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CYPRESS CREEK SUB-AREA III INVESTIGATION

Prepared For:

Velsicol Chemical Corporation
Memphis, Tennessee

Prepared By:

Memphis Environmental Center, Inc.
Memphis, Tennessee

October 2003

MEMPHIS ENVIRONMENTAL CENTER, INC.

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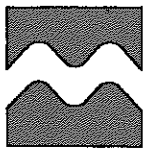

October 24, 2003

Mr. J. M. Apple, Director
Tennessee Department of Environment and Conservation
Division of Solid Waste Management
401 Church Street
Nashville, Tennessee 37243-1535

Re: Cypress Creek Sub-Area III Investigation
Velsicol Chemical Corporation, Memphis, Tennessee
Tennessee RCRA Permit No. TNHW-026

Dear Mr. Apple:

Enclosed, on behalf of Velsicol Chemical Corporation, is the Sub-Area III Investigation Report. This document describes the soil sampling and testing that was performed during April through July 2003 and presents soil analytical data, data evaluations and sampled property information for the study area.

Velsicol acknowledges and appreciates the sample collection and analytical testing support provided by the U. S. Environmental Protection Agency's Science and Ecosystem Support Division (SESD) in Athens, Georgia.

If you have any questions on this report, please contact me at 901-345-1788, ext. 120 or GHermann@Velsicol.com.

Sincerely,

Memphis Environmental Center, Inc.

Gary Hermann

Gary J. Hermann, P.E.
Senior Environmental Projects Manager

Enclosures

c: Mike Apple, TDEC (2 copies and one electronic copy)
Narindar Kumar, EPA Region IV
Sharon Matthews, EPA SESD
Andy Felker, Velsicol
Paul Patterson, City of Memphis Public Works
Norman LaChapelle, Memphis and Shelby County Health Department
Chris Saranko, GeoSyntec

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TABLE OF CONTENTS

LIST OF FIGURES, TABLES AND APPENDICES

FIGURES

TABLES

APPENDICES

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Gary Hermann

Gary J. Hermann, P.E.
Senior Environmental Projects Manager
Memphis Environmental Center, Inc.
Date: October 24, 2003

EXECUTIVE SUMMARY

This report presents the findings of an environmental investigation performed by Velsicol Chemical Corporation (Velsicol) of Cypress Creek Sub-Area III during 2003. The work was performed under the oversight of the Tennessee Department of Environment and Conservation (TDEC) and in accordance with an approved Work Plan. Velsicol also performed prior investigations along the Cypress Creek stormwater channel in 2001 and 2002. The 2001 Investigation divided the study area into five sub-areas based on different land uses and receptor types. Based on the results of the 2001 Investigation, additional investigations were recommended for Sub-Area III. The Cypress Middle School/University Park area, which is a portion of Sub-Area III, was investigated during 2002.

The 2003 Study Area consists of the overbank areas along Cypress Creek from Jackson Avenue to Evergreen Street, excluding the Cypress Middle School/University Park area. The creek channel is concrete lined with a variable width bottom and 10.5-foot high side walls. The subject overbank areas are well above the bottom of the channel and immediately outside of the concrete liner. The objectives of this 2003 Investigation are as follows:

- Collect and test soil samples to develop analytical data on contaminants in the soils adjacent to the creek channel in the Study Area.

- Use the analytical data to evaluate and characterize contaminant levels and distribution.

The above objectives were fully accomplished. A subsequent objective, which is outside of the scope of this report, is to use the collected data in the decision process related to the need for corrective actions in the Study Area.

The Study Area is 2.4 miles long and generally encompasses the properties next to the concrete liner. In accordance with the TDEC-approved Work Plan, the soil testing focused on non-volatile organochlorine compounds, which are commonly referred to as pesticides, as the chemicals of concern (COCs). A conceptual model was used as the basis of the design of the soil-sampling program. The general concept is that a primary means by which overbank areas could have been impacted is that contaminated channel bottom sediments may have been deposited in those areas during construction of the concrete liner during the late 1950's to late

1960's. Therefore, it was anticipated that COC levels may be higher within the historic construction easement than outside the easement.

