RECORD OF DECISION
SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

SMALLEY-PIPER SUPERFUND SITE

COLLIERVILLE, SHELBY COUNTY, TENNESSEE

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA, GEORGIA

SEPTEMBER 2008

RECORD OF DECISION
Smalley-Piper Superfund Site

THE DECLARATION

Site Name and Location

This Record of Decision (ROD) is for the Smalley-Piper Superfund Site located at 719 Piper Street in Collierville, Shelby County, Tennessee. The U.S. Environmental Protection Agency (EPA) Site Identification Number is TNN000407378.

Statement of Basis and Purpose

This decision document presents the Selected Remedy for the Smalley-Piper Superfund Site located in Collierville, Shelby County, Tennessee, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for the Site. This decision represents the final remedy selected for the Site and following completion of the remedial action, the Site will be ready for reuse.

The State of Tennessee, as represented by the Tennessee Department of Environment and Conservation (TDEC), has been the support agency during the remedial investigation/ feasibility study (RI/FS) process. In accordance with 40 Code of Federal Regulations (CFR) Section 300.430 *et. seq*., as the support agency, TDEC has provided input during the process, actively participated in the decision-making process, and concurred with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

This Selected Remedy is excavation and ex-situ stabilization/solidification of contaminated source area soil, disposal of treated soil to a non-hazardous waste disposal facility, and long-term ground water recovery and treatment for total chromium, hexavalent chromium, antimony, and iron. Specific elements of the Selected Remedy are:

1. Excavation of contaminated soil
2. Chemical stabilization and solidification of contaminated soil
3. Off-site disposal of stabilized soil
4. Extraction of contaminated ground water
5. Ex-situ treatment of contaminated ground water
6. Disposal of treated water
7. In-situ soil flushing
8. Implementation of institutional controls

The main activities associated with these remedy components are: (1) excavating 144,000 cubic feet of contaminated soil; (2) chemically stabilizing and solidifying the excavated soil into a non-hazardous solid matrix; (3) transporting the stabilized/solidified soil to a local off-site non-hazardous waste facility for disposal; (4) constructing and operating ground water extraction wells to remove contaminated ground water from various parts of the contaminated plume; (5a) construction and operation of a source area ground water treatment facility using conventional chemical reduction and precipitation; (5b) dewatering, solidifying and disposing (at an off-site hazardous waste facility) the chemical treatment residue; (5c) construction and operation of up to two additional water extraction and treatment systems in the northwest and southwest portions of the plume using ion-exchange resin technology; (6) water extracted from the source area will be reinjected into the Memphis aquifer after treatment. Water extracted from any additional locations beyond the source area will either be made available to the Town of Collierville as potable water or reinjected into the Memphis aquifer, depending on the Town's potable water requirements; (7a) flushing the subsurface soil below the excavation depth with treated ground water using the open excavation pit as the injection point; (7b) collecting and treating the flush fluid along with the source ground water through the source extraction well and chemical treatment facility (as in step 5a); and (8) implementing institutional controls against use of contaminated ground water until cleanup goals are met.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Although this remedy will not result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Five-Year Reviews will continue to be conducted until cleanup goals are obtained and unlimited use of the site is permissible.

The following information is included in the Decision Summary of this ROD. Additional information may be found in the Administrative Record file for this Site.

- Chemicals of concern (COCs) and their respective concentrations (Tables 1-4, pages 63-64);
- Baseline risk represented by the COCs (Tables 10-12, pages 70-72);
- Cleanup goals established for COCs and the basis for these levels (Tables 13 and 14, page 73);
- How source materials constituting principal threats are addressed (page 48);
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the Baseline Risk Assessment (BRA) and ROD (page 14);
- Potential land and ground water use that will be available at the Site as a result of the Selected Remedy (page 55);

- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Tables 18 and 19, pages 84 through 87); and
- Key factor(s) that led to selecting the remedy (i.e., describing how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (page 43).

Authorizing Signatures

Franklin E. Hill, Director
Superfund Division
U.S. Environmental Protection Agency, Region 4

9-30-08
Date

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ACRONYMS AND ABBREVIATIONS

ADD	Average Daily Dose
ADDi	Average Daily Dose for the ith Toxicant
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances Disease Registry
BHHRA	Baseline Human Health Risk Assessment
bls	Below Land Surface
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response Compensation Liability Act of 1980
CFR	Code of Federal Regulations
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
GWRTAC	Ground Water Remediation Technologies Analysis Center
Hess	Hess Environmental Services, Inc.
HI	Hazard Index
HQ	Hazard Quotient
HRS	Hazard Ranking System
ICs	Institutional Controls
LADD	Lifetime Average Daily Dose
MCL	Maximum Contaminant Level
μg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
MW	Monitoring Well
M/T/V	Mobility/Toxicity/Volume
NCP	National Contingency Plan
NPDES	National Polluant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OSWER	Office of Solid Waste and Emergency Response
PRP	Potentially Responsible Party
RA	Remedial Action
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfD	Reference Dose
RfDi	Reference Dose for the ith Toxicant

ACRONYMS AND ABBREVIATIONS (Continued)

RGO	Remedial Goal Option
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
TDEC	Tennessee Department of Environment and Conservation
UCL	Upper Confidence Limit
VOC	Volatile Organic Compounds

DECISION SUMMARY

1.0 Site Name, Location, and Description

This Record of Decision (ROD) is for the Smalley-Piper Superfund Site located at 719 Piper Street in Collierville, Shelby County, Tennessee. The U.S. Environmental Protection Agency (EPA) is the lead agency for this Site. The EPA Site Identification Number is TNN000407378. The Site was proposed for inclusion on the National Priorities List (NPL) on September 23, 2004, and was placed on the NPL on April 27, 2005. The Site was previously used for industrial operations.

The Smalley-Piper facility covers approximately 9 acres and is comprised of a self-storage facility, concrete building, metal storage building, vacant lot, and paved parking lot. The Site is bordered to the south by Norfolk Southern Railroad; to the north by commercial businesses; to the east by Raleigh Tire Company, U.S. Highway 72, and a small wooded area; and to the west by a wooded area. The Site location and layout maps are included as Figures 1 and 2, respectively.

Smalley-Piper is located in an area of recharge for the Memphis aquifer; therefore, no upper confining layer is present in the vicinity of the facility. The Town of Collierville maintains 11 wells, nine of which are located within 4 miles of the facility. Based on 2003 data from the Town of Collierville, the town serves 12,000 connections, and also sells water to the Town of Piperton, which serves 335 connections. The average number of persons served per well is 2,836 in Collierville and 182 persons served per well in Piperton. Several private wells are located within four miles of the facility and are in the Memphis aquifer. There are 83 private wells within one mile of the facility, serving 206 persons. Based on the results of the ecological risk assessment conducted for the Site, contaminated surface runoff from the Site does not pose a threat to the Nonconnah Creek, which is used for recreational fishing. Approximately nine miles of wetlands border surface water within 15 miles downstream of the Smalley-Piper facility.

2.0 Site History and Enforcement Activities

2.1 Site History

From April 27, 1955, until May 28, 1982, Paul P. Piper, Sr. owned the Site. On May 28, 1982, the Site was transferred by Warranty Deed to Piper Industries, Inc., a Tennessee Corporation. On December 28, 1985, the Site was transferred by Warranty Deed to Piper Industries, Inc., a Texas corporation, which transferred the Site that same day by Warranty Deed to Claudia B. Piper and Paul P. Piper, Sr., as trustees of three trusts. The trusts provided real property interests in the Site property to Annette A. Piper (1/12 interest), Paul G. Piper (1/12 interest), Ronald K. Piper, Jr. (1/12 interest), and Ronald K. Piper, Sr. (3/4 interest). Ronald K. Piper, Sr. died in 1990. On or about October 4, 1995, the Estate of Ronald K. Piper, Sr. transferred his 3/4 interest in the Site property in equal shares to three trusts established for the benefit of Annette A. Piper, Paul G. Piper, and Ronald K. Piper, Jr., as directed by the will of Ronald K. Piper, Sr. dated March 7, 1988. Claudia B. Piper is the Trustee of all six trusts (the Trusts).

From the 1950s through the 1980s, Paul Piper, Sr. leased the Site to various corporations, including, but not limited to, Piper Industries, Inc., Piper Brothers of Collierville, and Sweeco, Inc. Piper Industries, Inc. was terminated on or about December 31, 1986, and Piper Brothers of Collierville and Sweeco are now defunct. Various manufacturing operations were conducted at the Site, including the manufacture of farm tools. Manufacturing of magnesium battery casings was conducted at the Site in the 1970s. The battery casings went through a treatment train consisting of several vats which contained caustic soda, acetic acid, chromic acid, and water. Wastes generated from the process were discharged into an equalization pond on Site. In the pond, spent chromic acid was treated by the injection of liquid sulphur dioxide. The treated waste in the pond was allowed to flow into drainage ditches on Site that ultimately discharged into Wolf Creek. The on-site equalization pond was closed in the early 1980s.

The current owners of the Site, the Trusts, lease a portion of the Site to Piper Mini-Storage, Inc., which leases small storage units to individuals. The Trusts leased another portion of the Site to Piper Industrial Coatings, Inc., previously known as Piper Farm Products, Inc., from 1992 to 2004. Piper Farm Products, Inc. was incorporated on or about November 13, 1992, and changed its name to Piper Industrial Coatings, Inc. in 2002. Piper Industrial Coatings, Inc. manufactured tools and used an iron powder containing chromium in its manufacturing process.

On or about June 13, 2002, Piper Industrial Coatings, Inc. was notified by the Tennessee Department of Environment and Conservation (TDEC) that it was in violation of its National Pollutant Discharge Elimination System (NPDES) Permit #TN0000701. The notice of violation was based upon a sample collected from the NPDES outfall of the facility on April 24, 2002, indicating that 51 milligrams per liter (mg/L) of hexavalent chromium was detected. The concentration detected was more than three times the criterion maximum concentration of 16 mg/L cited in the Tennessee General Water Quality Criteria for Fish and Aquatic Life. Previous data collected by TDEC indicated that elevated levels of hexavalent chromium were detected in water from an on Site production well and in effluent discharging from the NPDES outfall of the facility. Piper Industrial Coatings, Inc. was informed by TDEC that its NPDES permit was terminated on October 31, 2002.

Lund Coating Technologies, Inc. purchased assets and equipment from Piper Industrial Coatings on April 15, 2004. Lund Precision Products, Inc., an affiliate of Lund Coating Technologies, Inc., leased approximately two acres of the Site property from the Trusts from April 22, 2004, until August 2007.

2.2 Enforcement History

In March 2001, a private environmental investigation for a subdivision northeast of the Site showed that water believed to flow from the Site to the subdivision contained 153 parts of total chromium per billion parts (ppb) of water. The level of chromium found in the sample raised concern because EPA's maximum contaminant level (MCL) for total chromium in drinking water is 100 ppb. The production well and the surface water drainage ditch serving the Site were sampled in April 2001. Concentrations of total chromium were found at 141 ppb and 139 ppb in the samples, respectively. In July 2001, additional sampling was conducted by City Center Management and Development at the Site. The results showed total chromium of 93 ppb and hexavalent chromium of 76 ppb from the on Site production well, while the drainage ditch was found to contain 89 ppb of total chromium and 75 ppb of hexavalent chromium.

In August 2001, two Town of Collierville public drinking water wells, located approximately ½ mile west of the Site, detected levels of total chromium at 19 ppb and 8 ppb. The samples revealed levels of hexavalent chromium at 21 ppb and 10 ppb. The on-site and Town wells were screened in the Memphis Sand Aquifer. In October 2001, the two Town of Collierville public drinking water wells were tested for hexavalent chromium. Both wells detected hexavalent chromium at levels of 20 ppb. In January 2002, hexavalent chromium was detected at levels of 20 ppb and 26 ppb.

Due to the presence of chromium in the ground water samples from the Memphis Aquifer in the vicinity of the Site, the Town of Collerville has been required by the State of Tennessee to perform periodic monitoring of chromium since 2002. In mid 2003, the Town began to adjust production of its two closest wells to the Site to ensure the maintenance of a voluntary total chromium level of 50 ppb in finished drinking water. In December 2003, the Town shut down the production of the two wells in an attempt to ensure that no chromium is present in the water it distributes for public use. EPA's MCL for total chromium in drinking water is 100 ppb.

EPA conducted a Site Investigation (SI) at the Site in July 2002 and installed three ground water monitoring wells. Seven surface soil, seven subsurface soil, six sediment, and four ground water samples were collected during the investigation. Total chromium concentration ranged from 130 to 330 milligrams per kilogram (mg/kg) in the surface soils. In addition, many other chemical compounds were detected in the surface soil at elevated levels, including antimony, cadmium, calcium, cobalt, copper, lead, magnesium, nickel, selenium, zinc, methyl ethyl ketone, benzyl butyl phthalate, and gamma chlordane. Subsurface soil samples showed total chromium at 140 mg/kg in the former retention pond area. Other chemicals found in the sub-surface soil included acetone, dieldrin, and gamma chlordane. Sediment samples showed total chromium concentration ranging from 49 to 700 mg/kg. Other contaminants found in the sediment at elevated levels included antimony, copper, cyanide, nickel, zinc, methyl ethyl ketone, benzyl butyl phthalate and dieldrin. One of the ground water samples showed total chromium at 250 ppb. The Site was proposed for listing on the NPL on September 23, 2004, and was listed on the NPL on April 27, 2005.

On October 4, 2004, EPA entered into an Administrative Order on Consent (AOC) for Remedial Investigation and Feasibility Study (RI/FS) with the Estate of Paul P. Piper, Sr. (Estate) and Claudia B. Piper, as Trustee for the Trusts, whereby the Estate and Trusts agreed to perform the RI/FS and reimburse EPA's RI/FS oversight costs. Thereafter, the Estate and Trusts commenced performance of the RI with oversight from EPA. Performance of the completion of the RI/FS was assumed by EPA upon receipt of notice from the Estate and Trusts on February 1, 2008, that they had ceased implementation of the RI/FS work. EPA filed a notice of federal lien pursuant to CERCLA Section 107(l) in the Shelby County Register of Deeds on the Site property on April 30, 2007. In 2008, EPA entered into an Administrative Settlement Agreement with the Estate, the Trusts, Ronald K. Piper, Jr., Paul G. Piper, and Piper Industrial Coatings, Inc. for recovery of response costs incurred and to be incurred by EPA at the Site.

3.0 Community Participation

EPA issued a Community Information Update Fact Sheet for the Smalley-Piper Superfund Site located in Collierville, Shelby County, Tennessee in May 2008. The Fact Sheet provided an overview of issues and activities related to the Site, including an overview of the Superfund process and opportunities for community involvement in Site cleanup decisions.

EPA mailed approximately 175 copies of the Proposed Plan (EPA, 2008) to citizens in neighborhoods adjacent to the Site on July 22, 2008. The notice of the public meeting to discuss the Proposed Plan was published in the Commercial Appeal on July 23, 2008, which is included as Appendix A1. A public comment period on the Proposed Plan was held from July 23, 2008 to August 23, 2008. A public meeting was held at the Collierville Town Hall located at 500 Poplar View Parkway, on July 31, 2008, at 6:00 p.m. The public meeting transcript is included as Appendix A2. EPA's responses to the comments received during the public comment period are included in the Responsiveness Summary, which is Appendix A3 of this ROD.

In addition, the RI, RI Addendum, and FS Reports and the Proposed Plan for the Site were made available to the public on July 23, 2008, at the information repositories. These documents can be found in the Administrative Record file and the information repositories at EPA Region 4 Superfund Record Center and at the Lucius E. & Elsie C. Burch, Jr. Library located at 501 Poplar View Parkway, Collierville, Tennessee 38017. The notice of the availability of these documents was published in the *Commercial Appeal* on July 23, 2008.

4.0 Scope and Role of Response Action

The selected remedy in this Record of Decision will address soil and ground water contamination concurrently or in phases depending on availability of funds. Once this remedy is complete all contaminated media associated with the Site will have been addressed. In so doing, this action will reduce or eliminate risks to human and ecological receptors from contaminated soil and ground water and make the property available for reuse. The ROD will be implemented pursuant to the remedial authorities of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), and in compliance with the National Contingency Plan (NCP). This decision document presents the final remedy for the Site.

5.0 Site Characteristics

The Site covers approximately 9 acres and is comprised of several buildings, a vacant lot, and a paved parking lot. The buildings consist of a self-storage facility, production building, and warehouse. Surface water from the facility flows into drainage ditches located on the southern and eastern boundaries of the property. Surface water draining from the southern boundary of the property enters the municipal sewer system and connects to the Wolf River drainage basin. Surface water draining from the northern and eastern boundaries of the property is directed to the Wolf River via overland flow. The Site Layout Map is included as Figure 2.

5.1 Conceptual Site Model

The conceptual Site model describes the release mechanisms, migration pathways, and potential exposure mechanisms for human receptors. A summary of the human health conceptual model is provided as Figure 3 and is summarized below:

- The former treatment ponds are the primary sources of contamination.
- Contaminants released from the former treatment ponds have impacted the ground water and soil via infiltration.
- Contaminated ground water poses a potential ingestion and dermal contact risk.
- Contaminated surface and subsurface soil poses a potential incidental ingestion, dermal contact, and inhalation of particulates risk.
- Runoff from contaminated surface soil has impacted the sediment in nearby drainage pathways. This poses a potential risk of incidental ingestion, dermal contact, and inhalation of particulates.
- The human receptors potentially exposed to contamination include child and adult residents, industrial workers, construction workers, and trespassers.

5.2 Site Geologic and Hydrogeologic Conditions

Ground cover in the investigation area varies. The Site is predominately covered by asphalt and concrete; however, the western portion of the property is covered with vegetation. Fill material beneath the asphalt/concrete is typically sandy gravel which varies in thickness from a few inches to one foot.

The upper sections of the borings installed during sampling activities are characterized by silty clay/clayey silt with trace amounts of sand and some cherty gravel. This soil is representative of Quaternary age loess deposits typical in the Gulf Coastal Plain. These soils tend to retard the downward migration of water. These deposits ranged in thickness from a minimum of 16 feet in monitoring well MW-10 to a maximum of 29 feet in MW-01.

Underlying the loess deposits, fluvial deposits characterized by fine to medium grained sands with silt, clay, and gravel were encountered. These fluvial deposits ranged in thickness from 31 feet in monitoring well MW-19 to 168 feet in MW-5.

The Jackson Formation/Claiborne Group confining unit was encountered in wells MW-19 and MW-20. In monitoring well MW-19, the confining unit was penetrated at a depth of 56 feet below land surface and exhibited a thickness of 59 feet. The upper 17 feet section was characterized by stiff gray clay and was underlain by light brown silty clay. In monitoring well MW-20, the confining unit was encountered at a depth of 86 feet with a thickness of 59 feet of stiff gray clay. Based on the absence of a definitive confining unit in monitoring wells MW-16 and MW-21, the clay unit encountered in MW-20 may represent the eastern extent of the Jackson Formation in the investigation area.

Sands penetrated beneath the confining unit in monitoring wells MW-19 and MW-20 are believed to be representative of the Memphis Sand. These sands were yellowish brown fine to medium grained with approximately 20 to 30 percent silt and clay.

One hundred thirty four shallow soil borings were also installed on-site and on the property adjacent to the east. These borings were installed in order to obtain shallow soil samples. The lithology encountered during installation of the shallow soil borings was consistent with loess and fluvial depositional environments except in the areas of the former treatment ponds. These areas were characterized by very moist clay fill material to a depth of approximately nine feet below land surface (bls). Soils in borings P-22, P-25, and P-26 exhibited a distinct green discoloration between 3.5 and 7 feet bls. These borings were advanced in the area suspected to be the location of the former treatment ponds. This area is mostly asphalt, with some concrete cover.

Due to the observed absence of the Jackson Clay confining unit beneath the source areas, the Site may be considered a recharge area for the Memphis Sands. Based on boring logs completed during the installation of source area monitoring wells, the top of the Memphis Sands is estimated to be approximately 50 bls in the source areas. Recharge to the shallow aquifers and the Memphis Sands will come predominately from infiltration of precipitation. Rates of infiltration will be higher during the period from November to April due to increased rainfall amounts and lower evaporation rates.

Approximately 2,000 feet west of the Site source areas, the Jackson Clay confining unit is first encountered in monitoring wells installed as part of this investigation. Within 500 feet of its first appearance at a depth of 86 feet bls (MW-20), it rises to a depth of 56 feet bls (MW-19). Based on formation logs from Town of Collierville wells, West Well No. 1 and East Well No. 2, which are west of MW-19 and MW-20, the confining unit appears to maintain a thickness of approximately 60 feet at a depth of approximately 50 to 60 feet bls.

Potentiometric surfaces for both the shallow and Memphis Sands aquifers in the investigation area slope to the west. The sharp uplift in the Jackson Clay confining unit in the area between MW-19 and MW-20 may induce an easterly flow component to the shallow water table as the clay pushes up the slope.

5.3 Surface Water Hydrology

Surface water is discharged to the drainage basin of the Wolf River to the north. Surface flow leaving the southern portion of the Site was originally thought to reach Nonconnah Creek, but inspection of the drainage pathway showed that the flow enters the municipal sewer system and connects to the Wolf River drainage basin. During rain, the surface drainage along the south property flows along the railroad track right-of-way to the east into a drainage ditch that runs to the south at the southeast corner of the Site. The Norfolk Southern railroad track runs south of the Site. The Site appears to be level and flat throughout the length and width of the property. The general surface topography of the Site gradually decreases in elevation from south to north.

5.4 Nature and Extent of Contamination

Several investigative studies were performed by the potentially responsible party (PRP) and EPA from 2001 through 2008. The studies included field data acquisition and laboratory analyses to evaluate the nature and extent of Site contamination. The details of these studies are documented in the RI, RI Addendum, FS, and BRA and are available in the Administrative Record at the Information Repositories for the Site. Findings of the studies are summarized below.

5.4.1 Soil Contamination

Surface soil samples were collected from depths of 0-0.5 and 0-1 foot below land surface (bls) in 2002, 2005, and 2006. One-hundred sixteen samples were analyzed for total chromium and hexavalent chromium. Seven samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and pesticides/polychlorinated biphenyls (PCBs). Thirteen samples were analyzed for target analyte list (TAL) metals. Fifty-five samples were analyzed for iron.

Total chromium was detected in 34 of the 116 samples. Total chromium concentrations ranged from 1,070 mg/kg to 1,290 mg/kg. Hexavalent chromium was detected in 3 of the 116 samples. Hexavalent chromium concentrations ranged from 0.84 mg/kg to 445 mg/kg. Iron was detected in 55 of the 55 samples. The iron concentrations ranged from 11,700 mg/kg to 125,000 mg/kg. Aluminum was detected in 11 of the 13 samples and the concentrations ranged from non-detectable to 11,000 mg/kg. Antimony was detected in 5 of the 13 samples and the concentrations ranged from non-detectable to 2.4 mg/kg. Arsenic was detected in 12 of the 13 samples and the concentrations ranged from non-detectable to 14 mg/kg. Manganese was detected in 12 of the 13 samples and the concentrations ranged from non-detectable to 1,100 mg/kg. Thallium was detected in 7 of the 13 samples and the concentrations ranged from non-detectable to 3.7 mg/kg. Benzo(a)pyrene was detected in 1 of the 7 samples. Benzo(a)pyrene concentrations ranged from nondetect to 100 ug/kg. No other SVOCs, VOCs, pesticides/PCBs were detected in surface soil.

Subsurface soil samples were collected at the Site in 2002. In 2005, samples were collected from depths of 1.5 to 195.5 feet below land surface (bls) and 2 to 186 feet bls in

2006. A total of 438 samples were collected across the Site. All seven samples collected in 2002 and SB021, which was collected in 2005, were analyzed for TCL parameters including VOCs, SVOCs, pesticides/PCBs, and TAL metals. All other samples collected in 2005 and 2006 were analyzed for total chromium, hexavalent chromium, and iron only. Select samples including P12, SB020, SB023, SB024, SB025, SB026, SB027, SB028 were also analyzed for TAL metals. Subsurface soil hexavalent chromium concentrations are elevated in the former treatment ponds area at concentrations ranging from 1,080 mg/kg to 50,000 mg/kg.

The maximum concentrations for total chromium were detected in subsurface soil samples collected from areas where former treatment ponds were located at P19 (5-5.5 feet bls and 10 feet bls) (4,880 mg/kg and 4270 mg/kg); P07 (3330 mg/kg and 31,900 mg/kg); and P13 (3370 mg/kg). Additionally, maximum concentrations of total chromium were detected in the self-storage facility area at locations SB051 (1.5 – 2 feet bls) (4530 mg/kg); P25 (9 feet bls) (10,900 mg/kg); P22 (2 – 2.5 feet bls) (5010 mg/kg); and P26 (6 feet bls) (12,900 mg/kg). The maximum results for hexavalent chromium were detected on the eastern portion of the Site in samples P07 (50,000 mg/kg), P12 (1080 mg/kg), P13 (1100 mg/kg) which are located in the area of the former treatment ponds.

The maximum concentration for iron was detected in subsurface soil sample SS041 (2-2.5 feet bls) (113,000 mg/kg) and is located on the eastern portion of the Site, near the area of the former treatment ponds. Subsurface soil concentrations for iron ranged from 7.8 mg/kg to 113,000 mg/kg. Four subsurface soil samples were analyzed for arsenic ranging from 3.8 mg/kg to 16 mg/kg. Figure 5 presents the subsurface soil locations that will be excavated. The concentrations range from 1,080 mg/kg to 50,000 mg/kg and the depths range from 16.5 feet bls to 20.5 feet bls . The volume of contaminated soil that will be excavated at the Site is approximately 144,000 cubic feet, to a depth of 25 feet bls.

5.4.2 Ground Water Contamination

Twenty-one ground water locations were sampled multiple times from various depths in 2005 and 2006. Five locations including MW-01, MW-02, MW-04, MW-05, and MW-10, were analyzed for TAL metals. Samples MW-04 and MW-05 were analyzed for VOCs, SVOCs, and pesticides/PCBs. All locations were analyzed for chromium, hexavalent chromium, and iron.

The monitoring wells can be divided into two general depth ranges, those with the bottom of the screen above 104 feet bls and those with the bottom of the screened unit below 104 feet bls. These correspond with clay-rich zones which may retard vertical migration of contamination. Shallow ground water samples were collected at depths ranging from 76 feet bls to 104 feet bls. Deep ground water samples were collected at depths ranging from 117 feet bls to 184 feet bls.

One shallow ground water sample was analyzed for antimony and arsenic. The concentrations for antimony (96 ug/L) and arsenic (5.6 ug/L) were detected in MW02 (2005) at 85 feet bls. The highest chromium and hexavalent chromium concentrations were detected in MW07 (2005 – 85 feet bls) and MW11 (2006 – 92 feet bls), respectively. The concentrations for total chromium ranged from non-detectable to 160,000 ug/L. Concentrations for hexavalent chromium ranged from non-detectable to 309,000 μg/L. The highest iron concentration (8,900 ug/L) was detected in MW12 (2006) at 94 feet bls. Concentrations of iron ranged from 309 ug/L to 8900 ug/L. The highest manganese concentration (113 μg/L) was detected in MW05 (2005) at 90 feet bls. Concentrations for manganese ranged from non-detectable to 113 ug/L. SVOCs 1,1-dichloroethane and cis-1,2-dichloroethene were detected in sample MW05 at concentrations of 1.4 ug/L and 1.1 μg/L, respectively. Pesticides/PCBs were not detected in any of the shallow ground water samples.

One deep ground water sample was analyzed for arsenic. The concentration for arsenic (5.1 μg/L) was detected in MW05 (2005) at 170 feet bls. The concentrations for total chromium ranged from non-detectable to 6,690 μg/L. The concentrations for hexavalanet chromium ranged from non-detectable to 5,290 μg/L. The highest chromium and hexavalent chromium concentrations were detected in MW18 in 2006 at 114 feet bls. The concentrations for iron ranged from 1,060 μg/L to 7,210 μg/L. The highest iron concentration was detected in MW10 at 155 feet bls. The concentrations for manganese ranged from non-detectable to 181 μg/L. The highest manganese concentration was detected in MW04 at 130 feet bls. Bis(2-ethylhexyl)phthalate (1.4μg/L), di-n-butyl phthalate (66 μg/L), fluoranthene (2.7 μg/L), 1,1-dichloroethane (2,300 μg/L), 1,1-dichloroethene (0.8 μg/L), cis-1,2-dichloroethene (0.71μg/L), toluene (2,400 μg/L), and trichloroethene (0.6 μg/L) were detected in deep ground water in sample MW04. Pesticides/PCBs were not detected in any of the deep ground water samples.

Figure 6 shows the estimate of total chromium contamination extent above the MCL of 100 μg/L, based on current water sampling data. The fluvial aquifer plume boundaries include water samples with total chromium concentrations ranging from 207 μg/L to 180,000 μg/L. The Memphis Sands aquifer plume boundaries include water samples with total chromium concentrations ranging from 248 μg/L to 66,900 μg/L.

5.4.3 Surface Water Contamination

Five surface water samples were collected at the Site in 2005. Four samples were analyzed for total chromium and iron. The total chromium concentrations ranged from 2.9 ug/L to 6.5 ug/L. The iron concentrations ranged from 239 ug/L to 8,880 ug/L. One sample, MW-09 was analyzed for total chromium, hexavalent chromium, and iron. The concentration for total chromium was 28.7 ug/L; hexavalent chromium was 240 ug/L; and iron was 32,600 ug/L.

5.4.4 Dry Sediment Contamination

Twenty-nine dry sediment samples were collected at the Site. The samples were collected from depths of 0 to 0.5 feet bls in 2005. The sediment samples were analyzed for chromium, hexavalent chromium, and iron. Six samples were analyzed in 2002 for VOCs, SVOCs, pesticides/PCBs, and TAL metals.

Total chromium was detected in 11 of the 29 samples. The concentrations for total chromium ranged from 15 mg/kg to 3,300 mg/kg. The maximum concentration was detected in the sediment sample collected near the concrete building area at location SS-060.

Hexavalent chromium was detected in 27 of the 29 samples. The concentrations for hexavalent chromium ranged from non-detectable to 46.5 mg/kg. The maximum result for hexavalent chromium was detected in sample SD-037 and is located near the metal building area.

Iron was detected in 29 of the 29 samples. The concentrations for iron ranged from 12,300 mg/kg to 86,200 mg/kg. The maximum concentration was detected in the sediment sample collected in the self-storage facility area at location SD-072.

Concentrations for VOCs were non-detectable in all six sediment samples. SVOC concentrations for 2-methylnapthalene ranged from non-detectable to 41 ug/kg; benzaldehyde ranged from non-detectable to 110 ug/kg; benzo(a)pyrene ranged from non-detectable to 190 ug/kg; benzo(b)fluroanthene ranged from non-detectable to 280 ug/kg; chrysene ranged from non-detectable to 240 ug/kg; phenanthrene ranged from non-detectable to 140 ug/kg; and pyrene ranged from non-detectable to 320 ug/kg. Pesticide/PCBs concentrations for 4,4'-DDE ranged from non-detectable to 33 ug/kg and dieldrin ranged from non-detectable to 46 ug/kg. Concentrations for TAL metals include aluminum from 6,300 mg/kg to 12,000 mg/kg; arsenic from 6.1 mg/kg to 15 mg/kg; barium from 60 mg/kg to 120 mg/kg; beryllium from non-detectable to 0.91 mg/kg; cadmium from 0.35 mg/kg to 1 mg/kg; copper from 13 mg/kg to 100 mg/kg; lead from 22 mg/kg to 71 mg/kg; and zinc from 73 mg/kg to 1000 mg/kg. Sediment samples collected at the Site were dry and treated as surface soil. The volume of contaminated soil that will be excavated at the Site is approximately 144,000 cubic feet to a depth of 25 feet bls.

5.5 Contaminant Fate and Transport

Antimony, iron, hexavalent chromium, and total chromium are the COCs in ground water at the Site. Hexavalent chromium is the COC found in subsurface soil. Metals can migrate from the source areas at the Site by:

- Surface runoff (over land transport of contaminated sediment and runoff through surface water pathways),
- Resuspension and relocation of surface sediment (deposition of contaminated suspended soil and sediment carried by over land runoff),
- Infiltration and percolation of precipitation through source area soils (where soil bound contamination can leach into ground water), and

- Ground water advection (flow) and dispersion (diffusion) as dissolved or colloidal contamination.

Environmental media requiring remedial action are source area subsurface soil and the plumes of contaminated ground water associated with the Site. The contaminated water plumes are found within the shallow and deep aquifers. The current extent of the deep aquifer plume is estimated at 900 yards northwest from the source, while the shallow plume is less than 400 yards from the source.

Chromium is one of the less common elements and does not occur naturally in elemental form. Chromium salts are persistent, inorganic contaminants that can change physical/ chemical form (based on oxidation/reduction levels, pH, and the presence of reactive species) and therefore are challenging contaminants to address at contaminated sites (ASTDR, 2000; EPA, 2007). Unlike organic contaminants, they are not amenable to decomposition or degradation. Trivalent (III) and hexavalent (VI) chromium are the common forms of chromium typically found at contaminated sites.

Chromium VI is the dominant (and toxic) form of chromium in aquifers where aerobic conditions exist. Chromium VI can be reduced to chromium III in the environment (e.g., by soil organic matter, sulfate $(S(O_4)^{2-})$ and ferrous (Fe^{2+}) ions under anaerobic conditions often encountered in deeper ground water). Chromium can exhibit complex chemistry and form anionic complexes such as chromate (CrO_4^{2-}) and dichromate $(Cr_2O_7^{2-})$ which precipitate readily in the presence of metal cations (especially barium $[Ba^{2+}]$, lead $[Pb^{2+}]$, and silver $[Ag^+]$) to form salts. Chromate and dichromate also adsorb on soil surfaces, especially iron and aluminum oxides. Chromium VI is also more soluble than chromium III.

Chromium III is the dominant form of chromium at a lower pH (<4) and in a reduced state. Chromium III can form solution complexes with ammonia (NH_3), hydroxide (OH^-), chloride (Cl^-), fluoride (F^-), cyanide (CN^-), sulfate (SO_4^{2-}), and soluble organic molecules. Chromium III mobility is decreased by adsorption to clays and oxide minerals below pH 5 and low solubility above pH 5 due to the formation of chromium hydroxides $(Cr(OH)_3)$.

Chromium mobility depends on sorption characteristics of the soil, including clay content, iron oxide content and the amount of organic matter present. Chromium can be transported by surface runoff to surface waters in its soluble or precipitated form. Some chromium complexes can leach from soil into ground water. The leachability of chromium VI increases as soil pH increases. Most of chromium released into natural waters is particle associated and is ultimately deposited into the sediment (Evanko and Dzombak, 1997).

6.0 Current and Potential Future Land Use

6.1 Current Land Use

The land use of the area surrounding the Smalley-Piper Site has changed over the years and has become developed into suburban commercial. A strip mall, retail outlets, gas stations, and restaurants adjoin the property along the nearby highway. Many land use types including commercial, industrial, and residential are now present in close proximity to the Smalley-Piper Site.

The eastern portion of the Site has been redeveloped and is currently used as a public mini-storage facility. From 1992 to 2004, a portion of the Site was operated by Piper Industrial Coatings, Inc., to manufacture and hard face farm equipment. Lund Coating Technologies, Inc., purchased the assets of Piper Industrial Coatings, Inc., in 2004. Industrial manufacturing operations at the Site ceased in 2007. The building structures utilized during the former industrial processes remain at the Site. The production building was previously occupied by Lund Coating Technologies, Inc. It consists of a one story concrete building and concrete parking lot to the east. The metal storage building is a warehouse that was previously used as a storage area. The area west of the warehouse is vacant.

6.2 Current Ground Water Use

Collierville operates several water plants that obtain their water from the Memphis Sands aquifer. The closest of these, Water Plant No. 2, was taken offline in 2003 and remains unavailable for public use because chromium was found in one of the two wells at a maximum concentration of 73 µg/L. However, no data were collected during the RI for this ROD specifically linking the chromium at these wells to the Smalley-Piper Site.

6.3 Potential Future Land Use

The soil cleanup goals are based on protecting a future construction worker. Once remediation is complete, the Site property will be suitable for commercial/industrial use similar to the current use.

6.4 Potential Future Ground Water Use

Restoration of the Memphis Sands aquifer should eliminate the human health and environmental risks posed by the contaminated plume due to the Site. Ground water will again be suitable for use as a drinking water resource once cleanup goals are met.

7.0 Summary of Site Risks

The risk assessment estimates what risks the Site poses to human health and the environment if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the BRA which includes an evaluation of Human Health and Ecological receptors for the Site.

7.1 Summary of Human Health Risk Assessment

7.1.1 Identification of Chemicals of Concern

Carcinogenic and non-carcinogenic chemicals of concern (COCs) were identified for the media evaluated at the Smalley-Piper Site. Non-carcinogenic COCs were identified as those chemicals of potential concern (COPCs) that contribute a hazard quotient (HQ) of 0.1 or greater to any pathway evaluated. Cumulative Site cancer risk that exceeded 1×10^{-4} are considered carcinogenic COCs. The COC in subsurface soil is hexavalent chromium. The COCs in ground water are antimony, hexavalent chromium, total chromium, and iron.

For the purposes of this risk assessment summary, the presentation is limited to the receptors and media of concern, which includes the future construction worker exposure to subsurface soil in the concrete building area and self-storage facility area and current/future residential exposure to ground water. These media and the exposure routes associated with them result in the greatest potential risk. The summary data for surface and subsurface soil in the concrete building area, self-storage facility area, and ground water may be found in Tables 1 through 4.

7.1.2 Exposure Assessment

An exposure assessment identifies pathways whereby receptors may be exposed to Site contaminants and estimates the frequency, duration, and magnitude of such exposures. The conceptual Site model (Figure 3) illustrates the mechanisms of contaminant releases to the environment. The primary release mechanisms were discharges to former treatment ponds plus spills and leaks from the manufacturing of magnesium battery casings. The most significant contaminants were total chromium and hexavalent chromium (chromium VI), both in the soil and ground water.

Based on the understanding of the fate and transport of contaminants and the potential for human contact, the following scenarios, exposure pathways, and exposure routes were quantitatively evaluated:

- Current Off-Site Resident. Residents currently living off-site may be exposed to the COCs in ground water if the contaminated water plumes continue to expand. Potential routes of exposure for the off-site child and adult residents include ingestion, inhalation, and dermal contact with ground water while showering.

- Future On-Site Resident. Residents may be exposed to the COCs in ground water, surface soil/dry sediment, and surface water if the land use allowed for residential development at the Site. Potential routes of exposure for the on-site child and adult residents include ingestion, inhalation, and dermal contact with ground water while showering; ingestion and dermal contact with COCs in surface soil/dry sediment; and ingestion of COCs in surface water.
- Current/Future On-Site Adolescent Visitor/Trespasser. Trespassers and visitors at the Site may be exposed to COCs in surface soil/dry sediment, and surface water. Potential routes of exposure for the adolescent visitor and trespasser include incidental ingestion of, and dermal contact with COPCs in surface soil/dry sediment and incidental ingestion of COCs in surface water.
- Future On-Site Industrial Worker (Outdoor). Workers at the Site in the future may be exposed to COCs in surface soil/dry sediment, surface water, and ground water. Potential routes of exposure for the on-site worker include incidental ingestion of, and dermal contact with, COCs in surface soil/dry sediment, incidental ingestion of COCs in surface water, and ingestion of COCs in ground water.
- Future On-Site Construction Worker. Future construction workers may be exposed to COCs in soil while working at the Site. Potential exposure routes for the construction worker include incidental ingestion of, dermal contact with, and inhalation of particulate emissions from surface soil/dry sediment and subsurface soil. Future construction workers may also be exposed to COCs in ground water via ingestion.

Exposure Point Concentrations (EPCs) were calculated in accordance with EPA Region 4 policies. Human intakes were calculated for each chemical and receptor using the EPCs. For noncarcinogens, intake was averaged over the duration of exposure and is referred to as the average daily dose (ADD). For carcinogens, intake was averaged over the average lifespan of a person (70 years) and is referred to as the lifetime average daily dose (LADD). ADDs and LADDs were calculated using standard assumptions in accordance with EPA Risk Assessment Guidance (EPA, 1989). The exposure models and assumptions are presented in Tables 4.1 through 4.12 in Appendix A of the Revised Final Baseline Risk Assessment.

Note that only hazards for current/future on-site and off-site residents and future construction workers are presented in this summary as they represent the greatest potential risk and justify implementation of the Selected Remedy. The potential hazards would also apply to off-site ground water. There was no cancer risks associated with the COCs at the Site. The risks and hazards associated with the other current and future receptors/media combinations may be found in the Revised Final Baseline Risk Assessment.

7.1.3 Toxicity Assessment

Toxicity assessment is a two step process whereby the potential hazards associated with route specific exposure to a given chemical are: (1) identified by reviewing relevant human and animal studies, and (2) quantified through analysis of dose response relationships.

EPA toxicity assessments and the resultant toxicity values were used in the baseline evaluation to determine both carcinogenic and noncarcinogenic risks associated with each COPC and route of exposure. EPA toxicity values that were used in this assessment include:

- reference dose (RfDs) values for noncarcinogenic effects, and
- cancer slope factors (CSFs) for carcinogenic effects.

Tables 5, 6, and 7 of this ROD summarize the toxicity values for noncarcinogenic COCs and Tables 8 and 9 summarize the toxicity values for carcinogenic COCs. Toxicological profiles of the COCs may be found in Appendix E of the Revised Final Baseline Risk Assessment.

7.1.4 Risk Characterization

The final step of the Baseline Human Health Risk Assessment (BHHRA) is the risk characterization. Human intakes for each exposure pathway are integrated with EPA reference toxicity values to characterize risk. Carcinogenic and noncarcinogenic effects are estimated separately.

To characterize the overall potential for noncarcinogenic effects associated with exposure to multiple chemicals, the EPA uses a hazard index (HI) approach. This approach assumes that simultaneous subthreshold chronic exposures to multiple chemicals that affect the same target organ are additive and could result in an adverse health effect. The HI is calculated as follows:

HI = ADD1 /RfD1 + ADD2 /RfD2 + ADDi /RfDi

where:

ADDi = Average Daily Dose for the ith toxicant
RfDi = Reference Dose for the ith toxicant

The term ADDi/RfDi is referred to as the hazard quotient (HQ).

Calculation of an HI in excess of unity indicates the potential for adverse health effects. Indices greater than one will be generated anytime intake for any of the COCs exceeds its RfD. However, given a sufficient number of chemicals under consideration, it is also possible to generate an HI greater than one even if none of the individual chemical intakes exceeds its respective RfD.

Carcinogenic risk is expressed as a probability of developing cancer as a result of lifetime exposure. For a given chemical and route of exposure, excess lifetime cancer risk is calculated as follows:

Risk = LADD × CSF

where:

LADD = Lifetime Average Daily Dose
CSF = Cancer Slope Factor

These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). An incremental lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of Site related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at the Site. For exposures to multiple carcinogens, the EPA assumes that the risk associated with multiple exposures is equivalent to the sum of their individual risks.

7.1.4.1 Summary of Noncancer Hazards Associated with the Current Off-Site Child Resident.

The current off-site child resident's noncancer hazard is primarily attributable to ingestion of shallow and deep ground water. The noncancer HIs for the off-site child resident are 2,387 (shallow ground water) and 32 (deep ground water). Noncancer hazard is primarily due to the ingestion exposure of hexavalent chromium in shallow and deep ground water. The highest noncancer hazard, shallow ground water, is summarized in the hazard assessment represented in Table 10.

7.1.4.2 Summary of Cancer Risk Associated with the Current Off-Site Child Resident.

The current off-site child resident's cancer risk (5E-5 [shallow] and 4E-5 [deep]) is within EPA's generally acceptable risk range. Therefore, cancer risk summary tables are not presented for the current off-site child resident.

7.1.4.3 Summary of Noncancer Hazards Associated with the Future Construction Worker.

The noncancer hazard for the future construction worker is primarily due to ingestion of shallow and deep ground water. Incidental ingestion of subsurface soil in the concrete building, metal storage building, and the self storage facility areas contribute to the noncancer hazard. The noncancer HI for the future construction worker is 405 (shallow ground water) and 5 (deep ground water). Noncancer hazard is primarily due to the ingestion exposure of hexavalent chromium in shallow and deep ground water. The highest noncancer hazard was determined to be in the concrete building area and shallow ground water. The risk characterization summary is presented in the hazard assessment in Table 11.

7.1.4.4 Summary of Cancer Risks Associated with the Future Construction Worker.

The future construction worker cancer risks, ranging from 1E-06 to 3E-05 are within EPA's generally acceptable risk range. Therefore, cancer risk summary tables are not presented for the future construction worker.

7.1.4.5 Summary of Noncancer Hazards Associated with the Future On-Site Child Resident.

The future on-site child resident's noncancer hazard is primarily due to the ingestion of ground water. The noncancer HI for the child resident is 2,390 (shallow ground water) and 35 (deep ground water). Noncancer hazard is primarily due to the ingestion exposure of hexavalent chromium in shallow and deep ground water. The highest noncancer hazard was determined to be in the self storage facility area and shallow ground water. The risk characterization summary is presented in the hazard assessment in Table 12.

7.1.4.6 Summary of Cancer Risks Associated with the Future On-Site Child Resident.

The future child resident's cancer risks, ranging from 4E-05 to 7E-05, are within EPA's generally acceptable risk range. Therefore, cancer risk summary tables are not presented for the future on-site child resident.

7.2 Summary of Ecological Risk Assessment

After evaluating the data available, the ecological risk assessment (ERA) concluded that risks posed by Site contaminants do not exist on-site. Therefore, Site remediation based on ecological concerns is not necessary at this time. The ecological conceptual model is included as Figure 4.

There are approximately two acres of wooded and grassy area close to the Site that may support ecological habitat. The ERA determined that no chemical characterization occurred in the nearby wooded area east of the Site. Therefore, surface soil and surface water samples are planned to be collected during the Remedial Design to allow a future assessment of potential ecological risk in this area. The characterization of soil for metals other than chromium was not very extensive in the western and southern vegetated areas near the Site. Therefore, additional characterization for metals in surface soil and surface water off-site are planned to be conducted during the Remedial Design to better characterize potential ecological risk in these areas.

Once the new chemical concentration data are available, it is recommended to reassess the ecological risk posed by the metals at the Site only if the 95% upper confidence limit (UCL) of the means of the combined data is significantly above those that were used in the assessment. If the concentrations of the metals measured in the new sampling effort are not substantially different than the existing data set (or the 95% UCL of the means of the total data set is not substantially different than that of the current data set), then a supplemental ERA would likely reach the same risk conclusions of this risk assessment.

If the data obtained demonstrates an ecological risk, an Explanation of Significant Difference (ESD) or ROD Amendment will be prepared.

8.0 Remedial Action Objectives

Remedial action objectives (RAOs) describe what a proposed Site cleanup is expected to accomplish. The RAOs for the Smalley-Piper Site follow:

- Prevent or minimize human exposure to contaminated subsurface soil at concentrations above the cleanup levels.
- Prevent or minimize human exposure to contaminated ground water at concentrations above the cleanup levels.
- Prevent further migration of the contaminated ground water plumes.
- Restore ground water to the cleanup levels and beneficial use.

The cleanup levels for the COCs at the Smalley-Piper Site are presented in Tables 14 and 15 and include the following:

- Subsurface soil : Based on construction worker and HQ of 1, the cleanup goal for hexavalent chromium is 876 mg/kg.
- Ground water: Based on child resident and HQ of 1, the cleanup goals for hexavalent chromium and iron are 47 μg/L and 4,693 μg/L, respectively.
- Ground water: Based on MCLs, the cleanup goal for antimony is 6 μg/L and for total chromium the cleanup goal is 100 μg/L.

9.0 Description of Alternatives

The July 2008 FS report evaluated eight soil and ground water remediation alternatives. The eight alternatives (1-8) were evaluated for effectiveness, implementability, and cost. Of the eight alternatives evaluated, Alternatives 2, 3, 6, and 7 were eliminated from further consideration and Alternatives 1, 4, 5, and 8 were retained for detailed analysis.

Alternative 2, Soil Removal, Off-Site Disposal, Ground Water Pump and Treat, Institutional Controls was eliminated based on its cost and liability concerns relative to transporting hazardous material for long distances over public highways. Alternative 3, In Place Soil Stabilization/Solidification, Ground Water Pump and Treat, Institutional Controls was eliminated due to concerns about the reliability of in-situ soil treatment and the potential for contaminated soil to remain untreated without the ability to demonstrate complete treatment. Alternative 6, In Place Soil Stabilization, In Place Ground Water Treatment, Institutional Controls was eliminated for the same reasons. Alternative 7, In Place Soil Stabilization, Ground Water Permeable Reactive Barrier was eliminated due to concerns about the reliability of in-situ ground water treatment and the potential for contaminated ground water and soil to remain untreated without the ability to demonstrate complete treatment. The remedial alternative cost comparison is presented in Table 15.

The detailed evaluation for those remedial alternatives retained is presented below and includes Alternatives 1, No Action; Alternative 4, Soil Removal, On-Site Solidification and Stablization Treatment, On-Site Disposal, Ground Water Pump and Treat, Disposal of Treated Water, and Institutional Controls; Alternative 5, Soil Removal, On-Site Stabilization and Solidification Treatment, Off-site Disposal, Ground Water Pump and Treat, Disposal of Treated Water, and Institutional Controls; and Alternative 8, In Place Soil Flushing, Ground Water Pump and Treat, Disposal of Treated Water, and Institutional Controls.

9.1 Detailed Remedial Alternatives Evaluation

9.1.1 Alternative 1: No Action

Estimated Capital Cost: $0
Estimated Annual O&M: $21,041
Estimated Total Present Worth: $ 262,328
Estimated Construction Timeframe: < 1 year
Estimated Time to Achieve RAOs: > 100 years

The No Action alternative is required by the NCP to provide a baseline scenario against which all other alternatives are compared. Costs and benefits of remedial actions are compared with the costs and benefits of doing nothing at the Site. The minimum activities for the No Action alternative include mandatory five-year reviews which, over the course of a 30-year period, will result in a total of six (6) five-year reviews, and minimal periodic sampling and analysis of ground water collected from existing monitoring wells to track contaminant concentrations in the two aquifers.

The No Action alternative is not protective of human health and the environment, does not comply with applicable or relevant and appropriate requirements, is not effective in the long-term, and does not reduce mobility/toxicity/volume through treatment. The other criteria are not applicable since there are no activities associated with this alternative.

9.1.2 Alternative 4: Soil Removal, On-Site Stabilization and Solidification Treatment, On-Site Disposal, Ground Water Pump and Treat, Disposal of Treated Water, and Institutional Controls

Estimated Capital Cost: $6,045,462
Estimated Annual O&M: $553,106
Estimated Total Present Worth: $ 12,481,622
Estimated Construction Timeframe: < 1 year
Estimated Time to Achieve RAOs: 3 – 10 years

The soil component of this remedy consists of two parts. First, approximately 144,000 cubic feet of source soil will be excavated to a depth of 25 feet bls, transported to an on-site staging area and treated on-site to stabilize and solidify the soil bound contaminants into a non-hazardous form. Concurrently, an on-site disposal cell will be designed and constructed to non-hazardous waste specifications to rebury the non-hazardous stabilized and solidified soil matrix. Secondly, contaminated soil below the excavation limit (i.e., below 25 feet bls) which is too deep to be excavated, will be flushed with treated ground water recycled into the ground through the excavation pit left by the removal of the upper 25 feet of soil. The injection of treated ground water will leach out the metal contaminants in the subsurface soil. The flush water that percolates through the contaminated soil will be captured by the ground water extraction well/treatment system used for the source area ground water. Once extracted ground water from the source area is shown (by laboratory analysis) to be at or below clean up goals, the excavation pit will be back filled with the clean soil obtained from construction of the on-site burial pit and the Site will be restored. The backfill soil will be obtained from a local vendor.

For the ground water treatment component of this alternative, contaminated ground water would be extracted from the subsurface using strategically placed extraction wells within the source area and at locations, downgradient in the chromium plume above the MCL. Ground water extracted from the source area would be treated on-site by chemical reduction, precipitation and filtration or separation to remove metal contaminants. Ground water extracted from locations downgradient will be treated by passing the contaminated water through ion-exchange resin to transfer the metal contaminants from the water to the resin. Two options exist for the treated water: transfer to the Town of Collierville for further treatment and inclusion into the drinking water supply; or return the treated water to the existing aquifer system. Institutional controls will be implemented to ensure that the ground water will not be available for use until the cleanup goals are achieved. The contaminant residue created during the ground water treatment processes will be collected, stabilized and transported off-site as hazardous waste to a permitted waste disposal facility.

This alternative involves active removal of contaminants from both soil and ground water, and therefore requires a high level of intrusiveness. Implementation will require consideration of the surrounding land use and infrastructure, as well as the geochemistry, geology, and geohydrology of the Site. The removal of COCs also requires consideration for disposition of the waste materials generated during the remedial activities for this alternative. This alternative will leave the Site free of contamination at the conclusion of its implementation.

Overall Protection of Human Health and the Environment
This alternative involves active removal and treatment of contaminants and therefore is protective of human health and the environment. Soil associated contamination is treated and converted into a non-hazardous form contained within an engineered disposal cell constructed on-site. Toxicity and mobility of soil contamination is reduced completely (i.e., by treatment and containment); volume is actually increased slightly due to the stabilization and solidification process included in the alternative.

Subsurface soil remediation is expected to succeed in effectively removing chromium (i.e., chromium available for leaching into ground water). The flushing and capture strategy will continue until flushed/leached chromium concentrations are below ground water remedial goal concentrations. This component of the alternative is expected to provide effective protection to human and ecological receptors against chromium and metal exposure and toxicity.

The ground water remediation strategy is protective of human health and the environment. Adequate protection is dependent on completeness of contaminant extraction over time, and this in turn depends on the specific interaction of chromium species with the local geochemistry and geology. Ground water treatment will create residue material (e.g., saturated ion exchange resin, etc.); however, this increase in treatment residue volume is more than offset by the volume reduction of contaminated ground water. The large volume of treated ground water would not adversely impact the Site.

Compliance with ARARs
The soil component of this alternative is expected to meet ARARs. Disposal of treated/stabilized soil on-site is the only potential issue with achieving all chemical, action and location-specific ARARs. Land use restrictions (via institutional controls) will be required for the west end of the property where treated soils will be buried.

- Chemical-specific ARARs (Table 16) for soil are expected to be met through contaminant mass removal and treatment. A possible exception to this expected result lies with uncertainty in the soil contaminant zone dimensions. If contaminated soil is unknowingly left unaddressed, chemical-specific ARARs might not be met. The contaminated soil under the excavation zone is expected to meet all chemical-specific ARARs through the flush/leaching strategy for removing contaminant mass from the Site. Treated flush fluid would be required to meet specific quality objectives prior to its use as recycled flush water.

- Action-specific ARARs (Table 17), which address primarily emission and disposal actions, are expected to be met by engineered controls and attention to procedural details during the implementation and operation phase. Care will be required to minimize particulate emissions during excavation and transport of contaminated soil between the source area and the staging/treatment area, and between the treatment area and the disposal cell.
- Location-specific ARARs. Due to the highly developed and urbanized nature of the adjacent land use, location-specific ARARs are not an issue at this Site. No valued historical, structural, or social features are endangered by the selected Site remedy.

