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March 27, 2000

Mr. Wm. Gerald Hardy, Chief
Land Division
Alabama Department of Environmental Management
1400 Coliseum Blvd.
Montgomery, AL 36110

Re: Work Plan for Estimating PCB Vapor Flux From Solutia Landfills
USEPA I.D. No. ALD 004 019 048

Dear Mr. Hardy:

In accordance with your letter dated February 1, 2000, and received by Solutia on February 8, 2000, Solutia has prepared a work plan to evaluate the potential for airborne releases of PCBs from Solutia's South Landfill and West End Landfill. Three copies of this work plan are enclosed for your review.

I look forward to receiving your early approval of this work plan. If I can expedite approval by meeting with you to answer any questions, please let me know.

Sincerely,

Craig R. Branchfield
Manager, Remedial Projects

cc: Mr. Wesley Hardegree - EPA (3 copies)
Mr. Russ McClean - EPA
Ms. Karen Knight - EPA Anniston
Mr. Craig Brown - EPA

PLAINTIFF'S EXHIBIT

Solutia, Inc.

Anniston, AL

Work Plan for Estimating PCB Vapor Flux From Two Landfills

ENSR

March 2000

Document No. 6105-006-100

WATER_PCB-SD0000067207

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1.0 INTRODUCTION

ENSR has been retained by Solutia, Inc. of Anniston, AL to design and implement an emissions flux measurement program. Results from the study will provide a basis for estimating the flux of PCBs, if any, originating from the South Landfill and West Landfill areas of Solutia's facility property located in Anniston, AL. The study has been crafted to meet the request for PCB flux characterization contained in the correspondence from the Alabama Department of Environmental Management (ADEM) dated February 1, 2000.

The language of the aforementioned ADEM letter suggests that the program must "evaluate the potential for releases of gaseous and particulate PCBs into the air" from the South and West End Landfills. The flux chamber study will support this request through providing an assessment of gaseous PCB flux. Evaluating the potential for release of particulate-associated PCBs from the affected areas requires separate consideration, relating to the fact that the PCB release mechanisms would be expected to differ between vapor phase and particulate-associated PCBs. Fugitive dusts from surface soils containing PCBs could be viewed as a probable pathway for particulate-associated species to enter the ambient air. However, the use of clean fill at both landfills effectively eliminates the particulate-bound fugitive dust PCB issue from consideration. As such, the proposed flux chamber study has been designed to evaluate the vapor phase partition of potential PCB releases from the landfills.

The program adopts technical elements from published EPA guidance for measurement of VOC flux and applies these technical tools to estimation of vapor phase PCBs flux at the Solutia landfills. Table 1-1 lists the target PCB analytes for this program. Though PCBs are semivolatile organic compounds with lower vapor pressure than VOCs, the vapor phase partition of these parameters is assumed to behave in a manner amenable to estimation via flux chamber methodology.

Flux chamber sampling will be performed during one work day at each landfill, and result in collection of six (6) samples at each area. Laboratory analysis using state-of-the-art high resolution gas chromatography/high resolution mass spectrometry will provide the lowest feasible method detection limits to the study.

Flux chamber design and operation along with site selection strategy are discussed in Section 2.0, sample validation requirements and laboratory analysis methods are described in Section 3.0, calculations are put forth in Section 4.0 and quality assurance/quality control elements are described in Section 5.0.

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Table 1-1
Target PCB Analytes

Monochlorobiphenyl
Dichlorobiphenyl
Trichlorobiphenyl
Tetrachlorobiphenyl
Pentachlorobiphenyl
Hexachlorobiphenyl
Heptachlorobiphenyl
Octachlorobiphenyl
Nonachlorobiphenyl
Decachlorobiphenyl

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2.0 FLUX CHAMBER PROGRAM DESIGN

The technical approach for the program relies upon design and operation of an emissions isolation flux chamber to estimate PCB flux, if any, from the South and West End Landfills. The flux chamber technique provides a direct means of estimating emission rates of target analytes from a given surface area per unit time. The subsections to follow describe the design and operation of the flux chamber apparatus, selection of measurement locations, and sample collection and laboratory analysis methods.