Eighty-four properties were sampled during 2003 with the support of the U.S. Environmental Protection Agency's Science and Ecosystem Support Division (SESD) of Athens, Georgia. Soil analytical data are now available for approximately half of the 170 properties in the 2003 Study Area.

A summary of the key findings of the contaminant levels and distribution evaluations follows:

- Dieldrin was the predominant compound found in the soil samples and was used as an indicator parameter for describing the Study Area contaminant levels and distribution.

- The conceptual model (i.e., contaminant levels are higher inside than outside of the historic construction easement) was found to be valid for two thirds of the sampled properties. Other factors, such as filling of holes along the concrete liner, earthmoving related to subsequent landscaping activities and the use of termiticides and other pesticides around buildings and in gardens, may also have impacted the distribution of COCs relative to distance from the channel.

- As shown on ***Figure 3-1***, contaminant levels are not uniform along the channel. A number of areas with elevated concentrations were identified as follows:
  - North Bank: Jackson Ave. to Hollywood St.
  - North Bank: One property on Greenview Circle
  - North Bank: Apartment complex at Tunica St.
  - North Bank: Undeveloped properties at west end of Vandale Ave.
  - South Bank: Undeveloped properties between Evergreen St. and McLean Blvd.
  - South Bank: Edward Ave. west of University St.
  - South Bank: Dawes St. to undeveloped properties downstream of Staten Ave.
  - South Bank: Vollintine Cove

- As shown on ***Figure 3-2***, the elevated contaminant levels were found on a small proportion of the sampled properties and the majority of the properties have relatively low contaminant levels.

The land use of the approximately 170 properties in the Study Area is predominantly residential. A breakdown of the specific land uses follows:

- Single family residences – 130
- Undeveloped open space – 22
- Commercial/industrial – 13
- Apartment complexes - 5

Human health risk evaluations were not included in the scope of work for this investigation. However, an evaluation of the soil analytical data was performed in coordination with the Tennessee Department of Environment and Conservation (TDEC) to determine if the elevated COC levels posed a concern for acute toxicity that would warrant emergency corrective action. The findings of this evaluation, which was prepared by GeoSyntec Consultants for Velsicol, were presented to TDEC on September 22, 2003. This evaluation found that the contaminant levels are not likely to present an acute (short-term) health hazard that requires an emergency remedial response. The evaluation also found contaminant levels at a number of locations that warrant further evaluation based on chronic (long-term) exposure. TDEC has informed Velsicol that they agree with these conclusions.

1.0 INTRODUCTION

This report presents the methods and findings of an environmental investigation performed by Velsicol Chemical Corporation of Cypress Creek Sub-Area III in Memphis, Tennessee during the spring/summer of 2003. The investigation is part of an ongoing Resource Conservation and Recovery Act (RCRA) Corrective Action Program related to Velsicol's manufacturing plant at 1199 Warford Street in Memphis. It follows Velsicol's investigations of the area along Cypress Creek performed during 2001 and the Cypress Middle School - University Park portion of Sub-Area III during 2002. Results of the "2001 Investigation" are presented in a report entitled Cypress Creek Drainage Channel Investigation and Preliminary Human Health Risk Evaluation, January 10, 2002. Results of the "2002 Investigation" are presented in a subsequent report entitled Cypress Middle School – University Park Area, Cypress Creek Investigation and Human Health Risk Evaluation, September 18, 2002.

The 2001 Investigation evaluated a 4.5-mile long reach of the Creek, from Scott Street near the Velsicol plant to the Wolf River. This investigation found that organochlorine pesticide concentrations in soil samples collected from overbank areas within a few feet of the Creek's concrete liner in the 2.4 mile-long Sub-Area III potentially exceed U.S. Environmental Protection Agency (EPA) target levels for long term (chronic) exposure and led to additional investigations. Sub-Area III is an area of predominantly residential land use along the concrete lined section of Cypress Creek from 200 feet downstream of Jackson Avenue to Evergreen Street. ***Figure 1-1*** shows the location of Cypress Creek, including Sub-Area III and the Cypress Middle School – University Park portion that was the focus of the 2002 Investigation. The "Study Area" addressed in this report is Sub-Area III, excluding the Cypress Middle School – University Park portion.

