
Manganese	MG/KG	2280	910.	100.0%	1,060.00	4	17	17		700.	898. E	474. E
Mercury	MG/KG	0.48	0.1	58.8%	0.1	5	10	17		**.11**	.04	.02 U
Nickel	MG/KG	192	80.6	100.0%	49	15	17	17		38.6 *	**85.2** E	**74.6** E

Table 7
FLYASH ANALYSIS RESULTS
LTTD TREATABILITY STUDY - SEAD 60 Soil

Seneca Army Depot Activity - Romulus, NY

STUDY ID:	NONE	LTTD	LTTD	LTTD
SDG:	79890	79890	79894	79894
LOC ID:	NONE	LTTDC	LTTDL	LTTDH
SAMP_ID:	LT4038RE	LT4039	LT4040	LT4041
FIELD QC CODE:	NONE	SA	SA	SA
SAMP. DEPTH TOP:	NONE	0	0	0
SAMP. DEPTH BOT:	NONE	0	0	0
MATRIX:	NONE	SOIL	SOIL	SOIL
SAMP. DATE:		23-Sep-00	23-Sep-00	23-Sep-00

Parameter	Units	Maximum Concentration	Average Concentration	Frequency of Detection	TAGM Value (1)	Number Exceeding TAGM	Number of Times Detected	Number of Analyses	Value (Q)	Value (Q)	Value (Q)	Value (Q)
Potassium	MG/KG	20900	9,588.1	100.0%	2,380.00	14	17	17		184.	7,240. E	6,870. E
Selenium	MG/KG	14	3.1	70.6%	2	8	12	17		4.	1.7	.37 B
Silver	MG/KG	2.5	1.3	100.0%	0.75	14	17	17		1.3 N	.6 BN	.96 N
Sodium	MG/KG	1510	858.6	100.0%	172	16	17	17		1,190.	477. B	947.
Thallium	MG/KG	41.6	10.3	100.0%	0.7	17	17	17		4.6	12.	3.3
Vanadium	MG/KG	102	61.3	100.0%	150	0	17	17		76.9 E*	30.	40.
Zinc	MG/KG	874	333.7	100.0%	110	17	17	17		231. EN	319. EN	113. EN

1. NYSDEC Technical and Administrative Guidance Memorandum #4046, January 24, 1994

TABLE-8
SUMMARY OF REMOVAL EFFICIENCY RESULTS
TREATABILITY STUDY - SEAD-60 SOIL

Seneca Army Depot Activity - Romulus, NY

Compound	**Unit**	**Average Concentration in SEAD-60 Soil Feed**	**Average Concentration in Treated Soil (1)**	**Removal Efficiency Treated Soil (2,3)**	**Average Concentration in Flyash (1)**	**Removal Efficiency Flyash (2,3)**
Semivolatile Organic Compounds						
2-Methylnaphthalene	UG/KG	120.	154.71	-28.9%	121.4	-1.1%
Acenaphthene	UG/KG	123.4	ND	NA	ND	NA
Anthracene	UG/KG	61.1	130.71	-113.9%	161.	-163.5%
Benzo(a)anthracene	UG/KG	171.	136.71	20.1%	147.1	14.0%
Benzo(a)pyrene	UG/KG	213.	148.14	30.4%	150.5	29.4%
Benzo(b)fluoranthene	UG/KG	265.	194.	26.8%	155.5	41.3%
Benzo(ghi)perylene	UG/KG	235.	132.86	43.5%	190.2	19.1%
Benzo(k)fluoranthene	UG/KG	246.	217.57	11.6%	159.8	35.0%
Bis(2-Ethylhexyl)phthalate	UG/KG	166.	147.71	11.0%	144.1	13.2%
Carbazole	UG/KG	118.9	127.43	-7.2%	162.1	-36.3%
Chrysene	UG/KG	282.	129.14	54.2%	147.2	47.8%
Dibenz(a,h)anthracene	UG/KG	76.2	124.	-62.7%	ND	NA
Dibenzofuran	UG/KG	102.2	176.	-72.2%	129.1	-26.3%
Fluoranthene	UG/KG	318.	182.	42.8%	187.9	40.9%
Fluorene	UG/KG	90.7	ND	NA	147.	-62.1%
Indeno(1,2,3-cd)pyrene	UG/KG	193.8	126.71	34.6%	151.4	21.9%
Naphthalene	UG/KG	88.5	ND	NA	145.9	-64.9%
Phenanthrene	UG/KG	203.2	133.57	34.3%	211.9	-4.3%
Pyrene	UG/KG	380.	163.14	57.1%	209.9	44.8%
PCBs						
Aroclor-1254	UG/KG	18.5	ND	NA	ND	NA
Aroclor-1260	UG/KG	27.13	ND	NA	ND	NA
Total Petroleum Hydrocarbons						
Diesel Oil	MG/KG	75.75	13.11	82.7%	26.2	65.4%
Motor Oil	MG/KG	379.2	107.9	71.5%	28.8	92.4%