Several key design elements have been considered for this program, as listed below:

- Flux chamber specifications for volume and surface area coverage
- Sweep gas selection and flowrate
- Flux chamber equilibration period
- Sample collection and laboratory analysis methods
- Sampling flowrate
- Selection of sampling locations

Each of these design considerations are discussed in the subsections that follow.

2.1 Flux Chamber Design

Figure 2-1 provides a schematic of the flux chamber apparatus. The flux chamber will consist of a sealed, non-reactive enclosure device with a single inlet and single outlet that will be placed over each defined sample collection area. Clean, dry sweep gas (zero air or nitrogen) will be introduced at a controlled rate to the flux chamber inlet, with the sweep gas flow directed parallel to the landfill surface and toward the center of the flux chamber. The sweep gas will capture vapor phase PCBs, if any, emanating from the surface area covered by the chamber and exhaust through the flux chamber outlet. After allowing the sweep gas and surface area to reach a state of equilibrium, the sweep gas flowrate will be adjusted and recorded. A portion of the exhaust gas will then be collected over a one-hour sampling period. The flux chambers will be constructed of a clear, plexiglass dome covering an area of approximately ¼ square meter and will have a volume of approximately 0.0125 cubic meters (see Figure 2-1). All flux chamber materials contacting the sample gas are either teflon, glass or stainless steel to provide an inert sample collection system.

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2.2 Selection of Sampling Locations

To provide as assessment of potential PCB flux from the two landfills, six sampling locations at each landfill have been selected for measurement. The number of sampling locations was chosen to provide a reasonably sized data set from which to evaluate the PCB flux while still considering program logistics. It is anticipated that the six sampling locations at each landfill can be accommodated over the course of two workdays (one day per landfill) using a two person field team.

Figure 2-3 and Figure 2-4 provides a schematic of the South and West End Landfills, respectively. A grid system has been overlayed on to each schematic, with vertical and horizontal grid lines marked at approximately 100' intervals. This produces 45 and 39 points, respectively, for the South and West End landfills. On the day designated for field work, six grid points will be randomly selected for sampling. A single flux chamber sample will be collected at a suitable location nearest each selected grid point. Locations deemed unsuitable for sampling could include areas characterized by steep incline, standing water or significant ground moisture, rocky terrain, or presence of manmade obstacles such as roads. Sampling locations utilized for the program will be documented in the field log and staked / flagged in the field for future reference.

2.3 Flux Chamber Sampling

Once sampling locations have been randomly selected on the day of field work, flux chamber sampling will be conducted based upon the specified protocol outlined below:

1. **Place clean flux chamber apparatus on selected landfill location and secure to ground.** The flux chamber apparatus will be initially solvent rinsed with acetone and allowed to air dry, then placed directly atop the landfill at the designated sampling location. To secure the chamber for sampling, a small trench corresponding to the outer dimensions of the flux chamber will be prepared using a solvent rinsed metal trowel. The flux chamber will then be secured into the small trench by physically sealing the chamber / ground interface with additional top soil. As mentioned above, the flux chambers will be constructed of a clear, plexiglass dome covering an area of approximately ¼ square meter and will have a volume of approximately 0.0125 cubic meters (Figure 2-1).

2. **Initiate sweep gas and allow chamber to equilibrate.** Prior to sampling, the flux chamber will secured and sweep gas flow initiated. The flux chamber will then be allowed to reach equilibrium. Published literature has suggested that it typically takes approximately four residence times to reach steady-state conditions within the flux chamber. Based upon a chamber volume of 0.0125 m^3 and a sweep gas rate of 2 liters per minute, equilibrium should be reached within approximately 25 minutes of beginning the sweep gas flow into the system.

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3. **Start pump and collect sample.** After operating the sweep gas flow for the time period required to reach steady-state, the sampling pump will be started and allowed to run for a 60 minute period. The sampling train will consist of a ¼" teflon line attached to the flux chamber outlet and an XAD tube where target PCB analytes will be sorbed. Sampling pumps will be calibrated at the beginning and end of each field day using a traceable calibrator. The target PCB parameters will be collected from the flux chamber outlets based upon the solid sorbent technique outlined in EPA Method 18 (40 CFR 60, Appendix A). Specifically, sample gas will be passed through an XAD tube at an approximate flowrate of 2 liters per minute. This will produce a sample volume of approximately 120 liters (0.120 m^3). XAD tubes will be subsequently analyzed using high resolution GC/MS to provide optimal method sensitivity to the program. PCBs will be reported for each of the mono through deca congener classes

4. **Recover samples and ship to analytical laboratory.** Following each 1 hour sampling period, samples will be collected, capped, labeled with a unique sample ID, and secured in a shipping cooler with chain-of-custody documentation. Samples will be shipped cool to the designated analytical laboratory via overnight courier.