The specific objectives of this 2003 investigation were as follows:

- Collect and test soil samples to develop analytical data on contaminants in the soils adjacent to the Creek channel in the Study Area.
- Use the analytical data to evaluate and characterize contaminant levels and distribution.

The contaminants of interest are non-volatile organochlorine compounds that could have emanated from Velsicol's manufacturing facility at 1199 Warford Street. These compounds are commonly referred to as pesticides and include compounds related to the manufacturing process and breakdown products related to the natural degradation of compounds. These compounds are

also referred to as the chemicals of concern (COCs) in this report. A subsequent project objective, which is outside of the scope of this investigation and report, is to use the collected data in the decision process related to the need for corrective actions in the Study Area.

A number of documents and discussions between the Tennessee Department of Environment and Conservation (TDEC) and Velsicol were utilized in developing the Study Area investigation Work Plan. The primary Work Plan documents are Velsicol's April 10, 2003 Revised Work Plan for Remainder of Sub-Area III of Cypress Creek and October 1, 2002 Investigative Work Plan for Sub-Area III of Cypress Creek. The Work Plan documents and this report were prepared by Velsicol's Memphis Environmental Center, Inc. (MEC), which also managed and performed the investigation.

Section 2 of this report describes the soil sampling methods and locations and analytical methods used in the investigation. ***Section 3*** presents the analytical results and characterizes the contaminant levels and distribution along the creek. ***Section 4*** presents additional study area information.

During the course of planning and executing this investigation, Velsicol involved the local community. This included a presentation on the sampling plans at a meeting of the University Lane Association block club during January 2003 and periodic meetings with the Cypress Creek Leadership Group during September and November 2002 and April and October 2003. Attendees at the Leadership Group meetings have included local residents and representatives of the Memphis and Shelby County Health Department, Memphis Division of Public Works, TDEC, Tennessee Department of Health, Memphis City Schools and the Vollintine- Evergreen Community Association (VECA).

2.0 SAMPLE COLLECTION AND ANALYSES

2.1 Sample Locations

The Work Plan envisioned that 162 soil samples (plus additional samples for quality control purposes) would be collected from overbank areas. Additional samples were also to be collected if, based on discussions with local residents, locations remote from the Creek were identified where contaminated creek bottom sediments may have been used to fill low areas. Thirty-eight of the samples were to be collected and analyzed by the U. S. Environmental Protection Agency's (EPA's) Science and Ecosystem Support Division (SESD) in Athens, Georgia and the remainder (i.e., 124 or more) were to be collected and analyzed by Velsicol. These samples were intended to generally cover the following:

- Every third single family (or duplex) residential property adjacent to the Creek. Note that these residential properties include small-undeveloped lots in residential areas where single-family homes could be constructed in the future.
- Each residential property where historic concrete liner construction design drawings indicated that an area outside of and adjacent to the concrete liner may have been backfilled during the construction phase.
- Three properties on Edward Cove where neighborhood residents had provided prior information that this was a former side or tributary channel area that may have been raised by filling with Cypress Creek sediments during the time that the concrete liner was being constructed in the nearby reach of the Creek.
- Two of every three "other" type properties, which include apartment complexes, commercial and industrial properties and undeveloped land.
- Any newly identified outlying areas suspected of having been backfilled with contaminated Creek sediments.

The sample collection and analyses objectives were fully achieved. At the completion of sampling, EPA had collected 38 samples and Velsicol had collected 124, for a total of 162 samples. No new outlying areas suspected of having been backfilled with contaminated Creek sediments were identified. Samples were collected at 61 single family (and duplex) residential properties, which is 43% of the total in that classification, and at 23 "other" type properties, which is 76% of that classification. The 162 sample locations are shown on ***Figures 2-1 through 2-9***. The sample location names are based on street addresses, where available. Some

properties do not have a specific street address, so alternate names were used, as indicated on the figures.

