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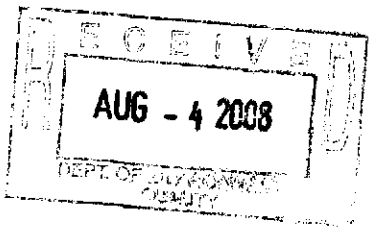

Remedial Action Report

Former Gulf States Creosoting Site
Hattiesburg, Mississippi

July 31, 2008

Project No. 21-04

MICHAEL PISANI & ASSOCIATES, INC.
Environmental Management and Engineering Services
1100 Poydras Street
1430 Energy Centre
New Orleans, Louisiana 70163
(504) 582-2468

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Executive Summary

The Gulf States Creosoting site is the site of a former wood treating plant in Hattiesburg, Mississippi. A Remedial Investigation (RI) was conducted at the site from 1996 through late 2001. Results of the RI demonstrated that site media (soil, ground water and sediment) had been impacted by former wood treating operations. From May 2003 through July 2007, Tronox LLC and its predecessor, Kerr-McGee Chemical LLC, conducted remediation of the site under an Agreed Order with the Mississippi Commission on Environmental Quality (MCEQ) and in accordance with a *Final Remedial Action Work Plan* (Michael Pisani & Associates, August 21, 2002) approved by the Mississippi Department of Environmental Quality (MDEQ). Site remediation addressed affected media in the following areas:

- the Gordon's Creek Fill Area;
- the former Process Area; and
- the Courtesy Ford Ditch and Norfolk Southern Railroad (NSRR) Track Area.

Remedial action activities at the Gordon's Creek Fill Area were completed from April through September 2003. Remediation of the Fill Area included the following tasks:

1. Installed approximately 21,000 square feet of sealable-joint sheet piling (Waterloo Barrier) to cut off intermittent seeps of dense non-aqueous phase liquid (DNAPL) to Gordon's Creek.
2. Installed approximately 200 feet of 48-inch re-enforced concrete culvert in the former ditch bisecting the Fill Area to allow drainage of surface runoff to Gordon's Creek.
3. Delineated the extent of visible DNAPL in the Gordon's Creek streambed. Removed and disposed of approximately 600 tons of sediment plus free DNAPL from the streambed.
4. Installed a recovery system consisting of 17 recovery wells and 12 monitoring wells behind the Waterloo Barrier to allow for the collection and disposal of DNAPL.
5. Installed over 10,000 square yards of geosynthetic clay liner atop affected Fill Area materials to inhibit the infiltration of precipitation through affected soils and reduce the potential for ground water mounding.
6. Planted nearly 800 phreatophytic trees in the Fill Area to reduce the potential for ground water mounding, promote the capture of affected ground water, and accelerate further degradation of site constituents in the root zone.

Remedial action activities at the former Process Area were completed from September through December 2003. Remediation of the former Process Area included the following tasks:

1. Delineated the extent of free product and creosote-saturated materials (i.e., source materials) in the subsurface beneath the former Process Area (now Courtesy Ford).
2. Removed free product and creosote-saturated materials contained within a concrete sump. Transported over 1,200 tons of stabilized materials to a Subtitle C Landfill for disposal. Transported recovered liquids to Kerr-McGee's Texarkana, Texas facility for recyling and treatment/disposal.
3. Removed free product and creosote-saturated materials (i.e., soils and treated timbers) from a wooden substructure. Transported over 1,000 tons of soil and debris to a Subtitle C Landfill for disposal.
4. Backfilled concrete sump with flowable fill and wooden substructure excavation with clean, compacted, sandy clay backfill.
5. Excavated base failures and unstable materials within the area to be capped and repaved, a portion of the Courtesy Ford parking lot. Transported approximately 3,500 tons of soil to a subtitle D Landfill for disposal and backfilled excavated areas with clean, compacted, sandy clay backfill.
6. Performed soil cement mixing to stabilize surface soils, then capped the residual affected soils with approximately 10,900 square yards of water-impervious geotextile liner and asphalt. The geotextile and asphalt cap prohibits direct contact with residual contamination and eliminates or greatly reduces the potential for percolation of water through affected soils.

Remedial action activities in the area situated between the former Process Area and the NSRR tracks were completed from August 2003 through July 2007. Remediation of the Courtesy Ford Ditch and NSRR Track Area included the following tasks:

1. Relocated a Wilmut Gas line to accommodate the construction of a concrete-lined ditch adjacent to the Courtesy Ford parking lot.
2. Removed affected sediment and soils within and beneath drainage ditches. Transported approximately 3,400 tons of affected materials to a Subtitle D Landfill and 80 tons of affected material to a Subtitle C landfill for disposal.
3. Constructed approximately 600 linear feet of concrete-lined ditch, which was poured atop water-impervious liner.
4. Removed all surface soil (i.e., soils from 0 to 6 feet below land surface) between Courtesy Ford and the NSRR tracks that exceeding the MDEQ-mandated cleanup level of 43 mg/kg benzo(a)pyrene. Transported approximately 4,100 tons of soil to a Subtitle D Landfill for disposal.
5. Removed all affected soil and treated timbers in a wooden trough that extended approximately 1,500 feet southwest of the dead end of Timothy Lane, parallel with the NSRR tracks. Transported approximately 1,200 tons of soil and timbers to a Subtitle D Landfill for disposal.