Ground water contaminants would be removed by hydraulic pumping through extraction wells, collection of the extracted ground water for treatment, monitoring treated ground water for attainment of remedial goals (i.e., chemical-specific ARARs), and disposal of treated ground water or return to the aquifer by direct injection or infiltration.

- Chemical-specific ARARs (Table 16) (i.e., established cleanup levels for various contaminants) for ground water are expected to be met by this alternative. Contaminant mass is removed from the aquifer, leaving no contamination for further migration or imposing additional hazard. Possible exceptions to this expected result are (1) the uncertainty in the contaminant plume zone location and dimensions and (2) the potential for aquifer sediment to retain chromium contaminant mass (i.e., tightly bound contamination that is not released for extraction). If contaminated ground water is unknowingly left unaddressed, chemical-specific ARARs might not be met.
- Action-specific ARARs (Table 17), which address primarily emission and disposal actions, are expected to be met by engineered controls and attention to procedural details during the implementation and operation phase. Care will be required to minimize spills during extraction and treatment of contaminated ground water.
- Location-specific ARARs. Due to the highly developed and urbanized nature of the adjacent land use, location-specific ARARs are not an issue at this Site. No valued historical, structural, or social features are endangered by the selected Site remedy.

<u>Long-Term Effectiveness and Permanence</u>
This alternative treats soil contamination and returns it to an on-site engineered disposal cell. The effectiveness and permanence of the excavation/treatment/burial component of this alternative is dependent on two technical issues. First, the integrity of the stabilization process must prevent contamination from escaping the inert solid matrix or from reverting back to the more hazardous hexavalent chromium form. Second, the integrity of the engineered disposal cell must be such that no contamination can migrate from the Site.

Two scenarios under which the anticipated effectiveness and permanence may not be realized are (1) if the extent of contamination has not been defined adequately (thereby potentially leaving contamination at the Site) and (2) if contaminated media are unable to be remediated due to technological limitations (e.g., inefficient flushing of subsurface chromium). In either case, contamination may remain in place after termination of remedial actions and may give rise to ongoing hazard, risk, and/or exposure potential.

Similarly, ground water associated contamination would be removed by hydraulic pumping through extraction wells, collection of the extracted ground water for treatment, monitoring treated ground water for attainment of remedial goals (i.e., chemical ARARs), and disposal of treated ground water or return to the aquifer by direct injection or infiltration. Long-term effectiveness and permanence should consider the ultimate disposition of the treatment residue material (e.g., metal sludge created by the on-site chemical treatment process, saturated ion-exchange resin material created by ground water treatment processes, filtration media, etc.) generated as part of this alternative. Disposal or regeneration of absorbent will ultimately require disposal of contaminants in a hazardous waste disposal facility.

Reduction of Mobility/Toxicity/Volume (M/T/V) Through Treatment
The toxicity and mobility of soil associated contamination would be reduced by physical stabilization/solidification and containment/isolation on-site. As highlighted previously, two technical issues are pertinent to the long-term reduction of toxicity and mobility of soil associated contamination. First, the integrity of the stabilization process must prevent contamination from escaping the inert solid matrix or from reverting back to the more hazardous hexavalent chromium form. Second, the integrity of the engineered disposal cell must be such that no contamination can migrate from the Site. Excavation is a well established method for addressing soil contamination; however, the overall volume of contaminated soil likely will increase through the excavation process. This increase in soil volume would be compounded by the addition of stabilization and solidification materials to create the final inert solid matrix necessary for disposal.

Ground water pump and treat is well established set of technologies that is easily implemented and appropriate for this Site. Mobility and toxicity of ground water contamination are reduced by the strategy employed in this alternative. The chemical precipitation and ion-exchange technologies recommended for the contaminated ground water will create treatment residue material (e.g., saturated ion-exchange resin, filtration media, metal solids, etc.); however, this increase in treatment residue volume is more than off-set by the volume reduction of contaminated ground water. The large volume of treated ground water would not adversely impact the Site.

Short-Term Effectiveness
This alternative involves active removal of contaminant mass from the Site and thus results in a high level of intrusion or disturbance of surrounding human and environmental features. Implementing and operating this alternative will result in substantial alterations in the Site area, as well as increased exposure potential during remedy construction.

Soil associated contamination would be addressed by physical excavation. Transport of contaminated soil from the source area to the staging/treatment area would require modest vehicular traffic only on-site.

- Soil remediation activities will result in temporary increased exposure potential for the surrounding population and remedial workers.
- The environmental impacts of soil excavation and transport could be limited to air emissions. No essential or protected environmental features are in danger of being adversely impacted; commercial buildings overlying the contaminated soil zone could require demolition.
- The time required to attain remedial goals is expected to be less than one year for the contaminated shallow soil, including excavation, treatment, and on-site burial of treated soil. The contaminated deeper soil to be addressed by the process of flushing, capturing, treating, and re-injecting is expected to require 3 to 10 years. The estimated completion time could increase if soil contamination is found at other locations not previously investigated (e.g., under currently existing structures and buildings). Thus, uncertainty in the extent of soil contamination could increase total time to attain soil remediation goals.

Ground water remediation activities generally are contained within wells, tanks, or pipes. There is little potential for uncontrolled exposure for the surrounding population and remedial workers. Monitoring activities might present some exposure potential for short periods of time (e.g., hours).

- The environmental impacts of ground water pumping, treating, and disposal could be limited to air emissions and the containerized solid waste residuals generated by the treatment process. No essential or protected environmental features are in danger of being adversely impacted.
- The time required to attain ground water remedial goals is estimated to be 10 years. Extraction of contaminated ground water is a slow process, generally complicated by on-going leaching of contaminants from aquifer matrix into ground water. Time to completion could be extended due to slowly leaching chromium or if portions of the contaminant plume are missed during extraction well placement. Thus, uncertainty in the extent of ground water contamination could extend the total time to attain ground water remediation goals.

Other elements of the alternative (e.g., periodic sampling and chemical analysis, confirmation sampling along excavation walls, monitoring well installation and operation, institutional controls, etc.) are not expected to cause adverse impacts to human health or environmental features during implementation. Monitoring may present a small exposure potential for sampling personnel; personal protective equipment required during sampling activities should prevent actual exposures to these individuals.

<u>Implementability</u>
Implementation will require consideration of the surrounding land-use and infrastructure, as well as the geochemistry, geology and geohydrology of the Site. The removal of contaminant mass also requires consideration for disposition of the waste materials generated during the remedial activities for this alternative.

Soil contamination would be removed from the Site by physical excavation of contaminated soil. A sizable portion of the contaminated soil zone appears to be situated under existing commercial storage warehouse structures and some of the highly contaminated soil may be at depths greater than 20 feet below land surface. Access to that contaminated soil will require extensive shoring of buildings and structures, or it will require demolition of structures prior to beginning the remedial phase of the project. Transport of contaminated soil between the source area and the staging/treatment area at the west end of the property represents a minimal exposure potential but would still require extensive health and safety conditions.

Excavation is a well established method for addressing soil contamination; no major implementation challenges are expected for the soil removal component of this alternative. Space considerations for excavation, contaminated-soil transport equipment, and clean back-fill transport equipment are significant factors for this alternative.

Similarly, ground water pump and treat are well established technologies that are easily implemented and appropriate for this Site. Implementation of this technology must consider disposal of the treatment residue material (e.g., metal sludge created by the source area chemical treatment process, saturated ion-exchange resin material created by ground water plume treatment processes, filtration media, etc.) generated as part of this alternative. No challenges to implementing this element of this alternative are anticipated.

Progress toward meeting remedial goals would be tracked by periodic sampling and chemical analysis. The highly immobile soil media would be monitored by confirmation sampling along excavation walls. To track the progress of the ground water remediation, however, a more comprehensive monitoring system would be required. This could include several monitoring wells placed at strategic locations throughout the ground water plume area screened at applicable depths. Ground water monitoring well installation and operation (i.e., sampling) are common environmental activities with numerous vendors available to provide the services. The minor challenge to implementing a suitable ground water monitoring program at this Site consists of installing new monitoring wells among the existing infrastructure of this urbanized area.

Cost

The capital expenses for this alternative (approximately $6,054,462) are associated with the construction, installation and/or start-up of:
(1) Source area ground water extraction (wells and pumps), treatment (chemical treatment), waste handling (sludge capture and dewatering) and treated water transport equipment;
(2) Source soil and disposal cell excavation and equipment staging areas, a soil treatment (stabilization and solidification) staging area;
(3) The on-site disposal cell and composite RCRA Subtitle C cap;
(4) Downgradient ground water extraction (wells and pumps), treatment (ion-exchange treatment), waste handling (saturated ion-exchange resin) and treated water transport equipment; and

(5) The on-site reinjection wells or infiltration galleries for flushing contaminated subsurface soil with treated ground water.

The estimated annual O&M cost (approximately $553,000 per year) is comprised of the operation of ground water extraction wells and treatment equipment for approximately 10 years. This annual amount was converted to an equivalent net present worth assuming a seven percent (7%) discount rate for technology-specific or activity-specific periods of time, resulting in a total net present worth O&M estimate of approximately $2,235,000.

The total remediation cost for Alternative 4, including a fees and contingency allowance, is estimated to be $12,481,622

9.1.3 Alternative 5: Soil Removal, On-Site Stabilization and Solidification Treatment, Off-Site Disposal, Ground Water Pump and Treat, Disposal of Treated Water, and Institutional Controls

Estimated Capital Cost: $4,893,765
Estimated Annual O&M: $524,106
Estimated Total Present Worth: $ 10,461,909
Estimated Construction Timeframe: < 1 year
Estimated Time to Achieve RAOs: 3 – 10 years

The soil component of this remedy consists of two parts. First, approximately 144,000 cubic feet of source soil will be excavated to a depth of 25 feet bls, transported to an on-site staging area, and treated on-site to stabilize and solidify the soil contaminants into a non-hazardous form. This non-hazardous soil matrix will be transported off-site to a permitted, non-hazardous waste disposal facility, thereby permanently removing this soil contamination from the Site. Secondly, contaminated soil below the excavation limit (i.e., below 25 feet bls) which is too deep to be excavated will be flushed with treated ground water recycled into the ground through the excavation pit left by the removal of the upper 25 feet of contaminated soil. The injection of treated ground water will leach out the contaminants in the subsurface soil. Flush water that percolates through the contaminated soil will be captured by the ground water extraction well/treatment system used for the source area ground water. Once extracted ground water from the source area is shown (by laboratory analysis) to be at or below clean up goals, the on-site soil excavation pit will be backfilled with clean soil and the Site restored. The backfill soil will be obtained from a local vendor.

For the ground water treatment component of this alternative, contaminated ground water would be extracted from the subsurface using strategically placed extraction wells within the source area and at locations downgradient in the chromium plume above the MCL. Ground water extracted from the source area would be treated by chemical reduction, precipitation and filtration or separation to remove metal contaminants from water. Ground water extracted from locations downgradient will be treated by passing water through ion-exchange resin to transfer the metal contaminants from the water to the resin. Two options exist for the treated water: transfer to the Town of Collierville for further treatment by the Town and inclusion into the drinking water supply or return the treated water to the existing aquifer system. Institutional controls will be implemented to ensure that the ground water will not be available for use until the cleanup goals are achieved. The contaminant residue created during the ground water treatment processes will be collected, stabilized and transported off-site as hazardous waste to a permitted waste disposal facility.

This alternative involves active removal of both soil and ground water contaminants, and ex-situ treatment of contaminant mass in soil prior to disposal at an off-site non-hazardous waste disposal facility. Both media strategies require a high level of intrusiveness. Implementation will require consideration of the surrounding land-use and infrastructure, as well as the geochemistry, geology and geohydrology of the Site. The removal of COCs also requires consideration for disposition of the waste materials generated during the remedial activities for this alternative. When complete, this remedy is expected to leave the Site ready for reuse.

Overall Protection of Human Health and the Environment

This alternative involves active removal and treatment of contaminant mass and therefore is protective of human health and the environment. Soil associated contamination would be removed from the Site by physical excavation of contaminated soil followed by treatment to stabilize the contaminants into a non-hazardous form. Toxicity and mobility of soil contamination are reduced completely (i.e., eliminated from Site). The overall protection of human health and the environment achieved by the ground water component of this alternative is equivalent to Alternative 4.

Compliance with ARARs

This alternative involves active removal of contaminant mass and therefore will cause substantial alteration to the Site. Soil contamination would be removed from Site by physical excavation of contaminated soil. Access to that contaminated soil will require extensive shoring of buildings and structures, or it will require demolition of some buildings. Transport of treated soil to an appropriate disposal facility would require an amount of vehicular traffic through populated areas of west Tennessee.

- Chemical-specific ARARs (Table 16) (i.e., established cleanup levels for various contaminants) for soil are expected to be met by this alternative. All contaminant mass is removed, leaving no contamination for further migration or imposing additional hazard. A possible exception to this expected result lies with uncertainty in the soil contaminant zone dimensions. If contaminated soil is unknowingly left unaddressed, chemical-specific ARARs might not be met. However, this uncertainty could be eliminated with properly planned sampling programs during remedial action construction.
- Action-specific ARARs (Table 17), which address primarily emission and disposal actions, are expected to be met by engineered controls and attention to procedural details during the implementation and operation phase. Care will be required to minimize particulate emissions during excavation and transport of contaminated soil.
- Location-specific ARARs. Due to the highly developed and urbanized nature of the adjacent land use, location-specific ARARs are not an issue at this Site. No

valued historical, structural, or social features are endangered by the selected Site remedy.

The ground water component of this alternative is equivalent to Alternative 4 in meeting ARARs.

Long-Term Effectiveness and Permanence
This alternative involves active removal of contaminant mass from the Site and thus results in the highest level of effectiveness and permanence possible from a remedial action. The removal of mass creates a contaminant-free environment and eliminates future hazard, risk and/or exposure to Site contaminants of concern.

Two scenarios under which the anticipated effectiveness and permanence may not be realized are (1) if the extent of contamination has not been defined adequately and (2) if contaminated media are unable to be reached due to technological limitations. In either case, contamination may remain in-place after termination of remedial actions and may give rise to on-going hazard, risk, and/or exposure potential.

The long-term effectiveness and permanence of the ground water component of this alternative is equivalent to Alternative 4.

Reduction of Mobility/Toxicity/Volume (M/T/V) Through Treatment
This alternative involves active removal, treatment and off-site disposal of treated soil and ground water. Contaminated soil would be removed from Site by physical excavation, treatment to stabilize the material, and disposal off-site. This alternative will leave the Site ready for reuse at the conclusion of its implementation. The ability of the ground water component of this alternative to reduce toxicity, mobility and volume through treatment is equivalent to Alternative 4.

Short-Term Effectiveness
This alternative involves active removal of contaminant mass from the Site and thus results in a high level of intrusion or disturbance of surrounding human and environmental features. Implementing and operating this alternative will result in substantial alterations in the Site area, as well as a temporary exposure potential during construction.
Contaminated soil will be removed from the Site by physical excavation. Transport of contaminated soil from the source area to the staging/treatment area would require modest vehicular traffic only on-site. Transport of treated soil to appropriate disposal facilities will require substantial vehicular traffic through both densely populated and sparsely populated areas of west Tennessee.

- Soil remediation activities will result in temporary increased exposure potential for the surrounding population and remedial workers.
- The environmental impacts of soil excavation and transport could be limited to air emissions. No essential or protected environmental features are in danger of being adversely impacted; commercial buildings overlying the contaminated soil zone could require demolition.

- The time required to attain soil remedial goals is less than one year for the contaminated shallow soil, including excavation, treatment, and off-site disposal of treated soil. The contaminated deeper soil to be addressed by the process of flushing, capturing, treating, and re-injecting is expected to require 3 to 10 years. The estimated completion time could increase if soil contamination is found at other locations not previously investigated (e.g., under currently existing structures and buildings). Thus, uncertainty in the extent of soil contamination could increase total time to attain soil remediation goals.

Ground water remediation activities generally are contained within wells, tanks, or pipes. There is little potential for uncontrolled exposure for the surrounding population and remedial workers. Monitoring activities might present some exposure potential for short periods of time (e.g., hours).

- The environmental impacts of ground water pumping, treating, and disposal could be limited to air emissions and the containerized solid waste residuals generated by the treatment process. No essential or protected environmental features are in danger of being adversely impacted.
- The time required to attain ground water remedial goals is estimated to be 10 years. Extraction of contaminated ground water is a slow process, generally complicated by on-going leaching of contaminants from aquifer matrix into ground water. Time to completion could be extended due to slowly leaching chromium or if portions of the contaminant plume are missed during extraction well placement. Thus, uncertainty in the extent of ground water contamination could extend the total time to attain ground water remediation goals.

Other elements of the alternative (e.g., periodic sampling and chemical analysis, confirmation sampling along excavation walls, monitoring well installation and operation, institutional controls, etc.) are not expected to cause adverse impacts to human health or environmental features during implementation and operation. Monitoring may present a small potential for sampling personnel exposure to Site COCs; personal protective equipment required during sampling activities should prevent actual exposures to these individuals.

Implementability

This alternative involves active removal of contaminant mass and therefore requires a high level of intrusiveness. Implementation will require consideration of the surrounding land-use and infrastructure, as well as the geochemistry, geology and geohydrology of the Site. The removal of contaminant mass also requires consideration for disposition of the waste materials generated during the remedial activities for this alternative.

Excavation is a well established method for addressing soil contamination; no implementation challenges are expected for the physical excavation element of this alternative. A sizable portion of the contaminated soil zone may be situated under existing commercial storage warehouse structures and some of the highly contaminated soil may be at depths greater than 20 feet below land surface. Access to that contaminated soil will require extensive shoring of buildings and structures, or it will require demolition of some building(s). Space considerations for excavation, contaminated-soil transport equipment, and clean back-fill transport equipment are significant factors for this alternative.

Transport of treated soil to appropriate disposal facilities would require substantial vehicular traffic through populated areas of west Tennessee. Depending on the distance from the Site to the disposal facility, total driving time on multiple trips to and from the Site (and associated vehicle safety concerns) and current fuel costs are considered.

The implementability of the ground water component of this alternative is equivalent to Alternative 4.

Progress toward meeting remedial goals would be tracked by periodic sampling and chemical analysis. The highly immobile soil media would be monitored by confirmation sampling along excavation walls. To track the progress of the ground water remediation, however, a more comprehensive monitoring system would be required. This could include several monitoring wells placed at strategic locations throughout the ground water plume area screened at applicable depths. Ground water monitoring well installation and operation (i.e., sampling) is a common environmental activity with numerous vendors available to provide this service. The minor challenge to implementing a suitable ground water monitoring program at this Site consists of installing the monitoring wells among the existing land-use of this urban developed area.

<u>Cost</u>
The capital expenses for this alternative (approximately $4,893,765) are associated with the construction, installation and/or start-up of:
(1) Source area ground water extraction (wells and pumps), treatment (chemical treatment), waste handling (sludge capture and dewatering) and treated water transport equipment;
(2) Source soil excavation and equipment staging areas, a soil treatment (stabilization and solidification) staging area;
(3) Downgradient ground water extraction (wells and pumps), treatment (ion-exchange treatment), waste handling (saturated ion-exchange resin) and treated water transport equipment; and
(4) The source area reinjection wells or infiltration galleries for flushing contaminated subsurface soil with treated ground water.

The estimated annual O&M cost (approximately $524,100 per year) is comprised of the operation of ground water extraction wells and treatment equipment for approximately 10 years. This annual amount was converted to an equivalent net present worth assuming a seven percent (7%) discount rate over technology-specific or activity-specific periods of time, resulting in a total net present worth O&M estimate of approximately $2,103,000.

The total remediation cost for Alternative 5, including a fees and contingency allowance, is estimated to be $10,461,909.

9.1.4 Alternative 8: In-Place Soil Flushing, Ground Water Pump and Treat, Disposal of Treated Water, and Institutional Controls

Estimated Capital Cost: $3,443,438
Estimated Annual O&M: $502,106
Estimated Total Present Worth: $ 8,049,106
Estimated Construction Timeframe: < 1 year
Estimated Time to Achieve RAOs: 10 – 12 years

The soil component of this alternative consists of flushing contaminants out of the soil by injecting treated ground water into the contaminated soil and capturing the flush water by the source area ground water extraction/treatment process. Removing contaminants from in-place soil by controlled flushing and capture/treatment is intended to eliminate future leaching of metals into the aquifer. Additionally, pumping contaminated ground water at the source area location hydraulically contains further migration of the ground water plume. The ground water treatment component of this alternative is equivalent to Alternative 4 and 5. To demonstrate the effectiveness of this process and the overall decrease in chromium to an acceptable level, an environmental monitoring program would be implemented. Sampling locations and analytical requirements would be designed to provide information needed to evaluate the progress of the remedial process. Reviews of data would document the status and progress of the remedial action.

Overall Protection of Human Health and the Environment
This alternative involves removal of all soil contamination by flushing with clean water. The remedy relies on effective leaching of chromium and metals from the subsurface soil solids. This makes confirmation and monitoring of toxicity and mobility reduction difficult. The strategy provides some level of overall protection to human health and the environment. The overall protection of human health and the environment achieved by the ground water component of this alternative is equivalent to Alternative 4.

Compliance with ARARs
Soil associated contamination would be treated in place in a way that removes leachable COCs and leaves tightly bound residuals that are likely resistant to future migration. The ability of both soil and ground water components of this alternative to meet ARARs is equivalent to Alternatives 4 and 5

Long Term Effectiveness and Permanence
This alternative involves active removal of contaminant mass from the Site and thus results in a high level of effectiveness and permanence. The removal of COCs creates an essentially contaminant free environment at the Site, with minimal chance of future hazard, risk and/or exposure.

Two scenarios under which the anticipated effectiveness and permanence may not be realized are (1) if the extent of contamination has not been defined adequately and (2) if contaminated media are unable to be reached due to technological limitations. In either case, contamination may remain in-place after termination of remedial actions and may give rise to on-going hazard, risk, and/or exposure potential.

The long-term effectiveness and permanence of the ground water component of this alternative is equivalent to Alternatives 4 and 5.

Reduction of Mobility/Toxicity/Volume (M/T/V) Through Treatment
This alternative applies soil flushing and ex-situ ground water treatment technologies to simultaneously remove and treat soil and ground water associated contamination. Soil associated contamination would be removed by induced leaching into the clean flush water and pumping to the surface. This activity has the potential to increase mobility of contaminants in the soil into the ground water. This is an advantage of soil flushing. If successfully implemented, the soil flush and ex-situ treatment strategy should leave the Site essentially contaminant-free. The ability of the ground water component of this alternative to reduce toxicity, mobility and volume through treatment is equivalent to Alternatives 4 and 5.

Short -Term Effectiveness
This alternative involves removal of contaminant mass by ground water recirculation. No soil disturbance activity is expected above ground; thus, short-term effectiveness of implementing this alternative likely will be very good. The short-term effectiveness of the ground water component of this alternative is equivalent to Alternatives 4 and 5. Other elements of the alternative (e.g., periodic sampling and chemical analysis, monitoring well installation and operation, institutional controls, etc.) are not expected to cause adverse impacts to human health or environmental features during implementation and operation. Sampling personnel have a small potential for exposure during monitoring; personal protective equipment required during sampling activities should prevent actual exposures to these individuals.

Implementability
The soil component of this remedy is to transfer leachable contaminants into the ground water and capture it through ex-situ ground water treatment. The implementability of the ground water component of this alternative is equivalent to Alternatives 4 and 5. Remediation progress toward meeting remedial goals would be tracked by periodic sampling and chemical analysis. This could include several monitoring wells placed at strategic locations throughout the ground water plume area screened at applicable depths. Ground water monitoring well installation and operation (i.e., sampling) is a common environmental activity with numerous vendors available to provide this service. The minor challenge to implementing a suitable ground water monitoring program at this Site consists of installing the monitoring wells among the existing land-use of this urban developed area.

Cost
The capital expenses for this alternative (approximately $3,443,438) are associated with the construction, installation and/or start-up of:

(1) Source area ground water extraction (wells and pumps), treatment (chemical treatment), waste handling (sludge capture and dewatering) and treated water transport equipment;
(2) Downgradient ground water extraction (wells and pumps), treatment (ion-exchange treatment), waste handling (saturated ion-exchange resin) and treated water transport equipment; and
(3) The source area reinjection wells or infiltration galleries for flushing contaminated surface and subsurface soil with treated ground water.

The estimated annual O&M cost (approximately $502,106 per year) is comprised of the operation of ground water extraction wells and treatment equipment for approximately 10 years. This annual amount was converted to an equivalent net present worth assuming a seven percent (7%) discount rate over technology-specific or activity-specific periods of time, resulting in a present worth O&M estimate of approximately $2,058,000.

The total remediation cost for Alternative 8, including a fees and contingency allowance, is estimated to be $8,049,106.

10.0 Comparative Analysis of Alternatives

Four remedial alternatives survived the screening step and were evaluated with respect to the requirements in the NCP, Code of Federal Regulations (CFR) (40 CFR Part 300.430(e) (9) iii), CERCLA, and factors described in *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988). The nine evaluation criteria include the following:

Threshold Criteria

1. Overall Protection of Human Health and the Environment – Eliminates, reduces, or controls health and environmental threats through institutional or engineering controls or treatment.
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) – Compliance with Federal/State standards and requirements that pertain to the Site or whether a waiver is justified.

Balancing Criteria

3. Implementability – Technical feasibility and administrative ease of conducting a remedy, including factors such as availability of services.
4. Short-Term Effectiveness – Length of time to achieve protection and potential impact of implementation.
5. Long-Term Effectiveness and Permanence – Protection of people and environment after cleanup is complete.
6. Reduce Toxicity, Mobility, or Volume by Treatment – Evaluates the alternative's use of treatment to reduce the harmful effects of principal contaminants and their ability to move in the environment.
7. Cost – Benefits weighed against cost.

Modifying Criteria

8. State Acceptance – Consideration of State's opinion of the Preferred Alternative(s).
9. Community Acceptance – Consideration of public comments on the Proposed Plan.

10.1 Description of Criteria

10.1.1 Overall Protection of Human Health and the Environment

Each remedial alternative is evaluated for its effectiveness at removing current or existing hazards to human health and/or the environment, and at protecting human health and/or the environment from future unacceptable risks in both the short- and long-term. Overall protection of human health and the environment draws on the assessments of the other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

10.1.2 Compliance with ARARs

CERCLA Section 121(d), specifies in part, that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or obtain a waiver [see also 40 *Code of Federal Regulations (CFR)* 300.430(f)(1)(ii)(B)]. Applicable or relevant and appropriate requirements (ARARs) include only federal and state environmental or facility citing laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 *CFR* 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (To-Be-Considered [TBC] guidance category).

In accordance with 40 *CFR* 300.400(g), EPA and TDEC have identified the specific ARARs and TBC for the selected remedy. The selected remedy complies with all ARARs/TBCs directly related to implementing the selected actions. Tables 16 and 17 lists respectively the Chemical-specific and Action-specific ARARs for remedial actions in the selected remedy. A brief summary of the remedial actions and associated ARARs/TBC guidance follows.

Chemical-Specific ARARs/TBC Guidance

Chemical-specific ARARs provide health or risk-based concentration limits or discharge limitations in various environmental media (i.e., surface water, groundwater, soil, air) for specific hazardous substances, pollutants, or contaminants and are listed in Table 16 and discussed below. There are no chemical-specific ARARs/TBC guidance. Remediation levels for soils will be based upon risk-based concentrations and/or in consideration of reducing releases into ground water.

One of EPA's Superfund Program goals under its ground water policy is to return usable ground waters to their beneficial uses within a timeframe that is reasonable given the particular circumstances of the site. The first consideration at a CERCLA site is determining whether the contaminated ground water is classified as a drinking water or is a potential source of drinking water. According to the final NCP preamble, EPA will make use of state classifications and consider their applicability in the selection of a remedy for ground water [55 Fed Reg. 8732-33, March 8, 1990].

Per 40 CFR 300.430 of the NCP, MCLGs (established under the Safe Drinking Water Act of 1974, as amended [SDWA] at 40 CFR Part 141 *et. seq.*) that are set at levels above zero, shall be attained by remedial actions for ground waters that are current or potential sources of drinking water, where relevant and appropriate to the circumstances of the release. Where the MCLG for a contaminant has been set at zero, or it is determined not to be relevant and appropriate, the corresponding MCL for that contaminant shall be attained [40 CFR 430(g)(2)(i)(B) and (C)].

The Memphis aquifer beneath the Smalley Site is a source of potable water for the Town of Collierville. There is no default classification for ground water in the State of Tennessee and it is classified as it is encountered according to the TDEC groundwater classification "General Use Ground Water". Accordingly, the MCLs and non-zero MCLGs are considered relevant and appropriate cleanup levels for the Site ground water. TDEC's Public Water System regulations at 1200-5-1-.06 list the MCLGs and MCLs, which are identical to the federal SDWA MCLGs and MCLs found at 40 CFR 141 *et. seq*. In addition, the Criteria specified in TDEC Rule 1200-4-3-.08(2) for General Use Ground Water are considered an ARAR.

Location-Specific ARARs/TBC Guidance

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, streams). There are no Location-specific ARARs/TBC guidance for the Site remedial actions.

Action-Specific ARARs/TBC Guidance

Action-specific ARARs include operation, performance, and design requirements or limitations based on the waste types, media, and remedial activities. Component actions include removal of contaminated soils, chemical stabilization and solidification of contaminated soil, off site disposal of treated soil, contaminated ground water extraction, ex *situ* treatment of contaminated ground water and disposal, and in-*situ* soil flush and capture. ARARs for each component action are listed in Table 17 and briefly discussed below.

Requirements for the control of fugitive dust contained in TDEC Rule 1200-3-8-.01(1) and storm water runoff potentially provide ARARs for all construction, excavation, and Site preparation activities. On-site remedial actions that involve land-disturbing activities include excavation of contaminated soils. Reasonable precautions must be taken and include the use of best management practices for erosion control to prevent runoff, and application of water on exposed soil/debris surfaces to prevent particulate matter from becoming airborne. Activities that disturb greater than one acre of land are required to comply only with the substantive requirements of the NPDES stormwater permit program as implemented by TDEC under its General Permit (Stormwater Discharge from Construction Activities, No. TNR10-0000). Per CERCLA Section 121(e) on-site response actions are not required to obtain permits or adhere to other administrative requirements (e.g., submittal of a Notice of Intent, a Storm Water Pollution Prevention Plan, and Notice of Termination).

The excavation of contaminated soil may result in the generation of remediation wastes that are considered RCRA characteristic hazardous waste due to elevated concentrations of hazardous constituents. Also, some secondary waste streams such as spent ground water treatment media may be considered RCRA waste. The toxicity characteristic leaching procedure (TCLP) test will be conducted on representative remediation/secondary waste samples to determine whether it is considered RCRA characteristic hazardous waste.

All RCRA hazardous waste will be managed in accordance with all applicable TDEC hazardous waste management regulations identified on Table 17, including those related to temporary storage of waste in containers and staging piles and transportation off-site.

Movement of hazardous remediation waste that contains RCRA-restricted waste off-site for treatment and disposal will trigger the RCRA land disposal restrictions (LDRs). These wastes must meet the specified treatment standards at 40 CFR 268 *et. seq.* and must be disposed of in a RCRA Subtitle C hazardous waste landfill or other approved disposal facility.

Any remediation wastes that are transferred off-site or transported in commerce along public right-of-ways must meet the requirements summarized in Table 17. These include packaging, labeling, marking, manifesting, and placarding requirements for hazardous materials. In addition, CERCLA Section 121(d)(3) provides that the off-site transfer of any hazardous substance, pollutant, or contaminant generated during CERCLA response actions be sent to a treatment, storage, or disposal facility that is in compliance with applicable federal and state laws and has been approved by EPA for acceptance of CERCLA waste (see also the 'Off-Site Rule' at 40 *CFR* 300.440 *et. seq.*).

In addition, ground water monitoring, injection, and recovery wells will be installed. The Ground Water Quality Control Board for Shelby County, Tennessee, has promulgated *Rules and Regulations of Wells in Shelby County*. These regulations govern the location, design, installation, use, modification, repair, and abandonment of all types of wells. These requirements are more stringent than corresponding federal and state rules. The substantive requirements of these regulations are considered ARARs. According to Tennessee Rule 1200-4-6, injection wells at the Site would be classified as Class V wells. Substantive requirements of an underground injection control (UIC) Class V permit application for injection wells will be adhered to, although no permit is required.

10.1.3 Long-Term Effectiveness and Permanence

Each alternative is assessed for its long-term effectiveness and permanence in addressing hazards at the Site and for the relative degree of certainty of remedial success if implemented at the Site. Factors considered when assessing this criterion include:

- The magnitude of residual risk/hazard from untreated contaminant(s), waste, or treatment residuals anticipated to remain at the conclusion of the remedial activities. Pertinent residuals characteristics that impact this assessment are the degree that they remain hazardous, their T/M/V and their propensity to bioaccumulate.
- The adequacy and reliability of controls such as containment systems and institutional controls needed to manage treatment residuals and untreated waste. This factor addresses the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative; and the potential exposure pathways and risks posed should the remedial action need replacement.
- The long-term impacts on the surrounding environment of the remedial alternative's activities and processes.

10.1.4 Reduction of Mobility/Toxicity/Volume through Treatment

The degree to which each alternative employs recycling or treatment that reduces M/T/V is assessed for each alternative, including how treatment is used to address the principal threats posed by the Site. Factors considered as appropriate include the following:

- The treatment or recycling processes that the alternative employs and the materials they are designed to treat;
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;
- The degree of expected reduction of M/T/V of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;
- The degree to which the treatment is irreversible;
- The type and quantity of residuals that will remain following treatment, considering the persistence, mobility, toxicity and propensity to bioaccumulate such hazardous substances and their constituents; and
- The degree to which treatment reduces the inherent hazards posed by principal threats at the Site.

10.1.5 Short-Term Effectiveness

Each alternative is assessed for its short-term effectiveness in addressing hazards encountered or created at the Site during implementation and operation of the remedial alternative. Factors considered when assessing this criterion include:

- The level of protection enjoyed by the community or adjacent populations during preparation, construction, start-up, operation, close-out, termination, and demobilization of the alternative's activities and processes;
- The level of protection enjoyed by remedial workers or operators during preparation, construction, start-up, operation, close-out, termination, and demobilization of the alternative's activities and processes;
- The length of time ("remediation period") needed for the alternative to achieve all remedial action objectives; and
- The short-term impacts on the surrounding environment of the remedial alternative's activities and processes.

10.1.6 Implementability

The ease or difficulty of implementing each alternative was assessed by considering the following types of factors as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required for obtaining necessary approvals and permits from other agencies (e.g., off-site disposal).
- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services;
- Availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources;
- Availability of services and materials; and
- Availability of prospective technologies.

10.1.7 Cost

For each remedial alternative, a minus 30 to plus 50 percent cost estimate has been developed. Cost estimates for each remedial alternative are based on conceptual engineering and design and are expressed in 2008 dollars. The cost estimate for each remedial alternative consists of the following four general categories:

Capital Costs. These costs include the expenditures that are required for construction of the remedial alternative (direct costs) and non-construction/overhead costs (indirect costs). Capital costs are exclusive of the costs required to operate and maintain the remedial alternative throughout its use. Direct costs include the labor, equipment and supply costs, including contractor markups for overhead and profit, associated with activities such as mobilization, monitoring, Site work, installation of treatment systems, and disposal costs. Indirect costs include items required to support the construction activities, but are not directly associated with a specific item.

Total Construction Costs. These costs include the capital costs with the addition of the contractor fee (at 10 percent of capital costs), engineering and administrative costs (at 15 percent of capital costs), and a contingency allowance set at 25 percent of the capital costs with contractor fees and engineering and administrative costs.

Present Worth O&M Costs. These costs include the post-construction cost items required to ensure or verify the continued effectiveness of the remedial alternative. O&M costs typically include long-term power and material costs (i.e., operational cost of a water treatment facility), equipment replacement/repair costs, five year review, and long-term monitoring costs (i.e., labor and laboratory costs), including contractor markups for overhead and profit. Present worth analysis is based on a 7 percent discount rate over a period of 30 years.

Total Present Worth Costs. This is the sum of the total construction costs, capital costs, present worth O&M costs and forms the basis for comparison of the various remedial alternatives.

The cost criterion is the simplest to rank since numeric rankings will be inversely related to the dollar value of the cost estimate for the alternatives; thus, the alternatives, ranked from least expensive to most expensive are: Alternatives 1, 8, 5, and 4 (Table 23). Ranking order is subject to change if cost estimates are recalculated under different assumptions or with improved information. Cost estimates provided at this stage of the CERCLA process are only accurate to within -30% and +50%; there could be substantial overlap in cost estimates if ranges are considered.

10.1.8 State Acceptance

Assessment of State concerns are completed after comments on the FS report are received but may be discussed, to the extent possible, in the proposed plan issued for public comment. The State concerns that shall be assessed include the following: the State's position and key concerns related to the preferred alternative and other alternatives; and State comments on ARARs.

10.1.9 Community Acceptance

This assessment includes determining with which components of the alternatives interested persons in the community support, have reservations about, or categorically reject. This assessment is completed after comments on the proposed plan are received.

10.2 Evaluation of Alternatives using Threshold and Balancing Criteria

The summary describing the evaluation of alternatives using the threshold and balancing and criteria is presented below.

10.2.1 Overall Protection of Human Health and the Environment

Overall, human health is at greater risk from exposure to ground water than is the environment; soil contamination is of greater concern as a continuing source to ground water than as a direct contact risk. The No Action alternative, Alternative 1, does not provide protection of human health or the environment. Actions designed to mitigate contamination at the Site are not included in this alternative.

The soil component of the remedial alternatives consists of soil removal via excavation and disposal at a hazardous waste facility or in-situ soil flushing. Both provide protection to human health and the environment to a large degree. The soil removal option rids the site of all soil contaminant mass; however, this technology only applies to the upper 20 to 25 feet of contaminated soil. Deeper contaminates subsurface soil is addressed by the in-situ soil flushing. The soil remedy component of Alternative 5 (excavation, stabilization and off-site disposal of contaminated soil followed by in-situ soil flushing of deeper subsurface soil) is the most protective of the alternatives evaluated.

The ground water component of the remedial alternatives all consist of the same elements: extraction, ex-situ treatment, and either reuse as flush liquid or disposal or reuse as potential potable water by the Town of Collierville. The ground water component does not provide any distinction between Alternatives 4, 5, or 8.

10.2.2 Compliance with ARARs

The No Action alternative, Alternative 1, does not comply with chemical-specific ARARs; activities designed to mitigate contamination at the Site are not included in this alternative. Action-specific and location-specific ARARs are met by virtue of the non-action nature of this alternative.

The soil removal option via excavation and disposal rids the Site of all soil contaminant mass; all chemical-specific ARARs would be met for soil. The on-site disposal option leaves contaminant mass on-site but encapsulated within an inert matrix and isolated by an engineered disposal cell. It also meets chemical-specific ARARS as long as the integrity of the solidified mass and the disposal cell is uncompromised. The potential for disintegration of the solidified mass and release of contamination over time gives on-site disposal of treated soil a slight disadvantage relative to the excavation/treatment/off-site disposal option.

The ground water component of the remedial alternatives all consist of the same elements: extract contaminated ground water, treatment, reuse as flush liquid, reuse as potable water or reinjection, collect and stabilize treatment waste (metal sludge or saturated ion-exchange resins) prior to off-site disposal. The ground water component of these alternatives does not provide distinction between Alternatives 4, 5, or 8.

Overall, the excavation and off-site disposal of stabilized/treated soil (Alternative 5) meets ARARs more definitively than on-site disposal of excavated/stabilized soil or the in-situ soil flushing option. All action-specific ARARs are met by all alternatives.

10.2.3 Long-Term Effectiveness and Permanence

The No Action, Alternative 1, does not provide long-term effectiveness or permanence of contamination reduction at the Site. Actions designed to mitigate contamination at the Site are not included in this alternative.

The soil removal option via excavation and off-site disposal permanently rids the Site of all contaminant mass. This provides no opportunity for return of contamination to the Site. The on-site disposal of pretreated soil option leaves contaminant mass in place but encapsulated within an inert matrix and an engineered disposal cell. It would provide long-term and potentially permanent removal of contamination at the Site if the integrity of the solidified mass and the disposal cell is uncompromised. The potential for disintegration of the solidified mass and release of contamination over time gives in-situ stabilization and solidification a disadvantage relative to the excavation/off-site disposal option.

The in-situ flushing treatment of deeper subsurface soil is effective on soluble metal contaminants, but not on insoluble metals. A small probability exists that subsurface conditions would change to alter the solubility of residual metals in the subsurface soil, thereby releasing them into the ground water at a future time. Long term monitoring would be used to detect any changes in conditions overtime and to confirm the long-term effectiveness and permanence of the flush/extraction option for deeper subsurface soil.

The ground water component of the remedial alternatives all consist of the same elements: extract contaminated ground water, treatment, reuse as flush liquid (at the source area) or reuse as potential potable water, collect and stabilize treatment waste (metal sludge or saturated ion-exchange resins) prior to off-site disposal. The ground water component of these alternatives does not provide distinction between Alternatives 4, 5, or 8.

Overall, off-site disposal of pretreated soil provides long-term effectiveness and permanence. On-site disposal of pretreated soil would provide the same level of effectiveness and permanence if favorable geochemical conditions and integrity of stabilized inert matrix and the engineered disposal cell could be guaranteed in the long term. The alternatives rank from most able to least able to meet this criterion, as follows: Alternatives 5, 4, 8, and 1.

10.2.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

No Action, Alternative 1 does not reduce T/M/V at the Site. Actions designed to mitigate contamination at the Site are not included in this alternative.

The soil removal option via excavation and disposal permanently rids the Site of all contaminant mass, thus reducing T/M/V. This provides no opportunity for return of contamination to the Site. The on-site disposal of pretreated soil option leaves a slight opportunity for contaminants to migrate. It reduces toxicity and mobility as long as the integrity of the solidified mass is uncompromised. Soil volume likely would increase because of the addition of treatment materials to the excavated soil. The potential for the solidified mass to disintegrate and to release contamination over time gives the excavation/treatment and on-site disposal option a slight disadvantage relative to the excavation/treatment and off-site disposal option.

The ground water component of the remedial alternatives all consist of the same elements: extract contaminated ground water, treatment, reuse as flush liquid (at the source area) or reuse as potential potable water, collect and stabilize treatment waste (metal sludge or saturated ion-exchange resins) prior to off-site disposal. The ground water component of these alternatives does not provide distinction between Alternatives 4, 5, or 8.

Overall, removal options clearly reduce T/M/V and in-situ flushing treatment options reduce volume but not toxicity and mobility. The alternatives ranked from most able to least able to meet this criterion are as follows: Alternatives 5, 8, 4, and 1.

10.2.5 Short-Term Effectiveness

All of the alternatives, with the exception of No Action Alternative 1, have some risk to surrounding populations during the construction/implementation period. The No Action alternative, Alternative 1, has the least impact on the surroundings of the Site; however, it is least successful at meeting any cleanup goals in the short-term.

The soil removal option via excavation and treatment represents a high potential for uncontrolled release of contaminated dust and soil to the surrounding environment. The in-situ soil flushing option treats contaminant mass in place throughout the process cycle. The short-term effectiveness of in-situ treatment options is greater than that of excavation/disposal because treatment activities remain in the subsurface.

The ground water component of the remedial alternatives all consist of the same elements: extract contaminated ground water, source area treatment, reuse as flush liquid (at the source area) or reuse as potable water or reinjection, collect and stabilize treatment waste (metal sludge from saturated ion-exchange resins) prior to off-site disposal. The ground water component of these alternatives does not provide distinction between Alternatives 4, 5, or 8.

Overall, potential for uncontrolled exposure to contaminants is greatest for soil excavation; in-situ flushing provides better short-term effectiveness protection of health and environment. The alternatives rank from most able to least able to meet this criterion, as follows: Alternatives 8, 5 and 4, and 1.

10.2.6 Implementability

No Action, Alternative 1, is the simplest alternative to implement at the Site. Actions designed to mitigate contamination at the Site are not included in this alternative. However, the time for this alternative to achieve cleanup goals is unacceptably long.

The soil removal option via excavation and disposal permanently rids the Site of much of the soil contamination, thus reducing T/M/V. It requires substantial effort and coordination. Some of the contaminated soil exists under existing structures; some demolition and a substantial amount of disruption to ongoing commercial activities will be required. The same assessment applies to the in-situ soil flushing option. Implementability of soil remedial options is approximately equal among all alternatives, with the exception that in-situ soil flushing by itself would take longer to achieve cleanup goals than would alternatives that include excavation and treatment/disposal of a substantial portion of the contaminated soil prior to initiating the in-situ flushing process.

The ground water component of the remedial alternatives all consist of the same elements: extract contaminated ground water, treatment, reuse as flush liquid (at the source area) reuse as potable water or reinjection, or collect and stabilize treatment waste (metal sludge or saturated ion-exchange resins) prior to off-site disposal. The ground water component of these alternatives does not provide any strong distinction between Alternatives 4, 5, or 8, except perhaps a slight advantage to Alternative 8 in that installation and operation of the re-injection wells or infiltration galleries is not dependent on coordination with the excavation of source area soil.

Considering both time to attaining goals and technical logistics, implementability of the alternatives rank from most able to least able to meet this criterion are as follows: Alternatives 5, 4 and 8, and 1.

10.2.7 Cost

Cost is the simplest criterion to evaluate since dollar values are quantitative and easily compared. The estimated capital expenditures are highest for the soil excavation and treatment remedies. On-site disposal of stabilized soil increases the capital expenditure because of the costs involved with construction of the on-site disposal cell. Excavation, treatment and off-site disposal is less capital intensive than the on-site disposal. The in-situ soil flushing option is the least capital intensive of the three active remedial alternatives.

Operation and maintenance costs are similar among the three active remedial alternatives evaluated for this Site. Alternative 4 has a slightly higher annual O&M cost because of the on-site disposal cell requiring maintenance overtime. Ranking order is subject to change if cost estimates are recalculated under different assumptions or with improved information. Cost estimates provided at this stage of the CERCLA process are only accurate to within -30% and +50%; there could be substantial overlap in cost estimates if ranges are considered.

Contingency and contractor fees are included in the overall cost estimates. The final costs show that Alternative 4 is the most expensive remedy, followed by Alternative 5, 8 and 1. Costs for the No Action alternative (Alternative 1) reflect the required five-year reviews over 30 years.

10.2.8 State Acceptance

The State of Tennessee, as represented by Tennessee Department of Environment and Conservation (TDEC), has assisted in the Superfund process through the review of the RI/FS documents and has actively participated in the decision making process. The State has concurred with the selected remedy in this ROD.

10.2.9 Community Acceptance

EPA mailed approximately 175 copies of the Proposed Plan (EPA, 2008) to citizens in neighborhoods adjacent to the Site on July 22, 2008. The notice of the public meeting to discuss the Proposed Plan was published in the Commercial Appeal on July 23, 2008, which is included as Appendix A1. A public comment period on the Proposed Plan was held from July 23, 2008 to August 23, 2008. A public meeting was held at the Collierville Town Hall located at 500 Poplar View Parkway, on July 31, 2008, at 6:00 p.m. The public meeting transcript is included as Appendix A2. EPA's responses to the comments received during the public comment period are included in the Responsiveness Summary, which is Appendix A3 of this ROD.

10.3 Principal Threat Wastes

The NCP establishes an expectation that EPA will address the principal threats posed by a Site through treatment wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat waste combines concepts of both human health hazards and cancer risks. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Subsurface soil at the former disposal and discharge areas at the Site are contaminated with high concentrations of hexavalent chromium, in chemical forms that are both toxic and mobile. These conditions justify identifying the source area soil at the Smalley-Piper Site as a principal threat waste. The high concentrations of hexavalent chromium in soil (and the ground water under these areas that are contaminated with high concentrations of hexavalent chromium, total chromium, antimony, and iron) require implementing remedial measures to protect human health and the environment and to restore the impacted ground water resource to beneficial use.

11.0 Selected Remedy

11.1 Rationale for the Selected Remedy

Based upon consideration of the requirements of CERCLA, the NCP, State of Tennessee applicable regulations, the detailed analysis of the alternatives, State input and public comments, EPA has selected Alternative 5 which consists of the following remedy: Source Area Soil Removal, On-site Stabilization and Solidification Treatment, Off-Site Disposal, Ground Water Pump and Treat, Disposal of Treated Water, and Institutional Controls.

The strategy associated with this alternative involves using technologies to remove both soil and ground water contaminants to the extent practicable, and ex-situ treatment of contaminant mass prior to off-site disposal. This general remedial strategy requires a high level of intrusiveness at the Site. Implementing this remedy will require consideration of the surrounding land-use and infrastructure, as well as the geochemistry, geology and geohydrology of the Site. The removal of contaminants also requires consideration for disposition of the waste materials generated during the remedial activities for this alternative. This alternative is expected to reduce Site contaminants to cleanup levels at the conclusion of its implementation.

The Selected Remedy will satisfy the statutory requirements of CERCLA Section 121(b) by being protective of human health and the environment; complying with ARARs; being cost-effective; utilizing permanent solutions and alternative treatment technologies to the maximum extent practicable; and meeting the preference for remedies that employ treatment that permanently and significantly reduces the M/T/V of hazardous wastes as a principal element. This action represents the final remedy selected for the Site, and, as such, is compatible with the intended future use of the Site.

11.2 Description of the Selected Remedy

The Selected Remedy employs a complete removal option for both contaminated soil and contaminated ground water. Specific elements of the Selected Remedy consist of:

1. Excavation of contaminated soil
2. Chemical stabilization and solidification of contaminated soil
3. Off-site disposal of stabilized soil
4. Extraction of contaminated ground water
5. Ex-situ treatment of contaminated ground water
6. Disposal of treated water
7. In-situ soil flushing
8. Implementation of institutional controls

The main activities associated with these remedy components are: (1) excavating 144,000 cubic feet of contaminated soil; (2) chemically stabilizing and solidifying the excavated soil into a non-hazardous solid matrix; (3) transporting the stabilized/solidified soil to a local off-site non-hazardous waste facility for disposal; (4) constructing and operating ground water extraction wells to remove contaminated ground water from various parts of the contaminated plume; (5a) construction and operation of a source area ground water treatment facility using conventional chemical reduction and precipitation; (5b) dewatering, solidifying and disposing (at an off-site hazardous waste facility) the chemical treatment residue; (5c) construction and operation of up to two additional water extraction and treatment systems in the northwest and southwest portions of the plume using ion-exchange resin technology; (6) water extracted from the source area will be reinjected into the Memphis aquifer after treatment. Water extracted from any additional locations beyond the source area will either be made available to the Town of Collierville as potable water or reinjected into the Memphis aquifer, depending on the Town's potable water requirements; (7a) flushing the subsurface soil below the excavation depth with treated ground water using the open excavation pit as the injection point; (7b) collecting and treating the flush fluid along with the source ground water through the source extraction well and chemical treatment facility (as in step 5a); and (8) implementing institutional controls against use of contaminated ground water until cleanup goals are met.

11.2.1 Excavation of Contaminated Soil

Contaminated soil in the former treatment pond area is acting as the source area for ground water contamination and needs to be removed. Eliminating this source material will stop the continued leaching of metals from the highest concentration source area soil, and will allow the ground water remedial actions to achieve their goals: prevent further migration of the contaminated ground water plume and decrease the total mass of metal contaminants in the aquifer.

Soil moving equipment will be mobilized to the location, and the source area will be cleared and prepared for excavation. This could entail demolition of existing buildings to facilitate accessing contaminated soil as well as previously uninvestigated soil. Soil (approximately 144,000 cubic feet) will be excavated to a depth of approximately 25 feet bls. Excavation to a depth of 25 feet is necessary to ensure that the most contaminated soil at the Site found between 16.5 feet bls and 20.5 feet bls is removed. In addition, equipment capabilities may be a limiting factor. Appropriate health and safety protections will be implemented to minimize the exposure of remediation workers and the surrounding populace to contaminated material during the remedial work. Progress of the soil excavation activities will be monitored by confirmatory sampling of the excavated surfaces.

The excavation pit(s) created by the soil removal operation will be used for other remedial actions prior to it being back-filled and restored with compacted clean borrow material from local sources. Acquisition and transport of the clean borrow material will require additional dump truck operation.

11.2.2 Chemical Stabilization and Solidification of Contaminated Soil

The excavated soil will be transported to the empty lot at the Site's west end for treatment. The soil treatment will consist of chemical stabilization (e.g., reduction of chromium (VI) to chromium (III)) followed by solidification (e.g. cement material) to encapsulate the contaminants in a non-leaching form within the inert matrix. Samples of the matrix will be sent to a laboratory for leachability analysis to demonstrate that the matrix will not leach hazardous metals. The final volume of stabilized and solidified soil is expected to be substantially larger than the volume of soil excavated from the source area due to the addition of several percent (by weight and volume) of the solidification material. This expansion in volume has been accounted for in the remedy evaluation.

11.2.3 Off-Site Disposal of Stabilized Soil

The stabilized soil matrix will be trucked to an off-site, non-hazardous waste disposal facility. The material will be secured from unintended spillage during transit.

11.2.4 Extraction of Contaminated Ground Water

The estimated volume of ground water that will be treated at the Site was assumed to be approximately three times the pore volume of the estimated plume size (300,000,000 gallons), or 900,000,000. Ground water extraction wells typically can not distinguish between contaminated and clean ground water as they operate. Extraction wells can not selectively capture contaminated ground water and allow clean ground water to pass. Thus, there will be a certain percentage of volume that will not be contaminated but is inadvertently captured by the process. This is expected to happen with the source area extraction wells as they capture some upgradient ground water (east of the source area) while capturing the main source area ground water directly under the Site. This is also expected to happen with the additional extraction wells as they capture a small amount of uncontaminated water from areas beyond the plume edges to the west.

The association of metal contaminants with subsurface aquifer soil is such that the desorption process is a decay function that is dependent both on the amount of contaminant on the soil and on the contaminant concentration in the surrounding ground water. Thus over time, fewer contaminants will leach off of the soil particles as the ground water treatment progresses, and greater volumes of ground water will require extraction to capture proportionally fewer contaminants toward the end of the ground water treatment period.

The combination of these two processes makes it challenging to accurately determine the total volume of ground water that will ultimately be processed through the extraction stations. In order to provide some basis for estimating the operation and maintenance costs for the ground water treatment, it was conservatively estimated that, over the entire life-cycle of the ground water treatment process, 3 times the simple ground water volume (calculated from the plume area, depth and porosity) will be processed. The actual total volume of ground water that passes through the treatment process will depend on specific design parameters selected and operational conditions throughout the treatment life-cycle. This volume of ground water that is expected to be treated by up to three ground water extraction facilities is described below.

Ground water contaminated with metals under the source area will be extracted using at least two dedicated extraction wells. These wells will be sized and operated to pump the maximum volumetric rate of ground water capable of being treated and disposed of or re-injected. This will ensure that there is no net flow of contaminated ground water further downgradient. Once cleanup goals for this portion of the ground water plume have been met, the extraction process will be discontinued and the extraction equipment decommissioned and demobilized.