MEC obtained resident and/or landowner permission to sample each property. This was generally accomplished by first mailing a request letter to each resident and/or landowner with supporting information and a form to be returned granting access. Where necessary, this was followed up by phone calls and personal visits. At the end of the several-week process, 43% granted access by returning the form or by other indication of approval upon initial contact, 42% granted access after follow-up by phone calls or site visits and 15% of the property owners/residents could not be contacted or denied access for sampling. Where access was not obtainable, alternate adjacent properties or properties in other neighborhoods were sampled. MEC periodically communicated with TDEC regarding the selection of replacement properties to ensure compliance with project goals.

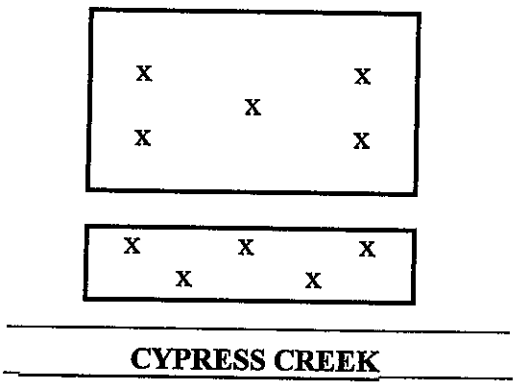
The general plan was to collect two samples from each property: one directly adjacent to the concrete liner and in the historic construction easement, and one farther away from the creek and outside of the construction easement. There were exceptions to this plan due to property shape and size and construction easement width, resulting in some properties having one or four samples being collected. Samples collected from within the construction easement and/or closest to the concrete liner were labeled with the extension "A" and those from outside of the construction easement and/or farther from the creek were labeled with the extension "B". There were some exceptions to the planned labeling approach. For example, the samples collected from Edward Cove were labeled with a "C", because their location is not related to the historic construction easement.

2.2 Sample Collection and Handling Methods

Soil samples were collected by MEC during the period of April 23 to July 2, 2003. Technicians from CMD Associates in Memphis supported MEC in this sample collection work. Staff from the USEPA Region IV Science and Ecosystem Support Division (SESD) laboratory in Athens Georgia, with TDEC support, collected samples on May 20 and 21. ***Table 2-1*** lists the sample locations and collection dates and which team (i.e., MEC or EPA) collected the samples. The list is presented in order from west to east or downstream to upstream, for the north side of the Creek and then the south side. Locations where duplicate samples were collected and other pertinent information are noted. Additional details on the sample locations are presented in ***Appendix A***. This Appendix also includes the locations and identifiers for the surface soil

samples (i.e., 0-inch to 12-inch depth) that were collected adjacent to the concrete liner in the Study Area during the 2001 Investigation.

At each sample location, a 5-point composite sample was collected and thoroughly mixed in equal proportions in stainless steel or glass bowls and then placed in glass jars for transportation and laboratory testing. To the extent practical, the five points were positioned in general accordance with criteria presented in the April 10, 2003 Revised Work Plan. The general layouts of the 5-points were as shown in the following sketch, with the "B" sample layout at the top of the sketch and the "A" sample layout, which is adjacent to the Creek, lower in the sketch.



Soil samples collected from within the construction easement (i.e., the "A" area) were generally taken as follows: two of the 5-point composite sub-samples were collected 3 feet from the concrete liner, and the other three were collected at 20 feet from the liner. If the construction easement area was less than about 25 or 30 feet wide, such that the represented area extended outside of the construction easement area, the locations of the 5-point composite sub-sample locations in the outer area (i.e., the "B" area) were adjusted to avoid overlap. Due to the presence of buildings, the property shape and other conditions, the layouts had to be adjusted from the above plan at many locations, but this was done with the underlying goal of representing human exposure conditions. Hand-drawn sketches with survey tape measurements from permanent structures, photographs and global positioning satellite (GPS) coordinates were used to document the sample locations.