Concurrent with the remedial action, a removal action was conducted to address affected media within and beneath a ditch (known as the Northeast Drainage Ditch) that flowed eastward from the former wood treating plant. Northeast Drainage Ditch Removal Action activities are documented in a separate report submitted to MDEQ on November 15, 2007 (*Removal Action Report, Northeast Drainage Ditch*, Michael Pisani & Associates).

The remedial action has resulted in the removal or containment/control of all creosote-affected materials at the site. Institutional controls (e.g., deed restrictions and a City ordinance restricting ground water use) ensure that potential exposure to residuals left in place has been eliminated or greatly reduced. Ongoing ground water monitoring has demonstrated that with source materials removed, constituent concentrations in ground water continue to decrease with time. Tronox has received verbal concurrence from MDEQ that no further remedial action is necessary at the former Gulf States Creosoting site.

1.0 Introduction

1.1 Site Description and History

The former Gulf States Creosoting site is located in Hattiesburg, Mississippi near the intersection of Scooba Street and West Pine Street (Figure 1-1). The site is situated entirely within Section 16 of Township 4 North, Range 13 West in Forrest County, Mississippi, and is roughly bounded by the NSRR tracks to the southeast, Scooba Street to the northeast, Corinne Street and Gordon's Creek to the northwest, and U.S. Highway 49 to the southwest (Figure 1-2).

The wood treating facility operated between the early 1900s and approximately 1960. Operations at the facility were of a relatively small scale, consisting of the use of creosote only in a single pressure treating cylinder. The site was redeveloped for commercial and light industrial use beginning in approximately 1962. Current businesses consist primarily of new and used automobile dealerships and automobile parts and supplies shops; there are no residential or institutional uses of the site. Figure 1-3 shows the site during operational times; Figure 1-4 shows the fully developed site prior to the remedial action.

Results of the Remedial Investigation (RI) indicated that media affected by constituents of concern were present in four areas:

- the Gordon's Creek Fill Area, an area where creosote-affected materials were apparently used to fill a former creek bed and other low-lying areas;
- the former Process Area, including potential source materials contained in two subsurface features referred to as the concrete sump and the wooden substructure;
- the area situated between the former Process Area and the NSRR tracks; and
- the Northeast Drainage Ditch.

1.2 Project Background

In January 1997, Tronox and the MCEQ entered into an agreement for the investigation of the former Gulf States Creosoting site in Hattiesburg, Mississippi pursuant to MDEQ's Voluntary Evaluation Program (VEP). The agreement called for characterization of the site under the direction and review of the MDEQ Office of Pollution Control, Uncontrolled Sites Section. MDEQ guidance for the VEP states that investigations will include all activities necessary to characterize the environmental setting and to define the nature and extent of affected site media. The MDEQ guidance refers to this investigative process as a Remedial Investigation.

The following reports presenting the results of RI activities were submitted to MDEQ:

- *Remedial Investigation Report* (June 30, 1997);
- *Interim Report - Phase II Remedial Investigation* (August 14, 1998);
- *Phase II Remedial Investigation Report* (December 30, 1998);
- *Report on Additional Site Investigation Activities* (November 22, 2000);
- *Report on Site Investigation Activities, February and March 2001* (June 12, 2001);

- Several letter reports presenting the results of additional subsurface soil sampling; and
- *Human Health Risk Assessment* (original submittal and several revisions approved by MDEQ on April 20, 2001).

In February 2000, Tronox submitted to MDEQ a *Remedial Action Work Plan* for the site. The work plan outlined proposed cleanup activities to address affected media in the following areas:

- the Gordon's Creek Fill Area;
- the former Process Area;
- the area situated between the former Process Area and the NSRR tracks; and
- the Northeast Drainage Ditch.

In a June 28, 2001 meeting, MDEQ and Tronox agreed that in order to expedite cleanup of affected sediment and soil in the Northeast Drainage Ditch, proposed activities to address the ditch would be presented in a stand-alone document. A *Removal Action Work Plan* for the northeast drainage ditch was submitted to MDEQ on August 3, 2001. Proposed response activities for affected media in the other above-listed areas, including additional work necessary to address MDEQ comments on the February 2000 plan, were presented in a *Remedial Action Work Plan* dated September 19, 2001.

Subsequent to the submittal of that plan, Tronox and MDEQ had numerous discussions and meetings regarding a mutually-acceptable remedy. On May 8, 2002, MDEQ provided written comments on the September 19, 2001 plan. In response to those comments, a revised *Remedial Action Work Plan* was submitted to MDEQ on July 12, 2002. MDEQ provided additional comments in a letter dated July 23, 2002. The *Final Remedial Action Work Plan* (MP&A, August 21, 2002), which incorporated Tronox responses to MDEQ's additional comments, was put out for public comment and subsequently approved by MDEQ for implementation.

1.3 General Remediation Strategy

The general plan for remedial action at the site consisted of three primary components:

1. The targeted removal and offsite disposal of free product and creosote-saturated materials in the Fill Area, the former Process Area, and the NSRR track area;
2. The implementation of engineering controls to reduce the potential for exposure to residual contaminants in site media; and
3. The use of institutional controls to ensure that: a) future uses of the affected areas of the site are consistent with their current use (i.e., commercial and/or industrial); and b) current and future property owners and/or lessees of the affected areas are advised of the presence of affected media and restrictions on land use.