Ground water contaminated with metals beyond the source area will be extracted using up to two sets of dedicated extraction wells: one at or near the northwest plume boundary and the other at or near the southwest plume boundary. These wells will be operated to pump the maximum volumetric rate of ground water capable of being treated and disposed of or re-injected. This will ensure that there is no net flow of contaminated ground water further downgradient of the source area. It is expected that the optimum locations of the extraction wells will be determined at the Remedial Design phase of the cleanup. Once remedial goals for this portion of the ground water plume have been met, the extraction process will be discontinued and the extraction equipment decommissioned and demobilized.

11.2.5 Ex-situ Treatment of Contaminated Ground Water

Extracted ground water from the source area containing high chromium concentrations will be treated at the source using conventional chemical treatment technology. This will consist of ground water pH adjustment and chemical reduction of chromium (VI) to chromium (III) followed by another pH adjustment to induce a chemical precipitation reaction. The chemical treatment process will generate a sizable volume of metal sludge composed of a mixture of insoluble chromium salts and other metal precipitates. This material will be separated from the effluent ground water by settling tanks, filtration, or a combination of these technologies, and dewatered to the greatest extent practicable. The metal sludge may be securely drummed and stored on-site until such time that a shipment of the drums of this hazardous material can be made to an appropriate hazardous waste disposal facility.

The treated source area water will be used in the in-situ deep subsurface soil flushing process (described in Section 11.2.6 of this document). Extraction and treatment process rates will be adjusted to balance the rate of ground water injection that the subsurface can accept. Once remedial goals for this portion of the ground water plume have been met, the ground water treatment process will be discontinued and the treatment equipment decommissioned and demobilized.

Ground water extracted beyond the source area containing diluted chromium concentrations will be treated using an ion-exchange resin treatment train. This treated water is intended to be made available to the Town of Collierville as potable water or reinjected into the Memphis aquifer. Therefore, additional metal treatment may be implemented by the Town before it distributes the water for potable use. Extraction and treatment process rates will be adjusted to balance the rate of ground water disposal or injection into the local subsurface geology. Once remedial goals for this portion of the ground water plume have been met, the ground water treatment process will be discontinued and the treatment equipment decommissioned and demobilized.

The contact between contaminated ground water and an ion exchange resin results in phase transfer of the dissolved hexavalent chromium (i.e., chromate and dichromate) from ground water to the resin. This process will result in two by product streams: metals saturated resin and a large volume of treated ground water. The spent resin could be addressed by appropriate regeneration methods. The regenerated resin can be reused in the treatment process; the metals laden concentrate collected from regenerating the resin could be combined with the metal treatment at the source area to be chemically treated, stabilized and/or solidified for off-site disposal as a non-hazardous waste.

The treated ground water will be analyzed to ensure that COCs are present at or below remedial goals before being discharged to the local drinking water supply systems or to reinjection wells located in the source area. The progress of remediation will be monitored directly by analyzing extraction well ground water. Remedial operation will continue until extracted ground water shows contaminant cleanup levels are attained.

11.2.6 In-situ Soil Flushing

It is anticipated that excavation of contaminated subsurface soil will address the most contaminated soil at the Site which is found between 16.5 feet bls and 20.5 feet bls and be limited by equipment capabilities (e.g., the length of the backhoe arm). Based on the conceptual Site model developed for this Site, it is suspected that deep subsurface soil (below 25 feet bls) also is contaminated with chromium at concentrations exceeding direct contact risk criteria or leachability criteria. To address the deep subsurface soil contamination, an in-situ soil flushing and flush fluid capture strategy will be used at the Site after completion of the excavation component of the soil remedy.

Extracted and treated source area ground water would be used as the flush fluid. Treated ground water would be pumped back to the excavation pit for percolation into the subsurface. Discharge options available to the Site include infiltration galleries or re-injection wells with positive pressure pumps. Either option would be constructed within the source area excavation pit(s) to take advantage of the absence of 20 to 25 feet of high silt-content fluvial aquifer sediment and maximize the infiltration efficiency of the injected treated ground water. The flush fluid that percolates through the deep subsurface soil is expected to leach residual chromium and other metal contamination from the soil column. The flush fluid is expected to infiltrate down to the water table where it will co-mingle with existing source area ground water and be captured by the source area extraction wells.

The criterion for determining remedy completion of the in-situ soil flushing process is the concentration of chromium (total and hexavalent), antimony, and iron in the extracted water collected from the source area extraction wells. When contaminant concentrations are at or below remedial goals, it will be inferred that no more leachable compounds exist within the treated soil zone and any soil bound contaminant is unavailable for migration into the ground water. The extraction/reinjection cycle at the source area will be decommissioned and demobilized when extracted source area ground water samples show chromium concentrations and other metals below remedial goals.

11.2.7 Implementation of Institutional Controls

Institutional controls (ICs) will be required as part of the Selected Remedy. ICs are non-engineering measures which will be used to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances during implementation of the remedy and until cleanup goals are obtained. Per TDEC Rule 1200-1-13-.08(10), institutional controls are required whenever a remedial action does not fully address concentrations of hazardous substances, which pose or may pose an unreasonable threat to human health or the environment. This includes deed restrictions for the sale and use of property. Accordingly, any transfer (i.e., sale or lease) of the Site parcels will include deed restrictions or other type of restrictive covenants describing the use restrictions such as prohibition on consumptive use of ground water.

In addition, Tennessee law requires that a "Notice of Land Use Restrictions" be prepared and recorded by a property owner wherein land use restrictions are part of the remedial action on such property. The Notice of Land Use Restrictions shall be recorded at the Shelby County Register of Deeds office in accordance with T.C.A. Section 68-212-225. The Notice must: (1) include a legal description of the Site that would be sufficient as a description of the property in an instrument of conveyance; (2) identify the location and dimensions of the areas of potential environmental concern with respect to surveyed, permanent benchmarks. Where a Site encompasses more than one parcel or tract of land, a composite map or plat showing all parcels or tracts may be recorded; (3) identify generally the type, location, and quantity of regulated hazardous substances and regulated substances known to exist on the Site; and (4) identify specific restrictions on the current or future use of the Site.

The Ground Water Quality Control Board for Shelby County, Tennessee, has promulgated *Rules and Regulations of Wells in Shelby County.* Under these rules, water wells are defined as wells developed for the primary purpose of producing a supply of water regardless of the intended use of the water supply. The rules prohibit water wells within a half-mile of the designated boundaries of a listed federal or state CERCLA site or RCRA corrective action site, unless the owner can demonstrate that movement of contaminated ground water or materials into adjoining aquifers will not be enhanced by the well. Similar location restrictions are not specified for any other type of well (e.g., monitoring, injection, and recovery). In addition, these rules allow the Shelby County Health Department to reject a permit application for a proposed well if the well will be harmful or potentially harmful to the water resources of Shelby County. Specific criteria for the determination of harm or potential harm are not identified in the rules.

11.3 Five-Year Reviews

A statutory review of the ongoing protectiveness of the remedy will be performed by EPA no less often than every five years after initiation of the remedial action and until cleanup goals are obtained allowing for unlimited use of the Site. This review is a public process, and will be conducted to ensure that the Selected Remedy remains protective of human health and the environment.

11.4 Summary of Estimated Remedy Costs

Total construction costs for this alternative ($4,893,765 for direct capital expenses and $2,947,978 for capital engineering management, fees and contingency) are detailed in Table 18. The O&M costs for this alternative ($2,103,133 net present worth cost based on an estimated annual O&M cost of $524,106, and $652,543 for O&M engineering management, fees and contingency) are detailed in Table 19. These are order of magnitude cost estimates within plus 50 percent to minus 30 percent of the actual project costs. Changes in the cost estimate may occur depending on new information and data collected during the engineering design of the remedial action selected. Minor changes, if they occur, will be documented in the form of a memorandum in the Administrative Record file, any significant changes will be addressed in an Explanation of Significant Differences, and any fundamental changes will be addressed in a ROD Amendment.

11.5Expected Outcomes of the Selected Remedy

The expected results from the implementation of the Selected Remedy include the restoration of contaminated ground water so that it may again be used as a safe drinking water source. Subsurface soil contamination will be reduced to the point where future direct contact risks for a construction worker are mitigated. The remedy is compatible with the Site's current and future industrial and commercial land-use designation. The required ICs would limit contact with contaminated soil and ground water and impact the long-term effectiveness of the remedy and Site reuse. The Selected Remedy has minimal short-term impacts on the community, and is consistent with similar decisions nationally.

11.6 Future Land Use

Ground water will be suitable for use as a drinking water resource once cleanup goals noted in Table 13 are met. The soil cleanup goal noted in Table 14 is based on protecting a future construction worker. ICs will limit the on-site land uses and will restrict the use of ground water on-site and in adjacent impacted areas. During remedy implementation, engineering and administrative controls will be used to protect the public from environmental exposure or safety hazards associated with the cleanup activities. When the construction is complete, the Site property will be suitable for commercial/industrial development. It is anticipated that reuse of the property can occur prior to meeting the ground water cleanup goals noted in Table 13.

11.7 Final Cleanup Goals

The final cleanup goals and the basis for the cleanup goals are included in Tables 13 and 14. These cleanup goals are protective of human health and the environment.

12.0 Statutory Determinations

Based on information currently available, EPA as the lead agency believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA 121(b): (1) be protective of human health and the environment; (2) comply with ARARs (or justify a waiver); (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies, and satisfy the preference for treatment as a principal element, to the extent practicable.

12.1 Protection of Human Health and the Environment

The Selected Remedy satisfies the statutory requirement for protection of human health and the environment through isolation of contaminated ground water from human receptors and ICs. The Selected Remedy includes treatment as a major element. The engineering principles and technology for the Selected Remedy are well established, and are expected to be reliable over the long-term. Site conditions are conducive to construction of the remedy, and it is compatible with the expected future use of the Site.

12.2 Compliance with ARARs

CERCLA Section 121(d), specifies in part, that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or obtain a waiver (see also 40 *Code of Federal Regulations (CFR)* 300.430(f)(1)(ii)(B)). Applicable or relevant and appropriate requirement (ARARs) include only federal and state environmental or facility citing laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 *CFR* 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (To-Be-Considered [TBC] guidance category).

In accordance with 40 *CFR* 300.400(g), EPA and TDEC have identified the specific ARARs and TBC for the selected remedy. The selected remedy complies with all ARARs/TBCs directly related to implementing the selected actions. Tables 16 and 17 lists respectively the Chemical-specific and Action-specific ARARs for remedial actions in the selected remedy. A brief summary of the remedial actions and associated ARARs/TBC guidance follows.

Chemical-Specific ARARs/TBC Guidance

Chemical-specific ARARs provide health or risk-based concentration limits or discharge limitations in various environmental media (i.e., surface water, ground water, soil, air) for specific hazardous substances, pollutants, or contaminants and are listed in Table 16 and discussed below. Remediation levels for soils will be based upon risk-based concentrations and/or in consideration of reducing releases into ground water.

One of EPA's Superfund Program goals under its ground water policy is to return usable ground waters to their beneficial uses within a timeframe that is reasonable given the particular circumstances of the site. The first consideration at a CERCLA site is determining whether the contaminated ground water is classified as a drinking water or is a potential source of drinking water. According to the final NCP preamble, EPA will make use of state classifications and consider their applicability in the selection of a remedy for ground water (see 55 Fed Reg. 8732-33, March 8, 1990).

Per 40 CFR 300.430 of the NCP, MCLGs (established under the Safe Drinking Water Act of 1974, as amended [SDWA] at 40 CFR Part 141 *et. seq.*) that are set at levels above zero, shall be attained by remedial actions for ground waters that are current or potential sources of drinking water, where relevant and appropriate to the circumstances of the release. Where the MCLG for a contaminant has been set at zero, or it is determined not to be relevant and appropriate, the corresponding MCL for that contaminant shall be attained (see 40 CFR 430(g)(2)(i)(B) and (C)).

The Memphis aquifer beneath the Site is a source of potable water for the Town of Collierville. There is no default classification for ground water in the State of Tennessee and it is classified as it is encountered according to the TDEC ground water classification "General Use Ground Water". Accordingly, the MCLs and non-zero MCLGs are considered relevant and appropriate cleanup levels for the Site ground water. TDEC's Public Water System regulations at 1200-5-1-.06 list the MCLGs and MCLs, which are identical to the federal SDWA MCLGs and MCLs found at 40 CFR 141 *et. seq.* In addition, the Criteria specified in TDEC Rule 1200-4-3-.08(2) for General Use Ground Water are considered an ARAR.

Location-Specific ARARs/TBC Guidance

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, streams). There is no Location-specific ARARs/TBC guidance for the Site remedial actions.

Action-Specific ARARs/TBC Guidance

Action-specific ARARs include operation, performance, and design requirements or limitations based on the waste types, media, and remedial activities. Component actions include removal of contaminated soils, chemical stabilization and solidification of contaminated soil, off-site disposal of treated soil, contaminated ground water extraction, ex *situ* treatment of contaminated ground water and disposal, and in-*situ* soil flush and capture. ARARs for each component action are listed in Table 17 and briefly discussed below.

Requirements for the control of fugitive dust at TDEC Rule 1200-3-8-.01(1) and storm water runoff potentially provide ARARs for all construction, excavation, and Site preparation activities. On-site remedial actions that involve land-disturbing activities include excavation of contaminated soils. Reasonable precautions must be taken and include the use of best management practices for erosion control to prevent runoff, and application of water on exposed soil/debris surfaces to prevent particulate matter from becoming airborne. Activities that disturb greater than one acre of land are required to comply with the substantive requirements of the NPDES stormwater permit program as implemented by TDEC under its General Permit (Stormwater Discharge from Construction Activities, No. TNR10-0000). Per CERCLA Section 121(e) on-site response actions are not required to obtain permits or adhere to other administrative requirements (e.g., submittal of a Notice of Intent, a Storm Water Pollution Prevention Plan, and Notice of Termination).

The excavation of contaminated soil may result in the generation of remediation wastes that are considered RCRA characteristic hazardous waste due to elevated concentrations of hazardous constituents. Also, some secondary waste streams such as spent ground water treatment media may be considered RCRA waste. The toxicity characteristic leaching procedure (TCLP) test will be conducted on representative remediation/secondary waste samples to determine whether it is considered RCRA characteristic hazardous waste.

All RCRA hazardous waste will be managed in accordance with all applicable TDEC hazardous waste management regulations identified in Table 17, including those related to temporary storage of waste in containers and staging piles and transportation off-site. Movement of hazardous remediation waste that contains RCRA-restricted waste off-site for treatment and disposal will trigger the RCRA land disposal restrictions (LDRs). These wastes must meet the specified treatment standards in 40 CFR 268 *et. seq.* and must be disposed of in a RCRA Subtitle C hazardous waste landfill or other approved disposal facility.

Any remediation wastes that are transferred off-site or transported in commerce along public right-of-ways must meet the requirements summarized in Table 17. These include packaging, labeling, marking, manifesting, and placarding requirements for hazardous materials. In addition, CERCLA Section 121(d)(3) provides that the off-site transfer of any hazardous substance, pollutant, or contaminant generated during CERCLA response actions be sent to a treatment, storage, or disposal facility that is in compliance with applicable federal and state laws and has been approved by EPA for acceptance of CERCLA waste (see also the 'Off-Site Rule' at 40 *CFR* 300.440 *et. seq.*).

In addition, ground water monitoring, injection, and recovery wells will be installed. The Ground Water Quality Control Board for Shelby County, Tennessee, has promulgated *Rules and Regulations of Wells in Shelby County*. These regulations govern the location, design, installation, use, modification, repair, and abandonment of all types of wells. These requirements are more stringent than corresponding federal and state rules. The substantive requirements of these regulations are considered ARARs.

According to Tennessee Rule 1200-4-6, injection wells at the Site will be classified as Class V wells. Substantive requirements of an underground injection control (UIC) Class V permit application for injection wells will be adhered to, although no permit is required.

12.3 Cost Effectiveness

EPA has determined that the Selected Remedy is cost-effective and that the overall protectiveness of the remedy is proportional to the overall cost of the remedy. The cost-effectiveness of the remedy was assessed by comparing the overall effectiveness of the remedy (i.e., long-term effectiveness and permanence; reduction in M/T/V; short-term effectiveness) with the other alternatives considered. More than one remedial alternative may be considered cost-effective, but CERCLA does not mandate that the most cost-effective or least expensive remedy be selected.

12.4 Permanent and Alternative Treatment Solutions

The Selected Remedy uses permanent solutions and alternative treatment solutions to the maximum extent practicable. The Selected Remedy will provide an acceptable degree of long-term effectiveness and permanence. The remedy will require Institutional Controls until it is demonstrated that ground water cleanup goals are obtained, but these remedy components are neither unusual nor exceptional in degree or cost. The remedy can be reliably considered permanent.

12.5 Preference for Treatment as a Principal Element

In addition to the four statutory mandates previously discussed, the NCP includes a preference for treatment for the selected remedies in addressing the principal threat at the Site. The Selected Remedy effectively addresses the principal threat waste identified as the source area subsurface soil within the Site property. Further, the Selected Remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

12.6 Five-Year Review Requirement

CERCLA Section 121 and 40 CFR Part 300 require a review of remedial actions at least every five years if the remedial action results in hazardous substances, pollutants, or contaminants remaining in place above levels that allow for unlimited use and unrestricted exposure. Since ground water contamination will persist until the cleanup is complete, the first statutory review of the remedial action is required within five years of the beginning of remedial construction and until cleanup goals are obtained allowing for unlimited use of the Site.

12.7 Documentation of Significant Changes

Pursuant to CERCLA 117(b) and NCP 300.430(f)(3)(ii), the ROD must document any significant changes made to the Preferred Alternative discussed in the Proposed Plan. There are no significant changes to this ROD from the Proposed Plan. However, there are two significant changes to this ROD from Section 5 of the FS (Summary and Conclusions) discussing the details of the alternative selected by EPA in this ROD. First, Section 5 of the FS states that the operation of the ground water extraction and treatment process will continue until extracted water from the source area and areas in the plume beyond the source area shows non-detect levels of chromium and other metals. In contrast, Section 2.2.1 of the FS (Preliminary Remedial Action Objectives) and the Proposed Plan provide that the operation of ground water extraction and treatment system(s) will continue until remedial action objectives are obtained, which include reducing human exposure to contaminated ground water at concentrations above 6 ppb for antimony, 100 ppb for total chromium, 47 ppb for hexavalent chromium, and 4,693 ppb for iron. For clarification purposes, extraction and treatment of contaminated ground water within the plume is planned to occur until the above listed remedial action objectives are obtained for antimony, total chromium, hexavalent chromium, and iron.

Second, Section 5 of the FS provides that ground water will be extracted from the source area, an area within the plume located southwest of the source area, and a possible contingent area within the plume located northwest of the source area. However, this ROD provides that EPA will first construct and operate a ground water extraction and treatment system in the source area and up to two additional ground water extraction treatment systems in the northwest and southwest portions of the plume if monitoring data, modeling and/or treatability studies so indicate. The optimal locations of the extraction and treatment system(s) will be determined based upon the data obtained from monitoring, modeling and/or treatability studies. It is conceivable that the contingency ground water extraction and treatment system will be located in the southwest portion of the plume instead of the northwest, but the need for extraction and treatment(s) beyond the source area will be dependent upon the influence or lack of influence of the source area extraction wells and the resulting direction of the contaminated ground water plume beyond the source area.

The estimated cost for the Preferred Alternative presented in the Proposed Plan was $10,350,859. However, the revised estimated cost for the Selected Remedy presented in this ROD is $10,461,909, which is considered a minor change.

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TABLES

Table 1: Data Summary for Subsurface Soil in the Concrete Building Area
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Soil On-Site Direct Contact	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
	Chromium (Hexavalent)	1.46 J	50,000	ppm	15/16	34,424	ppm	95% UCL

Key
ppm: Parts per million
J: Estimated value
UCL: Upper confidence limit

Table 2: Data Summary for Subsurface Soil in the Self-Storage Facility Area
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Soil On-Site Direct Contact	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
	Chromium (Hexavalent)	0.62J	345	ppm	20/20	114.1	ppm	95% UCL

Key
ppm: Parts per million
UCL: Upper confidence limit
J: Estimated value

Table 3: Data Summary for Shallow Ground Water
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Current/Future
Medium: Ground Water
Exposure Medium: Ground Water

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Ground Water Ingestion and Inhalation	Antimony	96	96	ppb	1/1	96	ppb	Max
	Chromium (Total)	5	180,000	ppb	11/14	68,910	ppb	Arithmetic Mean
	Chromium (Hexavalent)	5.6 J	243,000	ppb	11/14	111,062	ppb	Arithmetic Mean
	Iron	119	8,900	ppb	7/7	2059	ppb	Arithmetic Mean

Key
ppb: Parts per billion
J: Estimated value
Max: Maximum detected value
UCL: Upper confidence limit

Table 4: Data Summary for Deep Ground Water Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: *Current/Future*
Medium: Ground Water
Exposure Medium: Ground Water

	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Deep Ground water	Chromium (Total)	3.1 J	6,690	ppb	9/14	1764.3	ppb	Arithmetic Mean
	Chromium (Hexavalent)	5.4 J	5,290	ppb	8/12	1387	ppb	Arithmetic Mean
	Iron	624	7,210	ppb	5/5	3874.8	ppb	Arithmetic Mean

Key
ppb: Parts per billion
J: Estimated value
Max: Maximum detected value
UCL: Upper confidence limit

Table 5
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee

Chemical of Concern (1)	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (2)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (3) (MM/DD/YYYY)
Antimony	Chronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	Blood	1000	IRIS	12/18/2007
Chromium (Total)	Chronic	1.5E+00	mg/kg-day	2.5%	3.8E-02	mg/kg-day	NA	100	IRIS	03/01/2008
Chromium (Hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	NA	300	IRIS	12/18/2007
Iron	Chronic	3.0E-01	mg/kg-day	100%	3.0E-01	mg/kg-day	GI Tract/Liver	1	NCEA	05/01/2002

NCEA - National Center for Environmental Assessment
IRIS = Integrated Risk Information System
RfD = Reference dose
GI = Gastrointestinal
mg/kg-day = Milligrams per kilogram per day
NA = Not applicable

(1) Toxictiy values shown include COCs in subsurface soil and ground water
(2) The dermal RfD was assumed to equal the oral RfD, unless an adjustment factor was found in Exhibit 4.1 of RAGS-E (EPA 2004).
(3) IRIS values were confirmed against the EPA's online database, December 2007 and March 2008; Region 9 PRG Table, October 20, 2004; NCEA values obtained from NCEA on the date indicated.

Table 6
NON-CANCER TOXICITY DATA -- INHALATION
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee

Chemical of Concern (1)	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (2)		Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	RfC Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (3) (MM/DD/YYYY)
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (Total)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (Hexavalent)	Chronic	1.0E-04	mg/m^3	3.0E-05	mg/kg-day	Nasal septum atrophy	90	IRIS	3/1/2008
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA

IRIS = Integrated Risk Information System
RfC = Reference concentration
RfD = Reference dose
NA = Not applicable
mg/m^3 = Milligrams per cubic meter
mg/kg = Milligrams per kilogram per day
IRIS = Integrated Risk Information System
Route = Route-to-route extrapolation from Region 9 PRG tables, http://www.epa.gov/region09/waste/sfund/prg/index.htm
(1) Toxicity values shown include COCs in subsurface soil and ground water
(2) Inhalation RfDs were calculated from Inhalation RfCs assuming a 70 kg individual has an inhalation rate of 20 m3/day.(USEPA Risk Assessment Guidance for Superfund, Part A; December 1989).
(3) IRIS values were confirmed against the EPA's online database, December 2007 and March 2008

Table 7
SUBCHRONIC NON-CANCER TOXICITY DATA -- INHALATION
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee

Chemical of Concern (1)	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (2)		Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	RfC Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (3) (MM/DD/YYYY)
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (Total)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (Hexavalent)	Chronic	1.0E-04	mg/m^3	3.0E-05	mg/kg-day	Nasal septum atrophy	90	IRIS	3/1/2008
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA

IRIS = Integrated Risk Information System
RfC = Reference concentration
RfD = Reference dose
NA = Not applicable
mg/m^3 = M illigrams per cubic meter
mg/kg-day = Milligrams per kilogram per day
Route = Route-to-route extrapolation from Region 9 PRG tables, http://www.epa.gov/region09/waste/sfund/prg/index.htm
(1) Toxicity values shown include COCs in subsurface soil and ground water
(2) Inhalation RfDs were calculated from Inhalation RfCs assuming a 70 kg individual has an inhalation rate of 20 m^3/day.(USEPA Risk Assessment Guidance for Superfund, Part A; December 1989).
(3) IRIS values were confirmed against the EPA's online database, December 2007 and March 2008

Table 8
CANCER TOXICITY DATA -- ORAL/DERMAL
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee

Chemical of Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (1)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (2)
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (Total)	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (Hexavalent)	NA	NA	NA	NA	NA	NÀ	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA

Table 9
CANCER TOXICITY DATA -- INHALATION
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (2)
Antimony	NA	NA	NA	NA	NA	NA	NA
Chromium (Total)	NA	NA	NA	NA	NA	NA	NA
Chromium (Hexavalent)	1.2E-02	ug/m^3	4.1E+01	(mg/kg/day)-1	A	IRIS	03/01/2008
Iron	NA	NA	NA	NA	NA	NA	NA

IRIS = Integrated Risk Information System
NA = Not applicable
ug/m^3 = Micrograms per cubic meter
mg/kay/day = Mlligrams per kilogram per day
IRIS = Integrated Risk Information System
Route = Route-to-route extrapolation from Region 9 PRG tables, http://www.epa.gov/region09/waste/sfund/prg/index.htm
(1) Inhalation CSFs were calculated from unit risks assuming a 70 kg individual has an inhalation rate of 20 m3/day.
(2) IRIS values were confirmed against the EPA's online database, December 2007 and March 2008

EPA Weight of Evidence:
A - Human Carcinogen

Table 10: Risk Characterization Summary for Current Off-Site Resident – Noncarcinogens

Scenario Timeframe: Current
Receptor Population: Off-site Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Noncarcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Ground Water	Surficial Aquifer Shallow (<104 ft bls)	Tap Water	Antimony	Blood	15	NA	NA	15
			Chromium (Total)	NA	3	NA	NA	3
			Chromium (Hexavalent)	NA	2367	NA	NA	2367
			Iron	GI Tract/Liver	0.4	NA	NA	0.4
							Ground-water Hazard Index Total=	2387
							Receptor Hazard Index=	2387
							GI Tract/Liver Hazard Index=	0.4
							Blood Hazard Index=	15

Key
ft: Feet
bls: Below land surface
NA: Not applicable
GI: Gastrointestinal

Table 11: Risk Characterization Summary for Future Construction Worker – Noncarcinogens								
Scenario Timeframe: Future **Receptor Population: Construction Worker** **Receptor Age: Adult**								
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Concern**	**Primary Target Organ**	**Noncarcinogenic Hazard Quotient**			
					Ingestion	**Inhalation**	**Dermal**	**Exposure Routes Total**
	Subsurface Soil	Concrete Building Area	Chromium (Hexavalent)	NA	37	0.02	2	39
							Soil Hazard Index Total=	39
Ground Water	Surficial Aquifer Shallow (<104 ft bls)	Tap Water	Antimony	Blood	2	NA	NA	2
			Chromium (Total)	NA	0.4	NA	NA	0.4
			Chromium (Hexavalent)	NA	362	NA	NA	362
							Ground-water Hazard Index Total=	365
							Receptor Hazard Index=	405
							Liver Hazard Index=	0.76
							GI Tract Hazard Index=	0.6
							Skin Hazard Index=	0.2
							Blood Hazard Index=	2

Key
ft: Feet
bls: Below land surface
NA: Not applicable

Table 12: Risk Characterization Summary Future On-Site Resident – Noncarcinogens								
Scenario Timeframe: Future **Receptor Population: On-Site Resident** **Receptor Age: Child**								
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Concern**	**Primary Target Organ**	**Noncarcinogenic Hazard Quotient**			
					Ingestion	**Inhalation**	**Dermal**	**Exposure Routes Total**
Ground Water	Surficial Aquifer Shallow (<104 ft bls)	Tap Water	Antimony	Blood	15	NA	NA	15
			Chromium (Total)	NA	3	NA	NA	3
			Chromium (Hexavalent)	NA	2367	NA	NA	2367
			Iron	GI Tract/Liver	0.4	NA	NA	0.4
							Ground-water Hazard Index Total=	2387
							Receptor Hazard Index=	2390
							Skin Hazard Index=	1.6
							GI Tract Hazard Index=	1.4
							Liver Hazard Index=	2.1
							Blood Hazard Index=	15

Key
ft: Feet
bls: Below land surface
NA: Not applicable
GI: Gastrointestinal

Table 13: Cleanup Goals for Ground Water

Contaminant	Cleanup Goal (µg/L)[1]	Basis [2,3]
Antimony	6	MCL
Chromium (total)	100	MCL
Chromium (hexavalent)	47	HQ=1
Iron	4,693	HQ=1

[1] µg/L is micrograms per liter or parts per billion.
[2] MCL - Maximum Contaminant Level
[3] HQ – Hazard Quotient equal to one for future child resident

Table 14: Cleanup Goal for Subsurface Soil

Contaminant	Cleanup Goal (mg/kg)[1]	Basis [2]
Chromium (hexavalent)	876	HQ=1

[1] µg/L is micrograms per kilograms or parts per million.
[2] HQ – Hazard Quotient equal to one for future construction worker

Table 15: Cost Comparison of Remedial Alternatives

Alternative Description		Capital Cost	Annual Costs O&M	Duration (years)		Total Present Worth Cost
				Sub-surface Soil	Ground Water	
1	No Action	$0	$21,140	<1	1	$262,328
4	Soil Removal, On-Site Treatment, On-Site Disposal, Ground Water Pump and Treat, Institutional Controls	$6,054,462	$533,106	<1	3-10	$12,481,622
5	Soil Removal, On-Site Treatment, Off-Property Disposal, Ground Water Pump and Treat, Institutional Controls	$4,893,765	$524,106	<1	3-10	$10,461,909
8	In-Place Soil Flushing, Ground Water Pump and Treat, Institutional Controls	$3,443,438	$502,106	<1	10-12	$8,049,106

Total Present Worth Cost: The amount of money that EPA would have to invest now at seven percent interest to have sufficient funds available at the actual time the remedial alternative is implemented.

Table 16 Chemical-specific ARARs for the Smalley-Piper Superfund Site

Action/medium	Requirements	Prerequisite	Citation(s)
Restoration of ground water to its designated use(s)	May not exceed MCLs and MCLGs above zero established under the Safe Drinking Water Act for public water systems	Presence of contaminants in ground water of the State designated as *General Use* as defined in TDEC 1200-4-3-.07(2)(b) and classified in TDEC 1200-4-3-.07(4)(b)—**relevant and appropriate**	40 CFR 141 *et. seq.* TDEC 1200-5-1-.06
	Except for naturally occurring levels, shall not contain constituents in excess of the concentrations listed in Table 1. *Inorganic Criteria for General Use Ground Water*		TDEC 1200-4-3-.08(2)(a)
	Except for naturally occurring levels, shall not contain constituents exceeding those in TDEC 1200-4-3-.03 except that the criteria for *Fish and Aquatic Life* and *Recreational* Use shall not apply		TDEC 1200-4-3-.08(2)(b)

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
TBC = to be considered
TCA = *Tennessee Code Annotated*
TDEC = Rules of the Tennessee Department of Environment and Conservation, Chapter as noted

Table 17 Action-specific ARARs and TBC guidance for the Smalley-Piper Superfund Site

Action	Requirements	Prerequisite	Citation(s)
	General construction standards—all land-disturbing activities (i.e., excavation, etc.)		
Activities causing fugitive dust emissions	Shall take reasonable precautions to prevent particulate matter from becoming airborne; reasonable precautions shall include, but are not limited to, the following:	Fugitive emissions from demolition of existing buildings or structures, construction operations, grading of roads, or the clearing of land —**applicable**	TDEC 1200-3-8-.01(1)
	• use, where possible, of water or chemicals for control of dust, and		TDEC 1200-3-8-.01(1)(a)
	• application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces which can create airborne dusts;		TDEC 1200-3-8-.01(1)(b)
	Shall not cause or allow fugitive dust to be emitted in such a manner as to exceed 5 minute/hour or 20 minute/day beyond property boundary lines on which emission originates		TDEC 1200-3-8-.01(2)
Activities causing storm water runoff (e.g., clearing, grading, excavation)	Implement good construction management techniques (including sediment and erosion controls, vegetative controls, and structural controls) in accordance with the substantive requirements of *General Permit No. TNR10-0000* to ensure that storm water discharge:	Dewatering or storm water runoff discharges from land disturbed by construction activity—disturbance of ≥1 acre of total land —**applicable**	TCA 69-3-108(j) TDEC 1200-4-10-.03(2)
	• does not violate water quality criteria as stated in TDEC 1200-4-3-.03 including but not limited to prevention of discharges that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the designated uses for that water body by TDEC 1200-4-4	Storm water discharges from construction activities –**TBC**	*General Permit No. TNR10-0000* Section 4.3.2(a)
	• does not contain distinctly visible floating scum, oil, or other matter;		*General Permit No. TNR10-0000* Section 4.3.2(b)
	• does not cause an objectionable color contrast in the receiving stream; and		*General Permit No. TNR10-0000 Section 4.3.2(c)*
	• results in no materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream		*General Permit No. TNR10-0000 Section 4.3.2(d)*

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
	Underground injection well installation and closure		
Injection of contaminated ground water that has been treated and is being re-injected into same formation from which it was drawn if associated with remedial activity or injection used in innovative or experimental technologies	Wells shall be designed, constructed, and operated in such a manner that does not present a hazard to existing or future use of ground water and may not cause a violation of primary drinking water standards as given in TDEC 1200-5-1 or adversely effect the health of persons	Class V injection well associated with remedial activity and/or innovative or experimental technologies—**relevant and appropriate**	TDEC 1200--4-6-.06(5)(g) and (j) TDEC 1200-4-6-.09(1)-(4) TDEC 1200-4-6-.14(1)(b), (7), and (8)
Plugging and abandonment of Class V injection wells	A Class V injection well shall be plugged with cement in a manner which will not allow movement of fluids between underground sources of drinking water.	Permanent plugging and abandonment of a Class V injection well ---**relevant and appropriate**	TDEC 1200-4-6-.09(6)-(8)
	Shall be performed in accordance with the provisions for Seals at Rules of the TDEC 1200-4-6-.09(6)(e), (f), and (g); for Fill Materials at Rules of the TDEC 1200-4-6-.09(6)(h) and (i); for Temporary Bridges at Rules of the TDEC 1200-4-6-.09(6)(j); for Placement of Sealing Materials at Rules of the TDEC 1200-4-6-.09(7)(a) and (b); and Special Conditions at Rules of the TDEC 1200-4-6-.09(8)(a) and (b), as appropriate		TDEC 1200-4-6-.14(11)(b)
	Ground water monitoring and recovery well installation and closure		
Installation and maintenance of ground water monitoring and recovery wells	All wells shall be constructed in a manner that will guard against contamination of the ground water aquifers underlying Shelby County Shall be performed in accordance with the substantive provisions for Siting at Section 6.02, for Sanitary Protection at Section 6.03, for Construction Materials and Other Requirements at Section 6.04, for Maintenance and Protection of wells at Sections 6.05 and 6.06 respectively	Construction, modification, and repair of ground water monitoring and recovery wells--- **relevant and appropriate**	*Rules and Regulations of Wells in Shelby County* Section 6

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
Closure of ground water monitoring and recovery wells	Well shall be completely filled and sealed in such a manner that vertical movement of water from one aquifer or formation to another to avoid water quality and/or water quantity problems	Permanent plugging and abandonment of a well—**relevant and appropriate**	Rules and Regulations of Wells in Shelby County Section 9
	Waste generation, characterization, segregation, and storage—primary wastes (excavated contaminated soils) and secondary wastes (wastewaters, spent treatment media, etc.)		
Characterization of solid waste	Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR 261.4(b); and	Generation of solid waste as defined in 40 CFR 261.2 and which is not excluded under 40 CFR 261.4(a) — **applicable**	40 CFR 262.11(a) TDEC 1200-1-11-.03(1)(b)(1)
	Must determine if waste is listed under 40 CFR Part 261; or		40 CFR 262.11(b) TDEC 1200-1-11-.03(1)(b)(2)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used		40 CFR 262.11(c) TDEC 1200-1-11-.03(1)(b)(3)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste	Generation of solid waste which is determined to be hazardous – **applicable**	40 CFR 262.11(d); TDEC 1200-1-11-.03(1)(b)(4)
Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268	Generation of RCRA-hazardous waste for storage, treatment or disposal—**applicable**	40 CFR 264.13(a)(1) TDEC 1200-1-11-.06(2)(d)(1)
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the waste	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal – **applicable**	40 CFR 268.9(a) TDEC 1200-1-11-.10(1)(i)(1)
	Must determine if the waste is restricted from land disposal under 40 CFR 268 *et. seq.* by testing in accordance with prescribed methods or use of generator knowledge of waste		40 CFR 268.7 TDEC 1200-1-11-.10(1)(g)(1)(i)

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
	Must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 CFR 268.40 *et. seq.*		40 CFR 268.9(a) TDEC 1200-1-11-.10(1)(i)(1)
Temporary storage of remediation waste in staging piles (excavated soils)	An accumulation of solid, non-flowing remediation waste defined in 40 CFR 260.10 not in a containment building may be temporarily stored, including mixing, sizing, blending or other similar physical operations intended to prepare the wastes for subsequent management or treatment, at a facility if used only during remedial operations provided that the staging pile will:	Accumulation of remediation waste on site as defined in 40 CFR 260.10 **---applicable**	40 CFR 264.554(a)(1)
	• facilitate a reliable, effective and protective remedy;		40 CFR 264.554(d)(1)(i)
	• prevent or minimize releases of hazardous wastes and constituents into the environment and minimize or adequately control cross-media transfer as necessary to protect human health and the environment (e.g. use of liners, covers, run-off/run-on controls);		40 CFR 264.554(d)(1)(ii)
	• *not operate for more than 2 years from first time* remediation waste placed in staging pile or up to *an additional 180 days beyond the operating term* limit if the continued operation of the staging pile will not pose a threat to human health and the environment and is necessary to ensure timely and efficient implementation of remedial actions at the facility		40 CFR 264.554(d)(1)(iii) and 40 CFR 264.554(i)(1)
Closure of staging piles of remediation waste located in previously contaminated area	Must be closed within 180 days after the operating term by removing or decontaminating all remediation waste, contaminated containment system components, and structures and equipment contaminated with waste and leachate	Storage of remediation waste in staging pile in previously contaminated area **---applicable**	40 CFR 264.554(j)
Closure of staging piles of remediation waste located in an uncontaminated area	Must be closed within 180 days after the operating term according to 40 CFR 264.258(a) and 264.111 or 265.258(a) and 265.111	Storage of remediation waste in staging pile in uncontaminated area **---applicable**	40 CFR 264.554(k)

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
Temporary storage of hazardous waste in containers (secondary wastes – ground water spent treatment)	A generator may accumulate hazardous waste at the facility provided that:	Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10—**applicable**	40 *CFR* 262.34(a); TDEC 1200-1-11-.03(4)(e)
	• waste is placed in containers that comply with 40 CFR 265.171-173; and		40 *CFR* 262.34(a)(1)(i); TDEC 1200-1-11-.03(4)(e)(2)(ii)(I)
	• the date upon which accumulation begins is clearly marked and visible for inspection on each container		40 *CFR* 262.34(a)(2); TDEC 1200-1-11-.03(4)(e)(2)(ii)
	• container is marked with the words "hazardous waste" or		40 CFR 264.34(a)(3) TDEC 1200-1-11-.03(4)(e)(2)(iv)
	• container may be marked with other words that identify the contents	Accumulation of 55 gal. or less of RCRA hazardous waste at or near any point of generation—**applicable**	40 CFR 262.34(c)(1) TDEC 1200-1-11-.03(4)(e)(5)(i)(II)
Use and management of hazardous waste in containers (secondary wastes – ground water spent treatment)	If container is not in good condition (e.g. severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition	Storage of RCRA hazardous waste in containers—**applicable**	40 CFR 265.171 TDEC 1200-1-11-.05(9)(b)
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired		40 CFR 265.172 TDEC 1200-1-11-.05(9)(c)
	Keep containers closed during storage, except to add/remove waste		40 CFR 265.173(a) TDEC 1200-1-11-.05(9)(d)(1)
	Open, handle and store containers in a manner that will not cause containers to rupture or leak		40 CFR 265.173(b) TDEC 1200-1-11-.05(9)(d)(2)
Storage of hazardous waste in container area (secondary wastes – ground water spent treatment)	Area must have a containment system designed and operated in accordance with 40 *CFR* 264.175(b)	Storage of RCRA-hazardous waste in containers with free liquids—**applicable**	40 *CFR* 264.175(a) TDEC 1200-1-11-.06(9)(f)(1)

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid	Storage of RCRA-hazardous waste in containers that do not contain free liquids —**applicable**	40 *CFR* 264.175(c) TDEC 1200-1-11-.06(9)(f)(3)
Treatment/disposal of wastes—primary (excavated soils and treatment waters) and secondary wastes (ground water spent treatment)			
Disposal of RCRA-hazardous waste in a land-based unit	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste—**applicable**	40 CFR 268.40(a) TDEC 1200-1-11-.10(3)(a)
	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c) or according to the UTSs [specified in 40 CFR 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils—**applicable**	40 CFR 268.49(b) TDEC 1200-1-11-.10(3)(j)(2)
Disposal of RCRA hazardous waste in a land-based unit	May achieve compliance with alternative treatment standards if hazardous constituents reduced by at least 90% through treatments so no more than 10% of their initial concentration remains or comparable reduction in mobility for metals; or hazardous constituents must not exceed 10 times the universal treatment standards at 40 CFR 268.48	Land disposal of contaminated soils using alternative treatment standards---**TBC**	EPA 530-R-02-003, July 2002 Guidance on demonstrating compliance with the LDR alternative soil treatment standards
Disposal of hazardous waste in a miscellaneous unit	A miscellaneous unit must be located, designed, constructed, operated, maintained and closed in a manner that will ensure protection of human health and the environment	Disposal of hazardous waste in a miscellaneous unit ---**applicable**	40 CFR 264.600 Subpart X
	A miscellaneous disposal unit must be maintained in a manner that complies with 40 CFR 264.601 during post closure and if a treatment or storage unit has contaminated soils or ground water that cannot be completely removed or decontaminated during closure, then that unit must meet the requirements of 40 CFR 264.601 during post-closure care		40 CFR 264.601

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
Discharge of treated ground water to surface water	Shall receive the degree of treatment or effluent reduction necessary to comply with water quality standards and, where appropriate, will comply with the standard of performance as required by the Tennessee Water Quality Control Act of 1977 at TCA 69-3-103(30)	Point source discharge(s) of pollutants into surface water —**applicable**	TDEC 1200-4-3-.05(6)
Discharge of treated ground water	Are not prohibited from land disposal if such wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under section 402 of the Clean Water Act; or the wastes are treated for purposes of the pretreatment requirements of section 307 of the Clean Water Act; or the wasted are managed in a zero discharge system engaged in Clean Water Act equivalent treatment as defined in 40 CFR 268.37(a), unless the wastes are subject to a specified method of treatment other than DEACT in 40 CFR 268.40 or are DOO3 reactive cyanide	Restricted RCRA characteristically hazardous waste intended for disposal ---**applicable**	40 C.F.R. 268.1(c)(4) TDEC 1200-1-11.10(1)(iv)
		Transportation	
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR 171-180	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material —**applicable**	49 CFR 171.1(c)
Transportation of hazardous waste off site	Must comply with the generator requirements of 40 CFR 262.20–23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding and Sect. 262.40, 262.41(a) for record keeping requirements and Sect. 262.12 to obtain EPA ID number	Off-site transportation of RCRA hazardous waste—**applicable**	40 CFR 262.10(h) TDEC 1200-1-11-.03(1)(a)(8)
	Must comply with the requirements of 40 CFR 263.11–263.31 A transporter who meets all applicable requirements of 49 CFR 171–179 and the requirements of 40 CFR 263.11 and 263.31 will be deemed in compliance with 40 CFR 263	Transportation of hazardous waste within the United States requiring a manifest—**applicable**	40 CFR 263.10(a) TDEC 1200-1-11-.04(1)(a)(1)

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
Management of samples (i.e. contaminated soils and wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when:	Generation of samples of hazardous waste for purpose of conducting testing to determine its characteristics or composition---**applicable**	40 CFR 261.4(d)(1)
	• The sample is being transported to a laboratory for the purpose of testing;		40 CFR 261.4(d)(1)((i)
	• The sample is being transported back to the sample collector after testing; and		40 CFR 261.4(d)(1)(ii)
	• The sample collector ships samples to a laboratory in compliance with U.S. Department of Transportation, U.S. Postal Service, or any other applicable shipping requirements, including packing the sample so that it does not leak, spill or vaporize from its packaging		40 CFR 261.4(d)(2)
Management of treatability samples (i.e. contaminated soils and wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 263, nor are such samples included in the quantity determinations of 40 CFR 261.5 and 262.34(d) when:	Generation of samples of hazardous waste for purpose of conducting treatability studies as defined in 40 CFR 260.10—**applicable**	40 CFR 261.4(e)(1) TDEC 1200-1-11-.02(1)(d)(5)(i)
	• The sample is being collected and prepared for transportation by the generator or sample collector;		40 CFR 261.4(e)(1)(i) TDEC 1200-1-11-.02(1)(d)(5)(i)(I)
	• The sample is being accumulated or stored by the generator or sample collector prior to transportation to a laboratory or testing facility; or		40 CFR 261.4(e)(1)(ii) TDEC 1200-1-11-.02(1)(d)(5)(i)(II)
	• The sample is being transported to the laboratory or testing facility for purpose of conducting a treatability study		40 CFR 261.4(e)(1)(iii) TDEC 1200-1-11-.02(1)(d)(5)(i)(III)

Table 17 (continued)

Action	Requirements	Prerequisite	Citation(s)
Transportation of hazardous waste on site	The generator manifesting requirements of 40 CFR 262.20–262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way—**applicable**	40 CFR 262.20(f) TDEC 1200-1-11-.03(3)(a)(6)

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CWA = Clean Water Act of 1972
NPDES = National Pollutant Discharge Elimination System
DEACT = deactivation
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
RCRA = Resource Conservation and Recovery Act of 1976
HMR = Hazardous Materials Regulations
HMTA = Hazardous Materials Transportation Act
TBC = to be considered
TCA = *Tennessee Code Annotated*
TDEC = Rules of theTennessee Department of Environment and Conservation, Chapter as noted
UTS = Universal Treatment Standard

Table 18 : Estimated Remedy Construction Costs

Item Description	Units	Quantity	Unit Price Dollars	Total Cost Dollars
Institutional Controls (Physical)				
Mobilization/demobilization	each	1	$3,000	$3,000
Temporary Facilities	each	1	$500	$500
Fencing	lf	1,450	$50.00	$72,500
Signage	each	16	$100	$1,600
Health & Safety Equipment	each	1	$2,000	$2,000
Demolition, Site Preparation, Storm Water Management	LS	1	$35,000	$35,000
Installation of New Monitoring Wells (10)				
Mobilization/demobilization	each	2	$10,000	$20,000
Bore hole drilling	each	10	$4,000	$40,000
Well and screen installation	each	10	$4,000	$40,000
Well development and water analysis	each	10	$1,000	$10,000
Health & Safety Equipment	each	1	$1,000	$1,000
Bore hole logs and reporting	each	10	$500	$5,000
Soil Excavation, site prep, confirmatory sampling				
Mobilization/demobilization	each	2	$10,000	$20,000
Excavation - Contaminated Soil and Impoundment Area Material	CY	5,333	$15	$79,995
Excavation Confirmation Testing (1 test per 100 ft2)	each	20	$100	$2,000
Dust Control & Air Monitoring	CY	5,333	$10	$53,330
Health & Safety Equipment	each	1	$10,000	$10,000
Soil Treatment Facility (Ex Situ S/S)				
Staging and Site Area	ft^2	40,000	$3	$120,000
Dust Control (e.g., spray water)	months	1	$50,000	$50,000
Air Monitoring (equipment and personnel)	months	1	$10,000	$10,000
***Ex Situ* Soil Treatment, Confirmation**				
Mobilization/demobilization	each	1	$25,000	$25,000
Temporary Facilities	each	1	$5,000	$5,000
Ex Situ Soil Stabilization and Solidification (ExSSSS)	ton	7,150	$89	$636,350
Health & Safety Equipment	each	1	$10,000	$10,000
Dust Control & Air Monitoring	each	1	$30,000	$30,000
Off-site Disposal (Non-Hazard; RCRA Subtitle D Facility)				
Mobilization/demobilization	each	1	$20,000	$20,000
Temporary Facilities	each	1	$10,000	$10,000
Truck Transport	ton	6,933	$10	$69,329
Disposal at Subtitle C Treatment/Disposal Facility	ton	6,933	$25	$173,323
Dust Control (e.g., spray water)	months	1	$50,000	$50,000
Air Monitoring (equipment and personnel)	months	1	$10,000	$10,000

Item Description	Units	Quantity	Unit Price Dollars	Total Cost Dollars
Borrow Material and Backfill Excavation Pits				
Backfill Excavated Areas with Clean Fill	CY	8,000	$3	$24,000
Place 6-inch top soil layer over the excavated areas	CY	800	$20	$16,000
Grading & Compacting	acre	2	$5,000	$10,000
Seed & Mulch	acre	2	$2,000	$4,000
Dust Control (e.g., spray water)	months	0.2	$50,000	$10,000
Air Monitoring (equipment and personnel)	months	0.2	$10,000	$2,000
Ground Water Injection Well Installation and Operation (Source Area)				
Mobilization/demobilization	each	2	$10,000	$20,000
Bore hole drilling	each	2	$4,000	$8,000
Well and screen installation	each	2	$4,000	$8,000
Pump installation	each	2	$1,000	$2,000
Health & Safety Equipment	each	1	$1,000	$1,000
Bore hole logs and reporting	each	2	$500	$1,000
Ground Water Extraction Well Installation and Operation (Source Area)				
Mobilization/demobilization	each	2	$10,000	$20,000
Bore hole drilling	lf	400	$150	$60,000
Well and screen installation	lf	40	$165	$6,600
Pump installation (500 - 1000 gallons per minute)	each	2	$38,673	$77,346
Health & Safety Equipment	each	1	$1,000	$1,000
Bore hole logs and reporting	each	2	$500	$1,000
Ground Water Treatment (Conventional Chemical Treatment) (Source Area)				
Mobilization/demobilization	each	1	$20,000	$20,000
Temporary Facilities	each	1	$10,000	$10,000
Treatability Study	LS	1	$50,000	$50,000
Chemical Costs (acid/base)	1000 gal	900,000	$0.25	$225,000
Chemical Costs (oxidizing agent)	1000 gal	900,000	$0.25	$225,000
Chemical Costs (reducing agent)	1000 gal	900,000	$0.25	$225,000
Reactors, Pumps and Piping	each	1	$100,000	$100,000
Health & Safety Equipment	each	1	$30,000	$30,000
Ground Water Transfer (Pump from Treatment to Injection)	LS	1	$50,000	$50,000
Ground Water Extraction Well Installation and Operation (Dedicated Extraction Well 1, Southwest Plume Boundary)				
Mobilization/demobilization	each	2	$10,000	$20,000
Bore hole drilling	lf	400	$150	$60,000
Well and screen installation	lf	40	$165	$6,600
Pump installation (500 – 1000 gallons per minute)	each	2	$38,673	$77,346
Health & Safety Equipment	each	1	$1,000	$1,000
Bore hole logs and reporting	each	2	$500	$1,000

Item Description	Units	Quantity	Unit Price Dollars	Total Cost Dollars
Ground Water Treatment (Ion-Exchange) (Dedicated Extraction Well 1, Southwest Plume Boundary)				
Mobilization/demobilization	each	1	$20,000	$20,000
Temporary Facilities	each	1	$10,000	$10,000
Treatability Study	LS	1	$5,000	$5,000
Synthetic Resin (anionic)	Ft^3 resin	1,350,000	$0.45	$607,500
Chemical Costs (Filtration media)	Ft^3 resin	1,350,000	$0.05	$67,500
Reactors, Pumps and Piping	each	1	$100,000	$100,000
Health & Safety Equipment	each	1	$10,000	$10,000
Ground Water Transfer (Pump from Treatment to Injection) (Dedicated Extraction Well 1, Southwest Plume Boundary to Town)	LS	1	50000	$50,000
Ground Water Extraction Well Installation and Operation (Dedicated Extraction Well 2, Northwest Plume Boundary)				
Mobilization/demobilization	each	2	$10,000	$20,000
Bore hole drilling	lf	400	$150	$60,000
Well and screen installation	lf	40	$165	$6,600
Pump installation (500 – 1000 gallons per minute)	each	2	$38,673	$77,346
Health & Safety Equipment	each	1	$1,000	$1,000
Bore hole logs and reporting	each	2	$500	$1,000
Ground Water Treatment (Ion-Exchange) (Dedicated Extraction Well 2, Northwest Plume Boundary)				
Mobilization/demobilization	each	1	$20,000	$20,000
Temporary Facilities	each	1	$10,000	$10,000
Treatability Study	LS	1	$5,000	$5,000
Synthetic Resin (anionic)	Ft^3 resin	1,350,000	$0.45	$607,500
Chemical Costs (Filtration media)	Ft^3 resin	1,350,000	$0.05	$67,500
Reactors, Pumps and Piping	each	1	$100,000	$100,000
Health & Safety Equipment	each	1	$10,000	$10,000
Ground Water Transfer (Pump from Treatment to Injection) (Dedicated Extraction Well 2, Northwest Plume Boundary)	LS	1	50000	$50,000
Subtotal - Direct Capital Cost				$4,893,765
Contractor Fees				$470,876
Legal Fees, Licenses & Permits				$235,438
Engineering & Administrative Costs				$706,315
Direct Capital Contingency				$1,535,348
Subtotal - Contingency on Direct and Indirect Capital				$2,947,978
TOTAL CONSTRUCTION COST				$7,841,742