The general sample collection and handling methods, including equipment decontamination procedures, were performed in accordance with the TDEC approved Sampling and Analysis Procedures for the RCRA Corrective Action Program (the SAP), as revised January 30, 2003, unless otherwise noted. The soil samples were collected from the 0- to 9-inch depth

interval using hand operated soil augers. Where vegetated sod was encountered, the soil was shaken from the roots into the sample-mixing bowl and organic matter, such as roots and leaves, and inert material, such as gravel, were discarded.

As noted on ***Table 2-1,*** the MEC sample team collected seven duplicate soil samples and the EPA team collected 2 duplicate samples. The MEC sampling team collected field rinse blanks from sampling tools on the following dates: April 23 and 28, May 8 and 28 and June 4 and 20. EPA's sampling equipment was cleaned and quality control tested under a contract program prior to bringing the equipment from their laboratory.

The samples were placed in coolers on ice in the field. MEC's samples were transported on ice and under chain of custody protocols by MEC staff to GTW Analytical Services, LLC in Memphis for laboratory testing. EPA's samples were transported on ice and under chain of custody protocols by EPA staff to the SESD laboratory for testing.

During the course of the investigation, TDEC representatives observed MEC's sample collection work during nine of eleven sample collection days. Memphis and Shelby County Health Department representatives observed the sample collection work on two days.

If middle aged to elderly residents or neighbors were available at the time of sample collection or during contacting for access, and if they had resided at that location for many years, MEC asked if they had knowledge of the Creek conditions, concrete lining construction work and related sediment handling activities during the period of the early-1950's to the early 1970's. Several of those interviewed were aware of conditions before and during the concrete lining work. However, only limited new information was obtained on where sediments from the creek bottom may have been used for fill in areas away from the concrete liner. One resident on Vollintine Cove indicated that during the concrete liner construction work, soils from the creek had been stored for a while on the north side of the creek, which is at the 1005 Meagher sample location, before being hauled away by large trucks. Based on other historic information, it is possible that this material was disposed at the Hollywood Dump landfill.

2.3 Soil Testing

GTW Analytical Services, LLC of Memphis, Tennessee analyzed the soil and rinse blank samples collected by MEC. MEC's samples were analyzed in accordance with the TDEC-approved SAP, using EPA SW-846 Method 8081A, for the compounds listed on Page 4 of 6 of

Table 2 of the SAP. The samples collected by EPA were analyzed at the SESD laboratory in Athens, Georgia, also using EPA SW-846 Method 8081A. However, EPA's laboratory was unable to test for all of the compounds listed in the SAP and included a number of compounds that are not on the SAP list. These differences are shown on ***Table 2-2***, which lists the compounds reported by each laboratory.

All of the soil samples were also analyzed for moisture content, using EPA SW-846 Method 3550B.

2.4 Use of 2001 Investigation Soil Analytical Data

During the 2001 Investigation, MEC collected and analyzed several soil samples from Sub-Area III on behalf of Velsicol. Analytical data for nine soil samples taken from the 0- to 12-inch depth interval in the overbank area adjacent to the Creek were included in this investigation because they are representative of Sub-Area III Study Area conditions. These samples were typically taken from within a few feet of the concrete liner in the City of Memphis maintenance easement, and are from within the construction easement. Discrete samples were taken in 2001, rather than 5-point composites as collected in 2003. With the inclusion of the 2001 samples, data is available for a total of 91 Study Area properties.

The 2001 Investigation samples were analyzed for a wider range of compounds (i.e., volatile organic compounds, semi-volatile organic compounds, and metals as well as non-volatile organochlorine compounds or pesticides). However, only the pesticide data was included in this current investigation to be consistent with the project objectives and scope. Information on these additional samples is included in ***Table 2-1*** and ***Appendix A*** and the sample locations are shown on ***Figures 2-1 to 2-9***.