1.4 Report Organization

Remedial activities undertaken in the Fill Area, former Process Area and Courtesy Ford Ditch/NSRR Track Area are summarized in Sections 2.0, 3.0 and 4.0, respectively. Section 5.0 contains information on the ongoing monitored natural attenuation (MNA) remedy for site ground water. Health and safety procedures implemented during the remedial action are summarized in Section 6.0. A brief summary of the remedial action is provided in Section 7.0.

Appendices to this report are as follows:

A - Waits Engineering Consultants As-Built Drawings
B - Selected Photographs of Remedial Construction Activities
C - C3 Waterloo Barrier Installation Report
D - Transportation & Disposal Records
E - Air Monitoring Reports

2.0 Fill Area Remediation

The remedial action objectives for the Fill Area were to: 1) eliminate the intermittent seepage of DNAPLs from the Fill Area into Gordon's Creek; 2) delineate the extent of visible DNAPLs within the Gordon's Creek streambed and remediate visible DNAPLs, if necessary; 3) collect and remove DNAPLs perched on shallow, discontinuous clay layers within the Fill Area, to the extent practicable; 4) minimize the percolation of water through affected soils; and 5) promote the capture of affected ground water and accelerate further degradation of site constituents in shallow soils.

Seepage of DNAPLs into Gordon's Creek was addressed ~~through~~ by the installation of a vertical barrier constructed of sealable-joint steel sheet pilings (a/k/a a Waterloo Barrier system). The extent of DNAPLs within the Gordon's Creek streambed was assessed by collecting sediment cores adjacent to the Fill Area. DNAPLs were removed from the streambed by damming off the creek, excavating sediment containing DNAPL, and removing free DNAPL from the excavated areas. DNAPLs that accumulate as perched liquids within the Fill Area are now routinely gauged and recovered from wells behind the sheet piling barrier. The potential for infiltration of precipitation through affected soils was greatly reduced by placement of a low-permeability cap atop affected Fill Area materials. A phytoremediation program was implemented to reduce the potential for ground water mounding, promote the capture of affected ground water, and accelerate further degradation of site constituents in shallow soils.

2.1 Sheet Piling Installation

During the RI, the extent of affected soil in the Fill Area was delineated using the Rapid Optical Screening Tool (ROST) system and confirmatory soil samples. In July 2001, a soil boring program was undertaken in the Fill Area to obtain additional information necessary to fully develop the Fill Area remedy. The purpose of this program was to evaluate the thickness and lateral continuity of clay layers above the top of the Hattiesburg clay (i.e., within the first 20 to 30 feet below grade) and to delineate the extent of perched DNAPLs.

The 17 borings advanced during July 2001 were all advanced several feet into the Hattiesburg clay. No laterally continuous clay layers were identified above the top of the Hattiesburg clay, which was encountered at depths ranging from 20 to 27 feet below grade, or elevations of 158 to 165 feet above mean sea level (amsl).

Soil boring logs and ROST logs were reviewed to determine the vertical and horizontal extent of DNAPL within the Fill Area. The logs indicated that DNAPL was distributed as discontinuous pools of liquids perched upon lenses of less permeable materials (i.e., clayey and silty materials) above the Hattiesburg clay. DNAPLs were not encountered in any boring at depths exceeding 21 feet below land surface, with the majority of DNAPL encountered at depths ranging from 5 to 15 feet below grade.

Tronox and MDEQ agreed that the installation of a sealable-joint sheet piling wall would be the best methodology to ensure that DNAPL and affected ground water could no longer migrate from the Fill Area. Sealable-joint sheet pilings are similar to conventional pilings, but have interlocking joints between individual pilings that incorporate a cavity. The vertical barrier is installed using standard pile driving equipment and techniques. After driving, the cavity between each set of adjacent pilings is filled with sealant to prevent leakage through the joints.

Because no laterally continuous clay layers of significant thickness were identified above the top of the Hattiesburg clay, the sheet piling wall was designed to key into the Hattiesburg clay. Sealable-joint sheet pilings were driven near the top of the bank of Gordon's Creek, with "wing walls" for the containment area extending approximately 150 feet eastward toward West Pine Street (see the Waits Engineering "as-builts" for the Fill Area project in Appendix A). The base of pilings was driven to an average elevation of 156 feet amsl, or 2 to 9 feet into the Hattiesburg clay. Selected photographs of the Waterloo Barrier installation and other remedial activities are provided in Appendix B.

C3 Environmental Limited of Breslau, Ontario was contracted by Tronox to provide quality assurance assurance/quality control (QA/QC) services during the installation of the Waterloo Barrier system, and also to install helical tiebacks and perform joint sealing for the barrier wall. The report issued by C3, which is provided as Appendix C, provided the following summary of work performed:

- the area of installed Waterloo Barrier sheet piling was approximately 21,073 square feet;
- a tieback system consisting of a steel I-beam waler and 22 helical piers was installed along the creek to provide the cut-off wall with additional lateral support;
- a silica fume modified, cementitious grout was used to seal the joints of the cut-off wall; approximately 9,501 linear feet of sealable cavity were grouted;
- based on the results of C3 Environmental's QA/QC inspection, the barrier installation conformed to the procedures and specifications necessary to provide a low-permeability ground water barrier. C3's Statement of Certification is provided with its report.