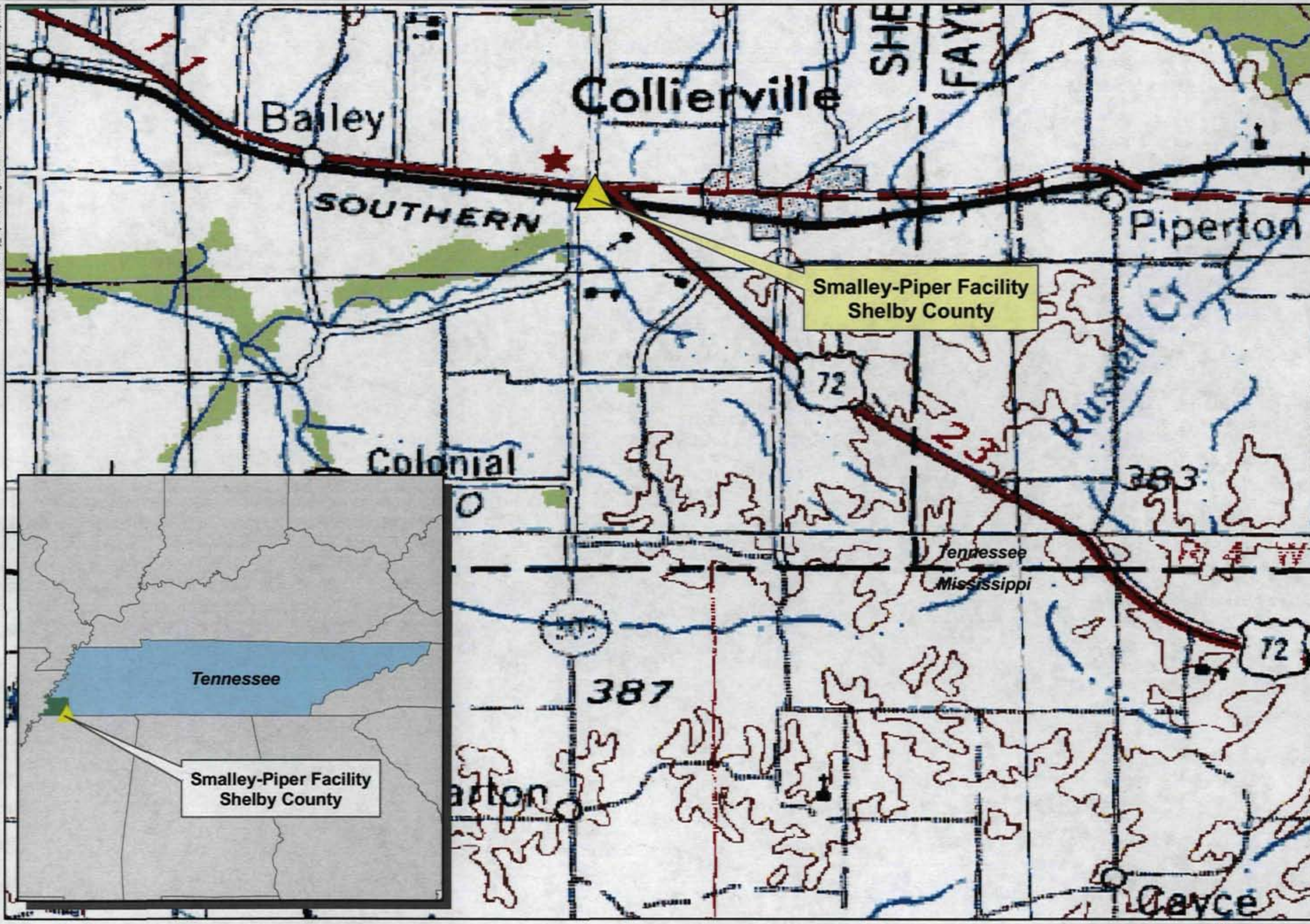
LS = lump sum lf = linear feet CY = cubic yard ft2 = square feet ft3 = cubic feet

Table 19 : Estimated Remedy Operation and Maintenance Costs

Item Description	Units	Quantity	Unit Price Dollars	Annual Cost Dollars	Time Yrs	NPW[1] Dollars
5-Year Review and Report						
Report Preparation (interviews, research)	LS	1	$25,000	$5,000	30	$62,045
Institutional Controls (Physical)						
Monitoring & Maintenance of Fenced Areas	quarterly	4	$2,000	$8,000	3	$20,995
Demolition, Site Preparation, Storm Water Management	LS	1	$5,000	$5,000		$5,000
Ground Water Monitoring (using existing monitoring wells)						
Personnel (2-man crew @ 10-hour days)	hours	100	$130	$13,000	30	$161,318
Supplies/ Travel	days	5	$2,000	$10,000	30	$124,090
Sampling and analytical (Period 1)	sample	20	$150	$3,000	10	$21,071
Report preparation (data summary report) (Period 1)	each	2	$5,000	$10,000	10	$70,236
Sampling and analytical (Period 2)	sample	10	$150	$1,500	10	$10,535
Report preparation (data summary report) (Period 2)	each	1	$5,000	$5,000	10	$35,118
Sampling and analytical (Period 3)	sample	10	$150	$1,500	10	$10,535
Report preparation (data summary report) (Period)	each	1	$5,000	$5,000	10	$35,118
Installation of New Monitoring Wells (10)						
Maintenance of Monitoring Wells (replace if necessary)	semi-annual	2	$1,000	$2,000	30	$24,818
Soil Treatment Facility (Ex Situ S/S)						
Soil Cap and Lawn Maintenance	year	1	$1,000	$1,000	30	$12,409
Truck hauling (on-site)	LS	1	$20,000	$20,000		$20,000
Borrow Material and Backfill Excavation Pits						
Soil Cap and Lawn Maintenance	year	1	$1,000	$1,000	30	$12,409
Ground Water Injection Well Installation and Operation (Source Area)						
Maintenance of Wells (replace if necessary)	semi-annual	2	$1,000	$2,000	2	$3,616
Ground Water Extraction Well Installation and Operation (Source Area)						
Maintenance of Wells (replace if necessary)	semi-annual	2	$1,000	$2,000	10	$14,047
Start-up Ground Water Treatment (Conventional Chemical Treatment) (Source Area)						
Treatment Process Operation and Maintenance	month	12	$3,000	$36,000	1	$36,000
Ground Water Transfer (Pump from Treatment to Injection)	LS	1	$50,000	$50,000	1	$50,000
Operation and Treatment-Derived Waste Management (Source Area)						
Treatment Process Operation and Maintenance	month	12	$4,642	$55,702	10	$391,226
Ground Water Extraction Well Installation and Operation (Dedicated Extraction Well 1 – Southwest Plume Boundary)						
Maintenance of Wells (replace if necessary)	semi-annual	2	$1,000	$2,000	10	$14,047

Item Description	Units	Quantity	Unit Price Dollars	Annual Cost Dollars	Time Yrs	NPW[1] Dollars
Start-up Ground Water Treatment (Ion-Exchange) (Dedicated Extraction Well 1 – Southwest Plume Boundary)						
Treatment Process Operation and Maintenance	month	12	$3,000	$36,000	1	$36,000
Ground Water Transfer (Pump from Treatment to Injection) (Dedicated Extraction Well 1 – Southwest Plume Boundary) to Town)	LS	1	$50,000	$50,000	1	$50,000
Operation and Treatment-Derived Waste Management (Dedicated Extraction Well 1 – Southwest Plume Boundary) Treatment Process Operation and Maintenance	month	12	$4,642	$55,702	10	$391,226
Ground Water Extraction Well Installation and Operation (Dedicated Extraction Well 2 – Northwest Plume Boundary) Maintenance of Wells (replace if necessary)	semi-annual	2	$1,000	$2,000	10	$14,047
Start-up Ground Water Treatment (Ion-Exchange) (Dedicated Extraction Well 2 – Northwest Plume Boundary) Treatment Process Operation and Maintenance	month	12	$3,000	$36,000	1	$36,000
Ground Water Transfer (Pump from Treatment to Injection) (Dedicated Extraction Well 2 – Northwest Plume Boundary to Town)	LS	1	$50,000	$50,000	1	$50,000
Operation and Treatment-Derived Waste Management (Dedicated Extraction Well 2 – Northwest Plume Boundary) Treatment Process Operation and Maintenance	month	12	$4,642	$55,702	10	$391,226
Subtotal - Operation and Maintenance (O&M) Cost				$524,106		$2,103,133
Contingency on O&M (25% of O&M Subtotal)						$517,033
TOTAL OPERATION AND MAINTENANCE + O&M CONTINGENCY						$2,620,167

Y:\EPA\048707\Smalley_Piper\GIS\Figures\InfoPiece\Figure 1 Site Location Map.mxd



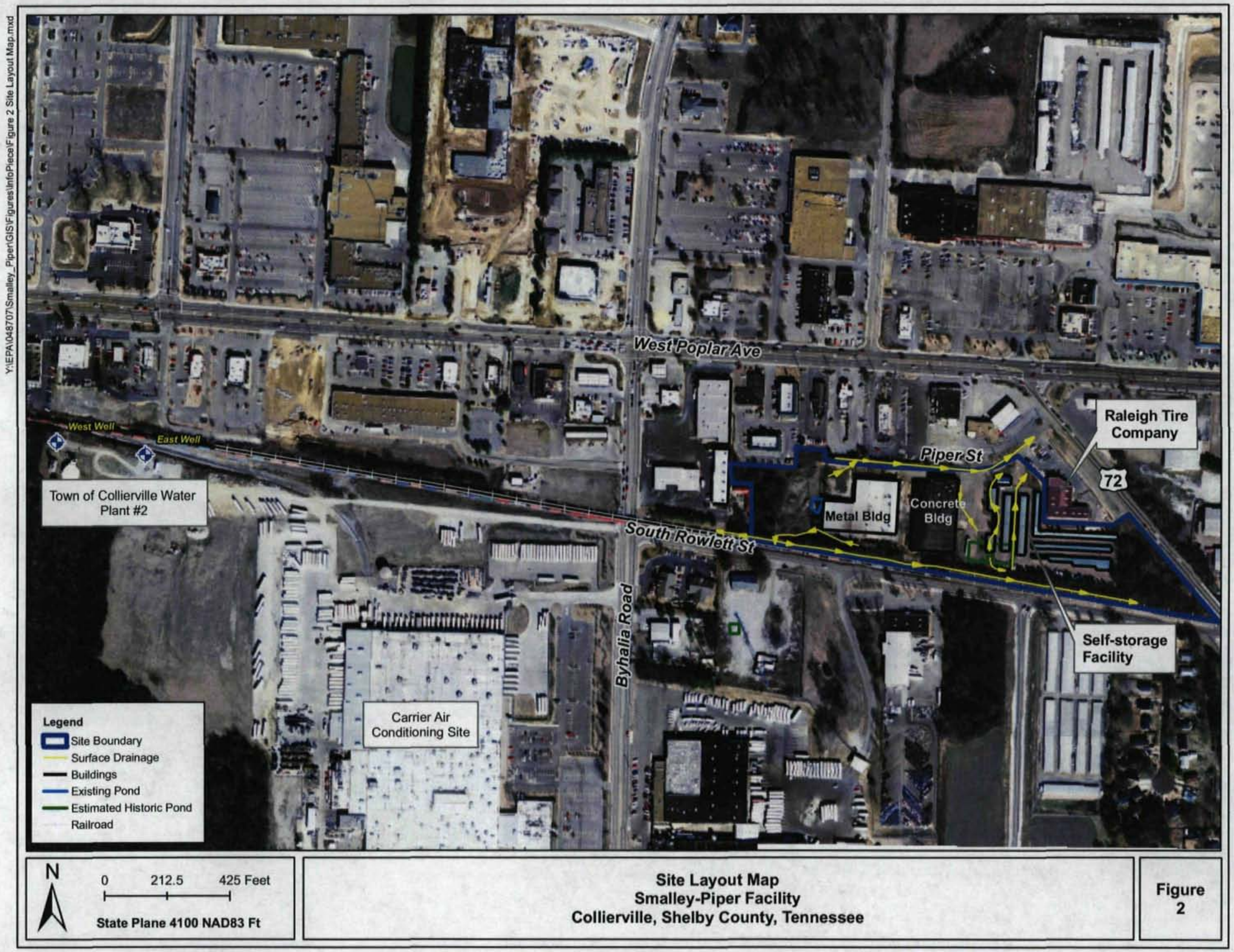
N

0 0.5 1 Miles

State Plane 4100 NAD83 Ft

Site Location Map
Smalley-Piper Facility
Collierville, Shelby County, Tennessee

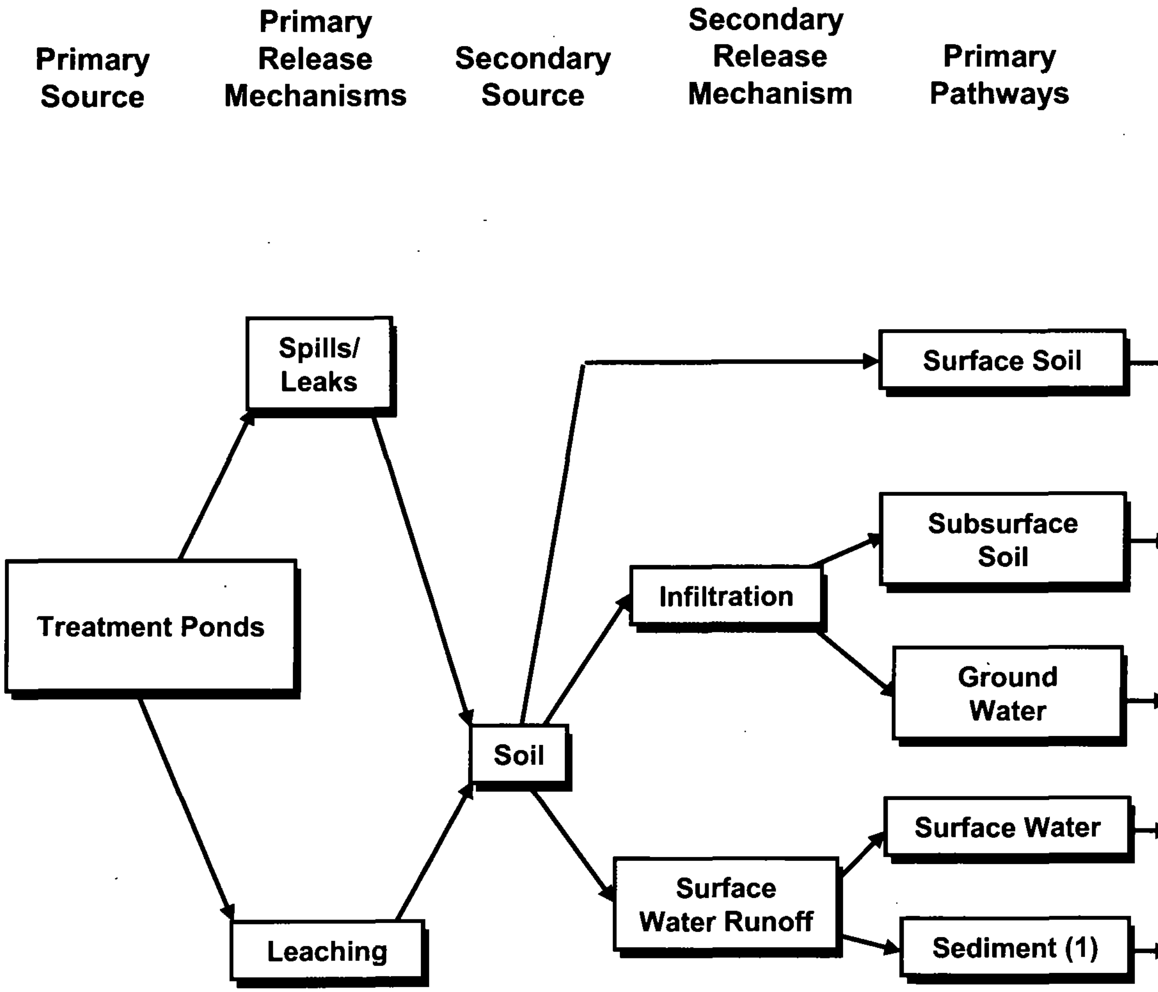
Figure 1



Site Layout Map
Smalley-Piper Facility
Collierville, Shelby County, Tennessee

Figure 2

Figure 3
Human Health Conceptual Site Model
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee

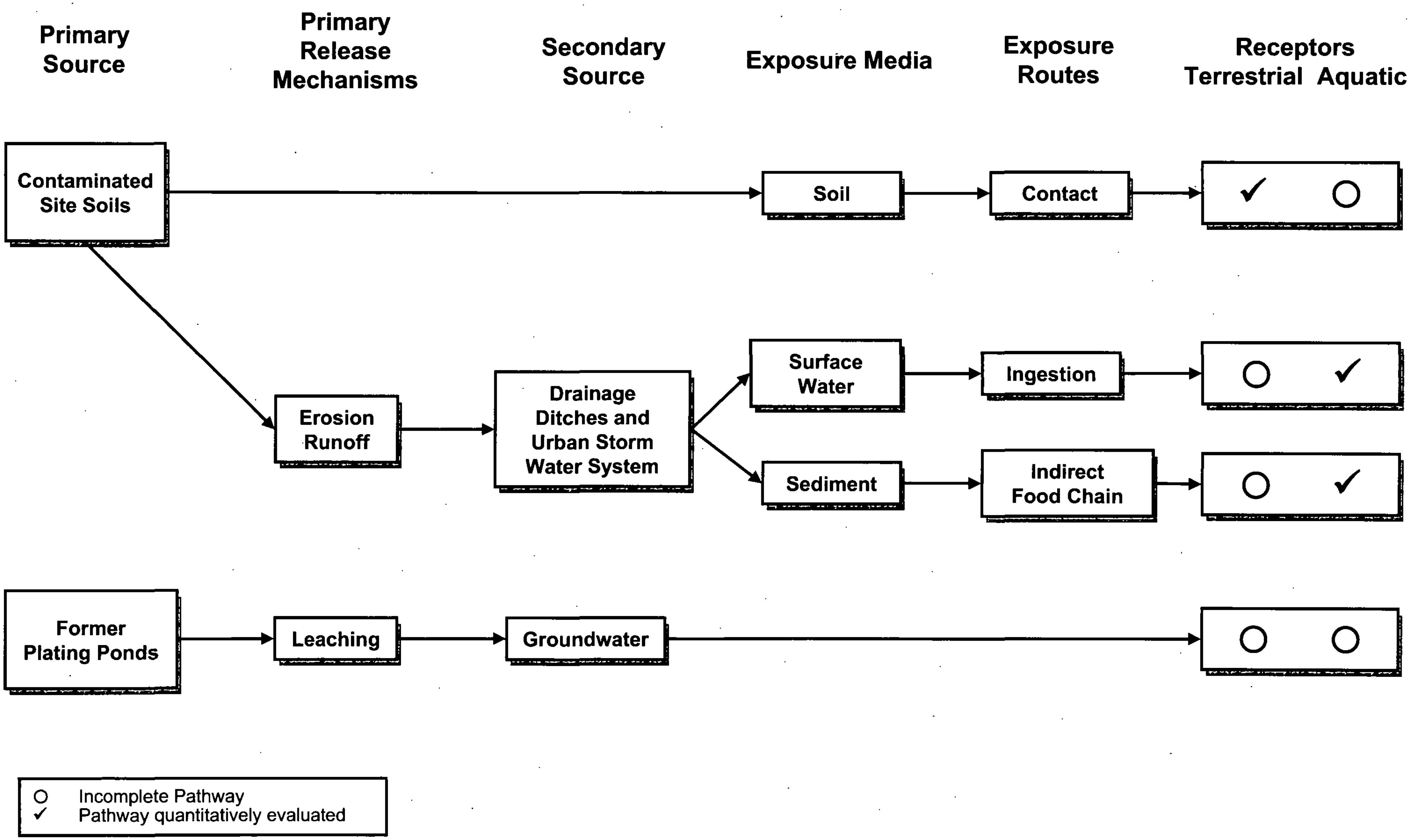


POTENTIAL HUMAN RECEPTORS

		CURRENT		FUTURE		
EXPOSURE ROUTE	Resident (Child & Adult)	Industrial Worker	Tresspasser	Construction Worker	Industrial Worker	On-Site Resident (Child & Adult)
Ingestion		X	X	X	X	X
Inhalation		●	●	X	●	●
Dermal Contact		X	X	X	X	X
Ingestion				X		●
Inhalation				X		●
Dermal Contact				X		●
Ingestion	X			X	X	X
Inhalation	X			●	●	X
Dermal Contact	X			X	X	X
Ingestion		X	X		X	X
Ingestion		X	X	X	X	X
Inhalation		●	●	X	●	●
Dermal Contact		X	X	X	X	X

X Pathway was quantitatively evaluated
● Pathway was qualitatively evaluated
(1) Sediment will be evaluated as surface soil.

Figure 4
Ecological Conceptual Site Model
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee



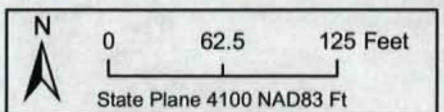
N

0 205 410 Feet

State Plane 4100 NAD83 Ft

Conceptual Model of Ground Water Plume Above Maximum Contaminant Level (MCL)
Smalley-Piper Superfund Site
Aerial (Plan) View
Collierville, Shelby County, Tennessee

Figure 5



Subsurface Soil Sample Locations Exceeding the RGO
Smalley-Piper Facility
Collierville, Shelby County, Tennessee

Figure
6

APPENDIX A1

Notice Published in the Commercial Appeal

U.S. Environmental Protection Agency Region 4 announces a Proposed Plan for the Smalley-Piper Superfund Site in Collierville, TN

The Smalley-Piper Superfund Site (Site) is located at 719 Piper Street in Collierville and covers about 9 acres. The US Environmental Protection Agency (EPA) Region 4 in Atlanta, in cooperation with the Tennessee Department of Environment and Conservation (TDEC) office in Memphis, has completed a remedial investigation and feasibility study (RI/FS) to determine the nature and extent of contamination related to past industrial activities at the Small-Piper Site and to evaluate the most cost-effective cleanup remedy to safeguard human health and the environment. RI/FS results indicate elevated concentrations of chromium onsite, likely related to past manufacturing activities that have affected ground water beneath the Site.

Summary of Remedial Alternatives

EPA evaluated the following eight alternatives for the Smalley-Piper Site. (A detailed analysis of Site risks and the alternatives evaluated to address those risks can be found in the Feasibility Study report at the Burch Public Library in Collierville).

Alternative 1: No Action The Superfund program requires "No Action" as a baseline. Under this alternative, EPA presents an evaluation of the Site if no remedial action takes place.

Alternative 2: Soil Removal, Off-Site Disposal, Ground Water Pump and Treat, Institutional Control

Source soil excavation, soil flushing to the water table, off-site disposal of contaminated soil at a permitted hazardous waste facility, backfilling of excavation pit with clean soil/fill material, site restoration, ground water pump and treat system, monitoring, and institutional control.

Alternative 3: In-Place Soil Stabilization/ Solidification, Ground Water Pump and Treat, Institutional Control

Soil chemically treated and solidified in-place, converting chromium into its trivalent form; ground water pump and treat system, monitoring, and institutional control.

Alternative 4: Soil Removal, On-Site Treatment, On-Site Disposal, Ground Water Pump and Treat, Institutional Control

Source soil excavation, soil flushing, on-site treatment to stabilize and solidify soil-bound contaminants, disposal cell for onsite burial of the treated soil matrix, backfill with clean soil and site restoration. Ground water pump and treat system, monitoring and institutional control.

Alternative 5: Soil Removal, On-Site Treatment, Off-Site Disposal, Ground Water Pump and Treat, Institutional Control

Soil source excavation, soil flushing, on-site treatment to stabilize and solidify soil-bound contaminants, off-site disposal at a permitted non-hazardous waste facility, backfill with clean soil/fill material, and site restoration. Ground water pump and treat system, monitoring, and institutional control.

Alternative 6: In-Place Soil Stabilization, In-Place Ground Water Treatment

Soil chemically treated and solidified in-place, converting chromium into its trivalent form; ground water pump and treat system; long-term monitoring. In-place chemical treatment of ground water contamination, monitoring, and institutional control.

Alternative 7: In-Place Soil Stabilization, Ground Water Permeable Reactive Barrier

Soil chemically treated and solidified in-place, converting chromium into its trivalent form; ground water pump and treat system; long-term monitoring. Ground water treatment same as Alternative 6, except it would use a "funnel and gate" arrangement; monitoring and institutional control.

Alternative 8: In-Place Soil Flushing, Ground Water Pump and Treat

Soil flushing, treated ground water and capture of flushed contamination; ground water pump and treat system, monitoring, and institutional control.

EPA's Preferred Remedy: Alternative 5: Soil Removal, On-Site Treatment by Solidification/ Stabilization, Off-Site Disposal, Ground Water Pump and Treat, and Institutional Control

EPA, in consultation with the State of Tennessee, believes the Preferred Alternative provides the best of tradeoffs among the alternatives with respect to the EPA's evaluation criteria. EPA expects the Preferred Alternative would protect human health and the environment, comply with Applicable or Relevant and Appropriate Requirements, be cost-effective, and use permanent solutions.

Public Comment Period: July 23 through August 23, 2008

Written comments on EPA's Preferred Alternative, as well as the other alternatives evaluated for the Smalley-Piper Site, will be accepted until August 23, 2008, and should be mailed to Mr. Femi Akindele, Superfund Remedial Branch, U.S. Environmental Protection Agency, 61 Forsyth St., Atlanta, Georgia 30303.

Public Meeting: Thursday, July 31, 2008, 6 PM, Collierville Town Hall

The EPA, in cooperation with TDEC, will hold a public meeting at Town Hall, 500 Poplar View Parkway, in Collierville to discuss the Smalley-Piper Site and provide an opportunity for citizens to ask questions and make comments.

For More Information

Mr. Femi Akindele
Remedial Project Manager
U. S. EPA, Region 4
(404) 562-8809 or 1-800-435-9234

Smalley-Piper Superfund Site
Information Repository, Reference Section,
Lucius E. & Elsie C. Burch, Jr. Library
501 Poplar View Pkwy, Collierville, TN 38017

APPENDIX A2

Smalley-Piper Public Meeting Transcript
July 31, 2008

SMALLEY-PIPER SUPERFUND SITE

PUBLIC MEETING

JULY 31, 2008

COLLIERVILLE TOWN HALL
500 POPLAR VIEW PARKWAY
COLLIERVILLE, TENNESSEE

6:00 P.M.

ORIGINAL

ALPHA REPORTING CORPORATION
236 Adams Avenue
Memphis, Tennessee 38103
(901) 523-8974
www.alphareporting.com

A P P E A R A N C E S

FOR WENSKA COMMUNICATIONS:

MARY WENSKA

FOR BLACK AND VEATCH:

GINA MONTGOMERY

FOR ENVIRONMENTAL PROTECTION AGENCY:

FEMI AKINDELE, PROJECT MANAGER

FOR THE TOWN OF Collierville:

MAYOR LINDA KERLEY
ALDERMAN TOM ALLEN
ALDERMAN STAN JOYNER
ALDERMAN JIMMY LOTT
ALDERMAN BUDDY ROWE, JR.

COURT REPORTING FIRM:

ALPHA REPORTING CORPORATION
Cindy Swords, CERT*D
236 Adams Avenue
Memphis, Tennessee 38103
(901) 523-8974
www.alphareporting.com

PUBLIC MEETING

MR. LEWELLYN: If I could have everybody's attention, we will go ahead and get started, if y'all don't mind.

My name is James Lewellyn. I'm the town administrator for Collierville. And just by way of getting this kicked off, I want to say, welcome to Collierville. We're very proud to host everyone here tonight. And welcome to our facility. And thank goodness for the rain. I'm not sure who's responsible for that, but thanks to those of you who brought it along with you.

We'd make note Mayor Kerley -- our officials are here. Mayor Kerley is there in the back. Alderman Tom Allen is right here (indicating). Alderman Jimmy Lott and Alderman Buddy Rowe and Alderman Stan Joyner are here from the Town of Collierville. Several other Collierville employees are -- y'all probably know better than I do.

So anyway, I just want to, on behalf of them and everyone with the Town of Collierville, welcome you here. I hope you find everything as you need it. If there's anything we can do, I'll be glad to offer it.

MS. WENSKA: Thank you. Is that music to our ears, everyone?

GROUP: Yes.

MS. WENSKA: I know. We had it bad in Atlanta. We didn't mean to share so much with our Collierville neighbors.

My name is Mary Wenska. I come from Atlanta. I come as a contractor working with EPA, the Environmental Protection Agency, down in Region 4 in Atlanta. My work is to help facilitate communication between the Agency and the people out in the audience, all of you, whom they represent, and specifically in this area of the Superfund program. So we're glad to be here tonight. We're very thankful, Ms. Mayor, for the opportunity to be here. And we want to acknowledge, again, all the aldermen who are with us tonight. And we want to especially thank the public works director. We're very happy. Mr. Kelp has been very important in our work, and his staff.

And in addition, we would also

like to thank Mr. John Fox, who is going to run the equipment. This is a beautiful building. Of all the meetings that I've done, a few, let me tell you, I've never been in a facility as first-rate as this one. And so I think you all are very lucky and very blessed to have such a place.

And we are relying on the skills of those around us to help us record this meeting and to help you get the best possible answers that you can for the Smalley-Piper site.

Okay. So with a little bit more to say, I'd also like to introduce Ms. Cindy Swords. Ms. Swords is the court reporter. And part of this meeting is to make public comments, so they will be able to be recorded.

I'd also like to introduce over here (indicating) Ms. Gina Montgomery. She works for Black and Veatch, the engineering firm that is working with EPA to understand and to propose alternatives for the Smalley-Piper site.

Within the audience, is there anyone else that might have been working on this site? I'm thinking about the Tennessee

Department of Environment and Conservation. Yes. Mr. Jamie Wood. And I don't know if Mr. --

MR. ENGLISH: Jordan English.

MS. WENSKA: Mr. Jordan English, welcome. They act as partners and collaborators with EPA to do the work. Okay. So I'm not going to talk to you very long. But I do want to show you a couple of slides to kind of introduce what we're -- what the process is that we use.

Tonight's agenda, in addition to welcoming and introducing ourselves to one another, getting a little bit acquainted and settling in, we follow in this arena something called the Superfund process. How many people of have ever heard of the Superfund process?

(Whereupon, they was a show of hands in the audience.)

MS. WENSKA: Oh. Well, gosh, we might have to skip that part. Okay. But the Superfund process is the key process to what we are talking about tonight, and to help you understand what we are trying to do here.

Mr. Femi Akindele is the project manager at EPA. And, Femi, if you will raise your hand, please.

MR. AKINDELE: (Raises hand)

MS. WENSKA: We're going to see Femi again, talking about the Smalley-Piper Superfund Site and the information EPA has gathered. Ms. Gina Montgomery supports Femi.

Then we're going to talk a little bit about, leaving tonight, what are the next steps that you can expect. And then it's your turn to be up here, if you want to be. We would like you to speak from the microphone. If you have a comment, question, would like to make a statement about this site, the court reporter will take it down, and then it will become part of the record that helps EPA decide whether what they think is a good alternative to clean up the site is indeed one that you all, as a community, can understand and would agree to.

Okay. Any questions about any of this?

(No verbal response)

MS. WENSKA: All right. Quickly through the Superfund process, and then to Femi.

This is the Superfund process.

It's a road map for finding a site, once found, what you can -- what you're going to do with it. Does anybody know where Superfund comes from?

ALDERMAN ALLEN: Uh-huh (affirmative response).

MS. WENSKA: What is Superfund about? What is it about?

ALDERMAN ALLEN: The different manufacturers obeying the government.

MS. WENSKA: Right. There were manufacturing activities that went on, industrial activities, other kinds of activities where remnants of that activity would enter the earth or would some way pollute the earth. In 1980, a law was passed, and the law is called -- I have to look down because sometimes I forget how to say it exactly -- but it's called the Comprehensive Environmental Response Compensation and Liability Act. It's acronym is CERCLA, but it became known as Superfund, and that's because that law established a tax on chemical and petroleum businesses; and the money that was collected from that tax in the first five years, 1.6 billion dollars, was put into a trust fund to clean up old hazardous waste sites.

Some of those sites didn't have a responsible party, and so they'd just be there. And the money was used, then, to clean up those sites. Well, since that time, CERCLA has been renewed under SARA, the Superfund Amendment and Reauthorization Act, and the fund was built up to about 8.5 billion dollars. So that's what we've been living on since 1996 because at that time Superfund, the tax, was allowed to go away.

So the Superfund process is about the money that's used by the Environmental Protection Agency, managed by the Agency to try to address old or abandoned hazardous waste sites in our country. Where there are people who can pay for them where they have the means, they've been tracked to the industrial activity or whatever it might be, then they are asked to contribute. But when there isn't anyone, then the Superfund falls into place. Okay?

So we are at the Smalley-Piper site in Collierville, Tennessee. It has been identified. It has been evaluated. It has been considered for listing on the National Priorities

List, which moved it along the process, then, to a remedial investigation, and that's where EPA becomes deeply involved in analyzing this settlement.

Then a study is done to look at different ways you could clean that up. What could you do to make it better? Right now, those two documents, a remedial investigation report and a feasibility study report, are available for you if you wanted to look at them at the Burch Library.

So the next step in the process, then, is to issue a proposed plan. And that's what EPA does when they say, we've looked at all the information about what's wrong at the site or what needs to be addressed. We've studied some alternatives that we think would be useful, but we've come up with one that we think is the best match for what this site has, and for what we want to do to protect, most of all, human health, okay, and then the environment. All right?

So there's a proposed plan issue. How many got such a document in the mail? Did you see this in the mail (indicating)?

(Hands raised)

MS. WENSKA: Okay. If you didn't get one, there are plenty of copies back there (indicating).

Part of the proposed plan is to come to the community, have a meeting like this, talk about it, and then ask for comments. And that's what we're doing tonight. And that's why Cindy is here. A little later, if you would like to say anything about anything related to Smalley-Piper tonight, please feel comfortable to do so. That's why we're here.

So that's where we are in the process. And eventually, a decision will be made, called a Record of Decision. And then we're going to end with the site being -- a design being done, the site being addressed through remedial action, and hopefully one day, that it will be a memory that it was on the Superfund list. But it can take a very long time, so it might be a while.

I won't say any more. If we can get the next slide, John. These are the opportunities for you in the community to be involved. Some may already be on this site mailing list. Others, if you want to be on it, just sign up on the sign-in sheet. This is the meeting that's always held in conjunction with the proposed plan, a proposed plan meeting. And this is our meeting for Smalley-Piper.

The comment period is between July 23rd and August 23rd. You can comment tonight, but you can also send a letter to Femi if you like. And if you want to know more about the specific information Femi will talk about -- or Femi will talk about, you can go to the library in the reference section; they have the reports.

That's all that I would like to say now because I want to have a chance for you to hear Femi and the information that he's collected, and the process that he's been implementing, along with TDOT, at the site. Femi, if you would come on up.

MR. AKINDELE: Thank you, Mary.

MS. WENSKA: Thank you.

MR. AKINDELE: Good evening, ladies and gentlemen. Appreciate your coming here in spite of the heavy rain. But I thought that, you know, it's been a blessing to have this rain here. We will take some back to Atlanta because we saw they need it, too.

Between what Mary said and the documents that you have seen, especially the proposed plan, I feel like you pretty much know as much as I know about Smalley-Piper. Nevertheless, EPA and TDEC, that's the Tennessee Department of the Environment- -- of Environmental Conservation, have collaboratively done some work at this site in an attempt to study what the problems are, and then to get to this point where we are proposing how to address the problems.

Jamie here was quite helpful in being at the site when we collected samples by virtue of proximity of TDEC to the site. We found it very sensible to utilize his help a lot. And Jordan, his boss, was quite familiar with all the -- what's going on there. So I'm glad they are here, especially since my EPA colleagues have not been able to make it here tonight due to heavy rain and delays and cancellation of flights in Atlanta. But I'll do what I can, and hopefully, Jordan and Jamie will add to whatever I said to make things explicit enough for you all so you can contribute to what EPA is planning to do in conjunction with TDEC for the site.

Go to the next slide, please.

Background information may be boring because, again, you're seeing the proposed plan. In any case, the site is at 719 Piper Street in Collierville here. It's a commercial/industrial type area. And it's about nine acres in size.

Currently, the facility is mainly used for self-storage. It's a self-storage facility basically. That's what it is right now. People come in and put in things in the storage facilities, come back and get them and put some more in.

Originally, it was being used to do commercial processes, which we will describe in the next slide. There is a site next to it just about 300, 500 yards, I believe, which has been there for years, Carrier. And of course, Carrier is a big plant in town, so I believe everybody that lives in Collierville probably knows about the Carrier facility.

The Town of Collierville operates a couple of wells at Carrier, and the two wells provide a portion of the water that's distributed for consumption around here.

Next slide, please.

We're showing here, again, this location of which we just described. Again, if we are familiar with where Carrier is, we should know pretty much where Smalley-Piper is. Smalley-Piper is just to the east of Carrier.

Next slide.

The layout is basically saying the same thing I've said with respect to location, so let's go to the next slide.

In the past, the property was leased to several corporations who conducted manufacturing processes in the early '60's. In the '70's, magnesium battery casings were treated with chromium, chromic acid, which generated chromium that has become the problem that we are disclosing now. And supposedly, that chromium acid treatment of battery was done under a government contract.

Between 1992 and 2004, there was hard-facing of farm equipment at the site. Hard-facing applies heated iron slurry to steel plows to strengthen tools whereby they are susceptible to wear and tear. The facility has continued operations in 2007. And as I said earlier on, a portion of the property is being used as mini-storage facility. Next.

In 2002, EPA began to study the problems that we heard about because it developed -- I was in the process of doing environmental investigation in the area, and detected chromium in the run-off. Based on that, EPA began to investigate the chromium issue in 2002.

Right about -- right after that, the Town of Collierville initiated periodic monitoring of the water source, well water, and the finished drinking water supply before it was distributed.

In 2005, the site was placed on the NPL, its National Priorities List due to metals that were found in soil, ground water, and surface water run-off.

Next, please.

Between 2005 and 2006, the potential irresponsible parties, especially the Piper family, contracted with a local company called Hess to conduct site investigation. The intent was to collect data that will be used to evaluate the problems at the site. That work was completed in 2007.

Back in 2003, EPA asked the Agency for toxic substances, and assist registry to conduct health consultation. The intent was to find out what human health danger was associated with the contaminants at the site. That organization, again, contracted a sub-contractor with the state Health Department to do the study. And the report was generated, which showed that there was chromium in the water that could have health effect if it was beyond certain level. And they came up with a number that they thought was safe for children, in particular.

Then, I guess about the beginning of this year the PRPs start working on the remedial investigation, by the time they finished the report in 2007. They were supposed to continue working on the site to provide what we call feasibility studies, but they say that they run out of money, so EPA took over the work. And what followed was the completion of the remedial investigation report, which EPA contracted to Black and Veatch. And we finished the addendum to the RI to complete the remedial investigation, and went into the feasibility studies -- next slide, please -- which, again, defined what will be done to the site in terms of remedial action, but we're getting to that.

Conceptually, this is how we represent what's going on at Smalley-Piper (referring to slide). Keep in mind that we are basing this on what we know from the limited amount of data collected earlier in the studying process. We felt like chromium was going into the ground water, and will eventually follow the flow direction, the natural direction of the aquifer in the area. And because one of the most important item in the area is the water well -- water wells for Collierville, we have prominently shown what will happen if the flow of chromium and any other contaminant in the ground water will follow that flow direction, eventually will get in the well. That's what you're seeing to the extreme left.

Next slide, please.

This is another conceptual drawing, the -- in that direction (indicating), again, showing that the chromium generator of the Smalley-Piper property will go into the ground, eventually find its way to the ground water. In the area, there are two sources of water: One is called the fluvial aquifer, which is the top aquifer here, source of water. And the lower one, which is predominantly used for source of drinking water in the area. It's called the Memphis aquifer.

There is some clear layers that looks like gray there on the drawing, which should not separate those two aquifers but it's not continuous. In certain areas, you'll find that clay is separating those two aquifers. But as I said, the most important aquifer in the area is the Memphis aquifer, which is the lower source of water in the area.

Chromium coming from the facility goes straight into the ground, gets in the ground water. And we found that from the data we collected that some of it -- some of the chromium, another contaminant, stays in the upper aquifer, and the rest went down to the most important aquifer in the area, which is the Memphis source of water.

Next one, please.

What this slide is showing is basically where we collected soil samples. The green data points are areas where we did not see significant amounts of chromium. The yellow ones were the locations where chromium was high in concentration. As a result, we used the green data points as the outer boundary of the soil that's affected by chromium and some other contaminants we found in the area, which I will mention later on, but antimony, lead, iron, and I think there's another contaminant, arsenic. Okay.

Next slide, please.

We also collected ground water samples. The data points, several in the area --

in there, those boxes, the rectangular boxes that you see there, those are data points. As you can see, several locations were tested with wells to collect ground water samples, which we analyzed for the various contaminants that we have now determined to be possible issue at the site, especially chromium.

Next slide will show the same thing, except that the first one was total chromium. And this is the hexavalent chromium, which is more of a health issue than the other one, total chromium. So what we are showing you, again, are the locations for ground water sampling.

Next slide.

With the data collected at the site, we go to the next step of evaluating what human health risk will be associated with these contaminants. In addition to human health risk, we evaluate what danger will be posed to animals in the area, which we call ecological risk assessment, that we follow later on.

What we're showing here is that we looked at children and adults that live in the area and have access to -- that can be affected by the contaminants. We also looked at industrial, commercial, and construction workers, and even trespassers that may have contact with the soil, the water, whereas ground water or surface water and whereas surface soil of all subsurface soil. The attempt here is to define what will happen if human being is exposed to any contaminants, whether by playing at the site or by drinking the water or excavating for construction or just by chance somebody passes through the site and has contact with any of the contaminants.

We then go to look at the risk involved, whether for cancer risk and no cancer risks. Next slide, please. Generally speaking, EPA believes that if cancer risk is between 1 in 10,000 to 1 in a million, we may have risk of cancer. If you have a cancer risk that's separated to give you a number as outside one in a million, we generally do not effect any clean-up. Anything in between the 1 in 10,000 to 1 in a million people being affected by any chemical, we begin to look at whether or not we will take any action.

When we looked at the chemicals found at the site, arsenic happened to be the chemical that put some slight risk, with respect to ground water. Now, cancer risks or hazards do tend to be associated with some chemicals. In other words, one who gets sick even though you do not get exposed to any cancer risk because of contact with certain chemicals. We do evaluate those possibilities. And when we come up with a number that's higher than 1, called the hazard index, then we begin to plan on taking action.

Again, we look at -- we looked at the industrial and construction workers, children and adults that live in the area to ensure that we calculate the risk involved from non-cancer hazards, if any of these individuals will be exposed to the chemicals at the site.

The contaminants of concerns mainly that we found after analyzing the data we collected included aluminum, arsenic, chromium 6. Then that was -- this was found in the soil. And then, of course, iron. In the ground water, we found antimony, arsenic, iron, chromium, both total chromium and hexavalent chromium.

Next slide, please.

We further looked at each contaminant and determined that even though arsenic was found at the site, it was not at a level that would require any remedial action. It did not cause major concern.

For children that may be contacting aluminum, arsenic, chromium, and iron, we calculated remedial goal option, in which case, we were looking at what level of chromium or any of these other contaminants will require us to do any remedial action.

Hexavalent chromium in subsurface soil was found to be a major issue at the site for construction workers. And in the ground water, the child that may be drinking the water for a long period of time could also be affected by total and hexavalent chromium. Again, the subsurface soil and ground water were the major issues that we determined from the analysis of the data.

Next slide, please.

This is basically repeating what

I just said, that the construction worker is more at risk from excavating and planning on doing any digging at the site because of the contact they will have with the fumes. And again, a child drinking the water could have issue with contact with respect to antimony, iron, and chromium, but -- hexavalent and total chromium.

Next slide.

We also looked at the animals, mainly in the area, to see if they will be affected by the contaminants in the -- at the site. The data we have suggests that there is no middle issue with respect to the animals and crickets and anything crawling around the site. We carefully looked at the wooded area close to the site to see if there are any -- again, any animals that we should be concerned about. We did not see much to worry about. However, we plan on doing additional sampling to confirm what we've seen and the completions we are making at this point based on current data. We intend to collect additional data when construction begins at the time we conduct the remedial action.

Next, please.

We normally calculate what goals we want to achieve with respect to cleaning up the site. Numbers were developed based on data and some mathematical and manipulation of information to show what level of chromium that will require us to clean the site, or our level where we begin to start cleaning the site. We did that for the subsurface soil, and came up with a number. And then, we did the same thing for ground water.

We also looked at what would happen if situations like we have now, the rain, will flush chromium or contaminants into the ground water. How much can we allow of any contaminant to stay in the ground such that the water below the ground is not affected? That's why we have individuals there that says subsurface soil are susceptibility threat to the ground water quality. In other words, we calculated what would be an issue if certain concentration of the chemicals remain in the soil.

Next slide, please.

I showed this slide earlier on

to show you the data points that we collected for soil, which we then used to define the boundary for soil clean-up. The same data as presented here to show the boundary of the area that will be treated for the contaminants at the site.

Next slide, please.

We also defined the boundary where we believe the water is contaminated at. Earlier on, I mentioned that there are two sources of water in the area: One is the shallow aquifer. You will notice that we have the red dashed lines there which define the area where the shallow aquifer is affected by the contaminants at the site. The dotted red points define the area that has been affected, based on the information we know now, in the lower aquifer or the Memphis sand aquifer.

Next slide, please.

Well, after looking at all the data that we collected and defining what risks were involved with them, we began to look at options available to us to effect clean-up for soil and ground water. The government requires analysis of remedial options to include some information about what will happen if nothing is done at the site. We call that Alternative 1, no action. We looked at that very critically.

Then we did the Alternative 2, which we felt like soil removal could be done, with off-site disposal, and the ground water pump and treat, which simply means that we pump the water using some wells, and then subject the water to certain chemical reaction to remove the contaminants, and then turn the water back to beneficial use, mainly, in particular, giving the water back to the Town of Collierville. And then, enforce institutional control whereby the water will not be used for any purpose until it's completely clean.

We have looked at Alternative 3, which is cleaning up of the soil by sterilization in place without digging anything out, and then cleaning the ground water outside its trivalent with some wells pumping the water out of the ground and treating the water at the surface.

The next alternative was soil removal, on-site treatment, in which case we dig up the soil and mix it with certain chemicals to bind the contaminants such that it will be immobile, the contaminants will be immobile. And then, we put the soil back in the ground, which is what we call on-site disposal, and then the ground water is pumped and treated outside its trivalent form.

The next alternative was soil removal, on-site treatment, and off-site disposal. In other words, we'll dig up the soil that's contaminated, mix it with certain reagents or chemicals that will bind the contaminant. And then, instead of putting the soil back in the ground at site, we ship the treated soil as well. There are several facilities around the country that accept treated soils because they have been licensed to do so. We will look at the one that's closest to Smalley-Piper. That is an option that we considered.

Number 6. Incidentally, I'd like to point out that institutional control is involved in all of the options we looked, even the no action. If we elect to do a no action ROD, or Record of Decision, we would impose some restriction on the soil in terms of digging, and the ground water with respect to drinking. So if I do not mention institutional control with any alternative, please bear in mind that it's involved in all of the options.

The next alternative is Number 6, in-place soil stabilization, whereby we inject certain chemical into the ground to bind the contaminants, and make the contaminants immobile. Then the ground water will be treated in place. Again, we will put in some wells or trenches and then dump some chemicals that have been designed -- or will be designed to remove the contaminants in place. Again, institutional control will be enforced.

Number 7 is in-place soil stabilization, similar to the one in Number 6. And construction of what we call permeable reactive barrier, which will be some type of engineered -- could be a trench, it could be a wall, which we will -- we will inject certain chemical, and the chemical will be contacted by the water flowing in the direction of this barrier. That will also help to remove the contaminants.

The other one, the last one that we considered is Number 8: In-place soil flushing, ground water pump and treat. The in-place soil flushing is similar to the -- well, what we would do under -- I believe, under 5, but it will be more extensive in the primary remedial action, in which case we put in wells and utilize those wells to inject certain chemicals to flush out the contaminants in the soil. It will then be flushed, of course, into the ground water, and we will bring the ground water up using wells to treat the water on-site and give the water back to the city or the Town of Collierville.

Next slide, please.

Of all those alternatives that we considered, eventually, we have to pick one. So the preferred one was Number 5 of the list of eight alternatives that I described a minute ago. And that alternative requires us to excavate about 144,000 cubic feet of soil to about 25 feet below the ground, below the surface. And the soil below that dent will be flushed with water to attempt to remove remaining contaminants and flush it into the water below because we're going to now remove the water and clean at the surface. That's what a flushing will do.

We will then remove the soil and treat that soil on-site. We'll dispose it at appointed facility. We'll extract the ground water and clean the ground water at the source. If you'll remember the area of the soil where I said earlier on that we determined will be essential for removal and treatment, that's where we will also have some extraction wells to remove contaminated soil -- I mean, water, which will be treated on surface.

The next step will be that the water in the area that we described as the plume would also be withdrawn and treated at the surface. The water will be transferred to, like I said before, the Town of Collierville because it will be cleaned to acceptable levels. We will impose institutional control, as I said, again, until the water is clean enough so that we can remove the restriction on its use. We'll then monitor the progress of the remedial action to ensure that we have completely cleaned the soil and the ground water.

Next slide, please.

Remember we looked at about eight options, including the no action alternative. We have to base all the analysis on certain criteria to eliminate, which is sensible, which is optimal from the ones that are not. And that's how we came up with the preferred option.

The basis of the criteria used for evaluating the various options are listed here. We look at the overall protection of human health and the environment. What would each action do to human health and the environment?

We looked at what we call ARAR, which is Applicable or Relevant and Appropriate Requirements. That's -- it explains itself.

We look at the -- what does the local government want? What does the state government allow? And what does the Federal government allow in terms of contaminants in the ground water or the soil?

Based on whichever one is the most stringent, we will clean to the level that's acceptable, to which government proposes what's the most acceptable. That's what ARAR stands for.

We look at implementability, in which case: How easy is it to do what we are planning on doing? It will make no sense to have the best method in the world if you cannot construct it. So we look at how easy we can construct what's being proposed.

Short-term effectiveness: How quickly will we find some effectiveness? We will have benefit from what we are doing. Then, the next one will be long-term effectiveness and permanence. Is this going to completely remove the problem? Is the action that we are taking going to be effective forever? Or how long will it be affected? We look at that.

Then the next one is looking at how much of the contaminants are you going to be removing using the alternative you are proposing or you're looking at? Then we look at the cost. We want to make sure that the State is on the same page with us, with the Federal government, that is. So we look at what it will accept and what it will not.

Then, we come to people in

Collierville to find out if what we are talking about, do we make sense or not? And that's why we are here. We have put out information we collected in the library. And we also have the information at EPA. The State also has all the information. So you are welcome to contact the State or EPA to get additional information and determine from what you know if we are proposing the right thing or not. Your comments will be considered in the final analysis. That's what the ninth item there suggests.

As I told you earlier on, we looked at cost. It's a major component of the criteria. We'll not go over the black ones, but the red numbers there will show what the Alternative Number 5 will cost. The same information is in the proposed plan that we mailed out. Basically, we're looking at about 10 million dollars to do the remedial action that's being proposed. It's not the cheapest. Again, based on the nine criteria, we had to choose the optimum solutions. It is not the most expensive, either.

Next slide, please.

Wow. And that's the end of my story. We will welcome comments, questions, and discussion of the problems.

ALDERMAN ROWE: Do you anticipate much contamination under the building foundations?

MR. AKINDELE: Yes, sir. The storage facility contains -- below the storage facility, we have found contaminated soil. We believe that probably we are, if not most, at least half of the soil to be removed. Yes, sir.

ALDERMAN ALLEN: Would you --

MS. WENSKA: Femi, I was just going to say, if you would like to make a comment, you're welcome, too, to come up and use the microphone if you want to be heard. I know it might not be the easiest. But to use the microphone and say your name --

ALDERMAN ALLEN: Okay.

MS. WENSKA: -- and address, please.

MR. AKINDELE: And I'm not the only one that can answer these questions. Jordan English, Jamie Wood, they are here to help me out if I can't answer.

ALDERMAN ALLEN: I'm Tom Allen. And I'd like to ask a question. Will the EPA cover the cost that's already been spent trying to contain this chromium problem?

MR. AKINDELE: Would EPA cover the cost --

ALDERMAN ALLEN: Right.

MR. AKINDELE: -- that we spent so far?

ALDERMAN ALLEN: Right. That's been spent over there so far. They're trying to control the chromium that's going into our --

MR. AKINDELE: Are you talking about --

ALDERMAN ALLEN: -- sewers.

MR. AKINDELE: -- EPA pay whoever spent the money?

ALDERMAN ALLEN: Yeah.

MR. AKINDELE: I cannot tell you that, sir.

ALDERMAN ALLEN: Okay.

MR. AKINDELE: I do not know. I doubt it because EPA did not cause the problem; we're just trying to solve the problem since then. Thank you.

MR. ENGLISH: A lot of the cost has already been paid by the responsible parties so far, I believe, until 2007. And so, a lot of the cost has already been paid by the Pipers, and --

ALDERMAN ALLEN: Piper, themselves?

MR. ENGLISH: Well, the family or the estate. The Pipers, yes. But the future costs are kind of open for debate on who's going to pay for those. EPA may pay a large portion of those out of the EPA fund. And the State is certainly responsible for a portion of that, about 10 percent of that or more, depending.

ALDERMAN JOYNER: My name is Stan Joyner. I've got a couple of questions, maybe one question, then a follow-up. But the suggestive alternative is Number 5. And when -- if I'm looking at the chart, it says the estimated time for implementation is less than one year. And then -- that's for the subsurface soil. And then, the ground water is from three to 10 years. But I think I read some place else that this is based on -- the recommended Number 5 alternative is based on funds being available.

Are the funds available now to begin the subsurface soil in less than a year? I mean, are we going to wait for funding? Did I --

MR. AKINDELE: Whatever --

ALDERMAN JOYNER: -- understand what I read?

MR. AKINDELE: -- whatever alternative we choose will still need to be funded.

ALDERMAN JOYNER: Okay.

MR. AKINDELE: So the request for funds will be initiated.

ALDERMAN JOYNER: Okay. So even though -- if the community, then -- or the results of the public hearing are to agree with your Alternative Number 5, that's still subject to funding of Alternative --

MR. AKINDELE: Yes, sir.

ALDERMAN JOYNER: -- Number 5? So it may be -- it may be a long time. How long, then, before we could expect -- it appears to me, from the diagram that you -- that you've shown that the plume seems to be moving northwest, away from our well Number 2. How long before we could get

well Number 2, you know, back in use? Or is
there any way to tell that?
MR. AKINDELE: I do not know that
it's moving away from the water plant Number 2.
ALDERMAN JOYNER: Okay.
MR. AKINDELE: That's what they're
showing that it's moving towards.
ALDERMAN JOYNER: It looks like --
you know, I'm just going to -- you know, I'm
looking at the diagram that's on Page Number 4.
And, you know, our well Number 2 is here
(indicating). And it just appears that the plume
is moving northwest --
MR. AKINDELE: Okay.
ALDERMAN JOYNER: -- to me.
MR. AKINDELE: All right.
ALDERMAN JOYNER: I don't know if
that's --
MR. AKINDELE: Okay. I see what
you're saying.
ALDERMAN JOYNER: Okay.
MR. AKINDELE: Jordan has some --
MR. ENGLISH: Let me make a comment
about that. That's a good slide to show the

answer to. The plume, without any other forces acting upon it, appears to be moving pretty much the way you see that plume drawn there (indicating). If you'll notice, the southwest portion of that lobe to the west is sort of moving towards the water plant. It's moving towards the water plant because the water plant pulls on the aquifer. And it has pulled on the plume, we believe, to the extent that it will pull the plume in that direction. And if the water plant is operating at full capacity, it will more than likely continue to exert a pull on that plume. And so --

ALDERMAN JOYNER: But that well's been out of service for, how long? Has it not?

MR. KELP: It's not pumping water into the system, but it is being pumped to treat the TCE in -- from --

ALDERMAN JOYNER: But I thought we had stopped that.

UNIDENTIFIED MALE: Uh-huh (negative response). No.