3.0 SOIL ANALYTICAL RESULTS

3.1 Laboratory Analytical Results

The laboratory analytical results from MEC's April – July 2003 samples and pertinent June 2001 samples are summarized in ***Table 3-1***. Analytical results from EPA's May 20 and 21, 2003 samples are summarized in ***Table 3-2***. Note that a line of data labeled "Total Chlordane" was added by MEC near the bottom of ***Tables 3-1 and 3-2***. This was done because the EPA and MEC laboratories reported chlordane differently (see ***Section 2.3***) and the Total Chlordane value provides an approximate means to present comparable data. These tables include all of the 2001 and 2003 overbank surface soil samples from the north and south sides of Cypress Creek from Jackson Avenue to Evergreen Street. The Sub-Area III database includes a total of 180 soil samples and duplicates. It does not include soil analytical data from the 2002 Investigation of the Cypress Middle School/University Park area

Copies of the GTW laboratory reports for the MEC samples were submitted to TDEC soon after they became available, as follows:

- April 23 and 28 and May 8, 2003 sample dates, reports submitted on June 19, 2003.
- May 20, 21, 28 and 30, 2003 sample dates, reports submitted on June 27, 2003.
- June 4, 2003 sample date, report submitted on July 2, 2003
- June 10 and 20, 2003 sample dates, reports submitted on July 29, 2003
- July 2, 2003 sample date, report submitted on August 13, 2003

On September 15, MEC received a copy of EPA's September 10, 2003 completed report on the Cypress Creek Sub-Area III Sampling Investigation. The report included a narrative description of EPA's sampling methods and analytical results, sample location maps and sketches, a table describing the sample locations and soil description, summary data tables, sample location photos, laboratory analytical data reports that included data quality evaluation qualifiers and sample receipt and chain of custody forms. EPA's analytical results were reported on a "dry weight" basis. These values were converted to an "as received" or "wet weight" basis using the moisture content analytical results, so that they would be compatible with the MEC data as presented and evaluated in this report.

3.2 Data Quality Evaluations

The quality of the laboratory analytical data for the samples collected by MEC were evaluated by Premier Environmental Services, Inc., in accordance with the SAP, to achieve Data Quality Objective Level III prior to incorporation into the project database. Premier's Analytical Data Quality Assessment and Validation Report (Data Validation Report), which is provided in **Appendix B**, is summarized as follows:

- **Sample Delivery** - The samples were transported, handled, and analyzed per the requirements of the SAP.

- **Holding Time Periods** - Sample extraction and analyses were performed within the holding times specified by the SAP and analytical method requirements.

- **Laboratory Blank Analyses** - The Data Validation Report indicated that no laboratory contamination occurred during sample analyses.

- **Blank Spike Analysis/Surrogate Compound Recovery** – These evaluation factors assess the laboratory's performance and accuracy. The recoveries for both of these internal QA/QC tests were within control limits for the analytical methods.

- **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses** – These factors evaluate the accuracy and precision on an individual sample basis. Due to the level of contamination in many of the samples and matrix interference, many MS and MSD recoveries were unavailable or outside acceptable recovery limits. Based on the data evaluations, it is believed that the MS/MSD failures are likely due to matrix interference and not due to laboratory systematic problems. Certain data were qualified as estimated based on this factor and flagged as "J".

- **Rinse Blank Analysis** – Five equipment rinse blanks were collected to verify the adequacy of decontamination procedures. Two analytes were detected in one rinse blank. However neither compound was detected in the related samples so no qualification of the data was necessary.

- **Field Duplicate Analyses** – This factor evaluates the precision of the field sample collection procedures and laboratory analytical methods. Seven field duplicate samples were collected and analyzed. Based on the evaluation, adequate precision was achieved. However, the Data Validation Report indicates that some of the compounds detected were outside the Relative

Percent Difference control limits used to compare the results of the primary and duplicate sample. The results, which were outside the control limits for both the primary and duplicate sample, are useable, but are qualified as estimated and flagged as "J."

- **Miscellaneous Quality Control** - Many samples were flagged by the laboratory as "UC" due to non-confirmation of results due to matrix interference. These data are qualified as estimated and flagged as "J".

  Some sample results were qualified by the laboratory with a flag of "CK" and the notation that the percent difference in the calibration checks exceeded the 15% criterion for that analyte. However method requirements were met. These data are qualified as estimated and flagged as "J".

  Some results were qualified by the laboratory with a flag of "LB" and the notation that the practical quantitation limit (PQL) is raised do to laboratory background and some results were qualified by the laboratory with a flag of "PM" and the notation that the PQL is raised due to matrix interference.