2.2 Culvert Installation

Prior to remediation, the Fill Area was bisected by a drainage ditch that conveyed surface runoff from the NSRR ditch and West Pine Street to Gordon's Creek. In order to allow for continued surface drainage, the drainage ditch between West Pine Street and Gordon's Creek was replaced with 206 feet of 48-inch, re-enforced concrete culvert, routed along the original ditch and through the sheet piling barrier. The culvert was wrapped in a polyethylene liner and placed on a sand bed within the base of the former ditch. The culvert pipe was covered with clean backfill material, which was seeded with native grass seed. The culvert, culvert bedding, and backfill material were placed in accordance with applicable City of Hattiesburg specifications for storm water collection and conveyance systems.

2.3 Gordon's Creek DNAPL Assessment and Removal

On July 9, 2003, a sediment coring program was conducted to delineate the extent of DNAPLs within the creek bed. Cores of the sediment column were collected at cross-creek transects located 50 feet upstream of the sheet piling barrier, at 50-foot intervals along the sheet piling barrier, and 100 feet and 250 feet downstream of the sheet piling barrier. Logging of visibly-affected materials indicated that DNAPLs were present in sporadic pockets; these pockets of DNAPL were only present at the contact between surficial sand and gravel deposits and underlying clays, generally at depths of 6 inches to 2 feet below the top of sediment. DNAPLs were present only in the segment of the creek immediately adjacent to the sheet piling barrier, extending from just downstream of the upstream end of the barrier to a distance 50 to 100 feet upstream of the downstream end of the barrier. On July 18, 2003, after discussing the results of the DNAPL assessment with MDEQ, Tronox submitted a letter detailing its proposed remedial action activities for Gordon's Creek.

In August 2003, Tronox conducted remediation of the Gordon's Creek streambed. Because the DNAPL was present in isolated pockets beneath visibly-unaffected sediment and resting on top of clayey materials, the only practical method of removal was to excavate the sand and gravel sediment and the upper surface of the underlying clay layer. However, because Gordon's Creek never goes completely dry, precautionary measures were taken so that potentially mobile materials were not released to the creek during the removal of DNAPL and sediment.

Before beginning excavation activities, a temporary dam was constructed across Gordon's Creek at the upstream end of the sheet piling barrier. The dam was constructed of sheet metal held in place with large, woven polypropylene bags (a/k/a supersacks) filled with sand. Two large-volume pumps and approximately 500 feet of discharge line were used to route water from above the dam to a point downstream of the area to be excavated. Three rows of floating sorbent booms were placed downstream of excavation activities to contain any potential releases during excavation activities.

Excavation was performed using a long-stick (i.e., extended reach) trackhoe positioned at the top of bank within the Fill Area. Visibly-unaffected sediment was segregated from visibly-affected sediment. Visibly-unaffected sediment was incorporated into the containment area, while visibly-affected sediment was stockpiled and allowed to drain into lined containment areas.

Excavation began at the sheet piling barrier and extended outward into the creek until no visibly-affected sediment was encountered. Excavation proceeded from upstream to downstream, and also included the widening of the Gordon's Creek channel and re-sloping of the bank opposite the sheet piling barrier for drainage improvement. Recoverable DNAPL and affected surface water were vacuumed out of the creek and pumped into a frac tank. After all affected sediment and DNAPL were removed, the excavated areas were backfilled to the approximate original creek bottom grade using clean sediment from the far bank of the creek.

After backfilling and re-grading of the excavated areas was completed, the dam was removed and the creek was allowed to assume its normal flow. The opposite bank of Gordon's Creek was seeded with Bermuda grass. Approximately 1,500 square feet of erosion-control mat (nylon mesh with interwoven hay) was installed atop the seeded area to prevent wash-outs during periods of heavy flow until the grass was established.

After the stockpiled sediment had drained into the lined containment areas, 565 tons of sediment were loaded into trucks and transported offsite for disposal as industrial solid waste at Waste Management's Emelle, Alabama facility, a Subtitle C landfill (Appendix D contains transportation and disposal records for materials shipped offsite during the remedial action). The water and DNAPL that drained from the sediment were pumped into the frac tank with the liquids recovered from the creekbed. These liquids were transported to Kerr-McGee's Texarkana, Texas facility for recyling of DNAPL and treatment/disposal of water.

2.4 Installation of Geosynthetic Clay Liner

Once the sheet piling barrier was installed, ground water was no longer able to discharge from the Fill Area into Gordon's Creek. Two steps were taken to minimize the potential for ground water mounding behind the barrier. First, a geosynthetic clay liner was placed atop affected Fill Area materials. This not only minimized the potential for ground water mounding, but also greatly reduced the potential for infiltration of precipitation through affected Fill Area materials. Secondly, trees with the ability to uptake large volumes of water (phreatophytes) were planted throughout the Fill Area. Details on the phytoremediation program are provided in Section 2.6 of this report.

A geosynthetic clay liner (GCL) was installed atop the stippled area shown on Sheet 4 of the as-built drawings for the Fill Area. The liner consisted of a layer of sodium bentonite between geotextile fabric and a laminate comprised of geotextile fabric and a polyethylene membrane which are continuously adhered together. The GCL panels were laid with approximately 12 inches of overlap at the joints between panels. The end of the liner extends beneath the upslope edge of the concrete driveway along the sheet piling barrier, such that overland drainage flows over the driveway and directly into Gordon's Creek

2.5 Fill Area DNAPL Recovery and Monitoring System

In late 2003, a recovery system was installed on the inside of the sheet piling barrier to collect and remove DNAPL that might accumulate behind the barrier. The recovery system consists of the following elements:

- 17 recovery wells installed at approximately 25-foot intervals behind the barrier to allow for the collection of DNAPL. Each recovery well was screened across the entire thickness of DNAPL encountered during the drilling of the borehole for the well.