UNIDENTIFIED MALE: But we agreed on reducing the rate --

MR. ENGLISH: We've reduced the rate, maybe, some.

ALDERMAN JOYNER: Okay.

MS. O'BRADOVIC: Can I say something -- ask a question about something? I just related to that how -- do I need to --

MS. WENSKA: Yeah. We -- --

MS. O'BRADOVIC: Sorry.

MS. WENSKA: Only because we want to hear your question.

MS. O'BRADOVIC: Okay. Sorry.

MS. WENSKA: Thank you so much. Thank you.

MS. O'BRADOVIC: Linda O'Bradovic. Just wondered what the anticipated pump and treat time for the Carrier clean-up is related to that. They were saying that they're still pumping the wells for the Carrier clean-up.

MR. AKINDELE: Right. Carrier clean-up is treated in TCE, as you know.

MS. O'BRADOVIC: Uh-huh (affirmative response). Right.

MR. AKINDELE: And the projection on

that was 30 years, if I'm not mistaken. And they've been going -- doing that for about 10 years now, so still a long ways to go.

MR. ENGLISH: The Carrier site has a solvent problem, and solvent plumes are a lot harder to manage. Because that was just considered as a 30-year clean-up, and, in fact, it may go beyond 30 years; it just depends on how that aquifer responds.

Our -- my feeling, and a lot of the people that's been involved in this, the contractors and EPA as well, believe that the chrom problem will be solved much more quickly and much more easily because the contaminants are soluble in the ground water. Therefore, when you pull on the water, the contaminants won't get hung up in the interstitial spaces of the soil and the sands; they'll move right along with the ground water. Chrom 6 is extremely soluble. Stay with the water, it should be easier to clean-up.

The solvent problem at Carrier, those will continue to be a problem. Solvent problems are called recalcitrant problems for a reason; they just don't like to be solved because water and solvents don't mix well.

Is that -- I guess -- we anticipate that we might see some improvement in the aquifer within three years, up to 10 years. Maybe even within 10 years, we anticipate we might effect a complete or near complete clean-up for the chrom problem.

MR. KELP: Bill Kelp. Alderman Joyner had asked a little bit about the time line but then we kind of got side tracked a little bit. I am, and I'm sure they are, as still interested in maybe some time line issues as to when we may see some remedial actions, soil removal, water treatment, things like that.

MR. AKINDELE: Since we're still at the proposed planning stage, I can only tell you about what the next step is, and that's the completion of the Record of Decision. That will be finalized by the end of this fiscal year, which will be end of September. After that, we will begin to look for money to do remedial design. Remedial -- if money becomes available right away, we will probably be able to do the remedial design within 12 to 18 months. And remedial action itself will begin as soon as the funds are appropriated by the Federal government and the State.

ALDERMAN ROWE: Are you far enough along to know where this project stands on the priority list?

MR. AKINDELE: No, sir.

ALDERMAN ROWE: So even if funds are available, we're two years away from even beginning remediation; is that what you're saying?

MR. AKINDELE: That would be my estimate at this time.

ALDERMAN ALLEN: Has the State agreed with the Federal government on this?

MR. ENGLISH: We're still reviewing the proposed alternative. Generically, we think it's the best alternative that we've seen, but we're not totally on board yet. We want to look at the cost and the timing and the well placements and everything to make sure we're okay with how it's going to proceed. We don't want to spend more money than necessary to solve the problem, but we do want to see it pursued aggressively enough to shorten the life of the total operations and maintenance of the program, and staying in the vested interested in not going beyond that time period because at the end of that time period, the State takes on all costs.

But the State would like to see the remedy started fairly aggressively, both for ground water and soil, and then, hopefully, be able to be culminated within the 10-year time frame that is allowed for long-term remedial action, which this site's ground water remedy falls under.

If we can get that done within that time frame, then we can feel more comfortable that the State won't have any long-term costs on the site. Otherwise, the State's cost are 10 percent of whatever the remedy costs are. So we're generically okay with the remedy but I think, as they say, the devil is in the details. And this site has been managed such that a lot of work, a lot of the unknowns is still out there to be fleshed out in the design phase, and until the design is complete, we won't know a lot of those answers.

Our deputy commissioner has been briefed on where we are to this date, and he's in agreement with my management that we need to continue to try to flesh out all the cost issues and timing issues, and we want to do it as cheaply as possible but we want it done as well as possible, as cheaply as possible. And I think you can actually have that happen sometimes. But that's kind of where the State is on it.

MR. AKINDELE: My only comment on that is that we are hoping that the State will finalize the designation so we can get the ROD done by the end of this fiscal year. Of course, if we don't get the ROD done, we can't even begin to ask for money.

Yes, sir?

ALDERMAN ROWE: Wouldn't -- and this question is for both you and Jordan. Wouldn't it facilitate the TCE removal project if you use the wells that are serving Water Plant 2 to remove chromium as a treatment well for chromium?

MR. AKINDELE: We have not ruled out the use of any available facility. If we want to use those two wells, we will only clean for chromium, and the water will still be given back to Carrier to address the TCE issue.

ALDERMAN ROWE: Right. But when the TCE is then removed, that water would be available -- it would be clean and available for the town; isn't that right?

MR. AKINDELE: That's correct.

ALDERMAN ROWE: That's why I feel like it wouldn't make sense to use that well or one of those wells rather than to go dig another well somewhere.

MR. AKINDELE: That is correct. And during the design phase, we will look at those wells as well.

ALDERMAN JOYNER: How aggressive is the movement of the plume? I mean, you know, have we got 18 months? I mean, who's going to monitor, you know, how that plume extends out and, you know, what affect it's going to have the longer it takes for funding to become available and for a decision to move forward on this?

MR. AKINDELE: Well --

ALDERMAN JOYNER: I mean -- go ahead.

MR. AKINDELE: I believe the Town of Collierville continues to monitor those wells or sample them, if I'm not mistaken, as the work started or stopped. You are monitoring those wells for chromium --

ALDERMAN JOYNER: I'm talking about the --

MR. AKINDELE: -- pretty regularly.

ALDERMAN JOYNER: Yeah.

MR. AKINDELE: And I think the County -- or the Town will continue to do that, if I'm not mistaken. But Bill Kelp can help you with that.

MR. KELP: Yeah. We do periodically take samples of the water to monitor the chromium. And as we just mentioned earlier, the plume is still -- it's still working from the source, moving in that northwesterly direction because the soil is still contaminated. So every time we have rainfall events and flushing, it continues to come, but we are monitoring it. And we're pulling a concentration pretty comparable to what we pulled last year.

ALDERMAN ROWE: Bill, who tests the

monitoring, though? We don't test --

MR. KELP: We're monitoring our --

ALDERMAN ROWE: No. I'm talking about all the monitoring going on.

MR. KELP: Maybe Carrier.

MR. AKINDELE: Oh --

ALDERMAN JOYNER: I'm talking about how it moves. Is it getting bigger? Is the plume getting bigger?

MR. AKINDELE: Is it -- well, the plume is bound to get bigger as water moves away from the source. Until we put in the remedial action, though, we will not be doing any monitoring other than what the Town of Collierville does.

ALDERMAN ROWE: Well, who monitors the existing monitoring wells?

ALDERMAN JOYNER: I mean, it could be more concentrated where our wells are, but still not be drawing.

MR. AKINDELE: The existing monitored wells are basically the wells that Carrier has, and those are monitoring for TCE. There are no active wells monitoring for chromium at this stage, other than what the Town of Collierville is doing.

Yes, sir?

ALDERMAN ALLEN: If you use the wells to flush it out -- okay -- you're going to have a tendency to draw it deeper into the soil and deeper towards that Memphis sand.

MR. AKINDELE: Yes, sir.

ALDERMAN ALLEN: And that's going to be the $64,000 question: How much can you flush it without drawing it all the way down to the Memphis sand?

MR. ENGLISH: Well, I don't think that's a correct statement. I think if you -- we're talking about three different locations for drawing the contaminants out. The location of the -- what is known as a proximal source location, where you're going to do your primary work of trying to clean the ground water up near the source, will happen closer to the source. And anything you remove there will clean-up water that will otherwise move down grading. So if you start at the point, from the source area, you'll cleaning that water up right away.

Virtual soil removal and stabilization will take a lot of the source away. And then any pump and treat that you do at that point will help the aquifer clean-up from that point, and circle downwards. And then the other wells will help the aquifer clean-up further out.

It is true that there's a risk for this plume to get larger and migrate off to the northwest. I'm sure Germantown will be interested in what we do.

But the other side of it is as the plume gets further away, it's going to dilute more and more, so the plume will get a little weaker as moves further away.

I'm interested in doing something as quickly as possible. I'm not happy about a 2-year time frame, but if that's what it takes to get the ball rolling, I think that's what we need to do. The State is going to move as quickly as possible to be able to meet EPA's ROD deadline, which is -- what is it? -- September 31st (sic)?

MR. AKINDELE: That's correct.

MR. ENGLISH: So the State will

probably have all the information they need by then. We'll have our comments to EPA on the public comment period, just like you will. And those questions will be addressed and everything resolved by the time the ROD needs to be signed.

If -- in the event the State can't accept it, well, then, I don't know what we're going to do because it's -- it's almost a Catch-22: We have to do something. We understand we have to do something. The answer is going to be expensive. We don't like that, either, but it's got to be done. So my impression is the State will eventually agree with the remedy, and the only thing that'll change is the arrangement of the wells, the -- maybe the number of wells that we involve of how we try to clean the aquifer up.

And, yes, I'm concerned about the water that migrates on out, and maybe at some point, there'll be a need to monitor the -- what I call the more distal portions of the plume to see what it's doing at that point. When the wells get installed, they will pull some of that water that's contaminated back towards the well and away from off-site migration. It'll pull them away from Germantown a little bit. How much of that works, I don't know, but we'll do the best we can. And if we have a concern, we'll certainly either monitor the water -- the State will monitor the water, or we'll get in touch with Germantown, and they can monitor their water.

MR. AKINDELE: Do we have any more comments or questions, please? Well, you all are welcome to -- oh, I'm sorry. I see another question there.

MR. HOLABIRD: At what point do you anticipate you might know if there's funding available? And how would you get back to the parties to let them know that?

MR. AKINDELE: Repeat that question, again, please.

MR. HOLABIRD: At what point do you anticipate you'll know if funding is going to be immediately available? And how would you let all the parties know if the funding is available?

MR. AKINDELE: Well, the process, again, is we will do the Record of Decision, then we will put in the -- request the money from the Federal government. The State will promise its own 10 percent share of the remedial action. As soon as we do that, and determine that the money is available, we send out information like we did in the past to inform the public that remedial design may be beginning at a certain time. So you will be -- remained informed as the appropriate -- process goes along.

MR. ENGLISH: And you kick me if I'm saying something out of school here. I think I know what their concern is, that we can do all we want to, we can sign a ROD and be real happy about the clean-up and what we're going to do, but we don't have any guarantee about the funding. And I think the answer is: Still, we don't have any guarantee about the funding.

The funding that is available is this funding that's available all over the country for the various sites that need remediation from EPA's fund, and, of course, from the State's involvement with it. The sites that might be considered across the country may have a higher priority or a lower piror than this site.

There's a separate board that addresses that and decides what site gets what funding. My hope is that this site, with an active water supply that needs help, would get quicker funding, but we can't bet on it. We can't be sure of it. There may be other sites with a more critical situation. Did I speak out of school?

MR. AKINDELE: I agree with you.

MR. ENGLISH: Okay. So it's really a -- I don't think it's quite a crap shoot, but it is a roll of the dice, where you have to understand that if there's another site that's more important with a higher priority that's got people that are drinking water and dying or something like that, it's certainly much worse than this situation. But I think it's a high enough priority in my mind that I'd like to see it addressed quickly.

ALDERMAN JOYNER: I guess one of the things that I'm thinking about with those remarks is do we need to abandon that well and put -- and as far as the Town is concerned, just abandon that well and go some place else and dig another well that is going to provide the water -- you know, the water that we need to service our citizens? And, you know, if it's such a -- an iffy situation, we'll just move on. Just tell us where we need to spend our money.

MR. ENGLISH: I can't answer that question because I'm not able to know what Collierville's water supply needs are as uniquely --

ALDERMAN JOYNER: Right.

MR. ENGLISH: -- as Collierville does. I can --

ALDERMAN JOYNER: Well, that is a real option for us, is to abandon that well and, you know, go to another site and dig a new well, and not worry with it.

MR. ENGLISH: I'd hate to see that resource lost.

ALDERMAN JOYNER: Well, I understand that. We would, too. But we need some -- you know, we need some answers.

ALDERMAN ALLEN: But that wouldn't solve your ground -- that wouldn't solve your subsoil problem.

ALDERMAN JOYNER: Well, if we -- if

we're not using that well --

ALDERMAN ALLEN: You just keep migrating -- it just keeps migrating --

ALDERMAN JOYNER: If we're not using that well, it won't, based on what I've heard tonight.

ALDERMAN ALLEN: Well, it would if -- rain water and stuff will keep remigrating that plume here if you don't do something.

MR. AKINDELE: Right. Because the water is moving from -- generally, in the northwest part of -- direction. So it -- the soils will still be there, and the natural flow of the ground water will move the contaminants northwest.

MR. ENGLISH: The environmentalist in me wants the city wells to be a part of the solution. I think it will save money -- this is just Jordan, now. This is not the State's position yet. We haven't made a final position on it.

But the city wells being involved will help clean-up the chromium in the ground water. They're also to help continue to clean-up the solvents in the ground water from Carrier. And they'll also continue with the valuable resource for that water plant and those two wells. So if there's any supplementation that needs to be done for other wells, you have to contain the chrom plume. And it can be done in a timely way so that the City doesn't lose its unique need for water. There's a way to hobble along, so to speak, over the short term. I'd sure want to try that.

ALDERMAN JOYNER: So, Jordan, it sounds like you would support the use of those wells, those existing wells to treat the chromium?

MR. ENGLISH: It -- it -- I would, so long as the modeling information that we get as we move forward shows that it will be effective. If those wells -- if the modeling shows that those wells only pull a finger of the chrom plume out, and treat that, that's not really effective for a full chromium plume remediation. But I do agree that we need those wells operating for Carrier's remedy.

I have to keep a global

perspective on this, that Carrier's problem is still an environmental problem we need to try to maintain. If we don't do that, I mean, I -- I'm just -- I'm speaking from Jordan English's view point. I'm not even speaking from the State's view point at this point. But I just hate to lose the resource we got. I know we have a need that we need to continue in Carrier, and we have a remedy we need to start at Smalley-Piper, and --

ALDERMAN JOYNER: Well, do you think that two wells would control the chromium plume, even --

MR. ENGLISH: It is very likely. There's a high transmissivity, which means the ground water moves rapidly and freely in this part of the aquifers. Why the wells were cited where they were is because they produced very well. They produced a very large amount of water.

The fact that the aquifer is that transmissive means that it can probably clean-up rather quickly. But it also means if we don't get busy, it's going to let it move on away rather quickly. So it's a little bit of good in one case, and bad in another case. So I'd like to see the remedy used, the resources we have to clean it up. Personally, if we can use the Carrier wells instead of two or three other wells, we're going to save on one or more well cost, installation cost.

The other side to that is, if those wells are installed for controlling the plume, and they are necessary, the City will have a resource at that point, more than likely, of those wells for a water supply. And I can't speak for EPA, whether EPA would say, okay, you can have these wells or not. If the remedy is cleaned up -- as the site's cleaned up, I don't know what need Carrier -- EPA has of those wells. I just can't imagine what it would be. Most of the time, EPA lets those resources go back for the public benefit. The State does, too, in those instances. But that's a little too large -- too far ahead to think, maybe, on that.

But the design work will tell us where the modeling information comes in, and tell us where it'll take one well, two wells, three wells, whatever. But the aquifer is fairly transmissive. I don't think it would take a lot of wells.

MR. AKINDELE: Do we have any more comments, please?

(No verbal response)

MR. AKINDELE: Well, I want to thank you, again, and to request that you submit to us any questions or additional comments you may have. We've got the comments -- the comment period extending to --

MS. WENSKA: August 23rd.

MR. AKINDELE: -- August 23rd, so please let us know what you want us to address for that, and we'll be done.

MS. WENSKA: We might also know that the response to these comments that have come tonight, EPA will take the record, and because the conversation was so good and rich, there's a lot that will be looked at and grouped, and then answers will be published. And that will be part of the Record of Decision. And that will be available, then, at the library as well.

But just for you to know that it

mattered that you came tonight and spoke what you wanted to know about.

MR. AKINDELE: Well, thank you very much. And just stay dry out there.

(Whereupon, the meeting concluded at approximately 7:18 p.m.)

C E R T I F I C A T E

STATE OF TENNESSEE:

COUNTY OF SHELBY:

I, CINDY SWORDS, Certified Electronic Reporter and Transcriber, and Notary Public, Shelby County, Tennessee, hereby CERTIFY:

The foregoing proceedings were taken before me at the time and place stated in the foregoing styled cause with the appearances as noted.

Being an Electronic Court Reporter, I then reported the proceedings digitally, and the foregoing pages contain a true and correct transcript of my said digital recording then and there taken.

I am not in the employ of and am not related to any of the parties or their counsel, and I have no interest in the matter involved.

I FURTHER CERTIFY that this transcript is the work product of this court reporting agency, and any unauthorized reproduction AND OR transfer of it will be in violation of Tennessee Code annotated 39-14-149, Theft of Services.

Witness my signature this the 15 day of August, 2008.

CINDY SWORDS, CERT*D

Notary Public at Large
For the State of Tennessee

My Commission Expires:
February 23, 2009

APPENDIX A3
Responsiveness Summary

Overview and Summary

This Responsiveness Summary documents public comments and U.S. Environmental Protection Agency (EPA) responses to comments on the Proposed Plan for remediation of the Smalley-Piper Superfund Site located in Collierville, Shelby County, Tennessee. The Public Notice for the Proposed Plan and Public Meeting were published in The Commercial Appeal on July 23, 2008. EPA mailed the Proposed Plan Fact Sheet announcing the public meeting to individuals and groups on the Smalley-Piper Site mailing list at the same time. EPA Region 4 held a public comment period from July 23 through August 23, 2008. EPA held a public meeting for the Site at the Town Hall, located at 500 Poplar View Parkway in Collierville, Tennessee on July 31, 2008, to discuss the proposed remedy and to receive oral public comments.

A copy of the Proposed Plan Notice published in the Commercial Appeal is provided in Appendix A1. The transcript of the July 31, 2008, public meeting is provided in Appendix A.2. Appendix A.3 contains copies of the original comments from XDD, LLC., Butler, Snow, O'Mara, Stevens & Canada, PLLC on Behalf of Gerdau Macsteel, Inc., and Tennessee Department of Environment and Conservation (TDEC).

Public Comments Received and EPA Responses

<u>I. Comments from XDD, LLC</u>

To: Femi Akindele, USEPA
From: Bruce Cliff, XDD
Cc: Bryan Kielbania, UTC
Jamie Woods, TDEC
Bill Kilp, Town of Collierville file (73271.01)
Date August 22, 2008

Re: Superfund Proposed Plan Fact Sheet, Smalley-Piper Superfund Site, July 2008
Final Feasibility Study of Remedial Alternatives, Smalley-Piper Superfund Site, July 2008, Collierville, TN

On behalf of Carrier Corporation (Carrier), XDD, LLC (XDD) appreciates the opportunity to provide public comment on the Superfund Proposed Plan (Plan) Fact Sheet dated July 2008 and the information in its supporting document the Final Feasibility Study (FS). The Plan favors Alternative 5, which, as described in the Final FS in more detail, proposes the installation of off-site wells northeast of the Town of Collierville's (Town) water plant number two (WP#2), extraction pumps, a treatment facility, and conveyance of the treated groundwater to the Town for potable use.

This review and comments on the Plan and the Final FS are not exhaustive, but rather focused on the favored off-site groundwater alternative presented in the Final FS with an emphasis of providing comments that will illustrate that an initial step of applying chromium treatment at WP#2 would yield the greatest benefit to the environment, taxpayers, and stakeholders. The Final FS does consider the use of WP#2 for its off-site remedy in Appendix A identifying a cost savings of approximately $650,000 when compared to the preferred alternative. However, Appendix A (page 23) of the Final FS finds disadvantages with the use of WP#2. The following comments addresses those perceived disadvantages.

1. *The location of the WP#2 wells (i.e., further west of the proposed location of the two dedicated SWEWs {southwest extraction wells}) implies that a longer remediation period will be required to capture the southern portion of the dilute plume, will result in treating a greater volume of 'relatively' clean water through the chromium/IXG; {ion exchange} facility, and will draw the contaminant plume further west before being captured by the WP#2 wells. The amount of additional remediation/treatment time incurred by using the WP#2 wells as part of the remedy is difficult to determine exactly, but the total time to reach ground water remedial goals using WP#2 could be on the order of three to five years.*

Installation of chromium treatment at WP#2 has four benefits; 1) it provides some or all containment and capture of the chromium ground water plume, 2) because of the existing infrastructure at WP#2 a chromium treatment system can be easily integrated and placed into operation years before the installation and operation of new wells, related pumping systems, and effluent conveyance piping on third party (none stakeholder) properties thereby controlling the further migration of the chromium plume, 3) operation of WP#2 would provide an engineering basis for evaluating the need; if any, for other off-site containment wells without installing them first and then determining what well system is optimal, and 4) if additional containment wells are needed to expedite the remedial time period and/or improve the capture of the chromium plume and the discharge of those additional wells will be directed to the Town for potable use, then the WP#2 facility is the most technically appropriate and cost effective place to handle those processes.

EPA Response: *Ground water remediation at the Smalley-Piper Site will be conducted in phases following treatability studies and Remedial Design. Water from the contaminant source area will first be extracted and treated. Based on modeling and/or other information to be obtained while operating the source area pump and treat system, additional extraction wells may then be installed to address the rest of the contaminated water plumes.*

2. The following comments are in reference to the off-site ground water remediation costs presented in Appendix A of the Final FS;

   a. The need for off-site extraction wells installed in the upper fluvial aquifer does not seem to be justified based on the delineation of chromium in the shallow ground water zone above the Jackson Clay.

EPA Response: *Hexavalent and total chromium were detected above the remedial goals in MW-18, which was installed beyond the source area in the upper fluvial aquifer. Multiple samples were collected from MW-18, at depths ranging from 78 feet below land surface (ft bls) to 114 ft bls. The concentrations detected at each depth are as follows: hexavalent chromium was detected at 10,000 micrograms per liter (ug/L) and total chromium was detected at 13,000 ug/L in the sample collected from 78 ft bls; hexavalent chromium at 7,590 ug/L and total chromium at 8,360 ug/L at 90 ft bls; hexavalent chromium at 560 ug/L and total chromium at 7,220 ug/L at 102 ft bls; and hexavalent chromium at 5,290 ug/L and total chromium at 6,690 ug/L at 114 ft bls. Therefore, one or more extraction wells may be needed to capture the contaminated ground water beyond the source area in the fluvial aquifer. Depths sampled in the monitoring wells at the Site were divided into two ranges and shallow ground water was considered to be at depths less than 104 feet below land surface (ft bls). Additional sampling during the Remedial Design stage of the CERCLA process will provide supplemental data for wells beyond the source area in the upper and lower portions of the fluvial aquifer. If subsequent ground water samples from the fluvial aquifer show concentrations of the COCs below respective remedial goal concentrations, then extraction wells screened within portions of this aquifer may not be necessary.*

   b. The estimate of $50,000 per extraction well capable of pumping at a rate of 500 gallons per minute (gpm) is considered low based on XDD's experience, which determined their costs to be approximately $150,000 each.

EPA Response: *Changes in the cost estimate may occur depending on new information and data collected during the engineering design of the remedial action selected. Any change that may occur will be documented in the form of a memorandum in the Administrative Record file if a minor change, an Explanation of Significant Differences (ESD) if a significant change, or a ROD Amendment if a fundamental change. The project costs presented in Appendix A of the Final FS are an order of magnitude estimates that are within plus 50 percent to minus 30 percent of probable costs based on data, materials and services detailed in the FS.*

c. The estimate of $0.50 per 1,000 gallons for tanker trucks to transport water from the extraction wells to a location where the Town can receive these waters seems to be low. The process for transporting via tanker trucks the water does not seem realistic as the off-site extraction wells may be pumping between 500 and 1,000 gpm per location, which would result in filling a 6,000 gallon tanker truck every 6 to 12 minutes. Additional costs would also be incurred to install a tanker unloading station.

EPA Response: *As stated above, actual project cost will depend on how the RA is designed. Any deviation from the cost estimates in the FS will be documented appropriately in the Administrative Record file if a minor change, an Explanation of Significant Differences (ESD) if a significant change, or a ROD Amendment if a fundamental change.*

3. Lastly, the presence of chromium at WP#2 has resulted in burdensome measures by the Town and Carrier to maintain its operation, the most significant of which has been the loss of a potable water source to a community that is in critical need of potable water. To date, the Town and Carrier have shouldered the burden of chromium impacts at WP#2 while waiting for the Superfund process to address the groundwater impact from the Smalley-Piper site. Further, it is our understanding that in 2009, the Town will need to seek other sources of potable water in lieu of WP#2. If the United States Environmental Protection Agency (USEPA) cannot discharge the extracted chromium treated water to the potable supply because the Town has already acquired its own new source wells, then the costs for this remedy for an alternative discharge option will increase substantially.

EPA Response: *Water extracted from the source area and treated will be reinjected into the Memphis aquifer. Water extracted from any additional extraction systems located beyond the source area will either be made available to the Town of Collierville as potable water or* *reinjected into the Memphis aquifer after treatment to cleanup goals, depending on the Town's potable water requirements*

Based on the information presented above, we respectfully request that the USEPA implement the use of WP#2 in its preferred alternative for the Smalley-Piper Superfund Site.

EPA Response: *The Smalley-Piper ground water plumes do not presently extend to Water Plant #2. Therefore, installation of a chromium treatment system at Water Plant #2 does not provide an optimal extraction location based on available data. Instead, a treatment system will first be installed at the source area and up to two additional extraction locations may be installed within the plumes.*

II. Comments from Butler, Snow, O'Mara, Stevens & Cannada, PLLC on Behalf of Gerdau Macsteel, Inc.

Mr. Femi Akindele
Superfund Remedial Branch
U.S. Environmental Protection Agency
61 Forsyth Street
Atlanta, Georgia 30303
August 22, 2008
Re: Collierville Superfund Sites

COMMENTS OF GERDAU MACSTEEL, INC.
ON THE PROPOSRD PLAN FOR THE
SMALLEY-PIPER SITE. COLLIERVILLE. TENNESSEE

In 1992, the United States Environmental Protection Agency ("EPA") issued a Superfund Record of Decision ("ROD") for the Carrier site in Collierville, Tennessee, which includes the Town of Collierville's Water Plant #2. That remedy was based on incomplete information, which suited the needs of Carrier Corporation, the primary potentially responsible party. Now, as EPA develops its Proposed Plan for the nearby Smalley-Piper Superfund site, it appears the Agency is about to repeat the same mistakes.

In 2005, Carrier sued a large number of parties, including Gerdau Macsteel, Inc. (f/k/a/Quanex Carp.), because chromium at Water Plant #2 was interfering with Carrier's preferred remedy. Gerdau Macsteel denies *any* liability with respect to environmental conditions in Collierville (for reasons largely explained in its pending summary judgment motion), has been vigorously defending itself against Carrier's claims, and intends to continue doing so. Over the past three years, Carrier's lawsuit has forced Gerdau Macsteel to develop information about Carrier and Water Plant #2--information that should have been considered sixteen years ago and that must be taken into account before choosing a remedy for the Smalley-Piper site, especially if Water Plant #2 is to be involved. Gerdau Macsteel is filing these comments to make sure the Agency aware of that information and to prevent Carrier from misusing the Smalley-Piper remedial process for purposes of its ongoing litigation.

I. Environmental conditions at and around the Carrier facility have not been fully investigated.

Under the Proposed Plan, EPA would extract ground water at or near Water Plant #2 regardless of the two most likely effects: pulling in more contamination and more water than is necessary to remediate Smalley-Piper. In this regard, the conclusion of the RI Addendum particularly bears emphasizing: No data substantiates that any Smalley-Piper chromium has reached Water Plant #2. Indeed, the attached expert report by Robert F. Powell of Environ concludes that Smalley-Piper is unlikely to be the source of chromium at Water Plant #2. *See Attachment 1.* So if chromium at Water Plant #2 is not from Smalley-Piper, where did it come from? For the answer, EPA need look first to Carrier's plant, which is contiguous to Water Plant #2.

The Carrier 1992 RI nowhere discusses Carrier's use of chromium, and Carrier has gone so far as to publicly claim that "[n]either chromium nor any other similar substance or chemical was ever used, deposited, discharged, spilled or released at the Carrier Property." That turns out to be false. For almost 40 years, Carrier has been using chromium and hexavalent chromium in its Collierville operations. Carrier's internal documents indicate it was discharging chromium to the sewer in 1969. *See e.g., Attachment 2.* Apparently, chromic acid was used in at least a process water rinse, which then was channeled into a clarifying pit. *Id.* When the Shelby County landfill refused to accept the chromium-containing waste from that pit, Carrier simply "[d]umped waste on plant property," *id.*, into what was an unlined lagoon just 500 feet from Water Plant #2, *see Attachment 3.* Chromium waste from the clarifying pit also appears to have been disposed of in at least one other "shallow hole," the location of which currently is unknown, even to Phil Coop of Ensafe who was in charge of the Carrier RI. *See Attachment 3.* According to a TDEHC site inspection Trip Report in 1987, moreover, "[i]t was reported that during times of wet weather the trucks could not make it to the lagoon and would dump their loads along the access road," which means that there are still other chromium disposal locations on the Carrier plant site. *See Attachment 4.* And Carrier has classified portions of its Collierville wastes as "D007" material, indicating that they may leach 5000 μg/L or more of chromium.

With Carrier denying that it ever even used chromium, there can be no legitimate argument that the 1992 Carrier RI adequately characterized Carrier's clarifying pit, its sewers, its other plant areas where chromium was handled, and its dump sites. For the sake of comparison, Carrier expressly set out in 1992 to identify its VOCs, but by 2003, it concluded that it had underestimated the extent of its VOC source areas by 200%. *See Attachment 5.* Carrier's current consultant, Bruce Cliff of XDD, recently has conceded that the chromium previously dumped by Carrier could have contributed to the chromium contamination at Water plant #2. *See Attachment 6.* Perhaps even more importantly, whatever was done in 1992 says nothing about Carrier's chromium management over the past 16 years, and Carrier may be continuing to use hexavalent chromium today. *See Attachment 7.*

Even back in 1992, however, there were troubling signs in the Carrier RI that went unheeded. Monitoring wells near the one identified waste lagoon and Water Plant #2 contained chromium at levels as high as 392 ppb; other wells on the Carrier property contained chromium at levels as high as 383 ppb. Early tests of the town's wells at Water Plant #2 in 1990 contained chromium up to 28 ppb. *See Attachments 1 & 8.* These findings show that Carrier released chromium into the shallow aquifer and contributed to chromium at Water Pant #2. *See Attachment 1.*

But Carrier's failure to fully characterize its site goes beyond chromium. Carrier's waste streams have contained other metals, including lead. See Attachment 9. The Carrier RI (at 85) dismissed shallow ground water findings for lead and zinc, even those above MCLs, because "a pattern of contamination" was not present, a finding in which no reliance can be placed when Carrier did not account for its disposal practices. In addition, sampling at Carrier's plant has detected cyanides and PCBs in the same samples as TCE, which could be expected to mobilize PCBs. *See Attachment 10.* Unfortunately, Carrier's RI appears to have ruled out these compounds as constituents of concern without analyzing groundwater samples from any well down gradient of the disposal area. A 2003 XDD document explains why the 1992 investigation was so selective:

"There is a real possibility that further subsurface work on site could produce additional source areas." *See Attachment 5.*

Some persons might argue that a clay layer under Carrier's plant prevents any chromium or other contamination there from reaching Water Plant #2, but they would be ignoring the facts. According to the Carrier ROD, vertical leakage through the clay is 1,300-27,000 gal/day/acre. Beyond that, the wells at Water Plant #2 reportedly were constructed with a gravel pack surrounding the well casing to the ground surface, making them a direct conduit from the shallow zones to the Memphis Sands aquifer, a migration pathway acknowledged in the 1992 RI. Carrier RI at 144. Aside from movement directly downward, the 1992 analysis showed that contamination at Carrier would flow around the edges of the clay. The stratigraphic investigation, for example, "clearly indicate[d] that shallow groundwater movement to the south and east will eventually migrate to an area in which the Memphis Sand aquifer and the shallow aquifer unit are hydraulically connected." *Id.* at 142. The fate and transport analysis in the Carrier ROD similarly shows groundwater migration to the southeast, Carrier ROD at 19, while the potentiometric map for the shallow aquifer in the Carrier RI shows flow in practically all directions, including to the southeast (and the hydraulic connection with the Memphis Sand), and for that matter, towards Smalley-Piper. Carrier RI at Figure 5-3.

Nor is Carrier the only source of groundwater contaminants that should concern EPA. Extraction at Water Plant #2 may be pulling in additional substances from the surrounding commercial/industrial area, which includes or has included a rail line and a former can plant. Indeed, the Tennessee Division of Water Supply rated Water Plant #2 to be of "high" susceptibility in 2001 because nearby were four hazardous waste facilities, one Superfund site, (presumably Carrier), and six facilities with priority SIC codes. The area to the south/southeast should be a particular concern since the 1992 capture analysis showed Water Plant #2 pulling in water from that direction, rather than from the north/northeast as is now being assumed.

With this risk of pulling in additional contamination, and thereby increasing the volume of material to be treated, it would be hoped that EPA has thoroughly studied area conditions before committing to any off-site ground water extraction. Instead, the Smalley-Piper FS reports "the existence of sizable uncertainties" (at 1-10), that the "true extent of contaminated soil volume(s) or contaminated ground water plume(s) is an uncertainty" (at 2-12), that the remedial alternatives represent "work in progress" (at 3-25) that "plume configuration, size, and trajectory represent a critical and substantial uncertainty" (at App. A-8), and that there is uncertainty about off-site groundwater, including "direction of ground water flows, the influence of the WP#2 extraction wells on ground water flow patterns, the degree to which chromium has migrated downgradient of the source area, etc," (at 1-10). The Proposed Plan even would draw ground water from underneath the Carrier Air Conditioning site although the contaminants there "have not been investigated by environmental ground water sampling as of yet" (at App. A-20).

EPA simultaneously concedes that its preferred alternative may not yield the expected "effectiveness and permanence" "if the extent of contamination has not been defined adequately." Smalley-Piper FS at 4-11. The information above shows that the extent of contamination at and around Carrier's plant and Water Plant #2 in fact has not been defined.

This also means that EPA's Smalley-Piper cost projections will bear little resemblance to what actually will happen. Carrier's estimates show how the costs of ion exchange at Water Plant #2 could balloon. Carrier's representatives have estimated the undiscounted cost of developing and operating an ion-exchange resin system for chromium at Water Plant #2 (without any remediation at Smalley-Piper) to be over $6.1 million, or about 60% of EPA's *total* estimated cost for its preferred Smalley-Piper remedy. *See* Attachment 7. That figure assumed a system sized to treat 500 gpm (the pumping rate necessary to capture Carrier's VOCs), whereas the Smalley-Piper FS (at App. A-20) assumes that 1000 gpm of "moderate to dilute" ground water contamination would need to be extracted from the southwest edge of the plume. Carrier originally estimated that treatment for chromium at Water Plant #2 of 1100 gpm, the approximate operating capacity of the well field, would cost $9 million and take 30 years in the absence of Smalley-Piper remedies. *See* Attachment 7. Not surprisingly with these costs, Carrier's representatives eventually concluded that discharging Carrier's treated water to sewer deserved more attention. *Id.*

Regardless of how the water would be treated, the Smalley-Piper FS concedes that trying to use Water Plant #2 to capture chromium from Smalley-Piper would *increase the volume of material to be treated.* The Smalley-Piper plume naturally is flowing away from Water Plant #2. As EPA acknowledges (Smalley-Piper FS App. A-23, 26), using Water Plant #2 in the Smalley-Piper remedy would increase cleanup time, treat a greater volume of "relatively clean" water, and draw the contamination farther west before it is captured. To top things off, EPA has not estimated how much water it would need to move through Water Plant #2 to provide effective capture (or whether that even is possible), but simply assumed it could be done. Smalley-Piper FS at 3-5.

Picking an off-site remedy under these circumstances-known sources of contamination unaccounted for, uncharacterized potential sources nearby, incomplete knowledge of groundwater flow and transport, and uncertain costs--makes no sense (apart from Carrier's vested interest in reducing its cleanup costs). The existing lack of information prevents the proper evaluation and selection of a reasonable and cost-effective remedy as directed by the National Contingency Plan ("NCP").

II. The analysis of remediation alternatives should not be biased in favor of extracting water for drinking.

Apart from the no-action alternative, the 1992 Carrier FS identified only options in which Water Plant #2 continued to pump. *See Carrier FS at iii.* As described in the Carrier ROD (at i), then, the remedy for the Carrier site became extraction from Water Plant #2, along with extraction from supplemental wells. After treatment, the ROD (at i) provided that extracted water was to be "(1) utilized in the municipal supply; (2) discharged to a local publicly owned treatment works (POTW); (3) discharged to surface water; or (4) reinjected to the Memphis Sands aquifer." In practice, the supplemental wells were dropped, leaving public water supply wells as the sole means of removing groundwater contamination, and the sole endpoint for the extracted water became public consumption. EPA's FS for Smalley-Piper appears to continue this agenda, with its discussion of an ion-exchange polishing step for Water Plant #2.

This bias ignores other approaches that are likely to be more cost-effective. As noted in the attached expert report, water blending and production management could reduce hexavalent chromium levels at Water Plant #2 to less than 30 ppb. See Attachment 1. EPA's Smalley- Piper FS never discusses this option. If the goal is to protect Water Plant #2 from chromium, moreover, another cost-effective approach would be for Carrier to install the supplemental extraction wells called for in its ROD. This would help provide VOC capture, while reducing the need to pump from Water Plant #2. Likewise, Carrier would be re-injecting some amount of extracted water from Water Plant #2, as envisioned in the Carrier ROD, thereby creating a "mound" that would block migration into the well system.

It is not apparent why EPA believes extracted water in the "offsite plume zone" or "OPZ" for Smalley-Piper should be "intended to be returned to the Town of Collierville as potable drinking water." Smalley-Piper FS at 3-4. Nowhere does the FS explain why that is necessary or why that water cannot be better treated for use as process water, re-injected, or discharged to the sewer.

While the Smalley-Piper FS pays lip service to use of in-situ groundwater treatment, it ultimately chooses extraction over those options because they cannot assure "complete treatment." *Id.* at 3-22, 3-24. Yet, EPA admits that its preferred alternative could leave behind a "small" (but unquantified) zone of uncaptured groundwater. Id. at App. A-23. This is acceptable to the Agency because the "small volume" of dilute chromium would not be fed by up-gradient contaminated groundwater and "would be expected to dissipate and dilute (i.e., attenuate) over time." Nowhere does the Agency explain what levels of untreated residue, dilution, and attenuation are acceptable, which is critical since remediation of less than the entire plume by in situ stabilization or another technique may be significantly less expensive than the Agency's preferred alternative.

By contrast, EPA's remedy at another chromium Superfund site--Frontier Hard Chrome--relied upon an in situ redox manipulation of the groundwater plume "hot spot," defined as the area exceeding 5000 μg/L chromium. The larger area of the plume was left to dilute and disperse naturally in conjunction with monitoring and institutional controls. "Due to the high cost of potentially remediating" the areas outside the hot spots, in return only "for limited contaminant removal," EPA did not consider alternatives addressing the entire plume.

Even in analyzing the Carrier site in 1992, EPA was willing to let lead and zinc remain in the ground water at concentrations yielding HQ's of 4.1 and 0.82, respectively. Carrier ROD at 31. Apparently, dilution, attenuation, and water blending in the Collierville system worked for those constituents. A similar approach should be taken for Smalley-Piper chromium.

In quantifying what level of chromium may remain, EPA should take full account of the existing institutional controls. According to the Smalley-Piper baseline risk assessment, "EPA institutional controls are not currently in place," and "[g]roundwater restrictions are not expected to be implemented by EPA in the future." This is a far cry from the Agency's prior assessments of intuitional controls for Carrier and Water Plant #2:

- “Use of the shallow water bearing zone and the Memphis Sand aquifer as a potable water source is restricted by city and county ordinances. Both these ordinances control and regulate the location and construction of wells in Collierville and Shelby County.” Carrier ROD at 25.
- "The Memphis Sand aquifer...is regulated by the Memphis Shelby County and the Town of Collierville (sic) to prohibit installation of wells in the Memphis Sand aquifer or shallow aquifer without a permit." EPA, Carrier A.C. Superfund Site Five Year Review at 6 (2000).
- "Shelby County prohibits installation of drinking water wells within 0.5 miles of state or federal superfund sites unless the well owner can demonstrate that the well will not enhance the migration of contaminants." 2004 Review at 21.

On top of all that, the Carrier ROD provided for implementation of additional institutional controls.

Any fixation with maintaining use of Water Plant #2 for drinking water, even it if means ignoring and violating existing institutional controls, is nothing short of arbitrary and capricious. On the one hand, Carrier insists that the wells are critical to the town, while on the other, its consultant privately admits that the 'Town might abandon its wells, doesn't need them to meet demand." *See* Attachment 5. As for the Town itself, its representatives indicated at the July 31, 2008 public meeting that it could install a new well; the Town voted $25,000 in 2007 for an analysis of where to put a replacement. For the sake of comparison to EPA's $10 million preferred remedy, the Town had planned to expand its Water Plant #4 for $725,000.

While the Town may want to have the option of using Water Plant #2, it also has taken the position that it would not allow *any* chromium to enter its drinking water. *See* Attachment 7. Thus, even full implementation of EPA's preferred alternative, and prompt attainment of the 47 ppb cleanup standard for hexavalent chromium throughout the plume (assuming such is even possible), does not return Water Plant #2 to service as a water supply well. The Smalley-Piper FS appears to recognize the Town's position, at least tacitly, because the "Summary and Conclusions" section describes the remedial alternatives as operating "until extracted ground water shows non-detect chromium and other metals." If EPA, the Town, or Carrier wants to ignore the Baseline Risk Assessment and volunteer to clean up Water Plant #2 to background levels, then it should acknowledge that its actions go beyond what the NCP requires.

Rather than wasting Superfund money on chrome treatment at Water Plant #2, the Agency should be focusing on how it can restore the Memphis Sand aquifer and prevent ingestion of chromium-contaminated groundwater. The way to do that consistent with the NCP is to address the hottest zones at Smalley-Piper, and rely on attenuation plus institutional controls for the more dilute portions. As for Water Plant #2, an effective management program is long overdue.

* * *

Sixteen years ago the Agency put in place a groundwater remedy that largely let two parties off the hook: Carrier, which had released massive mounts of TCE into the environment; and the Town of Collierville, which owned the Carrier plant site when Carrier was disposing of hazardous substances there. Those parties received a pass on fully characterizing their contamination and were allowed to pull their contamination passively to Water Plant #2 instead of having to actively find and remove it, and were allowed to promote use of a poorly sited drinking well.

Because it perpetuates those past mistakes, the Proposed Plan is plagued with significant deficiencies, including (among others) the failure to investigate the nature and extent of groundwater contamination, the failure to account for nearby sources, the failure to utilize institutional controls, the failure to institute managed pumping, the failure to rely upon alternative sources of municipal water, the failure to incorporate natural attenuation, and the failure to fairly assess in situ remediation. Unless these are corrected, the FS and Proposed Plan will remain inconsistent with the NCP.

EPA Response: *In accordance with the National Contingency Plan (NCP), nine evaluation criteria were used to examine the overall viability of the remedial technologies selected for consideration at the Smalley-Piper Site. The evaluation criteria include overall protection of human health and the environment, compliance with* applicable or relevant and appropriate requirements *(ARARs), short-term effectiveness, long-term effectiveness and permanence, reduction of mobility, toxicity, or volume through treatment, implementability, cost, state and support agency acceptance, and community acceptance. Based on consideration of all criteria and the information currently available, EPA selected, with concurrence from the State of Tennessee, the Preferred Alternative [Alternative 5 - Soil Removal, On-Site Treatment and Offsite Disposal, Ground Water Pump and Treat, and Institutional Controls] because it meets the threshold criteria and provides the best option among the alternatives evaluated with* *respect to balancing and modifying criteria. EPA selected the Preferred Alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) protect human health and the environment (2) comply with ARARs; (3) be cost effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element.*

The components of the selected remedy for the Smalley-Piper Site will be implemented in phases. The selected remedy is excavation and ex-situ stabilization/solidification of contaminated source area soil, disposal of treated soil to a non-hazardous waste disposal facility, and long-term ground water recovery and treatment for total chromium, hexavalent chromium, antimony, and iron. Specific elements of the selected remedy are:

1. *Excavation of contaminated soil*
2. *Chemical stabilization and solidification of contaminated soil*
3. *Off-site disposal of stabilized soil*
4. *Extraction of contaminated ground water*
5. *Ex-situ treatment of contaminated ground water*
6. *Disposal of treated water*
7. *In-situ soil flushing*
8. *Implementation of institutional controls*

The main activities associated with these remedy components are: (1) excavating 144,000 cubic feet of contaminated soil; (2) chemically stabilizing and solidifying the excavated soil into a non-hazardous solid matrix; (3) transporting the stabilized/solidified soil to a local off-site non-hazardous waste facility for disposal; (4) constructing and operating ground water extraction wells to remove contaminated ground water from various parts of the contaminated plume; (5a) construction and operation of a source area ground water treatment facility using conventional chemical reduction and precipitation; (5b) dewatering, solidifying and disposing (at an off-site hazardous waste facility) the chemical treatment residue; (5c) construction and operation of up to two additional water extraction and treatment systems in the northwest and southwest portions of the contaminant plumes using ion-exchange resin technology; (6) water extracted from the source area will be reinjected into the Memphis aquifer after treatment. Water extracted and treated to cleanup goals from any additional locations beyond the source area will either be made available to the Town of Collierville as potable water or reinjected into the Memphis aquifer, depending on the Town's potable water requirements; (7a) flushing the subsurface soil below the excavation depth with treated ground water using the open excavation pit as the injection point; (7b) collecting and treating the flush fluid along *with the source ground water through the source extraction well and chemical treatment facility (as in step 5a); and (8) implementing institutional controls against the use of contaminated ground water until cleanup goals are met.*

The Smalley-Piper ground water plumes do not presently extend to Water Plant#2. Therefore, installation of a chromium treatment system at Water Plant #2 does not provide an optimal extraction location based on available data.

Changes in the cost estimate for Smalley-Piper may occur depending on new information and data collected during the engineering design of the remedial action selected. Changes that may occur will be documented in the Administrative Record file if a minor change, an Explanation of Significant Differences (ESD) if a significant change, or a ROD Amendment if a fundamental change. The project costs presented in Appendix A of the Final FS are an order of magnitude estimates that are within plus 50 percent to minus 30 percent of probable costs. The goals of the selected remedies for soil and ground water are to reduce site contaminants to cleanup goals at the conclusion of its implementation and to make the property available for reuse and restore the Memphis sands aquifer. It is EPA's position that contaminated ground water on the Carrier Superfund Site is to be remediated by Carrier pursuant to an existing Unilateral Administrative Order.

III. Comments from Tennessee Department of Environment and Conservation

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
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2510 MT. MORIAH ROAD
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August 29, 2008

Mr. Femi Akindele
Remedial Project Manager
USEPA Region 4
61 Forsyth Street, SW 11th Floor
Atlanta, Georgia 30303-8960

Subject: Final Proposed Plan/ Feasibility Study of Remedial Alternatives Final (July 2008) Smalley-Piper Site, EPA ID # TNN000407378, TDSF ID # 79-676

Dear Mr. Akindele,

TDEC/DoR has reviewed both the Final Feasibility Study Report and The Final Proposed Plan as received on 7/23/08 and provides the following comments. While these comments are referenced to the Feasibility Study of Remedial Alternatives, they also apply to the referenced Final Proposed Plan, which summarized the remedial alternatives.

General Comment:

1. Within the generic outline of Alternative 5, in which TDEC/DoR agrees, consideration should be given to the substitution of SW- OPZ for NW- OPZ as the contingency well for extraction, depending on the influence (or lack of influence) of the on-site extraction wells and the overall component direction of the contaminated groundwater plume leaving the site. If on-site extraction wells influence the plume to flow in a more westerly direction, then SW-OPZ or WP #2 may be adequate for capturing the whole or at least the southern portion of the plume. If on-site extraction wells do not influence plume flow with a more westerly component, then the NW-OPZ will probably be a necessary extraction point regardless of what is used to the southwest (SW-OPZ or WP#2). The potential for the established infrastructure of Water Plant #2 to provide efficiencies of time and money should be considered, if shown to accomplish the same goal as SW-OPZ extraction wells (capture/control of SW portion of the Chromium plume). Operation of NW-OPZ and Water Plant #2 wells should allow for appropriate monitoring and modeling after sufficient monitoring well installations to better optimize the system and evaluate whether extraction well SW-OPZ is needed.

EPA Response: *This ROD provides that EPA will first construct and operate a ground water extraction and treatment system in the source area and up to two additional ground water extraction treatment systems in the northwest and southwest portions of the contaminated ground water plumes if monitoring data, modeling and/or treatability studies so indicate. The optimal locations of the extraction and treatment system(s) will be determined based upon the data obtained from* *monitoring, modeling and/or treatability studies. It is conceivable that the "contingency" ground water extraction and treatment system will be located in the southwest portion of the plume instead of the northwest. However, the need for extraction and treatment beyond the source area will be dependent upon the influence or lack of influence of the source area extraction wells and the resulting pattern of the contaminated ground water plume beyond the source area.*

2. TDEC looks forward to working with EPA in developing the remedial design to implement this remedy.

EPA Response: *EPA looks forward to continue working with TDEC on future activities at the Site.*

Specific Comments:

1. **Section 3.2.2.3, Deep Subsurface Soil Remedy, Page 3-4:** The last sentence of this section states that the infiltration gallery reinjection will continue until groundwater samples show non-detect concentrations for chromium and other metals, while earlier in Section 2.2.1 (Preliminary RAO's) it states that groundwater will be cleaned to either the MCL (total Cr = 100ppb) or the established RGO (Hexavalent Cr = 47ppb) at other reinjection points. Please clarify this discrepancy or state rationale for non-detect treatment. TDEC-DOR Rule 1200-1-13-.12 (5) (page 28) stipulates conditions in which pump and treat remedies may be discontinued at a site after hazardous substances in the ground water have reached asymptotic levels for contaminant removal. TDEC-DoR feels these guidelines should be considered and implemented for all long-term groundwater treatment associated with the site. (Reference link: **http://tennessee.gov/sos/ru1es/1200/1200-0l/1200-01-13.pdf**).

EPA Response: *The comment correctly identifies an inconsistency in the description of the criterion used to determine the point of completion for the deep subsurface soil remedy. The cycle of ground water extraction, treatment and reinjection will continue at the treatment station until metal/chromium concentrations reach an asymptotic minimum or the established remedial goal concentrations. The reference to nondetect concentrations is incorrect.*

2. **Section 5, Page 5-1, l(a):** TDEC/DoR suggests using the following language: 'Locate and install ***up to*** nine new monitoring wells throughout the off-site plume area. . . .'

EPA Response: *EPA agrees with TDEC's recommended change. In fact, the number of monitoring wells required for the RA will be determined during RD.*

3. **Section 5, Page 5-1, 2(a):** TDEC/DoR suggests using the following language: 'Excavate source area soils to ***the extent practicable as deep*** as 25 feet below ground surface.'

EPA Response: *EPA agrees with TDEC's recommended change in that it conveys flexibility in implementing the remedy at the Site and the extent practicable will be determined by equipment constraints and Site conditions during construction.*

4. **Section 5, Page 5-1, 3:** TDEC/DoR suggests allowing an option for POTW discharge of low volumes of sufficiently treated effluent. This might be if the injection points become fouled or temporarily overloaded/saturated from maximum injection loading or local precipitation events.

EPA Response: *The recommended option for disposing of sufficiently treated effluent is certainly a good contingency plan which the RD will explore.*

5. **Section 5, Page 5-3, 4(a-d):** TDEC/DoR suggests the consideration of utilizing Water Plant #2 wells for initial extraction and resin treatment instead of the proposed SW-OPZ extraction point. Consistent with the general comment above, this should allow for quicker cleanup of groundwater and sequential modeling efforts, as monitoring wells are installed in the plume area north of the water plant.

EPA Response: *See response to TDEC's General Comment 1.*

6. **Section 5, Page 5-2, 4:** It is unclear whether shallow groundwater will require treatment. If so, injection galleries with allowances for additional discharge consistent with comment 3, above could be utilized.

EPA Response: *Confirmatory sampling and other information which will address this comment are expected to be collected during the RA.*

7. **Section 5, Page 5-2, 4(b):** There may be significant cost saving in plumbing SWOPZ to Water Plant #2 instead of establishing a separate treatment plant at SWOPZ.

EPA Response: *See response to TDEC's General Comment 1.*

8. **Section 5, Page 5-2, 5:** TDEC DoR suggests substituting the SW-OPZ as the contingency component and making the NW-OPZ a required component should better serve a more efficient and less costly response to groundwater contamination in the deeper aquifer.

EPA Response: *See response to TDEC's General Comment 1.*

9. **Section 5, Page 5-3, 7:** TDEC/DoR suggests that the contingency option (NW-OPZ) should be the primary option and SW- OPZ retained as a contingency. (see General Comments and Comment 7 above).

EPA Response: *See response to TDEC's General Comment 1.*

MEMORANDUM

STRATEGIC. ENVIRONMENTAL. SOLUTIONS.

To: Femi Akindele, USEPA

Date: August 22, 2008

From: Bruce Cliff, XDD

cc: Bryan Kielbania, UTC
Jamie Woods, TDEC
Bill Kilp, Town of Collierville
file (73271.01)

Re: Superfund Proposed Plan Fact Sheet,
Smalley-Piper Superfund Site, July 2008

Final Feasibility Study of Remedial Alternatives,
Smalley-Piper Superfund Site, July 2008
Collierville, TN

On behalf of Carrier Corporation (Carrier), XDD, LLC (XDD) appreciates the opportunity to provide public comment on the Superfund Proposed Plan (Plan) Fact Sheet dated July 2008 and the information in its supporting document the Final Feasibility Study (FS). The Plan favors Alternative 5, which, as described in the Final FS in more detail, proposes the installation of off-site wells northeast of the Town of Collierville's (Town) water plant number two (WP#2), extraction pumps, a treatment facility, and conveyance of the treated groundwater to the Town for potable use.

This review and comments on the Plan and the Final FS are not exhaustive, but rather focused on the favored off-site groundwater alternative presented in the Final FS with an emphasis of providing comments that will illustrate that an initial step of applying chromium treatment at WP#2 would yield the greatest benefit to the environment, taxpayers, and stakeholders. The Final FS does consider the use of WP#2 for its off-site remedy in Appendix A identifying a cost savings of approximately $650,000 when compared to the preferred alternative. However, Appendix A (page 23) of the Final FS finds disadvantages with the use of WP#2. The following comments addresses those perceived disadvantages.