- **Data Completeness** - Completeness is a measure of the amount of valid data compared to the amount expected under normal conditions. In most cases, the reported concentration and associated quality control results indicate that the data are of sufficient quality. Some analytical results were qualified as estimated due to duplicate failures, MS/MSD failures, or reporting below the detection limit. The estimated data are useable as qualified. The completeness of the data collected during this investigation is 100%, which achieves the SAP requirement of greater than 85%.

The laboratory reports from EPA included data qualifier flags that were assigned by the SESD. MEC incorporated these flags were into the project database along with the EPA data. According to EPA's project report, the precision, comparability and accuracy of sample analysis are addressed in the EPA Region 4, Science and Ecosystem Support Division, Analytical Support Branch Operations and Quality Control Manual, January 2003. And, all samples were collected in accordance with Chapter 12 of the EPA Region 4, Science and Ecosystem Support Division, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, November 2001.

The EPA Region 4 SESD Office of Quality Assurance is also performing a quality control review of GTW's analytical work. On September 29, TDEC and EPA selected 12

samples for this review and requested that detailed laboratory data packages be provided for EPA's review. The requested information was assembled by GTW Analytical Services and submitted to EPA on October 21, 2003. The results of EPA's review were not available to include in this report.

3.3 Contaminant Levels and Distribution

The soil analytical results were evaluated by various means to characterize contaminant levels and distribution in the Cypress Creek Sub-Area III Study Area. The following evaluations were performed:

- Screening to select an indicator parameter for the contaminant levels and distribution evaluations.
- Comparison of contaminant levels inside and outside the construction easement and probable backfill areas.
- Contaminant distribution along the creek channel.
- Contaminant distribution by concentration ranking.

3.3.1 Indicator Parameter Screening

The soil analytical results were compared to the October 1, 2002 EPA Region 9 Preliminary Remediation Goals (PRGs) table for residential soil as a means to identify a parameter that could be used as an indicator of contaminant levels and distribution in Sub-Area III. Note that the PRGs are not cleanup standards, but rather are helpful as a screening tool. In addition, PRGs have not been established for all of the target analytes of this investigation. In those instances, conservative surrogate PRG values were used for the screening. These surrogates were selected by GeoSyntec Consultants based on a structural similarity search using ChemIDplus software developed by the U.S. National Library of Medicine. The same approach was used by GeoSyntec in the 2002 Investigation. A summary of the information developed from this screening follows:

- Dieldrin was the compound that most frequently exceeded its PRG in the soil samples.

- The next most frequently found compound to exceed its screening value was hex VCL. It exceeded its surrogate PRG (heptachlor) in 65% of the number of samples that dieldrin exceeded its PRG.

- The next compounds in order of decreasing frequency were hexachloronorbornadiene (heptachlor as surrogate), chlordene (chlordane as surrogate), heptachlor epoxide, endrin ketone (endrin as surrogate) and aldrin. These compounds exceeded their PRG or surrogate PRG in 37% to 18% of the number of samples that dieldrin exceeded its PRG, respectively.

- Wherever any compound exceeded its PRG or surrogate screening level at a sampled property, dieldrin also exceeded its PRG in one or more samples at that property.

Based on these factors, plus the risk evaluations performed as part of the 2001 and 2002 Investigations, which indicated that dieldrin was a primary compound driving health risk in those study areas, dieldrin was used in this report as an indicator parameter to evaluate contaminant levels and distribution.

3.3.2 Inside vs. Outside Construction Easement and Backfill Areas

The design of the soil sample locations (see ***Section 2.2***) was based on a conceptual model that anticipated that COC concentrations would be higher within the historic construction easement and/or within possible backfill areas adjacent to the concrete liner, than areas outside the construction easement and backfill areas. Note that the locations of the construction easement and possible backfill areas are indicated on ***Figures 2-1 to 2-9***. The conceptual model was based on the assumption that the distribution of contaminated sediments from the creek channel would have been limited to the construction easement and to where sediment was used as backfill outside of the concrete liner. The validity of the conceptual model was evaluated by comparing the "A" sample dieldrin concentrations with the "B" sample concentrations.