- Drop tubes extending from the base of each recovery well/monitoring well containing free DNAPL to land surface. Drop tubes are equipped with appropriate hardware at the surface to allow for easy hook-up to a pump.
- Nine monitoring wells placed at approximately 50-foot intervals behind the sheet piling barrier to monitor for the presence of DNAPLs to the top of the Hattiesburg clay, plus three additional monitoring wells along the northern wing wall. Each monitoring well is screened at the contact between the saturated Fill Area sands and the Hattiesburg clay.

During the first six months after installation of the system, recovery wells and monitoring wells were gauged monthly for the presence of DNAPL. After it became apparent that only a very small volume of DNAPL (generally less than one gallon total DNAPL per event from all wells containing DNAPL) was being recovered during each event, MDEQ approved a Tronox request to decrease the frequency of gauging and monitoring events to quarterly.

To date, DNAPL has been measured in six of 17 recovery wells and two of nine monitoring wells inside the creek-side wall. Wells containing DNAPLs are pumped directly from drop tubes to buckets until all visible DNAPL is removed. Recovered DNAPLs are transported to Tronox's facility in Texarkana, Texas for recycling. Annual summaries of DNAPL recovery activities are submitted to MDEQ.

2.6 Phytoremediation

In early 2004, approximately 800 phreatophytic trees (a mixture of hybrid poplars and black willows) were planted at the Fill Area to promote phytoremediation. Phytoremediation is the direct use of plants to contain, immobilize, degrade, or remove contaminants from affected water and soils. At the Fill Area, the trees were intended to provide the additional benefit of reducing ground water mounding behind the Waterloo Barrier System.

The trees are currently in their fifth growing season and are extremely healthy in appearance. Because of the planting frequency, a dense stand of trees remains despite the loss of approximately 25 percent of the trees during the first several growing seasons. The trees are inspected for any signs of disease or pests during each gauging/recovery event.

3.0 Process Area Remediation

The remedial action objectives for the former Process Area were to: 1) remove free product and creosote-saturated materials from historical subsurface features; 2) preclude direct contact with and minimize the potential for infiltration of precipitation through affected soils left in place; and 3) demonstrate that natural attenuation of constituents in ground water is occurring.

Materials considered to be potential sources of ongoing contamination (i.e., free product or creosote-saturated materials within or adjacent to a concrete sump and a wooden substructure within the former Process Area) were removed and transported offsite for disposal at a Subtitle C landfill. Affected soils left in place were capped with a water-impervious liner covered with asphalt to preclude direct contact and minimize the potential for infiltration of precipitation. Ground water monitoring necessary to demonstrate natural attenuation of site constituents is currently performed on an annual basis.

3.1 Removal of Materials from Concrete Sump

During previous investigations, a concrete structure containing suspected source materials was encountered beneath the Courtesy Ford body shop parking lot. Three walls of the rectangular concrete sump (the southwest, southeast and northeast walls) were located during exploratory excavation activities conducted in 2001. Although the northwest wall was not found, excavation proceeded to a point in that direction where native soils were encountered in the subsurface. The sump was estimated to be approximately 55 feet (the northeast and southwest walls) by 21 feet (the southeast wall) by 12 feet deep, and contained gravelly fill material saturated with oily water. The use of the concrete structure during historical wood treating operations was unknown.

MDEQ was notified prior to excavation and removal of source materials within the former Process Area and was present during the majority of the work performed. At the concrete sump, the asphalt cover was initially removed to reveal the southwest, southeast and northeast walls. Excavation of the materials within the sump was performed using a trackhoe, with excavated materials loaded directly into trucks for transportation to Waste Management's Emelle, Alabama Subtitle C landfill. The gravelly material within the sump was saturated with oily water at a depth of one to two feet beneath the asphalt. A frac tank was brought to the site to allow for the removal and containment of liquids.

To the extent possible, liquids were pump from the concrete sump to the frac tank as solids were excavated and loaded. However, due to the saturated nature of the gravelly materials in the sump, bed ash was brought in and mixed with the waste to dry residual liquids and stabilize the material. Bed ash is coarser-grained fly ash, a pozzolanic material often used to dry out and stabilize saturated materials during remediation projects.

The northwest wall was eventually located at a point past a one- to two-foot dip in the northeast and southeast walls (i.e., the longer walls of the rectangular sump), apparently to accommodate a railroad track. The actual dimensions of the sump were 64 feet southeast to northwest, 21 feet southwest to northeast and 12 feet deep. Concrete saddles were present in the base of the sump, apparently to accommodate two long, cylindrical, horizontal storage tanks. It is possible that the tanks were used to store product during early operational years. Historical aerial photographs show that the sump was filled near the time that large above-ground storage tanks were constructed. The source of the material used to fill the sump is not known.

Once completely empty, the concrete sump was backfilled with flowable fill, a mixture of cement and sand. Over 500 cubic yards of flowable fill was needed to fill the sump to approximately one foot below final grade. A total of 1,265 tons of stabilized source material was transported to Emelle as industrial solid waste (i.e., non-hazardous waste). Liquids were transferred from the frac tank to tanker trucks and were transported to Tronox's facility in Texarkana, Texas for recycling of NAPL and treatment/disposal of water.