1. *The location of the WP#2 wells (i.e., further west of the proposed location of the two dedicated SWEWs* {southwest extraction wells}*) implies that a longer remediation period will be required to capture the southern portion of the dilute plume, will result in treating a greater volume of 'relatively' clean water through the chromium/IXG* {ion exchange} *facility, and will draw the contaminant plume further west before being captured by the WP#2 wells. The amount of additional remediation/treatment time incurred by using the WP#2 wells as part of the remedy is difficult to determine exactly, but the total time to reach ground water remedial goals using WP#2 could be on the order of three to five years.*

Installation of chromium treatment at WP#2 has four benefits; 1) it provides some or all containment and capture of the chromium ground water plume, 2) because of the existing

MEMORANDUM

infrastructure at WP#2 a chromium treatment system can be easily integrated and placed into operation years before the installation and operation of new wells, related pumping systems, and effluent conveyance piping on third party (none stakeholder) properties thereby controlling the further migration of the chromium plume, 3) operation of WP#2 would provide an engineering basis for evaluating the need, if any, for other off-site containment wells without installing them first and then determining what well system is optimal, and 4) if additional containment wells are needed to expedite the remedial time period and/or improve the capture of the chromium plume and the discharge of those additional wells will be directed to the Town for potable use, then the WP#2 facility is the most technically appropriate and cost effective place to handle those processes.

2. The following comments are in reference to the off-site ground water remediation costs presented in Appendix A of the Final FS;

    a. The need for off-site extraction wells installed in the upper fluvial aquifer does not seem to be justified based on the delineation of chromium in the shallow ground water zone above the Jackson Clay.

    b. The estimate of $50,000 per extraction well capable of pumping at a rate of 500 gallons per minute (gpm) is considered low based on XDD's experience, which determined their costs to be approximately $150,000 each.

    c. The estimate of $0.50 per 1,000 gallons for tanker trucks to transport water from the extraction wells to a location where the Town can receive these waters seems to be low. The process for transporting via tanker trucks the water does not seem realistic as the off-site extraction wells may be pumping between 500 and 1,000 gpm per location, which would result in filling a 6,000 gallon tanker truck every 6 to 12 minutes. Additional costs would also be incurred to install a tanker unloading station.

3. Lastly, the presence of chromium at WP#2 has resulted in burdensome measures by the Town and Carrier to maintain its operation, the most significant of which has been the loss of a potable water source to a community that is in critical need of potable water. To date, the Town and Carrier have shouldered the burden of chromium impacts at WP#2 while waiting for the Superfund process to address the groundwater impact from the Smalley-Piper site. Further, it is our understanding that in 2009, the Town will need to seek other sources of potable water in lieu of WP#2. If the United States Environmental Protection Agency (USEPA) cannot discharge the extracted chromium treated water to the potable supply because the Town has already acquired its own new source wells, then the costs for this remedy for an alternative discharge option will increase substantially.

Based on the information presented above, we respectfully request that the USEPA implement the use of WP#2 in its preferred alternative for the Smalley-Piper Superfund Site.

BUTLER | SNOW

August 22, 2008

VIA UPS OVERNIGHT DELIVERY

Mr. Femi Akindele
Superfund Remedial Branch
U.S. Environmental Protection Agency
61 Forsyth Street
Atlanta, Georgia 30303

Re: Collierville Superfund Sites

Dear Mr. Akindele:

Please find enclosed the comments of Gerdau Macsteel, Inc. on the Proposed Plan for the Smalley-Piper Superfund Site.

Very truly yours,

BUTLER, SNOW, O'MARA, STEVENS & CANNADA, PLLC

Charles F. Morrow

Enclosures

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U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV

Superfund Proposed Plan
Smalley-Piper Superfund Site
Collierville, Shelby County, Tennessee

COMMENTS OF GERDAU MACSTEEL, INC.

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GERDAU MACSTEEL, INC.
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August 22, 2008

COMMENTS OF GERDAU MACSTEEL, INC.
ON THE PROPOSED PLAN FOR THE
SMALLEY-PIPER SITE, COLLIERVILLE, TENNESSEE

In 1992, the United States Environmental Protection Agency ("EPA") issued a Superfund Record of Decision ("ROD") for the Carrier site in Collierville, Tennessee, which includes the Town of Collierville's Water Plant #2. That remedy was based on incomplete information, which suited the needs of Carrier Corporation, the primary potentially responsible party. Now, as EPA develops its Proposed Plan for the nearby Smalley-Piper Superfund site,[1] it appears the Agency is about to repeat the same mistakes.

In 2005, Carrier sued a large number of parties, including Gerdau Macsteel, Inc. (f/k/a/ Quanex Corp.), because chromium at Water Plant #2 was interfering with Carrier's preferred remedy. Gerdau Macsteel denies *any* liability with respect to environmental conditions in Collierville (for reasons largely explained in its pending summary judgment motion[2]), has been vigorously defending itself against Carrier's claims, and intends to continue doing so. Over the past three years, Carrier's lawsuit has forced Gerdau Macsteel to develop information about Carrier and Water Plant #2—information that should have been considered sixteen years ago and that must be taken into account before choosing a remedy for the Smalley-Piper site, especially if Water Plant #2 is to be involved. Gerdau Macsteel is filing these comments to make sure the

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1 Superfund Proposed Plan Fact Sheet, Smalley-Piper Superfund Site, Collierville, Shelby County, Tennessee (July 2008) (the "Proposed Plan").

2 Defendant Quanex's Memorandum in Support of its Motion for Summary Judgment, *Carrier v. Paul P. Piper, Jr.*, Civil Action No. 2:05-cv-02307-JPM-dkv (D. Tenn. motion filed Oct. 9, 2007).

Agency aware of that information and to prevent Carrier from misusing the Smalley-Piper remedial process for purposes of its ongoing litigation.

I. Environmental conditions at and around the <u>Carrier facility have not been fully investigated.</u>

Under the Proposed Plan, EPA would extract ground water at or near Water Plant #2[3] regardless of the two most likely effects: pulling in more contamination and more water than is necessary to remediate Smalley-Piper. In this regard, the conclusion of the RI Addendum particularly bears emphasizing: No data substantiates that any Smalley-Piper chromium has reached Water Plant #2.[4] Indeed, the attached expert report by Robert Powell of Environ concludes that Smalley-Piper is unlikely to be the source of chromium at Water Plant #2. *See* Attachment 1. So if chromium at Water Plant #2 is not from Smalley-Piper, where did it come from? For the answer, EPA need look first to Carrier's plant, which is contiguous to Water Plant #2.

The Carrier 1992 RI nowhere discusses Carrier's use of chromium,[5] and Carrier has gone so far as to publicly claim that "[n]either chromium nor any other similar substance or chemical was ever used, deposited, disposed, discharged, spilled or released at the Carrier Property."[6] That turns out to be false. For almost 40 years, Carrier has been using chromium and hexavalent chromium in its Collierville operations. Carrier's internal documents indicate it was discharging chromium to the sewer in 1969. *See, e.g.,* Attachment 2. Apparently, chromic acid was used in

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3 *See* Black & Veatch Special Projects Corp., Feasibility Study of Remedial Alternatives, Smalley-Piper Superfund Site at App. A-20 (July 2008) (the "Smalley-Piper FS").

4 *See* Black & Veatch Special Projects Corp., Remedial Investigation Addendum, Smalley-Piper Superfund Site at 3-1 (July 1, 2008) (the "RI Addendum").

5 EnSafe, Collierville Site Final Remedial Investigation Report (1992) (the "Carrier RI").

6 Plaintiff's First Amended Complaint at ¶ 56, *Carrier v. Paul P. Piper, Jr.*, Civil Action No. 2:05-cv-02307-JPM-dkv (D. Tenn. complaint dated Aug. 25, 2005).

at least a process water rinse, which then was channeled into a clarifying pit. *Id.* When the Shelby County landfill refused to accept the chromium-containing waste from that pit, Carrier simply "[d]umped waste on plant property," *id.*, into what was an unlined lagoon just 500 feet from Water Plant #2, *see* Attachment 3. Chromium waste from the clarifying pit also appears to have been disposed of in at least one other "shallow hole," the location of which currently is unknown, even to Phil Coop of Ensafe who was in charge of the Carrier RI. *See* Attachment 3. According to a TDEHC site inspection Trip Report in 1987, moreover, "[i]t was reported that during times of wet weather the trucks could not make it to the lagoon and would dump their loads along the access road," which means there are still other chromium disposal locations on the Carrier plant site. *See* Attachment 4. And Carrier has classified portions of its Collierville wastes as "D007" material, indicating that they may leach 5000 μg/L or more of chromium.[7]

With Carrier denying that it ever even used chromium, there can be no legitimate argument that the 1992 Carrier RI adequately characterized Carrier's clarifying pit, its sewers, its other plant areas where chromium was handled, and its dump sites.[8] For the sake of comparison, Carrier expressly set out in 1992 to identify its VOCs, but by 2003, it concluded that it had underestimated the extent of its VOC source areas by 200%. *See* Attachment 5. Carrier's current consultant, Bruce Cliff of XDD, recently has conceded that the chromium previously dumped by Carrier could have contributed to the chromium contamination at Water Plant #2. *See* Attachment 6. Perhaps even more importantly, whatever was done in 1992 says nothing about Carrier's chromium management over the past 16 years, and Carrier may be continuing to use hexavalent chromium today. *See* Attachment 7.

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7 *See, e.g.*, Ensafe, USEPA Machinery, Manufacturing and Rebuilding Survey at 79 (1991).

8 Plus, the results of the1992 RI, or any other Carrier investigation, need to be considered in light of the extensive excavation and grading at the Carrier site over time. The results of any one boring there, even if accurately sited to target a historical chromium handling location, cannot be considered dispositive.

Even back in 1992, however, there were troubling signs in the Carrier RI that went unheeded. Monitoring wells near the one identified waste lagoon and Water Plant #2 contained chromium at levels as high as 392 ppb; other wells on the Carrier property contained chromium at levels as high as 383 ppb. Early tests of the town's wells at Water Plant #2 in 1990 contained chromium up to 28 ppb. *See* Attachments 1 & 8. These findings show that Carrier released chromium into the shallow aquifer and contributed to chromium at Water Plant #2. *See* Attachment 1.[9]

But Carrier's failure to fully characterize its site goes beyond chromium. Carrier's waste streams have contained other metals, including lead. *See* Attachment 9. The Carrier RI (at 85) dismissed shallow ground water findings for lead and zinc, even those above MCLs, because "a pattern of contamination" was not present, a finding in which no reliance can be placed when Carrier did not account for its disposal practices. In addition, sampling at Carrier's plant has detected cyanides and PCBs in the same samples as TCE, which could be expected to mobilize PCBs. *See* Attachment 10.[10] Unfortunately, Carrier's RI appears to have ruled out these compounds as constituents of concern without analyzing groundwater samples from any well down gradient of the disposal area. A 2003 XDD document explains why the 1992 investigation was so selective: "There is a real possibility that further subsurface work on site could produce additional source areas." *See* Attachment 5.

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[9] It appears from the 1992 Carrier RI that certain ground water samples were filtered prior to analysis, sometimes in the laboratory. *See* Appendix H. Consistent with Region 4 guidance, however, "[a]s a standard practice, ground water samples will not be filtered for routine analysis. ...Filtration is not allowed to correct for improperly designed or constructed monitoring wells, inappropriate sampling methods, or poor sampling technique." SESD Operating Procedure Groundwater Sampling (November 1, 2007).

[10] "PCBs will leach significantly in the presence of organic solvents ...." ATSDR, Toxicological Profile for Polychlorinated Biphenyls at 499 (November 2000).

Some persons might argue that a clay layer under Carrier's plant prevents any chromium or other contamination there from reaching Water Plant #2, but they would be ignoring the facts. According to the Carrier ROD, vertical leakage through the clay is 1,300-27,000 gal/day/acre.[11] Beyond that, the wells at Water Plant #2 reportedly were constructed with a gravel pack surrounding the well casing to the ground surface, making them a direct conduit from the shallow zones to the Memphis Sands aquifer, a migration pathway acknowledged in the 1992 RI. Carrier RI at 144. Aside from movement directly downward, the 1992 analysis showed that contamination at Carrier would flow around the edges of the clay. The stratigraphic investigation, for example, "clearly indicate[d] that shallow groundwater movement to the south and east will eventually migrate to an area in which the Memphis Sand aquifer and the shallow aquifer unit are hydraulically connected." *Id.* at 142. The fate and transport analysis in the Carrier ROD similarly shows groundwater migration to the southeast, Carrier ROD at 19, while the potentiometric map for the shallow aquifer in the Carrier RI shows flow in practically all directions, including to the southeast (and the hydraulic connection with the Memphis Sand), and for that matter, towards Smalley-Piper. Carrier RI at Figure 5-3.

Nor is Carrier the only source of groundwater contaminants that should concern EPA. Extraction at Water Plant #2 may be pulling in additional substances from the surrounding commercial/industrial area, which includes or has included a rail line and a former can plant.[12] Indeed, the Tennessee Division of Water Supply rated Water Plant #2 to be of "high" susceptibility in 2001 because nearby were four hazardous waste facilities, one Superfund site

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11 EPA, Record of Decision Carrier A.C. Site at 21 (1992) (the "Carrier ROD").

12 Database searching showed the former occupant of 110 S. Byhalia Road to be National Can Corp., a large quantity RCRA generator.

(presumably Carrier), and six facilities with priority SIC codes.[13] The area to the south/southeast should be a particular concern since the 1992 capture analysis showed Water Plant #2 pulling in water from that direction, rather than from the north/northeast as is now being assumed.[14]

With this risk of pulling in additional contamination, and thereby increasing the volume of material to be treated, it would be hoped that EPA has thoroughly studied area conditions before committing to any off-site ground water extraction. Instead, the Smalley-Piper FS reports "the existence of sizable uncertainties" (at 1-10), that the "true extent of contaminated soil volume(s) or contaminated ground water plume(s) is an uncertainty" (at 2-12), that the remedial alternatives represent "work in progress" (at 3-25), that "plume configuration, size, and trajectory represent a critical and substantial uncertainty" (at App. A-8), and that there is uncertainty about off-site groundwater, including "direction of ground water flows, the influence of the WP#2 extraction wells on ground water flow patterns, the degree to which chromium has migrated downgradient of the source area, etc." (at 1-10). The Proposed Plan even would draw ground water from underneath the Carrier Air Conditioning site although the contaminants there "have not been investigated by environmental ground water sampling as of yet" (at App. A-20).

EPA simultaneously concedes that its preferred alternative may not yield the expected "effectiveness and permanence" "if the extent of contamination has not been defined adequately." Smalley-Piper FS at 4-11. The information above shows that the extent of contamination at and around Carrier's plant and Water Plant #2 in fact has not been defined.

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[13] TDEC Division of Water Supply, Source Water Assessment Collierville Water Department – Wellfield #2 (2001) (available at http://gwidc.gwi.memphis.edu/website/dws/risk/GWI_Maps%5CCville_welf2_nomap.pdf).

[14] *See* EnSafe, Collierville Site Feasibility Study at Figure 3-2 (1992) (the "Carrier FS"). As noted in Attachment 1, Carrier's wells to the southeast contained total chromium at concentrations greater than 200 ppb, but those wells were too far to the south to have been affected by Smalley-Piper.

This also means that EPA's Smalley-Piper cost projections will bear little resemblance to what actually will happen. Carrier's estimates show how the costs of ion exchange at Water Plant #2 could balloon. Carrier's representatives have estimated the undiscounted cost of developing and operating an ion-exchange resin system for chromium at Water Plant #2 (without any remediation at Smalley-Piper) to be over $6.1 million, or about 60% of EPA's *total* estimated cost for its preferred Smalley-Piper remedy. *See* Attachment 7. That figure assumed a system sized to treat 500 gpm (the pumping rate necessary to capture Carrier's VOCs), whereas the Smalley-Piper FS (at App. A-20) assumes that 1000 gpm of "moderate to dilute" ground water contamination would need to be extracted from the southwest edge of the plume. Carrier originally estimated that treatment for chromium at Water Plant #2 of 1100 gpm, the approximate operating capacity of the well field, would cost $9 million and take 30 years in the absence of Smalley-Piper remedies. *See* Attachment 7. Not surprisingly with these costs, Carrier's representatives eventually concluded that discharging Carrier's treated water to sewer deserved more consideration. *Id.*

Regardless of how the water would be treated, the Smalley-Piper FS concedes that trying to use Water Plant #2 to capture chromium from Smalley-Piper would *increase the volume of material to be treated.* The Smalley-Piper plume naturally is flowing away from Water Plant #2. As EPA acknowledges (Smalley-Piper FS at App. A-23, 26), using Water Plant #2 in the Smalley-Piper remedy would increase cleanup time, treat a greater volume of "relatively clean" water, and draw the contamination farther west before it is captured. To top things off, EPA has not estimated how much water it would need to move through Water Plant #2 to provide effective capture (or whether that even is possible), but simply assumed it could be done. Smalley-Piper FS at 3-5.

Picking an off-site remedy under these circumstances—known sources of contamination unaccounted for, uncharacterized potential sources nearby, incomplete knowledge of groundwater flow and transport, and uncertain costs—makes no sense (apart from Carrier's vested interest in reducing its cleanup costs). The existing lack of information prevents the proper evaluation and selection of a reasonable and cost-effective remedy as directed by the National Contingency Plan ("NCP").

II. The analysis of remediation alternatives should <u>not be biased in favor of extracting water for drinking.</u>

Apart from the no-action alternative, the 1992 Carrier FS identified only options in which Water Plant #2 continued to pump. *See* Carrier FS at iii. As described in the Carrier ROD (at i), then, the remedy for the Carrier site became extraction from Water Plant #2, along with extraction from supplemental wells. After treatment, the ROD (at i) provided that extracted water was to be "(1) utilized in the municipal supply; (2) discharged to a local publicly owned treatment works (POTW); (3) discharged to surface water; or (4) reinjected to the Memphis Sands aquifer."[15] In practice, the supplemental wells were dropped, leaving public water supply wells as the sole means of removing groundwater contamination, and the sole endpoint for the extracted water became public consumption. EPA's FS for Smalley-Piper appears to continue this agenda, with its discussion of an ion-exchange polishing step for Water Plant #2.

15 In addition, "institutional controls" were to be "placed on well construction and water use in the general area of the Site." Carrier ROD at ii. It is unclear why use of Water Plant #2 itself never was restricted. Carrier and the Town in fact entered an agreement requiring the Town to pump a minimum of 7.5 million gallons per week (an average of about 744 gallons per minute). *See* EnSafe, 2004 Five Year Review at Appendix C (2005) (the "2004 Review"). A pumping rate of 500 gpm at Water Plant #2 is sufficient to contain Carrier's VOCs. Attachment 7. Even if any chromium from Smalley-Piper were to end up at Water Plant #2, the fault would seem to lie with the parties who designed and implemented the 1992 cleanup, particularly when they knew as of 1990 that chromium was present in the ground water at Smalley-Piper, *see* Attachment 7, but failed to limit the maximum pumping rate.

This bias ignores other approaches that are likely to be more cost-effective. As noted in the attached expert report, water blending and production management could reduce hexavalent chromium levels at Water Plant #2 to less than 30 ppb. *See* Attachment 1.[16] EPA's Smalley-Piper FS never discusses this option. If the goal is to protect Water Plant #2 from chromium, moreover, another cost-effective approach would be for Carrier to install the supplemental extraction wells called for in its ROD. This would help provide VOC capture, while reducing the need to pump from Water Plant #2. Likewise, Carrier could be re-injecting some amount of extracted water from Water Plant #2, as envisioned in the Carrier ROD, thereby creating a "mound" that would block migration to the well system.

It is not apparent why EPA believes extracted water in the "offsite plume zone" or "OPZ" for Smalley-Piper should be "intended to be returned to the Town of Collierville as potable drinking water." Smalley-Piper FS at 3-4. Nowhere does the FS explain why that is necessary or why that water cannot be better treated for use as process water, re-injected, or discharged to the sewer.

While the Smalley-Piper FS pays lip service to use of in-situ groundwater treatment, it ultimately chooses extraction over those options because they cannot assure "complete treatment." *Id.* at 3-22, 3-24. Yet, EPA admits that its preferred alternative could leave behind a "small" (but unquantified) zone of uncaptured groundwater. *Id.* at App. A-23. This is acceptable to the Agency because the "small volume" of dilute chromium would not be fed by up-gradient contaminated groundwater and "would be expected to dissipate and dilute (i.e., attenuate) over time." Nowhere does the Agency explain what levels of untreated residue,

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16 Sampling of finished water at Water Plant #2 from July 2001 to October 2003 showed that no hexavalent chromium exceeded 50 ppb. ATSDR, Smalley-Piper Health Consultation at 4 (Nov. 6, 2003) (the "ATSDR Report").

dilution, and attenuation are acceptable, which is critical since remediation of less than the entire plume by in situ stabilization or another technique may be significantly less expensive than the Agency's preferred alternative.

By contrast, EPA's remedy at another chromium Superfund site—Frontier Hard Chrome—relied upon an in situ redox manipulation of the groundwater plume "hot spot," defined as the area exceeding 5000 μg/L chromium. The larger area of the plume was left to dilute and disperse naturally in conjunction with monitoring and institutional controls. "Due to the high cost of potentially remediating" the areas outside the hot spots, in return only "for limited contaminant removal," EPA did not consider alternatives addressing the entire plume.[17]

Even in analyzing the Carrier site in 1992, EPA was willing to let lead and zinc remain in the ground water at concentrations yielding HQ's of 4.1 and 0.82, respectively. Carrier ROD at 31. Apparently, dilution, attenuation, and water blending in the Collierville system worked for those constituents. A similar approach should be taken for Smalley-Piper chromium.

In quantifying what level of chromium may remain, EPA should take full account of the existing institutional controls. According to the Smalley-Piper baseline risk assessment,[18] "EPA institutional controls are not currently in place," and "[g]roundwater restrictions are not expected to be implemented by EPA in the future." This is a far cry from the Agency's prior assessments of institutional controls for Carrier and Water Plant #2:

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17 EPA, Superfund Record of Decision Amendment: Frontier Hard Chrome, Inc. § 9.1 (2001).

18 Black & Veatch Special Projects Corp., Baseline Risk Assessment, Revised Final, Smalley-Piper Superfund Site at 7-2 (July 2008).

- "Use of the shallow water bearing zone and the Memphis Sand aquifer as a potable water source is restricted by city and county ordinances. Both these ordinances control and regulate the location and construction of wells in Collierville and Shelby County." Carrier ROD at 25.

- "The Memphis Sand aquifer … is regulated by the Memphis Shelby County and the Town of Collierville (sic) to prohibit installation of wells in the Memphis Sand aquifer or shallow aquifer without a permit." EPA, Carrier A.C. Superfund Site Five Year Review at 6 (2000).

- "Shelby County prohibits installation of drinking water wells within 0.5 miles of state or federal Superfund sites unless the well owner can demonstrate that the well will not enhance the migration of contaminants." 2004 Review at 21.

On top of all that, the Carrier ROD provided for implementation of additional institutional controls.

Any fixation with maintaining use of Water Plant #2 for drinking water, even it if means ignoring and violating existing institutional controls, is nothing short of arbitrary and capricious. On the one hand, Carrier insists that the wells are critical to the town, while on the other, its consultant privately admits that the "Town might abandon its wells, doesn't need them to meet demand." *See* Attachment 5. As for the Town itself, its representatives indicated at the July 31, 2008 public meeting that it could install a new well; the Town voted $25,000 in 2007 for an analysis of where to put a replacement.[19] For the sake of comparison to EPA's $10 million preferred remedy, the Town had planned to expand its Water Plant #4 for $725,000.

While the Town may want to have the option of using Water Plant #2, it also has taken the position that it would not allow *any* chromium to enter its drinking water. *See* Attachment 7.

[19] Commercial Appeal (Jan. 24, 2007). In evaluating whether continued operation of Water Plant #2 for drinking water is necessary, and whether replacement is feasible, it must be recognized that "[o]f the five water plants operated by the Town of Collierville, Water Plant #2 is by far the smallest volume plant." ATSDR Report at 4.

Thus, even full implementation of EPA's preferred alternative, and prompt attainment of the 47 ppb cleanup standard for hexavalent chromium throughout the plume (assuming such is even possible), does not return Water Plant #2 to service as a water supply well. The Smalley-Piper FS appears to recognize the Town's position, at least tacitly, because the "Summary and Conclusions" section describes the remedial alternatives as operating "until extracted ground water shows non-detect chromium and other metals." If EPA, the Town, or Carrier wants to ignore the Baseline Risk Assessment and volunteer to clean up Water Plant #2 to background levels, then it should acknowledge that its actions go beyond what the NCP requires.

Rather than wasting Superfund money on chrome treatment at Water Plant #2, the Agency should be focusing on how it can restore the Memphis Sand aquifer and prevent ingestion of chromium-contaminated groundwater. The way to do that consistent with the NCP is to address the hottest zones at Smalley-Piper, and rely on attenuation plus institutional controls for the more dilute portions. As for Water Plant #2, an effective management program is long overdue.

* * *

Sixteen years ago the Agency put in place a groundwater remedy that largely let two parties off the hook: Carrier, which had released massive amounts of TCE into the environment; and the Town of Collierville, which owned the Carrier plant site when Carrier was disposing of hazardous substances there. Those parties received a pass on fully characterizing their contamination and were allowed to pull their contamination passively to Water Plant #2 instead of having to actively find and remove it, and were allowed to promote use of a poorly sited drinking water well.[20]

Because it perpetuates those past mistakes, the Proposed Plan is plagued with significant deficiencies, including (among others) the failure to investigate the nature and extent of groundwater contamination, the failure to account for nearby sources, the failure to utilize institutional controls, the failure to institute managed pumping, the failure to rely upon alternative sources of municipal water, the failure to incorporate natural attenuation, and the failure to fairly assess in situ remediation. Unless these are corrected, the FS and Proposed Plan will remain inconsistent with the NCP.

[20] In 1967, the Town of Collierville installed two drinking water supply wells in the northwest corner of the property it was leasing to Carrier, known at the time as the Day and Night Manufacturing Company. The Town put the wells down gradient of the plant. Few would disagree that siting two municipal water supply wells in such close proximity to a manufacturing plant generating and disposing hazardous waste at a site overlying an aquifer known for its regional extent, transmissive nature, and water supply use, was ill-advised.

Introduction

I have been retained by Mayer, Brown, Rowe & Maw LLP, on behalf of its client, Quanex Corporation, to evaluate information related to a claim by Carrier Corporation (Carrier) for payment of future costs of water treatment at the Town of Collierville, Tennessee Water Plant # 2 for the removal of chromium. The basis of Carrier's claim is that the chromium contamination in the Town's wells allegedly originates at the Smalley-Piper site, located approximately 1200 feet east of Water Plant #2. Total chromium has been historically detected in two production wells at the Town's Water Plant at concentrations less than the federal Maximum Contaminant Limit (MCL) of 100 ppb, a finding that led to a temporary shutdown of the ground water pumping while potential technologies for removal and/or management of the chromium were considered.[1] Carrier has been treating the Town's water since 1990 to remove TCE and related chlorinated volatile organic compounds (CVOCs), which had been released into the regional aquifer from the nearby Carrier facility at 97 South Byhalia Road.[2]

I have been asked to opine on the nature and extent of chromium in ground water near the Smalley-Piper site, whether this chromium has affected the nearby Water Plant #2, and the appropriateness and cost effectiveness of the proposed remedial actions by Carrier Corporation to address chromium in Water Plant # 2.

My billing rate for this engagement is $260/hour.

The following report states the opinions I have reached on these related topics and identifies the basis for these opinions.

Qualifications

I am a Principal and a practicing environmental engineer and ground water hydrologist at ENVIRON International Corporation. I received a Ph.D. in Civil Engineering (Groundwater Hydrology) in 1983. I received an M.S. in Civil Engineering (Water Resources) in 1977. I received a B.S. in Civil Engineering (Environmental Engineering) in 1973. All my degrees were received from the University of Maryland.

[1] An oxidized form of chromium, known as hexavalent chromium (Cr+6), has also been detected in the ground water produced from these wells.
[2] Water Plant #2 is located on the northwest corner of the Carrier property.

I have over 30 years of experience as a practicing consultant in the fields of environmental engineering, surface and ground water hydrology, hazardous waste management, contaminated site investigation/ remediation, risk assessment, and environmental risk management. This experience includes professional consulting services at many of the largest hazardous waste disposal sites throughout the United States and Canada that are regulated under federal and state environmental statutes. My work in this regard has included remedial investigations and the evaluation and design of corrective actions at numerous industrial and commercial facilities that generate hazardous wastes and other regulated materials. These have included facilities that have undergone closure under RCRA, TSCA, CERCLA, and similar state regulatory programs such as the California Water Code. A copy of my full CV is attached to this report.

I have previously been qualified as an expert and testified in United States federal and state courts in the fields of ground water hydrology, environmental investigations and remediation planning, environmental risk management, and cost allocation/National Contingency Plan (NCP) consistency under CERCLA.

Basis of Opinions

The opinions provided in this Expert Report are based on my professional training in the field of ground water hydrology, my more than 20 years of experience in investigating and predicting the movement of contaminants in soil and ground water systems, and my review of documents that describe the historic and current conditions at the Carrier and Smalley-Piper facilities as well as at the Town's Water Plant #2. The principal documents I have reviewed and am relying on in this regard are as follows:

Expert Disclosure and Report of Gary R. Siebenschuh, PG, May 11, 2007.

East Well Aquifer Pumping Test Report, Collierville Municipal Well Field, Environmental Safety and Design, Inc. December 14, 1992.

Health Consultation, Smalley-Piper, Collierville, Shelby County, TN, background and Statement of Issues, ATSDR, April 3, 2006.

USEPA Superfund Record of Decision: Carrier Air Conditioning Co., USEPA, September 3, 1992.

Carrier Air Conditioning Superfund Site, Five-year Review, USEPA Region IV, August 24, 2000.

Remedial Investigation Smalley-Piper Site, Hess Environmental Services, Inc. March 29, 2007.

Characterization of Waste Water from the Day and Night Company and Recommended Treatment Processes, Ryckman/Edgerley/Tomlinson & Associates, Inc. December 1972.

DNP Interoffice Letter, Subject Chronological History of DNP-CV Waste Water Treatment Facility, D.R.Beaupre, June 27, 1974.

Internal Correspondence from Mike Kendig [DNP], February 15, 1971.

Collierville Site Final Remedial Investigation Report, ENSAFE, March 27, 1992.

Schedule of Interim Actions at Water Plant #2, ENSAFE, June 30, 2004.

Figure 2, Smalley-Piper Chromium-Contaminated Ground Water Plume Conceptual Site Model, Hess Environmental Services, Inc. February 17, 2006.

Expert Report of Phillip G. Coop, March 13, 2006.

UTC Interoffice Letter to Jerry Bailey from Nelson Wong, October 23, 1991.

In addition, I have reviewed materials obtained from TDEC and USEPA files and other various documents obtained from Carrier through discovery that describe their remediation activities related to ground water contamination on and around the Carrier site.

Opinions

Based on my review of data and historic records in this case I have formed the following opinions:

Opinion No. 1: The Carrier site has contributed chromium to the underlying aquifer and is a likely source of at least a portion of the chromium historically detected in both wells at Water Plant # 2.

Internal Carrier documents and records demonstrate that Carrier used chromic acid in its manufacturing process until the early 1970s. Carrier has also used chrome-based paints and according to Mr. Coop's report of March 13, 2006, Carrier may still be using chromium. Chromium waste was disposed by Carrier on its property in at least one wastewater lagoon and as sludge buried in soil beneath its site. A Carrier lagoon was later found to be a source of contamination into the underlying ground water. The chromium wastes disposed and/or released by Carrier would have contained Cr+6. Both chromium and Cr+6 were subsequently found in the ground water produced at Water Plant # 2.

Monitoring wells on the Carrier property were tested for total chromium circa 1991. At that time, concentrations of total chromium in monitoring wells near the identified waste lagoon and Water Plant # 2 were as high as 392 ppb, and in other wells on the Carrier property as high as 383 ppb. Both values are well above the federal MCL of 100 ppb. These monitoring wells are located within the projected capture zones and in close proximity to the Town's water supply wells. Concurrently, early tests of water from the adjoining Town's wells at Water Plant # 2 in 1990 were also reporting chromium at up to 28 ppb, indicating that Carrier is a likely source of at least some of the chromium historically reported in Water Plant # 2. For reasons that are unknown, Carrier appears to have subsequently ceased all efforts to test its onsite monitoring wells for chromium. The data from the early 1990s demonstrate, however, that ground water beneath the Carrier site had been affected by its releases of chromium.

Upgradient monitoring wells constructed by Carrier to the southeast of its plant also contained total chromium at concentrations in excess of 200 ppb, indicating that other as yet unidentified sources of chromium exist in this area. These wells are too far to the south, given the regional northwest direction of ground water flow, for Smalley-Piper to have contributed to this contamination.

For reasons that are not clear from the historic record, since the discovery of chromium in the Town's water supply wells in 2001, Carrier has not undertaken any further investigations of its historic monitoring well network to confirm the historic record on either chromium or Cr+6 in ground water and to determine the extent of Carrier's contribution to the contamination. Neither has Carrier investigated upgradient sites to the southeast to determine the extent of their contribution to the chromium in Water Plant # 2. Carrier apparently abandoned most of the monitoring well network that could have been used for this purpose circa 1997-2000, although some wells remain on the Carrier property.

Opinion No. 2: It is unlikely that the Smalley-Piper site was a source of the chromium that historically affected the quality of water at the Town's water supply wells.

Chromium has been detected in ground water beneath the Smalley-Piper site, apparently originating in the vicinity of the former wastewater treatment lagoons on the southern end of the property. The highest concentrations of chromium have been found in the shallowest portion of the underlying aquifers, although some chromium has migrated deeper into the Memphis Sands aquifer northwest of the Smalley-Piper site. [3] A Remedial Investigation (RI) by Hess Environmental Services, Inc. demonstrates that this chromium contamination migrates to the northwest with the regional flow of ground water from the Smalley-Piper site and currently extends to the vicinity of Hess Monitoring Well 20 (MW20), located approximately 2000 feet northwest of the Smalley-Piper property boundary. This location places the outer portion of the Smalley-Piper plume of chromium approximately 1200 feet northeast of the Town's production wells at Water Plant # 2. Monitoring wells located on the Smalley-Piper site (MW3) and offsite further to the west-northwest (MWs 17 and 19) were non-detect for chromium, establishing that there is a zone of clean ground water that separates the Smalley-Piper plume from the Town's water supply wells.[4]

Ensafe computer modeling of the capture zones of the Town's water supply wells indicates that the principal historic source of water produced by the Town's wells is from the southeast, beneath the Carrier site and other properties to the southeast of Carrier. The extent of the capture zone is entirely dependent on the rate the Town pumps its wells, which has historically varied. Assuming the Town operates its wells at the historic maximum pumping rates in the future, the "capture zone" model predicts that chromium from a portion of the plume originating at the Smalley-Piper site could eventually reach the west production well at Water Plant #2. The outer (northwestern) boundary of this predicted capture zone encompasses the area of Hess wells MW17 and 19, however, which have been shown in the Hess RI for the Smalley-Piper site to be clean of chromium. The absence of chromium in these monitoring wells indicates that the capture zone of the production wells in Water Plant # 2 has likely been overstated in this area. [5] The capture zone model also indicates that the east well at Water Plant # 2, a well that has

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[3] The Memphis Sands is the principal water supply aquifer used by the Town of Collierville Water Plant # 2 for ground water production.

[4] Carrier formerly operated two other monitoring wells in the same area as Hess MW 19 (MW-57 and 58). Although historic tests of ground water in Carrier MW-57 (the shallower well) indicated low levels of total chromium in 1991, no chromium was detected in the deeper Carrier well (MW-58) which is screened in the same aquifer used by the Town's water supply wells. As far as I am aware these wells were never tested for Cr+6 and were abandoned by Carrier circa 1997 without any further testing for chromium. The only contemporary information on chromium in ground water in this area is provided by Hess well MW-19.

[5] The extent of the capture zone is proportionally dependent on the rate at which the Town (or Carrier) pumps water from the aquifer. At lower rates of pumping it is far less likely that any of the Smalley-Piper plume would eventually be captured.

historically been contaminated with chromium, could not have been affected by releases from the Smalley-Piper site, but rather likely has been affected by releases at Carrier's facility.

The Ensafe capture zone model also failed to consider that a production well at the Smalley-Piper site was operated until sometime in 2001. This well was located along the centerline of the chromium plume originating from the former waste water lagoons. The pumping of ground water in this area would have inhibited, if not completely prevented, the movement of chromium offsite to the northwest. Once the use of this onsite production well ended in 2001, chromium could have migrated at a rate up to about 100-200 feet/year in the regional aquifer. The operation of the onsite well likely prevented the Smalley-Piper plume from migrating further into the regional aquifer to the northwest.

Opinion No. 3: Effective remediation of the Smalley-Piper plume should prevent any long-term impact on the quality of ground water produced at Water Plant # 2.

The Ensafe capture zone modeling for Water Plant # 2 indicates that at a sufficiently high pumping rate, and with a sufficient passage of time, some chromium from the Smalley-Piper plume could eventually reach the west well at Water Plant # 2. How much time would be required for this to occur is not discernable from the information I have reviewed to date. The rate of use of the Town's water supply wells is discretionary, however, and could be managed to limit any potential future impacts of the Smalley-Piper site on water quality. In addition, pumping could be shifted from the west well, which has been the principal source of Cr+6 at Water Plant #2, to the east well and a new well built farther to the south, in order to move the capture zone of the well field farther away from the Smalley-Piper plume. This option was previously considered by Carrier, but was apparently rejected for reasons that are unclear. Given that Carrier and Ensafe apparently knew as early as 1990 that the Smalley Piper site contained chromium in ground water, and their capture zone modeling was predicting this chromium could eventually migrate into the Town's water supply wells, it is unclear why they chose to continue pumping the Town's wells at historically high rates to deal with their own contamination problems without also considering the potential implications for chromium contamination.

Also, the Ensafe capture zone modeling implicitly assumes that no remedial actions will be taken to limit the further migration of the Smalley-Piper plume and prevent it from reaching downgradient municipal wells in the regional aquifer. The Smalley-Piper site is currently under investigation and based on the findings to date, it is highly likely that some remedial action will be required to prevent further migration of the offsite chromium plume. Such remedial actions should prevent the Smalley-Piper plume from affecting the quality of water at Water Plant # 2 in the future.

Opinion No. 4: Mr. Coop's projection of the long-term cost for management of chromium in ground water at Water Plant # 2 is overstated.

According to Mr. Coop's report of March 13, 2006, the estimated cost to operate a water treatment system to remove chromium at Water Plant # 2 is nearly $9,000,000. This cost is substantially overstated because he fails to consider the time value of future operation and maintenance costs, and fails to consider the potential benefits of remedial actions by Carrier and others to reduce the loading of CVOCs, chromium and other contaminants on the regional aquifer.

Mr. Coop has apparently added all future O&M cost for water treatment over an assumed 30 year period without any discount for the "time value of money". Such discounting is normal and customary for any estimates of remedial costs in CERCLA, and should have been applied to his cost estimate.

In addition, Mr. Coop has provided no evidence in his March 13, 2006 report to support his assumption that chromium treatment will be required for as long as 30 years; and, it is likely that this time frame is substantially overestimated. The Smalley-Piper chromium plume is found in a discrete area located 1200 feet to the northeast of the Town's Water Plant #2. Analysis indicates this plume will continue to migrate to the northwest if left unabated, even if the Town's wells continue to pump ground water, and could eventually pose a threat to the quality of ground water in other municipal well fields that use the Memphis Sands aquifer farther to the northwest. For this reason it is highly likely that remedial actions will be required by the USEPA to prevent the further migration of this plume and to begin a process of cleanup of the ground water beneath and offsite to the northwest of the Smalley-Piper site. These remedial actions will not only prevent the future contamination of downgradient well fields, but would also significantly shorten the period of time that chromium would be present above MCLs in the aquifer. To the extent Mr. Coop is assuming that Smalley-Piper is the source of the chromium in the Town's wells, he has apparently failed to consider the effect of such remedial actions in his projection that the Town will be required to treat ground water for the removal of chromium for 30 years.

Therefore, the current Present Worth value of the future cost for treatment of chromium at the Town's wells is substantially less than Mr. Coop has estimated. The actual Present Worth cost is dependent on the period of time that chromium will need to be treated, a key fact that has not been established.

Opinion No. 5: Carrier's proposed plan to manage chromium contamination in the aquifer through long-term water treatment at Water Plant #2 is not consistent with the National Contingency Plan.

The historic levels of total chromium detected in the Town's water supply wells is less than the drinking water standard (MCL) of 100 ppb[6], although concentrations had risen and had reached up to 74 ppb in the west well and 40 ppb in the blended water.[7] The decision to treat the water for chromium is apparently based on the Town's position that it wants "zero" chromium in its water supply before the use of Water Plant # 2 is restored, a position that goes beyond any promulgated drinking water standards. Carrier's proposal to treat water for the removal of chromium when it already meets the applicable drinking water standards, therefore, goes beyond what the NCP requires.

In addition, Carrier has apparently adopted wellhead treatment as the preferred strategy for chromium as a simple extension of its earlier decision to treat its own plume of CVOCs, and without a full consideration and evaluation of remedial alternatives as required by the NCP. The chromium issue at Water Plant # 2 is a distinct issue from the CVOC issue, however, and a complete analysis of remedial alternatives to address chromium should have been performed before a preferred remedial alternative was adopted. It is unclear, for example, why Carrier did not adopt water blending/production management instead of treatment to address the chromium contamination as a remedial action in this case. This approach would have potentially been more cost effective as compared to its plan for wellhead treatment. Nor is it apparent why Carrier did not install supplemental remediation wells to deal with its CVOC plume, as required by the ROD, which would have reduced the need to pump at Water Plant # 2 to control the Carrier plume. In addition, Carrier has made assumptions about the source of chromium in the well field, assumptions supported primarily by Ensafe's theoretical capture modeling study, but has performed little investigation to actually establish the pattern of chromium contamination in the aquifer and to "connect the dots" from the well field back to the definitive chromium source(s). In the absence of this information, there is little understanding of what the restoration of full production of the well field at this time will mean to the long term spread of chromium in the regional aquifer, and whether other more appropriate alternatives should have been preferred. A full investigation of the extent of chromium within and around

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[6] The ATSDR has recommended a health-based goal for the finished water of 30 ppb Cr^{+6} in this case. The current raw blended water from Water Plant # 2 slightly exceeds this value with full use of the west well. My review of analyses performed by Ensafe, however, indicates this health-based goal could likely be achieved by effective management of pumping and water blending without the need for water treatment.

[7] The prior operating history of the Town's wells indicates the chromium levels may have been leveling off and, therefore, may not continue to increase with the restoration of full pumping at historic rates.

the well field, and a full CERCLA evaluation of alternatives for management of the chromium issue, should have been performed before Carrier adopted wellhead treatment as its preferred remedy.

As a result, Carrier's plan to construct and operate a treatment plant for chromium removal to allow unlimited production of water at Water Plant # 2 also goes beyond what the NCP requires, may cause further harm to the aquifer by initiating the further spread of chromium contamination, and likely is not the most cost effective remedy to address the near-term chromium issue. Hence, Carrier's claim for payment towards chromium treatment at Water Plant #2 is not consistent with the requirements of the NCP.

I reserve the right to amend or supplement this report pending receipt of more information and records related to this case.

Robert L. Powell, Ph.D., P.E.

Robert L. Powell, Ph.D.

Education

1983 Ph.D., Civil Engineering (Groundwater Hydrology), University of Maryland

1977 M.S., Civil Engineering (Water Resources), University of Maryland

1973 B.S., Civil Engineering (Environmental), University of Maryland

Registrations & Affiliations

Registered Professional Engineer, state of Maryland, 1977

Registered Professional Engineer, state of Florida, 2006

Experience

Dr. Powell is an environmental engineer and ground water hydrologist with over 30 years consulting experience including design and management of complex, multi-source remediation projects, regional ground water studies and risk-based corrective actions. He provides strategic consulting services for a range of private and public sector projects involving the investigation, remedial design, and cleanup of industrial facilities, operating waste management facilities and landfill sites, Superfund sites and Brownfield redevelopments. Dr. Powell's practice particularly has focused on projects conducted under federal (USEPA) regulations in the Superfund (CERCLA) and RCRA Corrective Action programs and comparable state regulations. Dr. Powell also maintains an active litigation practice, providing litigation consulting services and expert testimony in state and federal courts and in administrative hearings. Representative projects in his major areas of practice are presented below.

Dr. Powell also serves as ENVIRON's Chief Administrative Officer, and in this capacity is responsible for management of the firm's health & safety and risk management programs.

CERCLA Remedial Investigations and Remediation Planning

Dr. Powell has conducted numerous Remedial Investigations and Feasibility Studies and related remedial planning projects for private and public-sector clients under the federal Superfund and related state programs for the investigation and remediation of contaminants released into the natural environment. Representative projects include:

- Completed an RI/FS of soil and ground water conditions for the McColl NPL Site, a former refinery-waste disposal site in Fullerton, California that was regulated under CERCLA by the USEPA. This work focused on the investigation and control of waste migration in shallow, perched ground water zones and the mitigation of impacts on regional water supply aquifers. Contaminants of concern at the site included hydrocarbons, aromatics, thiophenes and metals. The RI/FS lead to the issuance of final ROD by the USEPA to close the site and restore the overlying property to beneficial use as a community golf course. Ground water impacts were addressed by a Monitored Natural Attenuation remedy.

- Served as the principal technical advisor to the PRP Steering Committee, composed of a number of major international oil companies, during a negotiation with the USEPA for the development of a Scope of Work to implement the final remedy for closure of the OII NPL site near Los Angeles, California. This project focused on the development of specific performance metrics and verification measures to evaluate the effectiveness of identified remedial actions in meeting specific performance goals prescribed in the final ROD for the OII site, the development of work plans for the implementation of additional investigations to facilitate remedial design, and in the negotiation of a final Scope of Work with the USEPA to implement closure of the site.

- Directed the completion of a Supplemental Feasibility Study for the California EPA for closure of the primary disposal area at the Stringfellow NPL site in Glen Avon, California. This project also included conducting pilot tests for the evaluation of technologies for removal of VOC and other contaminants through the use of high vacuum extraction, and a performance review of the remedial systems in the downstream areas to control the migration of contamination. Prior to this work, Dr. Powell served for nearly ten years as the technical advisor to the Stringfellow Advisory Community, a group representing various community and local government interests.

- Prepared an analysis of the human health risks associated with emission of chemicals during the remediation of the Royal Hardage hazardous waste disposal facility in Criner, Oklahoma. The facility had served as a regional site for the disposal of hazardous liquids, sludge and solids in bulk and in drums. Waste management unit that were constructed at the facility included a hazardous waste landfill, a waste lagoon (filled with sludge and other bulk solids) and a large burial mound of liquid and solid waste in steel drums. This facility was closed under the oversight of the USEPA under the Superfund program.

- Prepared an analysis of the human health risks associated with the excavation of wastes from the Hyde Park Landfill NPL Site near Niagara Falls, New York. This landfill had been used for the disposal of a wide range of hazardous liquids and sludge from the manufacturing of pesticides, solvents and other chemical intermediaries into an open pit in fractured bedrock. The site was believed to be leaking DNAPLs and other liquids into ground water and the nearby Niagara River. The risk analysis was prepared for the USEPA and the US Department of Justice to support the negotiation with the landfill owner for the closure of the site.

- Managed the completion of a major regional ground water Remedial Investigation/Feasibility Study to address VOC contamination over a 30 square mile multi-layer aquifer system in New Brighton, Minnesota associated with releases from the Twin Cities Army Ammunition Plant. This project was completed for the Minnesota Pollution Control Agency under a cooperative agreement with the USEPA under CERCLA.

- Provided regulatory support and expert reports to three major corporations in a series of negotiations with USEPA regarding CERCLA liability for ground water contamination in the Baldwin Park Operable Unit of the San Gabriel Valley NPL site near Los Angeles.

- Prepared a remedial action plan and supported negotiation with the USEPA on behalf of a PRPs group for the closure of Atlas Mine NPL site near Coalinga, California. This site was formerly an asbestos mine and ore processing facility that was a major source of asbestos-contaminated sediments discharging into the Central Valley of California.

- On behalf of a PRP group, prepared pilot treatment tests and a remedial action plan to address releases of sulfuric acid and toxic metals in soil and ground water, and supported negotiation with the SCDHEC, for the closure of the Stoller Chemical site, a former fertilizer manufacturing facility near Charleston, SC listed on the NPL.

- Provided consulting services to Fairfax County, Virginia to oversee the investigation and cleanup of a large gasoline release from a ruptured pipeline into a new residential community. Services focused on the evaluation of applicable remedial strategies and the quantification of potential pathways for exposure from gasoline that accumulated on the underlying water table.

RCRA Facility Permitting, Compliance, and Corrective Action

Dr. Powell maintains an active practice of permitting, compliance support, and corrective action services, including RCRA facility investigations and remedial planning projects, to companies regulated under RCRA for the treatment, storage and disposal of hazardous wastes and under the RCRA UST program. Representative projects include:

- Directed the completion of a remedial investigation and remediation planning project in Culvert City, California to evaluate alternatives for the cleanup of MTBE and other gasoline constituents from the Charnock Sub-basin and to restore the use of municipal well field owned by the City of Santa Monica and the Southern California Water Company to productive use. This project involved extensive field investigations to define the nature /extent of contamination, development of regional ground water and water quality databases, computer modeling of ground water flow and contaminant transport, evaluation of technologies to treat ground water for gasoline, MTBE and tBA, and the development and evaluation of detailed remedial alternatives to restore regional ground water quality and the use of well fields for municipal supply. The project was completed under the oversight of the USEPA under RCRA and the LARWQCB under the state Water Code.

- Completed detailed hydrogeologic studies and analyses, designed final ground water monitoring systems, and prepared a final ground water monitoring program for the Laidlaw Environmental hazardous waste landfill in Pinewood, South Carolina, as part of a RCRA Part B permit application. Also completed investigation of shallow ground water contamination and developed a control strategy to limit the migration of contamination in accordance with applicable permit requirements. During the adjudicatory hearings for the Part B permit, served as the primary expert witness for the permit applicant on hydrogeologic characterization, ground water monitoring and landfill integrity issues.

- Served as a member in an expert international (US and Canadian) panel to develop an environmental management strategy and remediation plans for Laidlaw Environmental for the control of soil and ground water contamination at a former waste oil and solvent disposal site near Montreal, Canada. The site was used for the disposal of a range of bulk organic liquids into a former gravel-mining pit. Liquid organic wastes migrated as a DNAPL into underlying fractured bedrock zones and contaminated regional ground water supplies. The site closure was being conducted under the supervision of the Quebec Ministry of the Environment.

- Completed investigations of soil and ground water contamination at the BKK landfill in West Covina, California as part of a program for closure of a former hazardous waste co-disposal landfill under a RCRA Corrective Action program. The site was former used for the disposal of liquid hazardous wastes into an unlined municipal landfill area. This project was performed under the oversight of the USEPA.

- Prepared hydrogeologic investigations, developed statistically based environmental sampling programs, designed and constructed ground water monitoring systems, conducted RCRA facility investigations, developed statistically based closure plans for former hazardous waste lagoons, and provided regulatory support for negotiation of federal, state, and local permits for two major RCRA hazardous waste landfills (near Bakersfield and in the Imperial Valley) operated by Laidlaw Environmental in California. During later public and zoning hearings for the operating permits, provided testimony on the site hydrogeology and environmental monitoring programs. Also, provided turnkey ground water compliance monitoring programs for a period of 5 years at both facilities.

- Directed a RCRA Facility Investigation report and Stabilization Measures evaluation for soil/surface water/sediment and ground water contamination at a precious metals manufacturing facility in Massachusetts under a Consent Agreement with USEPA (Region I). This project has included extensive hydrogeologic and aquatic investigations, environmental monitoring, risk assessment and environmental fate & transport modeling to support the identification of site-related risks and developed focused stabilization measures for soil, ground water and storm water runoff. Contaminants of concern at the site that have been the focus of this work include VOCs, metals, PCBs and radionuclides.

- Prepared a RCRA Facility Investigation, a Corrective Measures Study, and remedial plans and specifications for the investigation of soil and ground water contamination to support the closure of several unlined waste disposal pits at an operating hazardous waste disposal facility in central Louisiana. The facility had been used for the storage, treatment, and recovery of fuel products from waste oils and related organic liquids. Sludge from the thermal treatment (distillation) units was disposed into two unlined pits. Contamination (oil and solvents) migrated into underlying soils and ground water. The facility was required to remove the wastes and install a ground water remediation system as part of the implementation of a new master plan to develop a regional waste management facility. ENVIRON's services were provided to the facility owner, Safety Kleen, the largest commercial hazardous waste management facility operator in North America.

- On behalf of GBF Power Systems in Pittsburg, California, developed an environmental risk management program and statistical sampling design to evaluate waste classification and direct the reuse/disposal strategies for certain combustion co-product materials (gypsum and fly-ash) under federal and California state hazardous waste criteria in accordance with procedures prescribed in CCR Title 22 and 40CFR Part 261.

- Completed an analysis of the performance of natural-clay liner for a wastewater storage lagoon near Barstow, California on behalf of Southern California Edison Co. to demonstrate compliance with regulations under the California Water Code. The project resulted in an agreement by the RWQCB that the pond liner systems meet the functional requirements of the liner standards under CCR Title 26.

- Provided supervision and oversight of a RCRA facility assessment at the Thermal Oxidation Corporation facility in Roebuck, South Carolina on behalf of the facility owner, Laidlaw Environmental.

Litigation/Mediation Services and Expert Testimony

Dr. Powell provides litigation/mediation consulting, negotiation, and expert testimony services in cases involving the recovery of damages to property and personal injury from contaminants in the natural environment; the consistency of remedial investigations and remedial/removal actions with the requirements of the NCP, insurance cost recovery, and cost allocation. Dr. Powell has also testified in administrative and zoning hearings regarding environmental permitting of commercial hazardous waste facilities. Representative projects include:

- Provided expert testimony in an international arbitration case involving the recovery of environmental response costs for soil and ground water contamination, environmental compliance, and worker Health & Safety pursuant to a contract indemnity. The principal environmental issues in the cases related to the release of chlorinated solvents from degreasing operation at former and operating aircraft fastener manufacturing facilities in the US and Europe.

- Provided expert testimony in Louisiana state court on behalf of Clean Harbors in a citizen's lawsuit related to the closure of former waste management lagoons on a hazardous waste management facility near Baton Rogue, LA. Testimony related to the nature of current contamination in the vicinity of the closed lagoons and the potential for migration into ground water and nearby surface waters.

- Provided expert and negotiation services to Lockheed-Martin in the settlement of claims by the City of San Francisco to recovery the costs for the investigation and remediation of jet fuel releases discovered during the redevelopment of the new international terminal at the San Francisco International Airport.

- Provided expert testimony services on behalf of National Semiconductor Corporation in support of settlement mediation negotiations for claims related to the release of chlorinated solvents into shallow aquifers in Santa Clara County, California. These claims were successfully mediated under the supervision of a federal District Court judge in San Jose, California.