1. ND = Not Detected
2. NA = Not Applicable
3. Removal Efficiency = (conc. Soil Feed - conc. Treated Soil)/(conc. Soil Feed) x 100%

found in both the treated soil (i.e., kiln ash) and flyash that was captured in the air pollution control devices.

Data provided on **Table 5** suggests that the petroleum hydrocarbon component originally identified in soil from SEAD-60 as TPH (**Table 1**) includes components that are further classified as diesel oil, motor oil, and a mixture of semivolatile organic compounds. The concentrations reported for the diesel oil ranges from a low of 18 to a high of 140 ppm (average of 76 ppm), while the comparable range shown for the motor oil component ranges from 5.3 to 720 ppm (average of 379 ppm). Also present in the soil are 19 semivolatile organic compounds, of which four (i.e., benzo(a)anthracene, benzo(a)pyrene, chrysene, and dibenz(a,h)anthracene) are found at concentrations above their respective soil TAGM criteria level.

Table 6 provides data from the analysis of the treated soil (i.e., kiln ash) which indicates that the concentration of TPH constituents is reduced (i.e., average of 13.1 ppm diesel oil and 108 ppm motor oil) in the treated soil. Four semivolatile organic compounds (i.e., benzo(a)anthracene, benzo(a)pyrene, chrysene, and dibenz(a,h)anthracene) still exhibit individual sample concentrations above their respective TAGM criteria levels, but overall the number of values found surpassing their respective criteria limits is decreased.

Table 7 provides analytical results for samples of the flyash that were captured in the air pollution control devices (i.e., high and low temperature coolers, cyclone and baghouse) of the APE 1236 system. Again the overall levels of TPH constituents are lower than originally found in the untreated soil and the number of semivolatile organic compounds seen to surpass their TAGM criteria value is again reduce.

Table 8 provides a summary of the removal efficiencies that were obtained during the treatability study. As is indicated by these data, removal efficiencies achieved for the TPH constituents in the treated soil were on the order of 60 to 93 percent for diesel oil and motor oil, respectively.

5.4 DISCUSSION OF REMEDIAL ALTERNATIVES

Petroleum-contaminated soil and sediment at SEAD-60 was excavated and transported to the Army's former APE-1236 deactivation furnace in SEAD-17 and used as the feed stock during a treatability test of the unit.

5.5 REMEDIAL ACTION COSTS

The removal action was performed by Army personnel. The soil was treated during a treatability test of the former deactivation furnace at SEAD-17. Economic data for the treatment of the petroleum-contaminated soil in the deactivation furnace will be provided in the report of the LTTD Treatability Demonstration at the former Deactivation Furnace that will be issued under Delivery Order #0013 to Contract DACA87-95-D-0031.

5.7 RECOMMENDATION

The removal action required at SEAD-60 to eliminate petroleum-contaminated soil and sediment is complete. SEDA received a letter from Mr. Scott Rodabaugh of the New York State Department of Environmental Protection dated July 13, 1999 that states:

Building 609, Spill No. 9812961

"Inspected open excavation, approximately 1½ to 2 feet deep, 40 to 50 feet long, and 20-25 feet wide. Excavation had approximately 6 inches of water. No visible soil contamination noted, no readings above background on HNu meter. Based on inspection plus previous analytical results, no further excavation to be required. Spill file to be left open until soil disposal/treatment completed."

The open excavation remaining at SEAD-60 will be backfilled and re-contoured to pre-excavation conditions. This action is necessary to close out the spill file.