3.3 Removal of Materials from Wooden Substructure

During previous investigations, a substructure comprised of treated timbers was identified at the southern corner of the Courtesy Ford parking lot. Two walls constructed of treated timbers and a wooden floor saturated with water exhibiting a hydrocarbon sheen were encountered during exploratory excavation activities conducted in 2001. The structure was estimated to be 50 feet by 50 feet by 5 feet deep, although it was much less well-defined than the concrete sump. The function served by the wooden substructure is unclear from historical aerial photographs. Soils within and immediately beneath the wooden substructure exhibited odors and staining, but free liquids were confined to the timbers themselves.

The wooden substructure contained soil mixed with some wooden timbers. The materials within the wooden substructure, the substructure itself, and the soils immediately beneath the floor of the substructure were excavated and loaded directly into trucks for transportation to Waste Management's Emelle, Alabama Subtitle C landfill. The substructure extended in a southeasterly direction (i.e., toward the NSRR track) almost to the ditch which paralleled the southeastern boundary of the Courtesy Ford property. Some timbers extended past the ditch and were addressed at a later date during the NSRR Track Area remediation (see Section 4.7).

Once the substructure and all materials deemed to be potential source materials were removed, the excavated area was filled with clean, sandy clay soil then compacted. A total of 1,050 cubic yards of materials was transported to Emelle as industrial solid waste (i.e., non-hazardous waste). The wooden substructure is believed to have been the source of affected ground water in the vicinity of monitoring well MW-02R, which has historically contained the highest concentrations of site constituents of any onsite well. Since the remediation of the wooden substructure in 2003, constituent concentrations in

MW-02 and other wells within the Process Area plume have shown generally decreasing trends.

3.4 Preparation of Subgrade

Before capping the Courtesy Ford parking lot, it was first necessary to excavate and remove base failures (i.e., areas where the subgrade consisted of weaker materials that might not support vehicular traffic). It was believed that this would entail the removal of a minimal amount of soil, mostly in areas where potholes had previously formed in the parking lot. However, when the paving contractors began to run heavy equipment over the area to be capped, shallow saturated soils exhibiting weakness (e.g., the ground "pumping" when heavy equipment passed over it) were encountered in several larger areas beneath the parking lot. The paving contractor indicated that these weak soils needed to be removed and replaced in order to construct a structurally-stable parking lot.

Approximately 3,500 cubic yards of unstable soil were removed and replaced in the area to be capped. Once the replacement soils were compacted and graded, soil cementing was undertaken to further stabilize the subgrade. Heavy road equipment was used to mix the uppermost 4 inches of the subgrade, including the thin and weathered existing asphalt layer, with Portland cement. The resulting stabilized surface was shaped slightly to achieve final grades and the parking area was ready to be capped and paved.

3.5 Construction of Cap/Parking Lot

The Courtesy Ford parking lot, (i.e., the site of the former Process Area) was capped to preclude direct contact with and to minimize the potential for infiltration of precipitation through affected soils left in place. In order to provide maximum protection and allow for continued use of the area as a parking lot, an alternative cap consisting of a water-impervious liner covered with asphalt was installed. The liner used was a composite geotextile material that consists of two layers (top and bottom) of 6 ounces/square yard non-woven polyester bonded to 15 mils of polyethylene vinyl acetate.

Once the subgrade was prepared, the water-impervious geotextile was placed atop the former Process Area, with approximately 12 inches of overlap at the joints between panels. Panels were bonded together at the joints using tack coat. A 2-inch asphalt layer was placed atop the geotextile, which is heat resistant up to a temperature of 400 degrees Fahrenheit. A total of 10,900 cubic yards of geotextile/asphalt cap was constructed atop the former Process Area.

4.0 Courtesy Ford Ditch/NSRR Track Area

The remedial action objectives for the NSRR Track Area were to: 1) remove free product and creosote-saturated materials from within and beneath drainage ditches; 2) eliminate the potential risks posed by direct contact with affected soils; 3) minimize the potential for infiltration of precipitation through affected soils; and 4) demonstrate that natural attenuation of constituents in ground water is occurring.

Free product and creosote-saturated soils within, beneath and immediately adjacent to drainage ditches in the NSRR track area were removed and transported offsite for disposal. Soils between the Courtesy Ford ditch and the NSRR tracks that exceeded the MDEQ-mandated remediation standard were also removed and transported offsite for disposal. Upon its discovery during soil removal in the NSRR track area, a wooden trough, which extended approximately 1,200 feet southwest of Timothy Lane parallel to the NSRR tracks, was also delineated and removed. Ground water monitoring necessary to demonstrate natural attenuation of site constituents is currently performed on an annual basis.

4.1 Relocation of Wilmut Gas Line

In order to allow for the removal of affected soil and construction of a concrete-lined ditch, it was necessary to re-route approximately 300 feet of a Wilmut Gas line located between Courtesy Ford and the NSRR right-of-way. Wilmut gas personnel performed the excavation and relocation of the line, with MP&A representatives onsite to assist with the delineation and management of creosote-affected soils. On August 28, 2003, approximately 300 tons of affected soil were removed from the area immediately surrounding the existing gas line and the trench dug to accommodate the new line. Soils were loaded directly into trucks and sent offsite for disposal at Waste Management's Central Landfill, a Subtitle D landfill in McNeill, Mississippi.