- Provided deposition and trial testimony in federal District Court regarding the nature, extent and source of contamination, the allocation of future remedial costs among PRPs, and the consistency of the RI/FS and past removal actions with the National Contingency Plan at a former wood-treating plant in Charleston, South Carolina.

- Prepared a cost allocation and NCP consistency analysis for a multiparty NPL site in Utica, NY involving a former manufactured gas plant, tar recovery plant, gas oil refinery, petroleum storage terminals, chemical plant, municipal harbor and dredge spoil areas. The allocation analysis formed the basis for opinions that were presented in an expert report in a cost recovery lawsuit filed in federal District Court. Subsequently provided deposition testimony in support of the allocation analysis.

- Prepared an analysis of the relative contribution by various PRP sectors (industrial, commercial, municipal, small quantity generation) of hazardous substances to five municipal landfills in the New York City area as part of litigation support to various PRPs in a Superfund cost recovery action. Also analyzed the associated environmental impacts of leachate discharges from the landfills into adjoining tidal and marine estuaries. Subsequently, Dr. Powell was retained by a Special Master to the federal District Court in New York to provide expert scientific services in support of the court's mediation of a lawsuit by private citizens against the City of New York regarding the extent of engineering controls that should be installed to control the migration of leachate into adjoining tidally-controlled estuaries from the Fresh Kills landfill.

- Provided litigation support to the South Carolina Electric & Gas Co. in a negotiation with the City of Charleston related to the former operation of an MGP and the alleged damages to nearby properties owned by the City. This project also included an analysis of the potential increase in construction costs for a new City aquarium and marina, and a storm water protection project, from manufactured gas plant-related contaminants in shallow soil and ground water.

- Provided litigation support and deposition testimony on allocation and NCP consistency in a CERCLA cost recovery case in Newark, California related to the remediation of a facility undergoing redevelopment as a Brownfield site, following over 100 years of operation of metals manufacturing. The case was won in summary judgment in favor of ENVIRON's client on NCP consistency issues.

- Provided expert litigation support services to a major international oil company in a negotiation with the Port of San Diego related to the allocation of costs for cleanup of hydrocarbon (gasoline and diesel fuel) and coal tar releases completed by the Port as part of a Brownfields redevelopment project.

- Provided expert litigation support on issues of NCP consistency for the recovery of costs related to the closure of waste lagoons at a facility manufacturing PCP-based wood treating chemicals in Newark, CA.

- Prepared a cost allocation analysis of former owner/operators and generators of wastes disposed of in a municipal landfill in central California. This analysis was used to provide information to the California EPA for its consideration in preparing an NBAR for this state Superfund site.

- Provided litigation support to a PRP to examine cost allocation among former owner/operators of two wood-treating plants in Missouri and Louisiana.

- Provided litigation support and deposition testimony on behalf of Cooper Industries related to environmental insurance claims for soil and ground water contamination at multiple facilities throughout the US.

- Prepared an expert report and provided deposition testimony on behalf of Lockheed Corporation for an insurance claim related to environmental releases from multiple aerospace test/manufacturing facilities in California.

- Prepared an expert report and provided deposition testimony on behalf of a major international oil company for an insurance claim related to environmental releases from multiple petroleum refineries and tank farm facilities throughout the US.

- Prepared an expert report and provided deposition testimony on behalf of Century Indemnity for an insurance claim related to environmental releases from a former manufacturing facility in Wilmington, North Carolina. A central issue in the case was the allocation of future remediation costs among potentially divisible sources of onsite DNAPL-VOC contamination.

- Prepared an expert settlement report and participated in settlement negotiations for the recovery of insurance related to environmental conditions at 45 MGP sites in the mid-western US on behalf of a major gas production and transmission company.

- Prepared an expert report and provided deposition testimony in support of litigation by the Southern California Gas Company for the recovery of insurance for environmental conditions at 29 former MGP sites in southern California.

- Prepared an expert report and presented deposition testimony on behalf of DOW Chemical Company in a case seeking recovery of past and future costs for environmental corrective action at DOW's chemical manufacturing plants in Freeport, Texas.

- Prepared an expert report and provided deposition testimony on behalf of Union Pacific Corporation in an insurance cost recovery case related to soil and ground water contamination from its former operation of a major locomotive and rail-car manufacturing facility in Sacramento, California.

- Provided deposition and trial testimony in federal District Court regarding the extent of contamination, costs to remediate, and the potential for community exposure in a property damage case related to a gasoline release in a residential area in Columbia, South Carolina.

- Provided expert consulting services in a cost recovery suit related to the rupture of a regional pipeline transporting gasoline near Davis, California. Services focused on an evaluation of the reasonableness of response costs and the forensic reconstruction of the mechanisms/actions that contributed to the initial release and subsequent spread of gasoline in nearby irrigation canals.

- Provided expert and deposition services to the owner of a large former "truck stop" near Sacramento, California that was an ongoing Brownfields redevelopment project related to the recovery of costs from former owner/operators for the remediation of soil and ground water for gasoline and diesel-range hydrocarbons.

- Provided litigation consulting support and presented trial testimony in state court regarding the source and extent of groundwater contamination and future remedial costs in a trespass/property damage case in Greenville, South Carolina.

- Testified before the California State Water Resources Control Board regarding proposed regulations on vadose zone monitoring at waste disposal sites.

- Provided expert testimony at administrative hearings on the environmental setting, ground water conditions, and monitoring programs for hazardous waste landfills in South Carolina and California operated by Laidlaw Environmental.

- Provided deposition and trial testimony in state court for a public water utility in Florida regarding the source and extent of ground water contamination in a major county-owned well field near Tampa, Florida.

Other General Engineering and Hydrology Practice

- Designed and supervised the installation and operation of a system to recover PCB-contaminated oil and VOCs from a shallow water table at a chemical manufacturing facility in northern New Jersey for compliance with the state ECRA statute.

- Provided expert consulting support to Hillsboro County, FL for the permitting of a major waster disposal landfill at the Gardinier Chemical Co. facility near Tampa, FL. The waste disposal facility was proposed to be used for the disposal of acidic gypsum wastes from the manufacturing of phosphate-based fertilizers by extraction with sulfuric acid.

- Evaluated the hydrologic impacts of land application of wastewater effluent on water resources in Orange County, Florida to demonstrate compliance with operating State permits.

- Conducted a flood protection analysis and developed a management strategy for the South Florida Water Management District to control agricultural discharges of storm water into drainage canals in St. Lucie County, Florida.

- Evaluated the feasibility of ground and surface water supply development on behalf of a municipal water utility in western Florida.

- Prepared a real-time flood forecasting system to optimize flood protection and water supply objectives for a major municipal reservoir in Manatee County, Florida.

- Evaluated the hydrologic impact of major municipal well field pumping on lake levels and wetlands near Ft Lauderdale and Tampa, Florida.

- Prepared numerous due diligence Phase I reviews for acquisition of industrial and hazardous waste treatment and disposal facilities.

- Conducted an in-depth due diligence review of environmental issues regarding operations of a Continental Airline on behalf of the successful investor group as part of an acquisition/reorganization of the company following bankruptcy.

- Managed multidisciplinary projects including flood hazard analysis, flood protection, sediment and erosion control, dam and reservoir analysis and design, lake restoration, surface mining impact evaluations, combined sewer overflow conveyance and storage systems, and solid waste disposal facilities in the mid-Atlantic and southeast regions of the US.

- Designed remedial measures for surface drainage and leachate control; directed restoration and closure; and performed water quality data analysis for a hazardous waste landfill, Glen Burnie, Maryland.

Prior to joining ENVIRON, Dr. Powell held the following positions:

- Manager of Water Resources Engineering Services, Gulf Coast Area; Camp Dresser & McKee, Inc.; Tampa, FL.
- Faculty Research Associate; University of Maryland, Department of Civil Engineering; College Park, Maryland.
- Department Head/Senior Engineer; Water Resources Division, Greenhorne & O'Mara, Inc; Riverdale, MD.
- Graduate Research Assistant; Department of Civil Engineering, University of Maryland; College Park, Maryland.
- Project Engineer; Water Resources Division, Greenhorne & O'Mara, Inc.; Riverdale, MD.
- Design Engineer; Dewberry, Nealon & Davis; Fairfax, VA.

Professional Activities

Member, American Society of Civil Engineers.

Selected Publications And Presentations

Calise, S.J., and R.L. Powell. 1984. Microcomputer based management of land disposal systems. Paper presented at the ASCE Annual Meeting (Florida Section), September.

Powell, R.L., and Y.M. Sternberg. 1983. Deterministic models of uncertainty for regional contaminant transport systems. Paper presented at the National Water Well Association-Eastern Regional Conference on Ground Water Management. October.

Onasch, C., R.L. Powell, and R.M. Ragan. 1982. Near surface regional ground water systems modeling and potential applications for remote sensing. *AGRISTARS Report* CP-G2-04361. NASA-GSFC, October.

Hawley, M.E., and R.L. Powell. 1982. Risk analysis in ground water quality testing at hazardous waste landfills. Paper presented at the 14th Mid-Atlantic Industrial Waste Conference, June.

Cook, D.E., R.H. McCuen, and R.L. Powell. 1980. Water quality projections: A preimpoundment case study. *Water Resource Bulletin* 16(1).

TRIAL/DEPOSITION TESTIMONY SUMMARY
Robert L. Powell, Ph.D.

YEAR	CASE NAME	VENUE	CASE NO.
1993	Johnson, et al. v. Hoechst Celanese and Daniel Construction	State of South Carolina, Count of Common Pleas	90-CP-23-2180
1994	The Alpine Forrest Partners v. Crown Central Petroleum Corporation	U.S. District Court of South Carolina, Columbia Division	3:90-2730-0
1994	Braswell Shipyard, Inc. v. Beazer East, Inc.	U.S. District Court, District of South Carolina, Charleston Division	2:89-455-8
1994	City of West Covina v. BKK Corporation	Superior Court of California, County of Los Angeles	KC 013713 BC 083729
1994	SnyderGeneral v. Century Indemnity	U.S. District Court, Northern District of Texas, Dallas Division	3:93-CV-0832-D
1995	Angelo K. Tsakopoulos v. Phillips Petroleum Company, et al.	Superior Court of California, County of Sacramento	526157
1995	James R. Thomason, Jr. v. Ortho Pharmaceutical Corporation	U.S. District Court, District of South Carolina, Greenville Division	6:94-2851-3
1996	Union Oil Company of California v. The Aetna Casualty & Surety Company	Superior Court of California, County of Los Angeles	BC 028271
1996	Atlantic Richfield Company v. Aetna Casualty & Surety Company of America, et al.	Superior Court of California, County of Los Angeles	BC 015575
1997	Employers Insurance of Wausau v. McGraw-Edison Company, et al.	Circuit Court of the 18th Judicial Circuit, Dupage County, Illinois	91 MR 0256
1997	AMOCO Chemical Company, et al. v. Certain Underwriters at Lloyd's of London, et al.	Circuit Court of Cook County, Illinois	93L8484
1998	Southern Pacific, et al. v. Certain Underwriters at Lloyd's of London, et al.	Superior Court of California, County of Los Angeles	BC 154722
1999	Niagara Mowhawk Power Corporation v. Jones Chemical et. al.	U.S. District Court, Northern District of New York	95-CV-717
1999	A.O. Smith Corporation v. Rheem Manufacturing Corporation	U.S. District Court, Northern District of California.	C 94 03887 CW
1999	Olin Corporation v. Fisons Corporation, et al.	U.S. District Court for the District of Massachusetts	CA93-11166-WGY
2000	Raytheon Company v. Certain Underwriters at Lloyd's London, et al.	Superior Court of California, County of San Francisco	950755
2002	Associated Indemnity Corporation, and The American Insurance Company v. The Dow Chemical Company The Dow Chemical Company v. Fireman's Fund Insurance Company, et al.	U.S. District Court, Eastern District of Michigan, Northern Division	No. 99 CV 10426 No. 99 CV 10427

TRIAL/DEPOSITION TESTIMONY SUMMARY
Robert L. Powell, Ph.D.

YEAR	CASE NAME	VENUE	CASE NO.
2005	Merco Group at Aventura Landings et.al. v. Tampa Electric Company	Circuit Court for Miami-Dade County Florida	No. 04-22909
2006	Terry Giauque, et al. v. Clean Harbors Plaquemine, LLC et al.	18th Judicial District Court, Parrish of Iberville, State of Lousianna	No. 60195
2007	Keystone Consolidated Industries, Inc. and Valhi v. Employers Mutual Liability Insurance Company of Wisconsin	U.S. District Court for the Central District of Illinois	No. 03-1201
2007	City of Rialto et al. v. US Department of Defense et al.	U.S. District Court, Central District of California	No. ED CV 04-00079 PSG

DNP INTER-OFFICE LETTER

TO P. K. THOMPSON (B)

FROM D. R. BEAUPRE

DATE 6-27-74

OFFICE PLANT ENGINEERING - COLLIERVILLE

SUBJECT CHRONOLOGICAL HISTORY OF DNP-CV WASTE WATER TREATMENT FACILITY

The following is a chronological history of the events concerning the waste water facility. This was constructed from letters, reports and documents from M. Kendig's file, my current file including the file turned over to me at the start of this new project.

Please review this history and update if necessary.

1969 - 1971 SUMMARY

8-12-69: Letter received from Memphis & Shelby County Health Department requesting compliance and limits on chromium, cyanide, sludge and use of water.

10-12-70: Sewer ordinance passed by the City of Collierville.

1971: Tennessee passed a Water Quality Control Act.

1972 SUMMARY

1-27-72: DNP management and City of Collierville met concerning cyanide pollution. DNP levels higher than 0.01 ppm. Reference letter M. Kendig to P. K. Thompson of 1-27-72.

1-31-72: Request from E.P.A. for permission and cooperation in conducting waste discharge sampling, analysis, and flow measurement.

2-3-72: J. Chaney, consultant for City of Collierville, gave brief survey of DNP waste products.

2-8-72: Conference with M. Kendig (CV) and P. Mundy (LP) cyanide process. Call to Ferro Corporation and call to Oxford Chemical Company.

2-16-72: Complaint investigated by Corps of Engineers of DNP dumping into stream.

2-18-72: 2-25-72: Tests and measurements conducted by Elaine Mann for E.P.A.

2-18-72: 2-28-72: Trial to eliminate cyanide from pickle process. Cyanide eliminated in pickle process.

4-27, 28 & 29-72: Consultants of City of Collierville (R.E.T.A.) sample DNP waste water.

7-25-72: DNP management, City of Collierville and John Phillips, representative of County Health Department, met to discuss DNP waste and results of the analysis and decided that DNP will sample for one month during September.

8-2, 3 & 4-72: Samples of DNP waste by consultants of Collierville (Clew, Inc.): Analysis of chromium 10.0 ppm. - high; and cyanide 2.0 ppm. - high. Reference Clew, Inc. reports 9-8-72.

8-72: Discontinued use of chromic acid in final rinses.

8-14, 17, & 18-72: Pumped out clarifying pit and hauled to county dump. Letter from J. Phillips of Pollution Control Division of Health Department to cease discharge of toxic waste into Collierville sewer. Request for a plan no later than 8-7-72.

8-20-72: Observed Collierville sewer line and sump at Byhalia Road was higher than the weir ports in DNP's clarifying pit, causing back flow when pumps were turned off.

8-20-72: Dug first section of clarifying pit out. Shelby County landfill refused truck load of waste. Dumped waste on plant property.

8-23-72 Letter from Tom Tiesler of Tennessee Solid Waste Management warning Shelby County that DNP must not dump semi-solids into landfill areas.

8-24-72: Letter to J. Phillips from L. S. Deaton stating intent of DNP to initiate program for pollution study. Reference L. S. Deaton's letter.

8-25-72: Letter from City of Memphis that no liquid wastes can be received at the sanitary landfill (Capleville).

8-28-72: Begin record keeping and audit of process (paint washers and pickling)

9-6-72: Purchase order to R.E.T.A., Inc. as consultants reference purchase orders #26091 and #26092.

9-12-72: Meeting with J. Chaney and Dr. C. Bulla of R.E.T.A. (day survey of DNP process).

9-20 & 21-72: R.E.T.A. sampled each tank and process. Reference R.E.T.A.'s letter of 10-9-72.

10-9-72: Letter from R.E.T.A., Inc. (Large chrome and lead levels in strip tank from paints.) Reference R.E.T.A. letter.

10-11-72: Notified all paint vendors to eliminate chrome from paint.

10-16-72: Samples started at clarifying pit on hourly basis by R.E.T.A., Inc.

10-20-72: Observed sampling had stopped.

10-23-72: Analysis of paints back confirming Dupont CP-73 and Pittsburgh CP-102 high in chrome.

10-29-72: Dumped strip tank and observed tank dumps directly into main plant sewer line and by passes clarifying pit. Notified R.E.T.A. on 10-30-72.

11-9-72: J. Chaney and M. Kendig meeting. Report by Chaney (verbal) saying that DNP cannot dump clarifying pit waste at county landfill areas. Surveyed plant property decision to dig shallow hole for waste.

11-10-72: Engage back hoe to begin digging hole.

12-72: Report from R.E.T.A. and recommended a treatment process.

1973 SUMMARY

1-73: E.P.A. Releases - State program elements necessary for participation in the National Pollution Discharge Elimination System.

1-25-73: Letter from R.E.T.A. to Tom Tiesler - An analysis of sludge for disposal to the sanitary landfill and a request for approval.

1-25-73: Letter from Hugh Teaford that the report and recommendations by R.E.T.A. had been accepted and that a time schedule for implementation was required.

2-21-73: Letter of acceptance from Tennessee Solid Waste Authority for acceptance of the sludge into sanitary landfill.

2-23-73: Retainer with R.E.T.A. expired.

3-12-73: Letter from R.E.T.A. to Tennessee Solid Waste Authority regarding composition of treated sludge and future treatment.

4-73: Water Quality Control Act of 1971 ammended.

4-12-73: Proposal from R.E.T.A. for the complete design of a heavy metals removal system. Engineering cost estimated at $13,200.

6-73: Effluent guidelines published by N.A.M.

7-73: Proposed regulations were received from E.P.A. for the control of pollutants and the implementation of the National Pollutant Discharge Elimination System.

7-15-73: City of Collierville diverted the waste discharge to Nonconnah Creek.

8-1-73: Meeting with R.E.T.A. to set up parameters for developing the system.

8-7-73: Basic agreement on design criteria with R.E.T.A.

8-21-73: E.P.A. regulations pertaining to grants and costs to users for industrial discharges into public water treatment works.

9-18-73: Official notice by the City of Collierville that waste water does not meet the City's use ordinance and responsibility for discharge into Nonconnah Creek solely DNP's.

9-24-73: Letter from R.E.T.A. to the City of Collierville with a schedule of activities for the waste water pre-treatment facilities and a report of steps taken to-date to minimize pollution.

9-27-73: Letter from R.E.T.A. to City of Collierville and State Department of Public Health on problems and progress to-date with a time schedule for completing facilities and outlining temporary means of disposing of concentrated wastes. Chlorination equipment installed to treat water delivered to Nonconnah Creek.

10-1-73: R.E.T.A. request to City of Memphis for permission to dump concentrated wastes with outline of characteristics and frequency and volumes.

10-1-73: Letter from L. S. Deaton to City of Collierville confirming intent to temporarily pump concentrated wastes.

10-8-73: Meeting with City of Memphis to discuss dumping concentrated wastes - approved.

10-9-73: Letter from R.E.T.A. to City of Collierville questioning waste discharge effluent standards.

10-9-73: Preliminary cost estimated by R.E.T.A. is $90,300 - $103,300.

10-10-73: Letter from R.E.T.A. revising engineering cost from $13,200 to $21,000 plus retainage.

10-10-73: Progress review with Ed Lehman and revised project cost estimate by R.E.T.A. of $166,200 including chromate treatment.

10-11-73: R.E.T.A. estimate to remove chromate treatment system saving $30,000.

10-30-73 Letter from Memphis & Shelby County Health Department requesting daily monitoring of wastes, PH control and pumping of concentrated wastes and permission to revert back to the city lagoon.

10-30-73: Water Quality Control Act ammended again.

10-31-73: City of Collierville diverted the waste discharge from Nonconnah Creek back to the lagoon.

11-5-73: Started pumping concentrated wastes and hauling to Memphis sewers.

11-23-73 Preliminary plans and specifications from R.E.T.A. received by DNP.

12-10-73: R.E.T.A. completed preliminary plans and specifications for the waste water disposal system.

12-18-73: Preliminary contract drawings for estimates and quotations received by DNP.

1974 SUMMARY

1-74: Plans approved by F.I.A.

1-17-74: Preliminary review of costs based on plans and specifications indicates cost at $225,000.

1-24-74: Review of plans and specifications by Memphis & Shelby County Health Department.

1-25-74: Major review by R.E.T.A. and DNP of plans and specifications.

1-25-74: Basic data submitted to Dr. Biermann, R.D.C.-Syracuse.

1-29-74: Supplementary data submitted to Dr. Biermann, R.D.C.-Syracuse.

1-29-74: Review by R.E.T.A. of questions on system by Memphis & Shelby County Health Department.

2-11-74: Meeting with Carrier representatives, DNP personnel, City of Collierville and Memphis & Shelby County Health Department.

2-12-74: Letter from Memphis & Shelby County Health Department to R.E.T.A. defining the discharge standards and the sewer use limits and the need for a bench scale laboratory examination prior to final approval.

2-14-74: Report by R.D.C. on review of plans and specifications and basic agreement on meeting the needs of the Collierville lagoon.

2-19-74: New lab study started by R.E.T.A. (as requested by the Health Department).

3-15-74: Letter from R.E.T.A. requesting a contract and additional funds.

3-19-74: Purchase order written to R.E.T.A. authorizing engineering costs not to exceed $24,760.

4-9-74: Letter to R.E.T.A. from D. R. Beaupre on increased equipment cost quotations.

4-17-74: Letter to R.E.T.A. from D. R. Beaupre on very high costs on contractors' estimates.

5-7-74: Meeting with R.E.T.A., contractors and DNP to review cost estimates and attempt to reduce the latest revised cost estimate of $250,000.

5-8-74: Letter to all parties involved on proposals to reduce costs.

5-17-74: Letter from R.E.T.A. requesting additional design time (and money).

5-21-74: Report and letter by R.E.T.A. on treatability studies completed at the request of the Memphis & Shelby County Health Department.

6-3-74: Revised plans and specifications received from R.E.T.A. on lower cost redesign.

6-17-74: Request by R.E.T.A. to Tennessee Division of Sanitary Engineering for permission to dump sludge in the sanitary landfill based on a higher water content from the sludge lagoon than the filter dryer.

6-18-74: Determination by R.D.C. and Carrier Towers not to accept the sludge lagoon system.

IN THE UNITED STATES DISTRICT COURT

FOR THE WESTERN DISTRICT OF TENNESSEE

WESTERN DIVISION

CARRIER CORPORATION,

Plaintiff,

v. CIVIL No. 05-2307-MI/V

PAUL P. PIPER, JR., ET AL,

Defendant,

LUND COATING TECHNOLOGIES, INC.
(F/K/A PIPER COATINGS TECHNOLOGIES, INC.)

Defendant and Cross Plaintiff,

v.

PIPER INDUSTRIAL COATINGS, INC.

Defendant and Cross Defendant.

RULE 30(B)(6) DEPOSITION

OF

CARRIER CORPORATION

PHILLIP G. COOP, REPRESENTATIVE

Wednesday, July 18, 2007

Reported by: Shyloa Myers, RPR

COPY

the site?
A. Yes, I do.
Q. And do you know if the chromic acid was dumped into that pit?
A. Yes, I was told that.
Q. Who told you that?
A. I interviewed the plant's environmental manager in 1980 -- who was the environmental manager in the early eighties. I interviewed him by telephone in '86, I believe it was.
Q. What was his name?
A. Cliff Ritter.
Q. Do you know or did you learn how chromic acid was used in the process?
A. It was my understanding that it was used as a passivation step to prepare the metal.
Q. And how was it -- strike that.
As part of the process of disposing of the chromic acid, was it then channelled into the clarifying pit?
A. Yes.
Q. So the clarifying pit was a disposal process?
A. It was a treatment process.
Q. Do you know what the treatment was?
A. Well, initially it was just sludge settling. They -- as I understand it from Mr. Ritter, the pit's

A. Largely based upon that conversation with Mr. Ritter, we planned a series of borings, soil borings as part of our investigation on the hill behind the plant, which was the general area where Carrier had maintained a lagoon that received those sludges.

(Exhibit No. 6 marked for identification)

Q. Let me hand you what I have marked as Exhibit 6 to your deposition, and I will ask if you can identify these.

A. Yes.

Q. What are these?

A. Well, they're memos that we obtained from Carrier's files as part of our inquiry into past practices; and they relate to the testing of the area where the Carrier lagoon had been.

Q. And when you say "Carrier lagoon," do you mean the clarifying pit?

A. I do not.

Q. Tell me about this lagoon.

A. Mr. Ritter told me that when they encountered difficulties in trying to place the sludge from their clarifier pit into landfills in the area that they constructed a lagoon on their property and diverted the sludges to that lagoon for a period of time.

Q. What did he tell you about the lagoon?
A. He told me it was on top of the hill behind the plant, and that was about it.
Q. Did he tell you what they did? Did they just dig a hole?
A. He -- I suspect that's what they did. He didn't offer to me -- if you're asking if it was lined, I don't think it was.
Q. They just dug a hole and they put the sludge in the hole?
A. I think that's what they did.
Q. So I note on your Exhibit 6 that there's several dates. One has got a January 7, 1980, date; and then it's stricken out and it has 1981. And then down at the bottom as best I can make it out it says, "Revised July 18, 1986."
Do you see that?
A. Yes.
Q. What is your knowledge of this document -- well, did you have any knowledge of this document in 1981?
A. No.
Q. And do you think that the revision relates to the work that you did in 1986?
A. Yes.
Q. And tell me what this piece of paper shows me.

A. Its purpose, as I understand it, was to separate liquids from solids as a treatment step so that the two could be handled separately.

Q. Do you know what clarifying pit is referred to in this entry of October 29,1972?

A. No, not specifically. But my assumption would be it's the clarifying pit that I was aware of.

Q. That's your assumption, but you don't know?

A. But I don't know.

Q. Now, Mr. Ritter never told you about this chromium problem; is that correct?

A. That's correct. And it may be that he was not at the plant at this time. I don't know.

Q. Now, do you see the entry on 11/9/72 --

A. Yes.

Q. -- where there was a survey done of the plant property. "Decision to dig a shallow hole for waste"?

A. Yes.

Q. And there was a backhoe to begin -- backhoe began to dig a hole for the waste.

A. Yes.

Q. Have you ever discussed with anyone about that hole and where that waste was deposited?

A. No.

Q. Did you know about that hole before today?

A. Not if it is not the same as the lagoon.
Q. There's nothing -- well, the lagoon that you testified to earlier had been prepared in August; isn't that true? Look at the second entry for August 20, 1972, where it indicates that the waste was dumped on the plant property.
Do you see that?
A. Yes, I do.
Q. And that was the lagoon that Mr. Ritter told you about?
A. Well, I made that assumption. I mean, the word "lagoon" is not used here.
Q. Right.
A. But I assumed when you pointed this out to me that that was in fact the lagoon they constructed on top of the hill.
Q. Right.
Now the entry for November 9 and November 10, 1972, is referring a different dig; isn't that correct?
A. It may be.
Q. Yes, sir.
And you've never been given any information at all about that different dig, have you?
A. I have not.
Q. And based on the information at hand, would you

TRIP REPORT

RECEIVED

SEP 11 1987

OWNER/FACILITY Carrier SITE # 79-552

TYPE FACILITY Manufacturing Plant

COUNTY Shelby CITY Memphis DATE 8/24-8/26

PURPOSE OF VISIT Oversee planned site investigation work.

INDIVIDUALS CONTACTED Paul Stoddard - En Safe, Rich Hosfeld - Dames & Moore

Carl Krull - Carrier, Drillers - Hall & Blake

OTHER DSF PERSONNEL PRESENT Bijon H.

WEATHER CONDITIONS Hot & Sunny

SAMPLES COLLECTED YES ___ NO X
PHOTOS TAKEN YES ___ NO X

COMMENTS AND DISCUSSION: An aireal photograph, which was taken on 10/21/80, was brought to the site and used to locate the lagoon. We then advanced 3 borings, B-17, 18, and 19 in the area where the lagoon should have been. The miran detected levels of TCE into the hundreds on all 3 holes and B-17 read 2800 ppm after completion. It was reported that during times of wet weather the trucks could not make it to the lagoon and would dump their loads along the access road. For this reason, boring B-20 was placed near the access road.

8/25/87 Advanced MW-5, shallow well of the pair behind the building, to 34.6 ft. and set 5 ft. of screen. This is into the clay unit approximately 1 ft. Geologic samples were taken every 2 1/2 ft. and four samples were split for lab analysis.

8/26/87 We pulled augers and finished setting MW-5, a sand pack to 26' and 2 ft. of bentonite. Hall-Blake personnel will grout the well later on today. We set up and began drilling MW-3 which is a shallow well of the pair in the edge of the parking lot along Bahalia Rd. The same sampling schedule will be followed here.

cc: File #79-552
Danny Brewer
Don Shackelford
James C. Ault

INSPECTOR'S SIGNATURE

8/2/87
DATE

2212 0501

Draft for internal discussion only

Project Summary by XDD
UTC Carrier Collierville, TN
September 2003

Reviewed documents

- ✓ ROD written in 1992
- ✓ Agreement between Carrier and Town of Collierville (4/12/96)
- ✓ Memo - Carrier Collierville Verification Modeling (3/12/97), page 10 of text is missing
- ✓ O+M Phase Strategy – Draft (undated, file created 10 17 02)
- ✓ 2002 Annual Report – Draft, figures and appendixes not included (February, 2003)

Operational chronology

- ✓ Releases occurred at North Remediation System (NRS, aka former waste lagoon area) form 1972 to 1979 and Main Plant Area (MPA, along south wall of main building) in 1979 and 1985.
- ✓ 2 SVE systems installed, 1995 at NRS and 1989 at MPA. Systems have been down frequently in 2002 and 2003.
- ✓ WP2 operating at 1.4 MGD to contain and treat TCE in Memphis sand aquifer, air stripping towers installed in 1990

Main points of documents

- ✓ ROD
  - Remedial alternative selected
    - SVE old lagoon release
    - SVE main plant area release
    - Extract and treat groundwater from Memphis Sands aquifer using Water Plant No 2
    - Periodic monitoring for 30 years to assess effectiveness
    - Institutional controls placed on well construction and water use in general area
  - TCE cleanup goal for soils is 533 ug/kg or until EPA determines that contaminant levels have ceased to decline. The ability to achieve goal cannot be determined until after years of application and modified as necessary.
  - Aquifer will be treated to MCLs. Discharge of treated water can be to water supply, POTW, surface water or reinjected into aquifer pending state and federal compliance requirements.
  - Air discharges shall be compliance with state or federal regulations.

- ✓ Agreement
  - Town and Carrier are PRPs

CVL00265070

- Covenant not sue in place
- Town must give Carrier notice of planned or unplanned shutdowns of Water plant # 2 (WP2)
- Carrier must notify Town of operational delays and prevent or cure them
- Town will operate WP2 for 5 years after MCLs have been met on the influent or longer as required by the EPA
- Carrier will inspect, maintain, repair or improve the water treatment for VOCs (note no mention of metals)
- Town will not take the west well out of production for more than 2 consecutive weeks or the east well for more than 4 consecutive weeks or both wells for 2 consecutive weeks until goals are met

✓ Memo - Carrier Collierville Verification Modeling
- Operation of WP2 is containing the plume
- Travel time is approximately 7 years to the WP2 wells

✓ O+M Phase Strategy
- In April 2002, soil sampled in 2 source area locations. TCE concentrations much higher than goal and previous sampling. Ensafe concludes remediation via SVE is not likely.
  - TCE is primarily in silts and clays 20 to 25 feet below grade
  - Source area is now estimated to be 10,000 square meters vs. 3,000 originally
- SVE systems have removed 17,000 # of TCE, 950 # per year
  - Systems shutdown frequently in winter and spring from excessive water uptake
- WP2 has removed 4,000 # of TCE, 600 # per year
- Concentrations at WP2 have risen and stabilized
- Ensafe recommends that NRS be shut down now and MPA be shutdown when stable or declining trends at the wellfield are confirmed
  - Significant effort expected to change ROD using risk based argument

✓ 2002 Annual Report
- NRS and MPA systems were shutdown in late 2001/early 2002 because of equipment failures, restart pending soil sample results
- WP2 VOC system was upgraded
- Estimate current MPA system will remove 250 to 500 #/yr and the NSR will remove 150 #/yr TCE
- MPA soil samples exceeded the goal from ground surface to 15 - 20 feet below grade, cleaner below this level. More permeable sands with depth.
- NRS soil samples exceeded the goal in all samples locations. Samples only taken between 10 and 20 feet below grade. Most TCE found in silts and clays down to 18 feet below grade.
- NRS SVE wells only targeting sands below high concentration source layers.

CVL0026507[illegible]

- Ensafe concludes
    - SVE systems are not likely to achieve soil goal because of tight soils
    - NRS system should discontinue operation
    - MPA system should be modified to improve reliability

Current status and issues

- ✓ SVES have been off for past year due to maintenance problem with water uptake by systems and/or possibly from age of system or other design related problems
    - Carrier has an agreement with the Town to keep their SVES running 24/7
- ✓ Recent soil sampling found area still highly contaminated and previously sized area is 1/3 of what appears to be the actual source area
- ✓ Chrome is entering WP2 in 2001, source is believed to be from Piper property
    - The Town shut down WP2 for a couple of months because of the chrome problem
    - Robinson and Cole are looking at Piper's ability to pay for remediation efforts to control their chrome problem
    - Town might abandon its wells, doesn't need them to meet demand
    - The chrome standard is 50 ppb for the town well, both wells need to operate to stay below 50 ppb of chrome

Carrier's other concerns and issues

- ✓ They would like to expand the facility
- ✓ There is a real possibility that further subsurface work on site could produce additional source areas

XDD conclusions

- ✓ Source areas
    - Extended downtime of the SVES is a violation of Carrier and Town agreement, system needs to be restarted immediately
    - Are far from meeting soil goals
    - Original delineation was off by a factor of 3, therefore the SVE systems must be equally under designed. Other design lapses appear to be in the water handling and well screen locations.
    - SVE systems although under designed have produced significant removals
        - Therefore a better designed system should perform significantly better for source removal and migration control
        - A more productive SVE system could reduce the overall time of the WP2 system operation
        - Soil air flow modeling could answer some of the time related performance questions
        - Disagree with Ensafe regarding a change in the ROD is required if the SVES are modified

- Other remediation technologies should also be considered (e.g. chemox, enhanced bio)
- EPA will be very reluctant to let the ROD be changed (i.e. let the SVES be turned off) when the systems are still productive or could be more so if modified based on current understanding of site conditions. A TI argument would fail based on a gap of information regarding source delineation.

✓ WP2
- Expect the VOC remediation time to be 7 years plus the time to get the source areas down to an insignificant mass flux rate
- The current treatment system cannot handle chrome removal and would have to be expanded to do so (i.e. more costs paid by whom?)
  - Potentially more cost effective (again to whom) way to control the chrome is a system or stabilizing process adjacent to the release area

Recommended next steps

✓ Restart the SVE systems (as soon as possible)

✓ Conference call with Ensafe, XDD and UTC in September to begin to develop a concerted plan and assignments:
- Reassess SVES design and other source area remediation processes (XDD, by mid October)
- Assess chemical delineation and fate and transport (Ensafe, by mid October)
- Do a cost benefit analysis of the different source remediation scenarios vs NFA at the source area, include cost to change ROD (XDD, by mid November)

✓ Determine who is going to pay for chrome treatment and where to locate it (no later than end of 2003)

✓ Meeting before end of the year with all parties on plan going forward and to get agreement on roles and responsibilities (early December)

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TENNESSEE
WESTERN DIVISION

CARRIER CORPORATION,

Plaintiff

Vs. Case No. 05-2307-MI/V

PAUL P. PIPER, JR., Et al,

Defendants

LUND COATING TECHNOLOGIES, INC.,
f/k/a PIPER COATINGS TECHNOLOGIES,
INC.,

Defendant and
Cross-plaintiff,

vs.

PIPER INDUSTRIAL COATINGS, INC.,

Defendant and
Cross-Defendant.

THE CONTINUED DEPOSITION OF

BRUCE L. CLIFF
July 25, 2007

- Volume II -

ALPHA REPORTING CORPORATION
AMY DILLINGER, RPR, CSR
236 Adams Avenue
Memphis, Tennessee 38103

trichlorethylene chemical characteristics or metals and solvents and would have no interaction or bearing on one another on the cleanup.

BY MR. WADE:

Q. Would it have bearing on the existence of chromium at the site?

MR. RAY: Objection.

THE WITNESS: You are saying this if there was chrome in the ground, does it have a bearing that there is chrome in the ground?

BY MR. WADE:

Q. I'm asking if that's a piece of information that would be useful for you to know that at one time there were high concentrations of chromium at the sludge lagoon?

A. No, I don't think so.

Q. Would that have any bearing on your investigation on the existence of chromium at Water Plant 2?

A. It could have some bearing.

Q. What bearing would it have, sir?

A. If it was chromium present it would be the existence of chromium and above the aquifer where chromium is being extracted from the water.

Q. I didn't understand some of the qualifications, that there be chromium above the aquifer?

A. Right, there is a standard aquifer that the water plant extracts the water from that, seals off the clay layer and these metals, if they exist, would have been in that area layer and would be present in that vicinity, but I don't know that they would be hydroactive.

Q. In other words the metals including the chromium over the period of time that they were in the lagoon could have migrated downward to the soil through the clay layer?

A. I'm saying there is a possibility, but I don't know there is any evidence of that.

MR. RAY: Objection, calls for speculations.

BY MR. WADE:

Q. It could have happened?

A. I would have to do an investigation to determine that.

Q. I'm not asking you to do an investigation. I'm asking whether or not that could happen that the chromium metal in that sludge pond, which was unlined, could have migrated through the soil to the clay layer?

MR. RAY: Objection.

BY MR. WADE:

Q. You may answer?

A. It's possible.

Q. Yes, sir. And now your testimony is that you think there is the existence of the clay layer relevant to the sands from which Water Plant 2 draws raw water?

A. I missed the question.

Q. I may not have stated it very well. Let me try it again. Why is the clay layer relevant to the sands from which Water Plant 2 draws raw water?

A. Essentially clays are impermeable to water movement of any significant nature and the ability for chromium to transport down to the clays would be rather difficult to get into the sands, hence extracted by the water plant to the wells.

Q. Do you know what the composition of the soil is above the clay layer?

A. Above -- well, there is over burden

Expert Report of Phillip G. Coop
in the matter of Carrier Corporation v. Paul P. Piper, Jr.
in the United States District Court for the
Western District of Tennessee
Civil Action No. 2:05-CV-2307-M1/V

March 13, 2006

(Revised August 8, 2007)

EXPERT REPORT OF PHILLIP G. COOP

INTRODUCTION

My name is Phillip G. Coop. I am a Principal at EnSafe Inc., Memphis, Tennessee. I have been asked by the law firm of Robinson & Cole, LLP to provide my opinions with respect to certain issues in the litigation titled Carrier Corporation, Plaintiff, v. Paul P. Piper, Jr., et al., Defendants, in the United States District Court for the Western District of Tennessee, Civil No. 2:05-CV-2307-M1/V. This case involves a demand by Carrier Corporation related to chromium contamination at Water Plant #2 in the Town of Collierville, Tennessee. My opinions are provided below and are based on my 28 years experience and the information I have available at this time. I reserve the right to modify or elaborate as may be necessary if additional information becomes available. This revision incorporates recent information on the project costs of addressing the chromium contamination at the Town of Collierville Well field #2.

RESUME AND APPLICABLE EXPERIENCE

Attachment 1 to this report contains a summary of my experience and education in the environmental field. Also included in Attachment 1 is a list of all other cases in which I have testified as an expert at trial or deposition within the last four years and a list of publications/presentations I have made in the last 10 years. In summary, I have been a practicing environmental consultant since 1978, initially at SAIC, Inc. and, since 1980, at EnSafe Inc., a firm I co-founded. I have managed remediation projects in many states, beginning generally in 1981. I have experience in the remediation of many types of contaminants, including trichloroethylene and chromium, which are constituents of concern in the present case. I have managed a great many projects in the State of Tennessee and within the U.S. Environmental Protection Agency (EPA) Region IV. I currently supervise a staff of approximately 265 employees who are primarily environmental scientists and supporting administrative staff.

Attachment 2 is a list of documents and sources relied upon for this opinion and are among the documents that will be used as exhibits to support my opinions.

I am being compensated for my time to prepare this opinion and testimony, if any, at the rate of $180 per hour.

BACKGROUND

In 1986, trichloroethylene (TCE), a common metal degreasing solvent, was discovered in the wells that served the Town of Collierville's Water Plant #2. Water Plant #2 is located near the intersection of Byhalia Road and Poplar Avenue, adjacent to Carrier Corporation (Carrier), a manufacturer of air conditioners in Collierville. Carrier was using TCE in its processes and had suffered releases of TCE. The Carrier plant is located southeast (hydrogeologically up gradient) of Water Plant #2.

Carrier then initiated an environmental investigation under the oversight of the State of Tennessee Department of Health and Environment, later called the Department of Environment and Conservation (TDEC). In 1990, the property was listed on the federal National Priorities List. From 1989 to 1992, Carrier conducted a second investigation under an Administrative Order (AOC) issued by EPA Region IV. That investigation, which included sampling and analysis of soils and groundwater for a wide range of contaminants, concluded that TCE had been released on the Carrier property and that these releases were the source of TCE contamination at Water Plant #2. That conclusion was supported by extensive geological and hydrogeological studies of that area of Collierville.

Starting in 1986, both Carrier and the Town of Collierville began frequent testing of the water at Water Plant #2 and from the two wells (the "east" well and the "west" well) serving the plant. Values for TCE remained below federal and state limits for TCE until 1990, when concentrations began to approach the limit of 5 micrograms per Liter (µg/L). In 1990, Carrier performed an interim remedy and installed a treatment system, an air stripping tower, at the Water Plant to eliminate TCE exposure risk to users of water from this plant. The air stripping tower is a well established technology that removes volatile chemicals from water by mixing the water with forced air. Volatile contaminants are removed, "stripped," from the water and enter the air where they are discharged from the tower. While effective for volatile solvents such as TCE, this technology is not effective on non-volatile contaminants, such as metals.

This treatment system resulted in the elimination of TCE from the potable water supply in 1990. The Town of Collierville therefore continued to use the Water Plant as a source of drinking water while the investigation and remedial action activities by Carrier were under way.

In 1992, with the investigation completed, EPA issued a Record of Decision (ROD) for the site. The ROD concluded that TCE and related chlorinated solvents were the constituents of concern for the site. The ROD also included lead and zinc as constituents of concern because these two metals showed elevated concentrations in some of the shallow wells but the ROD also noted that there was no pattern of metals contamination or a source area for metals, except at the former lagoon area where sludges from zinc phosphating had once been disposed. With regard to the lagoon area, the ROD concluded that removal of those sludges (which had occurred in approximately 1982) was a sufficient remedy. Therefore EPA did not require Carrier to undertaken any further remedial actions to address metals.

In 1993, Carrier was issued a Unilateral Administrative Order (UAO) to design and implement a remedial action to address TCE contamination. The UAO contained a draft Scope of Work (SOW) that required Carrier to implement certain actions. The actions included: the installation of soil vapor recovery systems at Carrier's main plant location and at the former lagoon location on Carrier's property; operation of Water Plant #2 for groundwater treatment/containment; supplemental extraction well treatment in the former lagoon area on the Carrier property; and the continued monitoring of groundwater, both shallow and deep, on the Carrier property.

The SOW's requirement that Carrier operate the Water Plant #2 system was the result of information developed in the investigation. It was concluded that a system was needed to prevent further migration of TCE off site in the Memphis Sands aquifer. Technically, this would have required the installation of one or more pumping wells in the Memphis Sands aquifer to capture TCE migrating through the aquifer at or near Carrier's property line. This is known as "containment" – the wells pump water containing TCE with sufficient force that TCE cannot migrate past the wells. The migration direction of TCE is from Carrier's main plant, northwesterly toward Collierville's Water Plant #2, which is located adjacent to the Carrier property. The pumping rate required of such wells would have approximated the pumping rate of the two water wells serving Water Plant #2 at this time and the optimum location for these wells would have been at or near the location of the wells serving Water Plant #2. Therefore, rather than installing new wells, Carrier, with the concurrence of the Town of Collierville, TDEC, and the federal EPA, developed a groundwater remedy that utilized the existing Water Plant #2 wells as part of the remedial action. This approach was presented in public meetings prior to issuance of the ROD and became a requirement of the SOW. The system operated without incident until 2002 when the chromium controversy arose.

In 2002, the TDEC requested that the Town of Collierville begin more frequent monitoring of the water from Water Plant #2 for the constituent chromium because of concerns created by the discovery of chromium in surface and groundwater at and near the Smalley-Piper Site in Collierville, which is located approximately one-quarter mile east of Water Plant #2. In March 2003, the town notified Carrier that Water Plant #2 was shut down because concentrations of chromium in the water had been detected and could reach a concentration of 30 µg/L — a concentration that the Agency for Toxic Substance and Disease Registry (ATSDR) has stated is harmful to children if present in drinking water. Further, the TDEC notified the Town of Collierville that the Water Plant could not be operated as a potable water supply if the concentration of chromium exceeded 50 µg/L (later revised downward to 30 µg/L). The Water Plant resumed operation after six weeks, while chromium concentrations were monitored and the operating conditions were varied. However, by December 2003, the town determined that it could not ensure that the 30 µg/L limit could be maintained. It should be noted that the TCE removal system installed by Carrier has no effect on chromium which passes through the air stripper without being treated; nor could that system be modified to include chromium treatment.

Further, the town developed a voluntary policy that any detectable chromium must be avoided. It therefore closed the plant.

Thus the wells that served the dual purpose of supplying drinking water and containing the TCE contamination from the Carrier property were shut off. This has impacted Carrier's ability to maintain compliance with the UAO.

Source of the Chromium Contamination at Water Plant #2

I have been asked my opinion on the source of the chromium found in Collierville's Water Plant #2.

My opinion is that the chromium in Water Plant #2's wells originates at the Smalley-Piper Site east of the plant.

In May 1990, during the Carrier investigation of groundwater on its property and the surrounding area, Carrier conducted analyses of 10 offsite private wells in the area to determine whether TCE from its site had impacted these wells. Those tests included analyses for volatile contaminants and for metals including chromium. The test results from these wells were negative for TCE and chromium, except for tests conducted on a Memphis Sands well on the Smalley-Piper Site, believed to be a production well, where chromium was identified at 1,570 µg/L. Thus the only indication at that time of chromium in the area affecting groundwater was at the Smalley-Piper Site. That site is located east of Water Plant #2.

A review of the TDEC file on the Smalley-Piper Site provided information related to the use of chromium on this site for many years. The companies operating there used chromic acid to treat metal and discharged chromium containing wastewaters to one or more onsite lagoons. There is also information related to surface water discharges of wastewater containing chromium as late as 2001. As a result, the federal EPA has ordered potentially responsible parties at the Smalley-Piper Site to conduct an investigation of the impact of these chromium releases – an investigation which is under way at present. It is known from Carrier's studies of the geology of the Collierville area that the tight clay formation known as the "Jackson Clay" does not exist east of Byhalia Road. Therefore, the chromium releases at the Smalley-Piper Site were able to reach the Memphis Sands aquifer rapidly.

It is known from hydrogeological studies conducted on the Carrier property that water in the Memphis Sands aquifer flows northwesterly. Thus, chromium-contaminated water from the Smalley-Piper Site would naturally flow northwest, north of Poplar Ave, generally parallel to the TCE plume from the Carrier property. However, several unexpected changes occurred in the early 2000's that affected chromium migration in this area. First, the Town of Collierville began pumping wells at Water Plant #2 more frequently and at higher pumping rates than had been the case in 1990. This higher pumping rate and frequency drew more ground water in toward the wells, pulling water from the north. Second, the Smalley-Piper production well was apparently shut down in or about 2001. This well had been serving, coincidentally, to contain the migration of chromium contamination from the Smalley-Piper Site. However, when it stopped pumping, the chromium was able to migrate more freely offsite. Once offsite, the higher pumping rates at Water Plant #2 acted to pull the chromium contamination southward.

These data clearly establish that Smalley-Piper used and released chromium to the environment and that this chromium reached the Memphis Sands aquifer and Water Plant #2.

Chromium was also among the contaminants studied during the Carrier investigation to determine whether Carrier was a source of chromium contamination. However, data from the Carrier investigation confirm that groundwater on the Carrier property was not impacted by chromium; nor was Carrier a source of chromium contamination to groundwater. I reviewed documents that indicate that Carrier did (and may still) use chromium compounds in its processes, primarily dichromates as an ingredient in paint. The extensive investigation of the Carrier property between 1986 and 1992, however, did not show any impact to groundwater from Carrier's use of chromium.

Therefore, it is my opinion that the chromium being found in tests of the wells at Collierville's Water Plant #2 is solely from the Smalley-Piper Site.

Imminent and Substantial Endangerment

I have been asked whether, in my opinion, the presence of chromium in groundwater at Water Plant #2 creates an imminent and substantial endangerment.

It is my opinion that an imminent and substantial endangerment exists in the water produced by Water Plant #2 as a result of chromium contamination.

Chromium concentrations in the wells at Water Plant #2 have exceeded 30 µg/L, the concentration at which ATSDR has stated chromium is a health threat to children. Computer modeling of the chromium pathways in the Memphis Sands aquifer have projected that the concentration of chromium in these wells (especially the west well) are likely to rise to 100 µg/L if the wells continue to pump, and in the absence of any effective chromium remediation.

The federal Maximum Contaminant Level for chromium is 100 µg/L in drinking water. Other limits are lower. ATSDR, as noted above, has suggested that a limit of 30 µg/L is appropriate where children are consuming public drinking water and has noted that the EPA limit assumes a lower ratio of trivalent chromium to hexavalent chromium than exists at Water Plant #2. (Hexavalent chromium is considered more toxic than trivalent chromium.) Thus, the site specific conditions at Water Plant #2 suggest a lower acceptable level than the national standard.

It is therefore clear that at a concentration as low as 30 µg/L total chromium, where significant hexavalent chromium is present, water is dangerous for children and that at 50 µg/L water is unsuitable for consumption by adults. ATSDR in its health consultation on the Smalley-Piper Site concluded that if the chromium concentration continued to rise as computer modeling suggests will happen if the wells continue to pump, then a public health hazard would exist. The State of Tennessee Public Water Supply regulatory agency concurred and informed the Town of Collierville that the wells may not be pumped if the plant exceeds 30 µg/L in finished water.

Because chromium contamination in Water Plant #2 has exceeded 30 µg/L, it is my opinion that an imminent and substantial endangerment exists, which has only been mitigated by the decision to close Water Plant #2.

Costs to Address the Chromium Issue at Water Plant #2

I have been asked to offer an opinion as to the costs Carrier will incur as a result of the chromium problem at Water Plant #2.

My opinion is that the presence of chromium in the wells serving Water Plant #2 may require Carrier to expend $~~9~~4.8 million or more to remove chromium to allow for continued containment of the TCE plume.

As noted above the TCE removal system has no effect on the chromium contamination. In the absence of the chromium problem, Carrier would not incur these additional expenses because the TCE removal system would continue to effectively control the TCE plume.

Because the two wells serving Water Plant #2 prevent the migration of TCE into the Memphis Sands aquifer and protect down gradient portions of the aquifer from TCE contamination, Carrier must ensure that the wells continue to pump (or replace them). Thus, with Water Plant #2 closed, Carrier has only a few options to maintain its compliance with the UAO.

One option is the installation and operation of a chromium treatment system at the Water Plant to restore the plant to potable water use. Carrier, at its expense, has performed an assessment of treatment options and a pilot test of the most promising option, which is an ion exchange removal system. A potential vendor and Carrier's consultants ~~have~~initially estimated the capital cost of such a system at approximately $666,000. However in June, 2007 Carrier received a quotation from a vendor for capital purchase and installation costs of $519,000. The annual operating cost of this system (which requires periodic removal and replacement of the ion exchange resin) is estimated at ~~$230,000 per year~~approximately $128,000 per year for the first two years. (After the first two years, the cost of the resin required to treat chromium is inflated by the vendor by an amount equal to the producer's price index (PPI) for organic chemical manufacturers. For purposes of this report, I have assumed a 4% inflation for the PPI.) This annual operating cost differs from prior estimates in that the flow rate of the system is now assumed to be 500 gpm instead of 1100 gpm. The basis for this assumption is that 500 gpm is the minimum pumping rate required to contain the TCE plume. The prior estimate assumed 1100 gpm which is approximately the operating capacity of the wellfield. In the absence of remediation of the chromium at the Smalley-Piper Site, the system may be expected to operate for 30 years or more20 years or more. This is a reduction in the 30 year estimate for the system on the assumption that possibly within 20 years the TCE plume will have attenuated and the continued pumping of the wells will not be necessary. Carrier's costs to date as reported to me on August 7, 2007 include $500,000598,000 for pilot testing and engineering and $40,000 per month (18 months already expended) in sewer fees for discharge of the water from the one well still pumping to maintain containment, sewer upgrades and legal fees and $1,071,000 in sewer use fees to discharge groundwater to the Town of Collierville sewer system. Therefore, if this option is implemented, Carrier's total costs will reach $9 million. This is the likely6.1 million as shown below:

Past Costs thru August 7, 2007:	$1,669,000
Capital costs for a 500 gpm system:	$ 519,000
O&M costs for 20 years at 4% annual PPI:	$3,925,000 (undiscounted)
Total:	$6,113,000

To further refine this estimate, I calculated the Net Present Value (NPV) of the O&M amount at a 3.5% discount rate. Carrier's stated policy with regard to its accounting for environmental liabilities is to use a NPV calculation if the future costs are fixed and reliably determinable. The use of a NPV is appropriate where future costs are reasonably predictable and consistent. These criteria apply to resin costs with the caveat that the future PPI inflator may vary. Carrier currently uses a discount rate of 3.5% for its NPV calculations. The discounted O&M cost is therefore $2,644,967.

Total costs using the discounted O&M value are: $4,833,000. This value does not include future legal costs, future consultants fees or future EPA and TDEC oversight costs; the total of which are likely to be significant but which are difficult to estimate.

This is currently the lowest cost option and also puts Water Plant #2 back into operation to provide a continuing source of useable water to the Town of Collierville.

A second option includes an expansion of the Collierville sewer system to enable it to receive water discharged from the Water Plant #2 wells. At present, this discharge does not require further treatment for chromium (because the limits placed on discharge water are higher than the chromium concentration in the wells) but does incur sewer fees of $43,000 or more per month, which would be much more expensive than the treatment system itself. For instance, 30 The sewer discharge fee applicable to Carrier when, and if, it resumes discharging to the Town's POTW will be $2.32 per 1000 gallons. A 500 gpm discharge rate is 720,000 gallons per day; yielding a cost of $1670.40 per day or $50,000 per month. However the Town cannot accept this discharge during high rain fall events so I have used a reasonable assumption of $43,000 per month to account for those periods. (The Town's sewer fees are adjusted annually and therefore are likely to rise but the amount is difficult to estimate.)