The evaluation was performed by comparing the 76 pairs of A and B samples collected during 2003 that had detectable dieldrin concentrations. This evaluation found the following:

- The A-sample concentrations were higher than the B-sample concentrations in 67% (two thirds) of all of the comparable the samples.

- The A-sample concentrations were higher than the B-sample concentrations in 74% (about three fourths) of the samples where the A-sample was collected from a probable backfill area.

Based on this evaluation, the conceptual model is valid for the majority of the sampled properties in Sub-Area III. This also indicates that other factors, in addition to the late-1950's to late-1960's concrete liner construction-related earthwork, may have impacted the distribution of contaminants in some areas. One factor observed during the sample collection work is that property owners/residents and City of Memphis crews have used imported soil and possibly other materials to fill holes in the ground next to the concrete liner. These holes have been created as the result of soil being washed into the channel through construction joints by stormwater runoff or fluctuating water levels in the channel. This fill work could result in lower COC levels in the A-samples. Other factors, such as earthmoving related to subsequent landscaping activities and the use of termiticides and other pesticides around buildings and in gardens, may also have impacted the distribution of COCs relative to distance from the channel.

3.3.3 Contaminant Distribution Up and Down the Channel

Figure 3-1 depicts dieldrin concentrations along the north and south sides of the channel in the Study Area. The x-axis "distance" refers to the distance of each sample location downstream from Scott Street, as presented in ***Appendix A***. The left end of the figure at distance 12,000+ feet is Evergreen Street and the right end of the figure at distance 1,000 feet is Jackson Avenue. This figure indicates the following:

- The area with the most elevated contaminant levels in the Study Area is the north bank of the channel between Jackson Ave. and Hollywood St. (3,900 to 1,100 feet downstream of Scott Street).

- Elevated contaminant levels were also found in three additional areas on the north bank. These are one property on Greenview Circle (11,670 feet), an apartment complex at 1188 Tunica St. (8,350 to 7,900 feet), and two undeveloped properties near the west end of Vandale Ave. (6,260 to 5,780 feet).

- Elevated contaminant levels were found in four areas on the south bank of the channel. The first grouping is comprised of undeveloped City, County and VECA properties between Evergreen St. and McLean Blvd. (12,045 to 11,100 feet). The second group is on Edward

Ave., west of University St. (9,965 to 9805 feet), the third group is from Dawes St. to undeveloped properties downstream of Staten Ave. (5.970 to 4,860 feet), and the fourth area is on Vollintine Cove (3,670 feet).

- The inset to the south bank figure indicates that the three "C" samples, which were collected on Edward Cove, have relatively low contaminant levels.

3.3.4 Contaminant Distribution By Concentration Ranking

Figure 3-2 shows a ranking of the 91 sampled properties by dieldrin concentration. This graph was developed using the higher of the two dieldrin concentrations, where more than one sample was collected on a property. As indicated by the shape of the graph, elevated contaminant concentrations were found on a small proportion of the properties, and the majority of the properties have relatively low contaminant levels.

4.0 ADDITIONAL STUDY AREA INFORMATION

Additional site information was collected for each neighborhood and sampled property as part of the work to contact the residents/landowners for access and during soil sampling. The information is based on visual observations, February 23, 2002 aerial photomaps, Shelby County Tax Assessor records and personal contacts. The objective was to develop information that can be used in future human health risk evaluations.

A summary of pertinent information is presented in ***Table 4-1***. The number of properties sampled in each city block or neighborhood during 2003 is shown along with the total number of properties in the block. The land use is presented for all properties in each block. Note that the numbers for single-family residences include duplexes and vacant lots in single family residential areas and the commercial/industrial land use numbers include undeveloped lots adjacent to commercial/industrial lots and parking lots.

Additional information related to how long individuals lived at sampled properties, property ownership, outdoor/gardening activities and residents ages was also collected by visual observation and discussions with residents. This information is incomplete for many of the sampled properties, so it was not summarized for this report. However, it will be available for use as appropriate in future risk evaluations.