4.2 Removal of Affected Sediment and Soil – Courtesy Ford Ditch

The Courtesy Ford ditch is an approximately 650-foot long ditch that flows northeast parallel to and within 15 feet of the southeastern boundary of the Courtesy Ford parking lot. At Scooba Street, the ditch turns 90 degrees and flows approximately 65 feet southeast toward the NSRR tracks, at which point drainage turns northwest and flows through a culvert beneath Scooba Street. After flowing into a low-lying and flat drainage area immediately northwest of the intersection of the NSRR tracks and Scooba Street, drainage again turns 90 degrees and flows through a culvert beneath the NSRR tracks, at which point flow ties into the northeast drainage ditch project completed between 2003 and 2007 as part of a removal action.

Initially, the Courtesy Ford ditch was cleared of brush and other vegetation. Excavation of soils within and beneath the ditch then proceeded with a trackhoe, with excavated materials loaded directly into trucks for transportation offsite and disposal. Approximately 2,900 tons of soils were transported offsite for disposal. Almost all of the

excavated soils were trucked to Waste Management's Central Landfill. Due to the presence of heavily-impacted soils beneath the ditch immediately adjacent to Scooba Street, a small volume (80 tons) of soils was trucked to Waste Management's Subtitle C landfill in Emelle, Alabama as a precautionary measure. Soil removal activities performed in 2003 stopped just short of the NSRR right-of-way, as an access agreement with NSRR could not be obtained prior to beginning remedial construction activities.

4.3 Construction of Concrete-Lined Ditch

The ditch excavation was backfilled with clean fill material to the designed grade. Backfill was compacted and shaped to accommodate the construction of a flat-bottomed concrete-lined ditch with sloped sides. A water-impervious liner similar to the liner used to cap the Courtesy Ford Parking lot was placed in the ditch. The ditch was then formed up and poured with 4-inch thick reinforced concrete.

4.4 Removal of Affected Soil – Chain Electric Expansion

During the expansion of the Chain Electric facility northeast of Scooba Street in late 2004 and early 2005, creosote-affected soils were encountered in the shallow subsurface adjacent to a low-lying drainage area. When contacted by Chain Electric regarding this discovery, Tronox agreed to arrange for the offsite transportation and disposal of these materials. In December 2004 and February 2005, approximately 600 tons of affected soil were removed from the Chain Electric expansion area and transported to Waste Management's Central Landfill for disposal. Clean soils were brought in to fill excavated areas to appropriate project grades.

4.5 Removal of Affected Soil – NSRR Track Area

The approved *Final Remedial Action Work Plan* stated that if appropriate easements/deed restrictions could be obtained from NSRR, affected soils outside the Courtesy Ford ditch would be left in place and capped. The plan further stated that if the necessary easements/ deed restrictions to leave affected soils in place could not be obtained, Tronox would attempt to obtain permission from NSRR to conduct soil removal activities. After agreeing to remove soils in the NSRR Track Area to a MDEQ-mandated remediation standard of 43 milligrams per kilogram (mg/kg) benzo(a)pyrene, Tronox and NSRR negotiated an access agreement that would allow for the removal of soils exceeding that standard. It was agreed by all parties that by achieving the remediation standard, no easements or deed restrictions beyond the land use restriction already placed on the property by the State of Mississippi and the Hattiesburg School District were necessary.

The results of extensive previous sampling in the NSRR track area were used to guide soil remediation. Prior to beginning excavation, 20 previous sampling locations in the approximately one-acre area were staked, with the depth of soil exceeding the remediation standard marked on each stake. Approximately 4,100 tons of soil exceeding the remediation goal were excavated, loaded directly into trucks and sent to Waste Management's Central Landfill. Excavated areas were backfilled with clean soils, the

surface of which were graded to drain to the concrete-lined ditch and seeded with Bermuda grass.

4.6 Completion of Drainage Components – NSRR Track Area

Following the removal of all affected soils within the NSRR right-of way, construction of the drainage components on both sides of Scooba Street was completed. On the upstream (i.e., southwest) side of Scooba Street, this consisted of extending the concrete-lined ditch to the culvert that crosses beneath Scooba. On the downstream (northeast) side of Scooba Street, drainage is poor due to the elevations of the culverts leading into and out of the area. For this reason, after affected sediment and soils were removed, the drainage area was backfilled to appropriate final design grade, lined with 40-mil HDPE lined, then filled with large diameter rip-rap. This has allowed the water and the sediment in the flat area to "find its own level" over time.

4.7 Removal of Affected Materials – Wooden Trough

During soil removal near the previously-excavated wooden substructure (i.e., at the Timothy Land end of the NSRR Track Area), a wooden trough was encountered extending from the wooden substructure toward the NSRR tracks. The trough consisted of a base and sides constructed of treated timbers, with six inches to one foot of stained soil immediately beneath its base. At a distance of approximately 55 feet from the tracks, the trough turned 90 degrees to the southwest and paralleled the NSRR tracks. The utility of this trough during operational times is unknown.

Because the wooden trough was not know to exist, measures to address affected materials in the NSRR Track Area southwest of Timothy Land were not contemplated in the *Final Remedial Action Work Plan.* However, once the affected timbers and soil were identified, MDEQ requested that Tronox excavate the trough and affected soil. Tronox complied with MDEQ's request for this additional work.