Therefore, 20 years at $43,000 per month exceeds $~~14~~10 Million. Not only is this option more expensive, it may not be viable because the Town of Collierville has told Carrier that it may soon lack sufficient capacity to continue to accept water from the Water Plant 2 well that is still pumping.[1] This pending capacity limit makes the resolution of the chromium issue urgent. ~~The town may be able to expand its capacity but may also ask Carrier to fund the costs of some or all of this expansion.~~

A third option is pumping of the wells and subsequent discharge to Nonconnah Creek under a state-approved permit without going through the Collierville sewer system. This option avoids the large monthly sewer fees and the ~~town~~Town's sewer capacity issues. However, TDEC has placed a very low limit on the concentration of chromium that may be discharged (12 µg/L). This is lower than the concentration of chromium in the Water Plant #2 wells and therefore requires that the water be treated prior to discharge. The treatment would be the same as described above in Option #1, ~~with a cost of at least $9 million (including costs already expended),~~ and may even cost more because it will be necessary to construct piping to and discharge structures at the Creek. There may also be a technical issue requiring treatment of the water to ambient temperatures prior to discharge which will add to the cost.

Other options, which included replacement wells for the Town of Collierville or replacement wells for TCE containment, were also considered. The technical issues associated with these options cannot be resolved until better information on the fate and transport of chromium has been developed. If found to be feasible, these options would involve costs, which would approximate or exceed the ~~$9 million~~ cost of option one.

After completion of the original expert report, discussions with the Town of Collierville continued. Recent discussions have raised the possibility that some or all of the groundwater may be routed to the Town's sewer facilities and discharged without treatment thus enabling the Town to accept the water despite its capacity restrictions and to reduce or eliminate the sewer use fees. Capital costs would include the cost of constructing a discharge line from Well field #2 to the sewer facility (about 3 miles). Operations and maintenance costs would include electricity, analytical fees, and labor to operate and maintain the well pumps and sewer fees, if any, from the Town. This and other options are still being considered as of August, 2007.

Because option one is the least costly option at present and allows the Town of Collierville to have continued access to Water Plant #2 for potable water, it is my opinion that this option provides an appropriate basis for determining the costs Carrier may incur (including costs already incurred) in resolving the chromium issue.

[1] After the Town of Collierville closed Water Plant #2 wells as sources of potable water, one well resumed being pumped on an interim basis to provide minimal containment. The water from this well is being discharged to the town sewer system at great expense. The town has indicated that its sewer system is at capacity and that this discharge cannot continue in the future.

Consistency with the National Contingency Plan

I have also been asked to consider whether the costs Carrier has incurred and will incur are consistent with the National Contingency Plan.

My opinion is that the costs Carrier is incurring and will incur are consistent with the National Contingency Plan.

The National Contingency Plan (40 CFR 300) (NCP) sets out the procedures and authorities of various federal and state responders to releases of petroleum and hazardous substances. Subpart H of the plan also includes the procedures for response by non-governmental entities. Subpart H clearly provides that actions carried out under CERCLA sections 106 and 122 are considered consistent with the NCP. Actions not conducted under one of these sections may still be considered consistent with the plan if they meet the substantive, applicable provisions of 40 CFR 300, including worker safety, documentation, permit requirements, identification of other applicable requirements, reporting, remedial evaluation, selection of remedies, and other related requirements (see 40 CFR 300. 700 (c)(5)). Further, parties must meet the public notice and public involvement requirements of the NCP.

Carrier's actions to date have been conducted under, and designed to maintain compliance with, the UAO from the federal EPA issued under CERCLA section 106 and have been conducted in coordination with and under the supervision of the EPA. Adequate public notice was given and a public hearing was conducted in 1992 prior to issuance of the ROD. A change, if required, in the remedial action would also require EPA concurrence and perhaps further public review, which will ensure compliance with the NCP. Resolution of the chromium issue at Water Plant #2, which is impacting Carrier's ability to comply with the UAO, is being coordinated with EPA. Actions taken are also consistent with the provisions of 40 CR 300.700(c)(5). Through participation in public meetings with the Board of Aldermen, EPA and Carrier have presented information on the chromium problem at Water Plant #2. In addition, the Smalley-Piper Site investigation is being conducted under an Administrative Order issued by EPA under section 122 of CERCLA and will require public notice and involvement prior to implementation of remedial actions.

I conclude therefore that the actions to date and that may be required to address chromium contamination at Water Plant #2 are consistent with the National Contingency Plan.

CONCLUSION

Based on my knowledge of the investigations and remedial actions undertaken by Carrier and information developed by EPA, TDEC, the Town of Collierville, and ATSDR, I conclude that:

- Carrier is not the source of chromium contamination at Water Plant #2;
- the Smalley-Piper Site is the source of chromium contamination at Water Plant #2;
- chromium contamination in the water produced by Water Plant #2 presents an imminent and substantial endangerment; and
- Carrier has incurred and may continue to incur costs to address chromium contamination at Water Plant #2 that are consistent with the National Contingency Plan and may total at least $94.8 million.

~~March 13, 2006~~

August 8, 2007

Phillip G. Coop, CHMM — Date

Attachment 1

Resume

ENSAFE # PHILLIP G. COOP, CHMM

PRESIDENT

SUMMARY OF QUALIFICATIONS

Mr. Coop is a Principal at EnSafe and coordinates scientific and technical efforts for the firm. He has 29 years' experience in environmental management, including 25 years as an environmental consultant. He is the co-founder of EnSafe Inc., a 265+ person environmental consulting firm based in Memphis, Tennessee.

- **Education**
  A.B., History and Science, Magna cum Laude, 1970, Harvard University

- **Certifications**
  Certified Hazardous Materials Manager, Master's Level

Mr. Coop has managed projects associated with the investigation and remediation of hazardous substance and petroleum releases since 1980. His experience includes many solvent, metals and pesticide contamination sites at which he has performed nature and extent studies, fate and transport studies, and developed remedial actions. Under his direction, EnSafe has developed Remedial Action Plans for soil and water contamination at more than 100 locations, involving soil treatment, soil disposal, wetlands mitigation, groundwater remediation, land restoration and air emissions controls.

Mr. Coop is a specialist in the management of Superfund and RCRA site investigations. He is currently Project Coordinator for six National Priorities List sites, responsible for the implementation of Remedial Investigations, Feasibility Studies, and Remedial Actions. His experience on such sites includes federal sites in USEPA Region IV (sites Tennessee, Florida, South Carolina, Alabama and Virginia), Region VI (sites in Texas and Arkansas), Region I (sites in Rhode Island), Region V (sites in Michigan and Ohio), as well as non-NPL federal and state sites throughout the United States. These sites have included a diverse set of environmental issues and contaminants. His experience also includes voluntary and state-managed investigations throughout the United States, Mexico, and Eastern Europe.

Environmental investigations under his management include many chlorinated solvent sites (TCE, TCA, PCE) in soil, air and groundwater; pesticide sites (DDT, Chlordane, endrin, aldrin, dieldrin, lindane, etc) in soil, surface water and groundwater; metals contamination (arsenic, barium, chromium, lead, cadmium) in soil, groundwater and surface water; polychlorinated biphenyls (PCBs) in soil; petroleum contaminants in soil, surface water, ground water and air; and various less common contaminants in soil and groundwater.

Mr. Coop has conducted numerous compliance audits and assessments of facilities throughout the United States. These audits include assessing a facility's compliance with regulations under the Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act, Emergency Planning and Community Right-to-Know Act, Toxic Substance Control Act, and the Federal Insecticide, Fungicide, and Rodenticide Act, as well as state environmental regulations

His experience includes audits of a wide variety of industries including, metal finishing, steel smelting, foundry and forging, chemical manufacture and formulation, consumer products, and transportation. Mr. Coop currently serves on the Air Quality Control Board of Memphis-Shelby County, which operates a federally delegated air quality enforcement program. In this capacity he reviews compliance and permitting issues from regulated industries.

Prior Testimony Including Depositions (last 4 years)

2003-2004

Deposed and testified in the matter of Interfaith Community Organization v. Honeywell International Inc. In the United States District Court for the District of New Jersey Civil Action No. 95-2097. Testimony related to the standards applicable to a real estate transaction environmental inquiry in 1981.

* PUBLICATIONS/PRESENTATIONS (Last 10 Years)

Presentation, 34th Annual Solid/Hazardous Waste Conference and Exhibition, Gatlinburg, TN, Co-Remediation of Municipal Landfills and Petroleum Contamination Sites: Binagadi, Baku, Azerbaijan. May 18, 2005

Environmental due diligence issues in M&A transactions, presentation to AGC Memphis, co-hosted by Scott Thomas (Bass, Berry & Sims). August 23, 2005

New SPCC Regs, Universal Waste and Manifesting Update, El Paso Gas Environmental Roundtable, March 9, 2004

GIS Applications in Shelby County, East Memphis Rotary Club, September 17, 2003

Innovative Approaches to the NBA Arena Redevelopment, MAESC Conference, May 15, 2003

Applicability of the EPA Brownfields Act to Tennessee, Solid/Hazardous Waste Conference, April 30 – May 2, 2003

Environmental Compliance for Small Businesses, UTC Small Business Conference, December 10, 2002

Innovative Approaches to Redevelopment of the Memphis NBA Arena, Florida Brownfields Conference, September 23, 2002

Current US Environmental Issues, Kazakhstan Environmental Conference August 19, 2002

CAM Rule Update (Compliance Assurance Monitoring), Mid-South Environmental Conference – TN – AR – MS, October 31, 2001

Current Issues in Hazardous Waste Materials, presentation to the Tennessee Environmental Law Compliance Course and Update. Nashville, TN. June 28, 2001

Managing Environmental Issues: Past experiences and Future Concepts, Keynote Speech to the US Navy and Marine Corps 2000 Water Managers Conference. Charleston, SC. June 27, 2000.

Interpreting Environmental Data, Fourth Annual Joint Law Conference, Arkansas and Oklahoma Bar Associations, Eureka Springs, Arkansas, May 19, 2000

Understanding Environmental Reports, Environmental Law Seminar, Memphis Bar Association, Memphis, Tennessee, March 24, 2000

Review of Privately Financed Environmental Remediation in Eastern Europe, Oak Ridge Environmental Conference, Oak Ridge, Tennessee, December 9, 1999

Environmental Risk Management, Region IV USEPA/DOD Joint Conference, Atlanta, Georgia, May 6, 1998

Hazardous Substance Exercise & Response Planning, second annual EUCON Joint Environmental Conference, Weinheim, Germany, July 16, 1997

Review of the Environmental Movement: Past, Present, and Future, Chemical Producers and Distributors Association and Southern Crop Protection Association (Pesticide Workshop, Memphis, Tennessee), May 14, 1997

Hazardous Waste Response Issues, NOSC Training Course sponsored by NAVSEA SUPSALV, Yokosuka, Japan, May 8, 1997

(Most presentations were supported by slides and not prepared remarks.)

Attachment 2

Sources Relied Upon for this Opinion

Personal knowledge and expertise.

Review of TDEC files in re: Smalley-Piper, TDEC Site #76-676, by P.G. Coop, March 9, 2006.

Telephone conversation with Bruce Cliff, XDD, March 8, 2006.

Carrier Air Conditioning Superfund Site Record of Decision (USEPA, September 9, 1992)

East Well Aquifer Pumping Test Report, Collierville Municipal Well Field (EnSafe, December 14, 1992)

Carrier Air Conditioning Superfund Site Unilateral Administrative Order and Scope of Work (USEPA, February 1993)

Groundwater Remedy Design (EnSafe, August 25, 1994)

Technical Memorandum, Site Downgradient Monitoring Well Data Quality Assessment (EnSafe, October 18, 1994)

Memorandum, Carrier Collierville Verification Modeling (EnSafe, March 12, 1997)

Carrier Air Conditioning Superfund Site Five-Year Review, August 28, 2000 (USEPA, August 28, 2000)

2002/2003 Annual Progress Report, UTC – Carrier Air Conditioning, Collierville, Tennessee (EnSafe, June 30, 2004)

Letter from S. Qualls, TDEC Division of Water Pollution Control, to L. Goetz, EnSafe. March 9, 2004. Subject: Planning Limits, Potential Discharge to Nonconnah Creek or to Lateral J/Wolf River, Collierville, Shelby County.

Schedule for Interim Actions at Water Plant #2, UTC – Carrier Air Conditioning,
NPDES Permit Application Submittal, Carrier Facility, Collierville, Tennessee. Letter to Mr. Ed Polk, TDEC-WPC, from Mrs. Lori Goetz, EnSafe Inc., September 13, 2004.

2004 Five Year Review (Revision 2), Carrier Air Conditioning Site, Collierville, ~~Tennesse~~Tennessee (USEPA, 2005)

Site Inspection, Revision 0, Smalley-Piper, Collierville, Shelby County, Tennessee, USEPA ID No. TNN000407378. (Weston Solutions Inc., 2002)

Health Consultation: Smalley-Piper, Collierville, Shelby County, Tennessee, EPA Facility ID: TNN000407378. (US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation, prepared by Tennessee Department of Health; 2003)

Public Comment Draft – Public Health Assessment: Smalley-Piper, Collierville, Shelby County, Tennessee, EPA Facility ID: TNN000407378. (US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation, prepared by Tennessee Department of Health; 2005)

Environmental Compliance Assessment, Final Report, Piper Plow Works, Inc. ~~Colilerville~~Collierville, Tennessee (EnSafe, 1991)

Environmental Compliance Audit, Field Data Collection Booklet, Piper Plow Works Inc., 779 Piper Street, Collierville 38017, 1-16-91 (EnSafe, 1991)

Final Remedial Investigation Report, Collierville Site, Collierville, Tennessee, (including supporting data and laboratory reports) (EnSafe, 1992)

Background Information collected in support of the Final Remedial Investigation Report, Collierville Site Regarding former lagoon sludge, (1980-1982)

Review of Carrier Collierville Tier II reports 1994-2004

Letter quotation of Siemens Water Technologies (formerly U.S. filter) dated June 6, 2007 to Bruce Cliff, XDD LLC

Document comparison done by DeltaView on Wednesday, August 08, 2007 5:31:07 PM

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Document 2	c:\cmprev.doc
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Total changes	51

COLLIERVILLE SITE

COLLIERVILLE, TENNESSEE

SITE: Carrier Air
BREAK: 3.10
OTHER: V3

FINAL REMEDIAL INVESTIGATION REPORT

VOLUME 2

EnSafe

Environmental and Safety Designs, Inc.
P. O. BOX 341315, MEMPHIS, TN 38184-1315
(901) 372-7962

MARCH 27, 1992

APPENDIX H

PHASE II AND III COLLIERVILLE SITE

GROUNDWATER DATA

NOTES:

1) Monitoring wells 1A, 9, 11, and 15 did not produce sufficient amounts of water for sampling for the second or the third quarter groundwater sampling events.
2) Monitoring well 21 only produced enough water for the CLP volatile analysis.
3) Suffix identifiers "EC" and "WC" are for the City East well and the City West well respectfully.
4) The suffix identifier "F" for wells 3,5, and 23 (page H-9) denotes that these samples were filtered through a 0.45 micron filter in the laboratory for CLP metals analysis.
5) Monitoring wells 25, 27, 29, 31, 33, 35, 37, 39, 41, and 43 had not been installed at the time of the second quarter groundwater sampling event. These wells were installed in August, 1990. Of the new monitoring wells, 25,33, 41, and 43 did not produce sufficient amounts of water for sampling.
6) See Appendix A for explanations of the data qualifiers.
7) See Plate 1 for monitoring well locations.

COLLIERVILLE SITE: RESULTS OF SECOND QUARTER GROUNDWATER SAMPLING EVENT; MAY 16-18, 1990

CMP	CL	SITE / SAMPLE ID / LAB SAMPLE ID / SAMPLING DATE / MATRIX / COMPOUND	COLLIERVILLE 05189021 05189021 05/18/90 WATER ug/l	COLLIERVILLE 05179023 05179023 05/17/90 WATER ug/l	COLLIERVILLE 051890EC 051890EC 05/18/90 WATER ug/l	COLLIERVILLE 051890WC 051890WC 05/18/90 WATER ug/l
101	M	Antimony		BDL 39	BDL 39	BDL 39
102	M	Arsenic		BDL 3	BDL 3	BDL 3
103	M	Beryllium		BDL 1	BDL 1	BDL 1
104	M	Cadmium		BDL 5	BDL 5	BDL 5
105	M	Chromium		BDL 7	BDL 7	28
106	M	Copper		12 B	19.6 B	BDL 5
107	M	Lead		21.2	3.1	BDL 2
108	M	Mercury		BDL 0.2	BDL 0.2	BDL 0.2
109	M	Nickel		BDL 34	BDL 34	BDL 34
110	M	Selenium		BDL 10	BDL 10	BDL 10
111	M	Silver		BDL 4	BDL 4	BDL 4
112	M	Thallium		BDL 3	BDL 3	BDL 3
113	M	Zinc		8430	20.6	52.1
114	M	Barium		96.5 B	11 B	11.7 B
115	M	Iron		15100	680	257
116	M	Manganese		230	BDL 4	BDL 4
117	M	Vanadium		7.6 B	BDL 5	BDL 5
118	M	Aluminum		892	BDL 23	BDL 23
120	M	Cobalt		BDL 7	BDL 7	BDL 7
121	M	Magnesium		2920 B	972 B	958 B
129	M	Calcium		7980	2730 B	2840 B
130	M	Sodium		58100	6710	6580
131	M	Potassium		BDL 3970	BDL 3970	BDL 3970
203	V	Benzene	BDL 5	BDL 5	BDL 5	BDL 5
204	V	Bromoform	BDL 5	BDL 5	BDL 5	BDL 5
206	V	Carbon tetrachloride	BDL 5	BDL 5	BDL 5	BDL 5
207	V	Chlorobenzene	BDL 5	BDL 5	BDL 5	BDL 5
208	V	Dibromochloromethane	BDL 5	BDL 5	BDL 5	BDL 5
209	V	Chloroethane	BDL 10	BDL 10	BDL 10	BDL 10
211	V	Chloroform	BDL 5	BDL 5	BDL 5	BDL 5
212	V	Bromodichloromethane	BDL 5	BDL 5	BDL 5	BDL 5
214	V	1,1-Dichloroethane	BDL 5	BDL 5	BDL 5	BDL 5
215	V	1,2-Dichloroethane	BDL 5	BDL 5	BDL 5	BDL 5
216	V	1,1-Dichloroethene	BDL 5	BDL 5	BDL 5	BDL 5
217	V	1,2-Dichloropropane	BDL 5	BDL 5	BDL 5	BDL 5
218	V	Cis-1,3-Dichloropropene	BDL 5	BDL 5	BDL 5	BDL 5
219	V	Ethylbenzene	BDL 5	BDL 5	BDL 5	BDL 5
220	V	Bromomethane	BDL 10	BDL 10	BDL 10	BDL 10
221	V	Chloromethane	BDL 10	BDL 10	BDL 10	BDL 10
222	V	Methylene chloride	BDL 5	BDL 5	2 J	BDL 5
223	V	1,1,2,2-Tetrachloroethane	BDL 5	BDL 5	BDL 5	BDL 5
224	V	Tetrachloroethene	BDL 5	BDL 5	BDL 5	BDL 5
226	V	Toluene	3 J	4 J	1 J	4 J
227	V	1,1,1-Trichloroethane	BDL 5	BDL 5	BDL 5	BDL 5
228	V	1,1,2-Trichloroethane	BDL 5	BDL 5	BDL 5	BDL 5
229	V	Trichloroethene	690 E	79	19	18
231	V	Vinyl chloride	BDL 10	BDL 10	BDL 10	BDL 10
250	V	Trans-1,3-Dichloropropene	BDL 5	BDL 5	BDL 5	BDL 5
251	V	Styrene	BDL 5	BDL 5	BDL 5	BDL 5
252	V	Acetone	38	BDL 10	BDL 10	BDL 10
253	V	2-Butanone	BDL 10	BDL 10	BDL 10	BDL 10
254	V	Carbon disulfide	BDL 5	BDL 5	BDL 5	BDL 5
255	V	2-Hexanone	BDL 10	BDL 10	BDL 10	BDL 10
256	V	4-Methyl-2-pentanone	BDL 10	BDL 10	BDL 10	BDL 10
257	V	Vinyl acetate	BDL 10	BDL 10	BDL 10	BDL 10
258	V	Xylenes (Total)	BDL 5	BDL 5	BDL 5	BDL 5
299	V	1,2-Dichloroethene(Total)	380 E	1 J	BDL 5	BDL 5

COLLIERVILLE SITE: RESULTS OF SECOND QUARTER GROUNDWATER SAMPLING EVENT: April/May, 1991

CMP	CL	COMPOUND	* SITE: COLLIERVILLE			COLLIERVILLE			COLLIERVILLE			COLLIERVILLE			COLLIERVILLE		
		SAMPLE ID	04230131D			05010135			05010135D			04240137			04240137D		
		LAB SAMPLE ID	2820.0			3106			3106			2865.0			2865.0		
		SAMPLING DATE	04/24/91			05/01/91			05/01/91			04/24/91			04/24/91		
		MATRIX	WATER			WATER			WATER			WATER			WATER		
			ug/l			ug/l			ug/l			ug/l			ug/l		
101	M	Antimony	1	B		BDL		0.8	2.3	B		1.2	B		1	B	
102	M	Arsenic	BDL		1	BDL		5	BDL		5	1.3	B		1.5	B	
103	M	Beryllium	BDL		1.1	BDL		1.1	BDL		1.1	39			BDL		1.1
104	M	Cadmium	BDL		3	BDL		3	BDL		3	14			BDL		3
105	M	Chromium	BDL		9.5	15			BDL		9.5	276			BDL		9.5
106	M	Copper	5	B		21	B		10	B		86			7	B	
107	M	Lead	2.9	B		3.9			BDL		0.5	24.4			BDL		0.5
108	M	Mercury	BDL		0.2	BDL		0.2	BDL		0.2	0.21			BDL		0.2
109	M	Nickel	BDL		8.6	29	B		26	B		181			BDL		8.6
110	M	Selenium	BDL		0.5	0.7	B		0.9	B		BDL		0.5	BDL		0.5
111	M	Silver	BDL		8.1	BDL		8.1	BDL		8.1	BDL		8.1	BDL		8.1
112	M	Thallium	BDL		0.7	BDL		0.7	BDL		0.7	1	B		BDL		0.7
113	M	Zinc	22500			945			903			571			87		
114	M	Barium	39	B		61	B		57	B		778			278		
115	M	Iron	399			5440			258			267000			308		
116	M	Manganese	64			399			393			2010			301		
117	M	Vanadium	BDL		4.2	BDL		4.2	BDL		4.2	249			BDL		4.2
118	M	Aluminum	BDL		195	1230			BDL		195	70300			BDL		195
120	M	Cobalt	BDL		6.4	10	B		10	B		49	B		BDL		6.4
121	M	Magnesium	1690	B		4070	B		4250	B		19700			11700		
129	M	Calcium	10800			11300			11900			23800			17700		
130	M	Sodium	24200			41800			43400			61800			60600		
131	M	Potassium	1980	B		2940	B		2500	B		21800			14400		
203	V	Benzene				BDL		5				BDL		50			
205	V	Bromoform				BDL		5				BDL		50			
206	V	Carbon tetrachloride				BDL		5				BDL		50			
207	V	Chlorobenzene				BDL		5				BDL		50			
208	V	Dibromochloromethane				BDL		5				BDL		50			
209	V	Chloroethane				BDL		10				BDL		100			
211	V	Chloroform				BDL		5				BDL		50			
212	V	Bromodichloromethane				BDL		5				BDL		50			
214	V	1,1-Dichloroethane				BDL		5				BDL		50			
215	V	1,2-Dichloroethane				BDL		5				BDL		50			
216	V	1,1-Dichloroethene				BDL		5				BDL		50			
217	V	1,2-Dichloropropane				BDL		5				BDL		50			
218	V	Cis-1,3-Dichloropropene				BDL		5				BDL		50			
219	V	Ethylbenzene				BDL		5				BDL		50			
220	V	Bromomethane				BDL		10				BDL		100			
221	V	Chloromethane				BDL		10				BDL		100			
222	V	Methylene chloride				17	B					65	B				
223	V	1,1,2,2-Tetrachloroethane				BDL		5				BDL		50			
224	V	Tetrachloroethene				BDL		5				BDL		50			
225	V	Toluene				BDL		5				BDL		50			
227	V	1,1,1-Trichloroethane				BDL		5				BDL		50			
228	V	1,1,2-Trichloroethane				BDL		5				BDL		50			
229	V	Trichloroethene				BDL		5				1200					
231	V	Vinyl chloride				BDL		10				BDL		100			
250	V	Trans-1,3-Dichloropropene				BDL		5				BDL		50			
251	V	Styrene				BDL		5				BDL		50			
252	V	Acetone				BDL		10				170	B				
253	V	2-Butanone				BDL		10				BDL		100			
254	V	Carbon disulfide				BDL		5				BDL		50			
255	V	2-Hexanone				BDL		10				BDL		100			
256	V	4-Methyl-2-pentanone				BDL		10				BDL		100			
257	V	Vinyl acetate				BDL		10				BDL		100			
258	V	Xylenes (Total)				BDL		5				BDL		50			
259	V	1,2-Dichloroethene(Total)				BDL		5				160					

* QA Samples

COLLIERVILLE SITE: RESULTS OF SECOND QUARTER GROUNDWATER SAMPLING EVENT: April/May, 1991

		SITE	COLLIERVILLE	COLLIERVILLE	COLLIERVILLE	COLLIERVILLE	COLLIERVILLE
		SAMPLE ID	04249137DUP	04249137DUPD	05019157	05019157D	05019157DUP
		LAB SAMPLE ID	2868.9	2868.9	3102.3	3102.3	3106
		SAMPLING DATE	04/24/91	04/24/91	05/01/91	05/01/91	05/01/91
		MATRIX	WATER	WATER	WATER	WATER	WATER
CMP	CL	COMPOUND	ug/l	ug/l	ug/l	ug/kg	ug/kg
101	M	Antimony	BDL 0.8	BDL 0.8	BDL 0.8	1.9 B	BDL 0.8
102	M	Arsenic	BDL 1	1.2 B	BDL 1	BDL 5	BDL 1
103	M	Beryllium	57	BDL 1.1	3 B	BDL 1.1	21
104	M	Cadmium	17	BDL 3	BDL 3	BDL 3	7
105	M	Chromium	392	BDL 9.5	33	BDL 9.5	141
106	M	Copper	144	9 B	54	12 B	78
107	M	Lead	46.8	0.7 B	11	0.9 B	19.8
108	M	Mercury	0.23	BDL 0.2	BDL 0.2	BDL 0.2	BDL 0.2
109	M	Nickel	259	BDL 8.6	38 B	BDL 8.6	95
110	M	Selenium	BDL 0.5	BDL 0.5	0.4 B	BDL 0.4	0.4 B
111	M	Silver	BDL 8.1	BDL 8.1	BDL 8.1	BDL 8.1	BDL 8.1
112	M	Thallium	1.6 B	BDL 0.7	BDL 0.7	BDL 0.7	BDL 0.7
113	M	Zinc	738	99	93	120	223
114	M	Barium	1220	253	241	72 B	340
115	M	Iron	390000	270	15700	431	136000
116	M	Manganese	3670	250	658	227	962
117	M	Vanadium	377	BDL 4.2	22 B	BDL 4.2	147
118	M	Aluminum	118000	BDL 196	8600	236	54400
120	M	Cobalt	79	BDL 6.4	13 B	BDL 6.4	28 B
121	M	Magnesium	23500	11300	5320	3570 B	9440
129	M	Calcium	31300	17700	18800	14600	20500
130	M	Sodium	60900	58700	49600	52600	56700
131	M	Potassium	22800	13700	8470	7310	12000
203	V	Benzene	BDL 50		BDL 5		BDL 5
205	V	Bromoform	BDL 50		BDL 5		BDL 5
206	V	Carbon tetrachloride	BDL 50		BDL 5		BDL 5
207	V	Chlorobenzene	BDL 50		BDL 5		BDL 5
208	V	Dibromochloromethane	BDL 50		BDL 5		BDL 5
209	V	Chloroethane	BDL 100		BDL 10		BDL 10
211	V	Chloroform	BDL 50		BDL 5		BDL 5
212	V	Bromodichloromethane	BDL 50		BDL 5		BDL 5
214	V	1,1-Dichloroethane	BDL 50		BDL 5		BDL 5
215	V	1,2-Dichloroethane	BDL 50		BDL 5		BDL 5
216	V	1,1-Dichloroethene	BDL 50		BDL 5		BDL 5
217	V	1,2-Dichloropropane	BDL 50		BDL 5		BDL 5
218	V	Cis-1,3-Dichloropropene	BDL 50		BDL 5		BDL 5
219	V	Ethylbenzene	BDL 50		BDL 5		BDL 5
220	V	Bromomethane	BDL 100		BDL 10		BDL 10
221	V	Chloromethane	BDL 100		BDL 10		BDL 10
222	V	Methylene chloride	69 B		BDL 5		23 B
223	V	1,1,2,2-Tetrachloroethane	BDL 50		BDL 5		BDL 5
224	V	Tetrachloroethene	BDL 50		BDL 5		BDL 5
225	V	Toluene	BDL 50		BDL 5		BDL 5
227	V	1,1,1-Trichloroethane	BDL 50		BDL 5		BDL 5
228	V	1,1,2-Trichloroethane	BDL 50		BDL 5		BDL 5
229	V	Trichloroethene	1100		BDL 5		8
231	V	Vinyl chloride	BDL 100		BDL 10		BDL 10
250	V	Trans-1,3-Dichloropropene	BDL 50		BDL 5		BDL 5
251	V	Styrene	BDL 50		BDL 5		BDL 5
252	V	Acetone	270 B		BDL 10		BDL 10
253	V	2-Butanone	BDL 100		BDL 10		BDL 10
254	V	Carbon disulfide	BDL 50		BDL 5		BDL 5
255	V	2-Hexanone	BDL 100		BDL 10		BDL 10
256	V	4-Methyl-2-pentanone	BDL **		BDL 10		BDL 10
257	V	Vinyl acetate	BDL 100		BDL 10		BDL 10
258	V	Xylenes (Total)	BDL 50		BDL 5		BDL 5
259	V	1,2-Dichloroethene(Total)	45 J		BDL 5		BDL 5

*QA Samples

COLLIERVILLE SITE: RESULTS OF SECOND QUARTER GROUNDWATER SAMPLING EVENT: April/May, 1991

		SITE	COLLIERVILLE			COLLIERVILLE			COLLIERVILLE			COLLIERVILLE			COLLIERVILLE		
		SAMPLE ID	05019157DUPD			06068158			06068159			06068159D			06068161		
		LAB SAMPLE ID	3106			4180.8			4181.6			4182.4			4183.2		
		SAMPLING DATE	05/01/91			06/06/91			06/06/91			06/06/91			06/06/91		
		MATRIX	WATER			WATER			WATER			WATER			WATER		
CMP	CL	COMPOUND	ug/kg			ug/l			ug/l			ug/l			ug/l		
101	M	Antimony	2.3	B		BDL		0.8	1.5	B		1.6	B		1.1	B	
102	M	Arsenic	BDL		5	BDL		1	1.2	B		1.4	B		1.1	B	
103	M	Beryllium	BDL		1.1	BDL		1.1	26			28			42		
104	M	Cadmium	BDL		3	BDL		3	9			11			18		
105	M	Chromium	11			BDL		9.5	121			127			214		
106	M	Copper	10	B		73			91			98			167		
107	M	Lead	0.7	B		3.6			6.2			7.8			43.8		
108	M	Mercury	BDL		0.2	BDL		0.2	0.38			BDL		0.2	0.26		
109	M	Nickel	BDL		8.8	12	B		68			74			146		
110	M	Selenium	0.5	B		BDL		0.6	BDL		2.5	BDL		2.5	BDL		0.5
111	M	Silver	BDL		8.1	BDL		8.1	BDL		8.1	BDL		9.8	BDL		8.1
112	M	Thallium	BDL		0.7	BDL		0.7	BDL		0.7	0.7	B		BDL		0.7
113	M	Zinc	33			24			184			177			1780		
114	M	Barium	65	B		136	B		230			244			791		
115	M	Iron	199			1100			184000			204000			301000		
116	M	Manganese	233			103			1360			1520			6640		
117	M	Vanadium	BDL		4.2	BDL		4.2	203			220			369		
118	M	Aluminum	BDL		196	439			60600			60800			114000		
120	M	Cobalt	BDL		6.4	BDL		6.4	48	B		56			61		
121	M	Magnesium	3480	B		4720	B		3210	B		3410	B		8080		
129	M	Calcium	14400			10700			38800			41300			21900		
130	M	Sodium	50000			12300			118000			120000			34500		
131	M	Potassium	6730			4830	B		60800			63000			8510		
203	V	Benzene				BDL		5	BDL		5	BDL		5	BDL		5
205	V	Bromoform				BDL		5	BDL		5	BDL		5	BDL		5
206	V	Carbon tetrachloride				BDL		5	BDL		5	BDL		5	BDL		5
207	V	Chlorobenzene				BDL		5	BDL		5	BDL		5	BDL		5
208	V	Dibromochloromethane				BDL		5	BDL		5	BDL		5	BDL		5
209	V	Chloroethane				BDL		10	BDL		10	BDL		10	BDL		10
211	V	Chloroform				BDL		5	BDL		5	BDL		5	BDL		5
212	V	Bromodichloromethane				BDL		5	BDL		5	BDL		5	BDL		5
214	V	1,1-Dichloroethane				BDL		5	BDL		5	BDL		5	BDL		5
215	V	1,2-Dichloroethane				BDL		5	BDL		5	BDL		5	BDL		5
216	V	1,1-Dichloroethene				BDL		5	BDL		5	BDL		5	BDL		5
217	V	1,2-Dichloropropane				BDL		5	BDL		5	BDL		5	BDL		5
218	V	Cis-1,3-Dichloropropene				BDL		5	BDL		5	BDL		5	BDL		5
219	V	Ethylbenzene				BDL		5	BDL		5	BDL		5	BDL		5
220	V	Bromomethane				BDL		10	BDL		10	BDL		10	BDL		10
221	V	Chloromethane				BDL		10	BDL		10	BDL		10	BDL		10
222	V	Methylene chloride				BDL		5	BDL		5	BDL		5	BDL		5
223	V	1,1,2,2-Tetrachloroethane				BDL		5	BDL		5	BDL		5	BDL		5
224	V	Tetrachloroethene				BDL		5	BDL		5	BDL		5	BDL		5
225	V	Toluene				BDL		5	BDL		5	BDL		5	BDL		5
227	V	1,1,1-Trichloroethane				BDL		5	BDL		5	BDL		5	BDL		5
228	V	1,1,2-Trichloroethane				BDL		5	BDL		5	BDL		5	BDL		5
229	V	Trichloroethene				BDL		5	BDL		5	BDL		5	BDL		5
231	V	Vinyl chloride				BDL		10	BDL		10	BDL		10	BDL		10
250	V	Trans-1,3-Dichloropropene				BDL		5	BDL		5	BDL		6	BDL		5
251	V	Styrene				BDL		6	BDL		6	BDL		5	BDL		5
252	V	Acetone				30			BDL		10	BDL		10	BDL		10
253	V	2-Butanone				BDL		10	BDL		10	BDL		10	BDL		10
254	V	Carbon disulfide				BDL		5	BDL		5	BDL		5	BDL		5
255	V	2-Hexanone				BDL		10	BDL		10	BDL		10	BDL		10
256	V	4-Methyl-2-pentanone				BDL		10	BDL		10	BDL		10	BDL		10
257	V	Vinyl acetate				BDL		10	BDL		10	BDL		10	BDL		10
258	V	Xylenes (Total)				BDL		5	BDL		5	BDL		5	BDL		5
259	V	1,2-Dichloroethene(Total)				BDL		5	BDL		5	BDL		5	BDL		5

*QA Samples

CLP TCL/TAL

CMPD	CL	COMPOUND								
		SITE	COLLIERVILLE		COLLIERVILLE		COLLIERVILLE		COLLIERVILLE	
		SAMPLE ID	08209104		08239133		08239133		08239133D	
		LAB SAMPLE ID	4942.9		5023.0		5023.0 D		5027.3	
		SAMPLING DATE	08/20/91		08/23/91		08/23/91		08/23/91	
		MATRIX	WATER		WATER		WATER		WATER	
			ug/l		ug/kg		ug/kg		ug/kg	
101	M	Antimony	1 B		BDL	358	968		BDL	14.3
102	M	Arsenic	BDL	1	BDL	1	BDL	1.2	1.8 B	
103	M	Beryllium	BDL	1.1	24.5		24.5		4.4 B	
104	M	Cadmium	BDL	3	120 B		224		6.1	
105	M	Chromium	BDL	9.5	383		383		94.8	
106	M	Copper	5 B		442 B		955		101	
107	M	Lead	2.9 B		87		7.1		18.3	
108	M	Mercury	BDL	0.2	5.4		BDL	0.2	0.72	
109	M	Nickel	BDL	8.8	134		134		29.8 B	
110	M	Selenium	BDL	0.5	1.3 B		0.8 B		1.2 B	
111	M	Silver	BDL	8.1	BDL	65	608		BDL	2.8
112	M	Thallium	BDL	0.7	1.2 B		BDL	0.6	BDL	0.6
113	M	Zinc	22500		1190		511		497	
114	M	Barium	39 B		1140		1140		303	
115	M	Iron	399		1740000		BDL	5.3	304000	
116	M	Manganese	64		21700		19800		3700	
117	M	Vanadium	BDL	4.2	706 B		89.9		156	
118	M	Aluminum	BDL	196	151000		151000		59600	
120	M	Cobalt	BDL	6.4	753		753		146	
121	M	Magnesium	1690 B		15100 B		12900		7970	
129	M	Calcium	10800		35000 B		219000		17100	
130	M	Sodium	24200		24500		24500		26500	
131	M	Potassium	1980 B		6060		6060		3890 B	
203	V	Benzene	BDL	5	BDL	5			BDL	5
205	V	Bromoform	BDL	5	BDL	5			BDL	5
206	V	Carbon tetrachloride	BDL	5	BDL	5			BDL	5
207	V	Chlorobenzene	BDL	5	BDL	5			BDL	6
208	V	Dibromochloromethane	BDL	5	BDL	5			BDL	5
209	V	Chloroethane	BDL	10	BDL	10			BDL	10
211	V	Chloroform	BDL	5	BDL	5			BDL	5
212	V	Bromodichloromethane	BDL	5	BDL	5			BDL	5
214	V	1,1-Dichloroethane	BDL	5	BDL	5			BDL	5
215	V	1,2-Dichloroethane	BDL	5	BDL	5			BDL	5
216	V	1,1-Dichloroethene	BDL	6	BDL	5			BDL	5
217	V	1,2-Dichloropropane	BDL	5	BDL	5			BDL	5
218	V	Cis-1,3-Dichloropropene	BDL	5	BDL	5			BDL	5
219	V	Ethylbenzene	BDL	5	BDL	5			BDL	5
220	V	Bromomethane	BDL	10	BDL	10			BDL	10
221	V	Chloromethane	BDL	10	BDL	10			BDL	10
222	V	Methylene chloride	BDL	5	BDL	5			BDL	5
223	V	1,1,2,2-Tetrachloroethane	BDL	5	BDL	5			BDL	6
224	V	Tetrachloroethene	BDL	5	BDL	5			BDL	5
225	V	Toluene	BDL	5	BDL	5			BDL	5
227	V	1,1,1-Trichloroethane	BDL	5	BDL	5			BDL	6
228	V	1,1,2-Trichloroethane	BDL	6	BDL	5			BDL	5
229	V	Trichloroethene	BDL	5	BDL	5			BDL	5
231	V	Vinyl chloride	BDL	10	BDL	10			BDL	10
250	V	Trans-1,3-Dichloropropene	BDL	5	BDL	5			BDL	5
251	V	Styrene	BDL	5	BDL	5			BDL	5
252	V	Acetone	17		BDL	10			BDL	10
253	V	2-Butanone	BDL	10	BDL	10			BDL	10
254	V	Carbon disulfide	BDL	5	BDL	5			BDL	5
255	V	2-Hexanone	BDL	10	BDL	10			BDL	10
256	V	4-Methyl-2-pentanone	BDL	10	BDL	10			BDL	10
257	V	Vinyl acetate	BDL	10	BDL	10			BDL	10
289	V	Xylenes (Total)	BDL	5	BDL	5			BDL	5
299	V	1,2-Dichloroethene(Total)	BDL	5	BDL	5			BDL	5

ETC
ENVIRONMENTAL TESTING & CONSULTING INC.
751 E. BROOKHAVEN CIRCLE • MEMPHIS, TENNESSEE 38117 • PHONE (901) 767-0840

Stat 7/14/80

June 27, 1980

EXHIBIT
Def 13
7.26.07

Mr. William T. Brown, Facility Manager
Carrier Air Conditioning Company
97 S. Byhalia Road
Collierville, Tennessee 38017

REF: INDUSTRIAL WASTEWATER
HOLDING LAGOON

Dear Mr. Brown:

Per my visit to your plant and discussion with Mr. Beaupre, ETC, Inc. has sampled the above referenced water and sludge (see attached data sheet).

Examination of the data indicated the water has suspended solids, oil & grease & trichloroethylene that we feel are out of specifications and require treatment. The water can be processed and discharged to the stream allowing the remaining sludge to dry out during July. The sludge (see attached data sheet) would be classified as hazardous because of the high concentration of lead, chromium, copper and cadmium. The sludge must be transferred in 55 gallon drums to a hazardous waste approved landfill.

CONTRADICTION

ETC, Inc. makes the following recommendations:

1. The standing water must be processed to remove the suspended solids, oil & grease and trichloroethylene. This can be done at the site with a portable processing system.

2. The sludge would be allowed to dry for approximately five to six weeks and then be removed by a backhoe and stored in drums for disposal at an approved landfill. ETC, Inc. can make application to the State for approval of the sludge disposal.

3. Once the sludge has been removed the lagoon should be filled with dirt. This can be done by hauling in fill or moving the earth around the lagoon with a bulldozer.

Proposal - ETC, Inc. can provide the following:

1. A processing system to remove suspended solids, oil &

grease and trichloroethylene @ a cost of $0.06/gallon. We have estimated 75,000 gallons; however, it is impossible to figure the exact gallonage until we actually filter it (flow meter).

Alternate: Cost plus expenses

ETC, Inc. would provide one man @ 150.00/per day to operate the processing system. Carrier would pay for the equipment rental and chemicals estimated to be $2,400.00.

We estimate 15 days to process the 75,000 gallons.

Carrier would also assume the cost of any solid material that required landfilling.

In either case the pH of the wastewater would be continuously recorded yielding a permanent record of the discharge. Also, a continuous sampler would acquire a composite sample that would be analyzed for a permanent record of the chemical parameters discharged.

Cost Summary (cost plus expenses)

1. One man per day (8 hours) @ 150.00/per day plus $.18 per mile from Memphis to operate process system.

   Cost of equipment rental at invoice cost plus 10% of rental. Estimated at $2,400.00.

   Estimate processing 5,000 gallons per day therefore requiring approximately 15 days, or $2,250.00 labor. Estimated cost $4,650 (labor and expenses).

2. Cost estimate ($.06/gallon. Estimated 75,000 gallons processed at $.06 per gallon - $4,500 (actual flow measured in field).

   Gallons in excess of 100,000 gallons to be processed at $.05/gallon.

The cost of the sludge removal from the lagoon cannot be determined until the water has been removed. The cost for a front-end loader and operator is approximately $25.00/per hour. If you bring in fill the cost is approximately $5.00/per yard. (We recommend using a bulldozer and moving your own earth. Mr. Beaupre and I agreed that a detail quote on this part would come after the water had been eliminated.

We look forward to working with you on this project. If you have any questions or would like to discuss this proposal in more detail, please feel free to call me.

Very truly yours,

Nathan A. Pera
President

NAP/mg

cc: Roger Beaupre

Attachments

TABLE I

ANALYTICAL DATA

Industrial Holding Lagoon

Unfiltered Parameters	(mg/l)	Filtered (mg/l)	Sludge
pH	8.4	8.4	52 % Moisture
TSS*	30	<10	-
Oil & Grease	40	12	-
Total Solids	1828	1752	-
Aluminum	0.51	0.42	-
Cadmium	<0.01	<0.01	12 mg/l
Chromium	0.06	0.06	230 mg/l
Copper	0.06	0.06	350 mg/l
Iron	0.74	0.36	-
Lead	<0.01	<0.01	2588 mg/l
Nickel	0.21	0.21	-
Tin	<0.01	<0.01	-
Zinc	0.27	<0.23	-
Trichloroethylene	0.102	0.002	-

* Total Suspended Solids

Carrier Corporation 1981

Interoffice Letter

JANUARY 7, ~~1980~~

To MR. CLIFFORD RITTER

CC: MR. HARRY KLODOWSKI
MR. DONALD RICH
MR. MICHAEL RIDGE

From HENRY B. BALDUZZI

Office RDC

Subject E & IH, COLLIERVILLE LAGOON SLUDGE SAMPLES. (2216, 9-3005-07).

Six (6) samples of sludge from the Collierville lagoon were analyzed as per Mr. Ridge's 9/23/80 outline request (attached). The samples (dated 9/19/80) are identified as follows.

SAMPLE NUMBER	SAMPLE IDENTIFICATION
N-top	North side - top
N-1F	North side - one foot down
N-2F	North side - two foot down
S-top	South side - top
S-1F	South side - one foot down
S-2F	South side - two foot down

Results of our testing are listed on the Analytical Report Sheets attached. Analyses for EP toxicity and ignitability were completed in accordance with the Federal Register, Part 261 and reported earlier.

Samples appear to contain a mixture of different PCB's (Arochlors) which are difficult to isolate. Results were calculated as totals and are reported as a concentration range.

Henry B. Balduzzi

HBB/les
Attachments

ANALYTICAL REPORT SHEET

SIS No. 2216 DATE 12/22/80

UBJECT: SLUDGE SAMPLES FROM CUL LAGOON

NALYST: Balduzzi / N. Clark

PARAMETER	N-top	N-1F	N-2F	S-Top	S-1F	S-2F
EP toxicity (mg/l)						
1. Barium	.28	.18	.18	.37	.19	.16
2. Chromium	.010	.011	<.003	.020	.004	.016
3. Cadmium	.014	.036	.006	.028	.029	.009
4. Lead	.08	.09	.08	.09	.06	.05
5. Silver	.010	.005	.005	.010	.005	.005
6. Mercury	<.001	<.001	<.001	<.001	<.001	<.001
7. Arsenic	.007	.009	.007	.004	.004	.005
8. Selenium	.010	.007	.007	.009	.019	.009
Ignitability flash point (°F)	>150	>150	>150	>150	>150	>150
Organics (ppm)						
1. Methyl ethyl Ketone	<1	<1	2.46	7.8	1.4	<1
2. Toluene	1.77	<1	<1	<1	<1	<1
3. Xylenes	2.72	5.2	6.4	11.9	<1	<1
4. Trichloroethylene	160	106	12.3	369	93.7	1.0
5. Acetone	<1	<1	<1	8.8	<1	<1
6. Methanol	<1	<1	<1	<1	<1	12.1
7. n-Butanol	5.16	<1	<1	22.6	14.4	<1
Cyanides (ppm)	2.44	.40	.60	.48	.84	.40
PCB (ppm)	17-20	10-12	4-5	5-9	2-5	.4-1.0

[redacted]

9/23/80

SLUDGE SAMPLES FROM COLLIERVILLE

(1) ANALYZE FOR

a) EP TOXICITY - LEACH TEST - METALS ONLY

b) ORGANICS

1) XYLENE
2) TRICHLOROETHYLENE
3) ACETONE
4) N-BUTYL ALCOHOL
5) METHANOL
6) TOLUENE
7) MEK

c) CYANIDES

d) PCB'S

e) Ignitability

2) ANALYZE: NORTH TOP FIRST, REPLICATE
SOUTH TOP NEXT, REPLICATE
REST OF SAMPLES MAY OR MAY NOT NEED TO BE RUN

3) SAVE ALL MATERIALS UNTIL AFTER DISCUSSION WITH CLIFF RITTER, CVL EXT 324

DISCUSSED WITH H. BALDUZZI, RDC EXT 6279, & CLIFF RITTER, CVL, 9/22/80

M C Ridge

Corporation

Interoffice Letter

THIS COPY FOR

To: OCTOBER 9, 1980

MR. JOHN BREWER - CV
MR. MICHAEL RIDGE - TOWER 13
MR. DONALD RICH - RDC

From: HENRY B. BALDUZZI/HARRY F. KLODOWSKI

Office: RDC - SYRACUSE

Subject: E & IH - EP TOXICITY - LAGOON SLUDGE (2198, 9-3005-07)

The sample of dried lagoon sludge, numbered 0089, was analyzed for heavy metals in accordance with EP toxicity requirements. Testing for herbicides and pesticides was considered unnecessary due to the nature and origin of the sludge. The results of our findings are listed as follows:

Contaminant	Concentration found (mg/L)	Maximum Concentration (mg/L)
Arsenic	.001	5.0
Barium	.94	100.0
Cadmium	.014	1.0
Chromium	.005	5.0
Lead	.21	5.0
Mercury	<.0001	0.2
Selenium	<.001	1.0
Silver	.013	5.0

HBB/HFK/pav

Rec. 7.18.86

Interoffice Letter

DECEMBER 15, 1980

MR. JOHN BREWER
MR. DONALD RICH
MR. MICHAEL RIDGE

HENRY B. BALDUZZI/HARRY F. KLODOWSKI

RDC

E & IH - LAGOON SLUDGE (2198, 9-3005-07)

In addition to EP Toxicity testing (subject of our letter of 10/9/80) the sample of dried lagoon sludge, numbered 0089, was analyzed for organic compounds. Results of our findings are listed as follows:

Contaminant	Concentration (ppm)
Methyl ethyl ketone	< 1
Toluene	< 1
Xylenes	21.4
Trichloroethylene	1626
Acetone	< 1
Methanol	112
N-butanol	22
PCB	10-20

The sample appears to contain a mixture of different PCB (Aroclors), which are difficult to isolate. The results are reported as a range of concentrations.

HBB/HFK/mjg

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
MEMPHIS ENVIRONMENTAL FIELD OFFICE
SUITE E-645, PERIMETER PARK
2510 MT. MORIAH ROAD
MEMPHIS, TENNESSEE 38115-1520
PHONE (901) 368-7939 STATEWIDE 1-888-891-8332 FAX (901) 368-7979

August 29, 2008

Mr. Femi Akindele
Remedial Project Manager
USEPA Region 4
61 Forsyth Street, SW 11th Floor
Atlanta, Georgia 30303-8960

Subject: **Final Proposed Plan/ Feasibility Study of Remedial Alternatives Final (July 2008)**
Smalley-Piper Site
EPA ID # TNN000407378, TDSF ID # 79-676

Dear Mr. Akindele,

TDEC/DoR has reviewed both the Final Feasibility Study Report and The Final Proposed Plan as received on 7/23/08 and provides the following comments. While these comments are referenced to the Feasibility Study of Remedial Alternatives, they also apply to the referenced Final Proposed Plan, which summarized the remedial alternatives.

General Comment:

1. Within the generic outline of Alternative 5, in which TDEC/DoR agrees, consideration should be give to the substitution of SW- OPZ for NW- OPZ as the contingency well for extraction, depending on the influence (or lack of influence) of the on-site extraction wells and the overall component direction of the contaminated groundwater plume leaving the site. If on-site extraction wells influence the plume to flow in a more westerly direction, then SW-OPZ or WP #2 may be adequate for capturing the whole or at least the southern portion of the plume. If on-site extraction wells do not influence plume flow with a more westerly component, then the NW-OPZ will probably be a necessary extraction point regardless of what is used to the southwest (SW-OPZ or WP#2). The potential for the established infrastructure of Water Plant #2 to provide efficiencies of time and money should be considered, if shown to accomplish the same goal as SW-OPZ extraction wells (capture/control of SW portion of the

Chromium plume). Operation of NW-OPZ and Water Plant #2 wells should allow for appropriate monitoring and modeling after sufficient monitoring well installations to better optimize the system and evaluate whether extraction well SW-OPZ is needed.

2. TDEC looks forward to working with EPA in developing the remedial design to implement this remedy.

Specific Comments:

1. **Section 3.2.2.3, Deep Subsurface Soil Remedy, Page 3-4:** The last sentence of this section states that the infiltration gallery reinjection will continue until groundwater samples show non-detect concentrations for chromium and other metals, while earlier in Section 2.2.1 (Preliminary RAO's) it states that groundwater will be cleaned to either the MCL (total Cr = 100ppb) or the established RGO (Hexavalent Cr = 47ppb) at other reinjection points. Please clarify this discrepancy or state rationale for non-detect treatment. TDEC-DOR Rule 1200-1-13-.12 (5) (page 28) stipulates conditions in which pump and treat remedies may be discontinued at a site after hazardous substances in the ground water have reached asymptotic levels for contaminant removal. TDEC-DoR feels these guidelines should be considered and implemented for all long-term groundwater treatment associated with the site. (Reference link: **http://tennessee.gov/sos/rules/1200/1200-01/1200-01-13.pdf)**

2. **Section 5, Page 5-1, 1(a):** TDEC/DoR suggests using the following language: 'Locate and install ***up to*** nine new monitoring wells throughout the off-site plume area...'

3. **Section 5, Page 5-1, 2(a):** TDEC/DoR suggests using the following language: 'Excavate source area soils to ***the extent practicable as deep as*** 25 feet below ground surface.'

4. **Section 5, Page 5-1, 3:** TDEC/DoR suggests allowing an option for POTW discharge of low volumes of sufficiently treated effluent. This might be if the injection points become fouled or temporarily overloaded/saturated from maximum injection loading or local precipitation events.

5. **Section 5, Page 5-3, 4(a-d):** TDEC/DoR suggests the consideration of utilizing Water Plant #2 wells for initial extraction and resin treatment instead of the proposed SW-OPZ extraction point. Consistent with the general comment above, this should allow for quicker cleanup of groundwater and sequential modeling efforts, as monitoring wells are installed in the plume area north of the water plant.

6. **Section 5, Page 5-2, 4:** It is unclear whether shallow groundwater will require treatment. If so, injection galleries with allowances for additional discharge consistent with comment 3, above could be utilized.

7. **Section 5, Page 5-2, 4(b):** There may be significant cost saving in plumbing SW-OPZ to Water Plant #2 instead of establishing a separate treatment plant at SW-OPZ.

8. **Section 5, Page 5-2, 5:** TDEC DoR suggests substituting the SW-OPZ as the **contingency** component and making the NW-OPZ a **required** component should better serve a more efficient and less costly response to groundwater contamination in the deeper aquifer.

9. **Section 5, Page 5-3, 7:** TDEC/DoR suggests that the contingency option (NW-OPZ) should be the primary option and SW- OPZ retained as a contingency. (see General Comments and Comment 7 above).

If there are any questions concerning my comments, please feel free to contact me at (901) 368-7910 or e-mail at jamie.woods@state.tn.us .

Sincerely,

Jamie A. Woods
Geologist-Project Manager
Division of Remediation
Memphis Environmental Field Office

c: File NCO 79676
c: File MFO 79676