The trough and affected soils were removed to a distance of approximately 1,200 feet southwest of Timothy Lane. As the excavation extended to the southwest, the depth of the trough increased. When visibly-unaffected soils were present above the trough, they were segregated for subsequent use as backfill. Approximately 1,200 tons of treated timbers and soils were excavated, loaded directly into trucks and sent to Waste Management's Central Landfill for disposal. The trough excavation was backfilled with clean soils to surrounding grade.

At a point approximately 1,200 feet southwest of Timothy Land, the trough appeared to turn slightly and continue in a westerly direction, extending beneath paved areas for businesses located northwest of the NSRR tracks. These properties are subject to deed restrictions that: a) require that the properties are only used for commercial purposes; and b) prohibit excavation and other intrusive activities such as drilling, trenching and plowing.

5.0 Monitored Natural Attenuation

At many sites, monitored natural attenuation (MNA) is a viable technology for addressing site constituents in ground water. MNA is a proven and widely-accepted remedial technology whereby natural processes such as biodegradation, dispersion, dilution, sorption, and volatilization combine to remediate affected media. The use of MNA as a remedy at the former Gulf States Creosoting site is appropriate because:

1. Shallow ground water is unused in the vicinity of the site.
2. A City of Hattiesburg ordinance places restrictions on the use of shallow ground water. The ordinance requires that the City be notified and that a well be tested prior to use.
3. Source materials have been removed and/or contained by engineering controls, such that little to no potential remains for future releases to ground water.
4. It is unlikely that traditional ground water remediation technologies (e.g., pump and treat), regardless of the duration of the remedy, would be able achieve the extremely low Tier 1 TRGs for site constituents (e.g., 10 parts per billion for naphthalene).

Site-wide ground water is currently monitored annually, with annual Ground Water Monitoring Reports submitted to MDEQ and the City of Hattiesburg. The summary and conclusions from the most recent annual report are as follows:

1. Tronox has conducted ground water investigations at the site since 1996. Affected ground water is present in two separate and distinct areas. The extent of affected ground water in both areas has been fully delineated.
2. The affected shallow water-bearing zones are not used for any purpose in the Hattiesburg area. Furthermore, a 2002 City ordinance established rules and regulations for the development and use of ground water within the City limits.
3. Tronox has completed remedial measures that included the removal of potential sources of ground water contamination. In addition, containment measures (i.e., vertical and horizontal barriers) reduce the potential for migration of affected ground water and preclude infiltration/percolation of water through affected soils left in place.
4. Constituent concentrations in both affected areas have reached either steady-state or declining conditions. Furthermore, sampling results indicate that conditions are favorable for continued natural attenuation of ground water constituents.
5. Tronox plans to continue annual ground water monitoring at least through 2008. At that time (i.e., at the end of five years of annual monitoring), Tronox will evaluate the data to determine if a change in monitoring frequency is warranted.

6.0 Health and Safety

Before beginning work in each project area, comprehensive Health and Safety Plans were developed for each project. The plans required that all workers involved in the removal and handling of affected materials be HAZWOPER trained in accordance with OSHA regulation 40 CFR 1910.120. Plans addressed physical and chemical hazards, safe work practices, hazard communications, worker personal protective equipment, and key health and safety personnel. All persons working at or visiting the site, including but not limited to Tronox, MDEQ and City of Hattiesburg personnel, were required to adhere to the provisions of the Health and Safety Plans.

Air monitoring was not required by the Health and Safety Plans because the primary routes of exposure for PAHs are ingestion and dermal contact, not inhalation. However, in early September 2003, MDEQ requested that air monitoring be conducted when affected materials were being excavated and odors were generated. Tronox complied with this request, and had its remediation contractors subcontract an air monitoring firm (EarthCon out of Jackson, Mississippi) to perform air monitoring. EarthCon recorded measurements using a field screening meter and collected air samples for laboratory analysis for coal tar pitch volatiles (CTPVs), which make up the volatile fraction of creosote. The air monitoring reports provided in Appendix E indicate that at no time did concentrations of any CTPV exceed the worker protection limits specified by OSHA, meaning that there was no significant exposure to creosote constituents via the air pathway during remedial action activities.

7.0 Summary

From 2003 through 2007, Tronox LLC completed an environmental cleanup at the former Gulf States Creosoting site in Hattiesburg, Mississippi. The objectives of the remedial action were to remove source materials and eliminate the potential for exposure to creosote-affected site media. All work on the project was performed in accordance with plans approved by MDEQ and with MDEQ oversight.

The remedial action included the following tasks:

- Removal and offsite disposal of 15,000 tons of sediment, soil and debris (in addition to the 14,000 tons removed during the northeast drainage ditch removal action);
- Implementation of engineering controls (capping, vertical barrier and phytoremediation system) at the Fill Area to eliminate the potential for exposure and migration and also to promote breakdown and/or uptake of creosote constituents;
- Source removal and capping of residual affected soils in the former Process Area to eliminate the potential for exposure and future releases;
- Removal of affected materials in the NSRR Track Area to achieve the MDEQ-mandated cleanup standard; and
- Completion of drainage improvements in the NSRR Track Area to promote better drainage and tie into the northeast drainage ditch removal action drainage improvements.

The remedial action was successful in achieving its objectives and MDEQ has concurred that all work necessary to address affected site media has been completed. The potential for exposure to creosote constituents has been greatly reduced or eliminated. The results of ongoing ground water monitoring indicate that source removal and containment measures have resulted in improved shallow ground water quality. Tronox will continue to work with MDEQ to perform post-closure care at the site, as appropriate and necessary.