2.4 Sample Handling and Documentation

XAD sampling tubes will be purchased from SKC Inc. and shipped to the site for field use. When used for sampling, cartridge tips will be opened immediately prior to attaching the tubes to the sampling system. Sample coolers for sample shipment will be stored in a clean location with their lids sealed until use. After sampling, XAD tubes will be recapped and packed snugly in coolers with ice packs. Sample coolers will be shipped via overnight courier to the analytical laboratory.

Chain-of-custody procedures will be employed to provide a mechanism for assignment of responsibility for sample integrity and to provide physical evidence of the history and integrity of each sample, from collection through analysis and data reporting.

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FIGURE 2-1
Schematic of Isolation Flux Chamber Sampling System

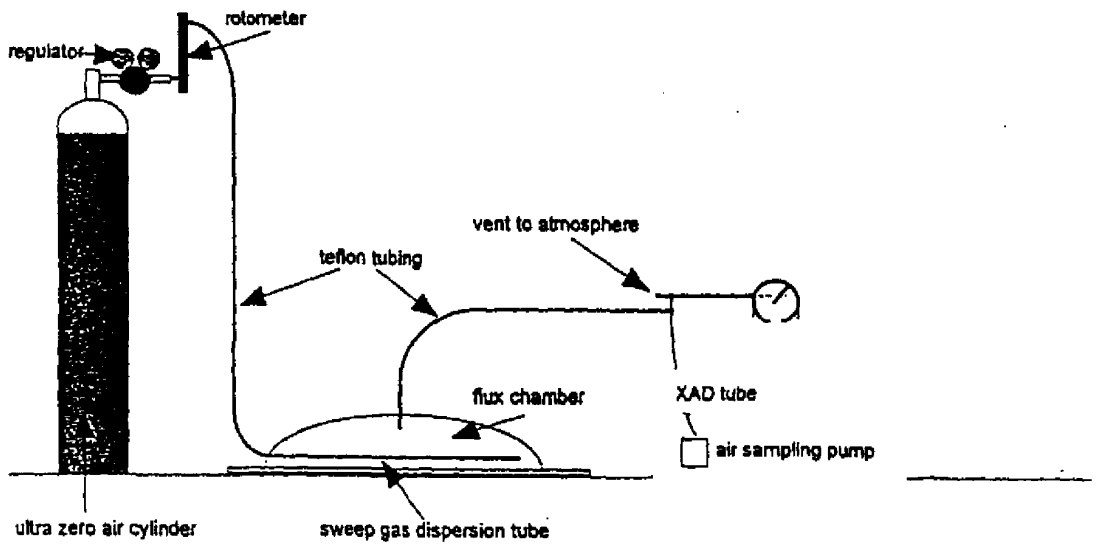

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FIGURE 2-2
Flux Chamber Specifications

Flux Chamber Specifications

dimensions

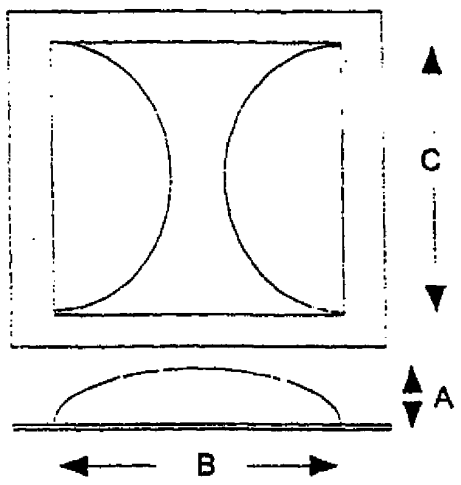
	inches	meters
A - height	3.9	0.1000
B - width	19.7	0.5000
C - length	19.7	0.5000

surface area

sq inches	sq feet	sq meters
387.5	2.69	0.250

volume

cu inches	cu feet	cu meters
762.6	0.8826	0.0125



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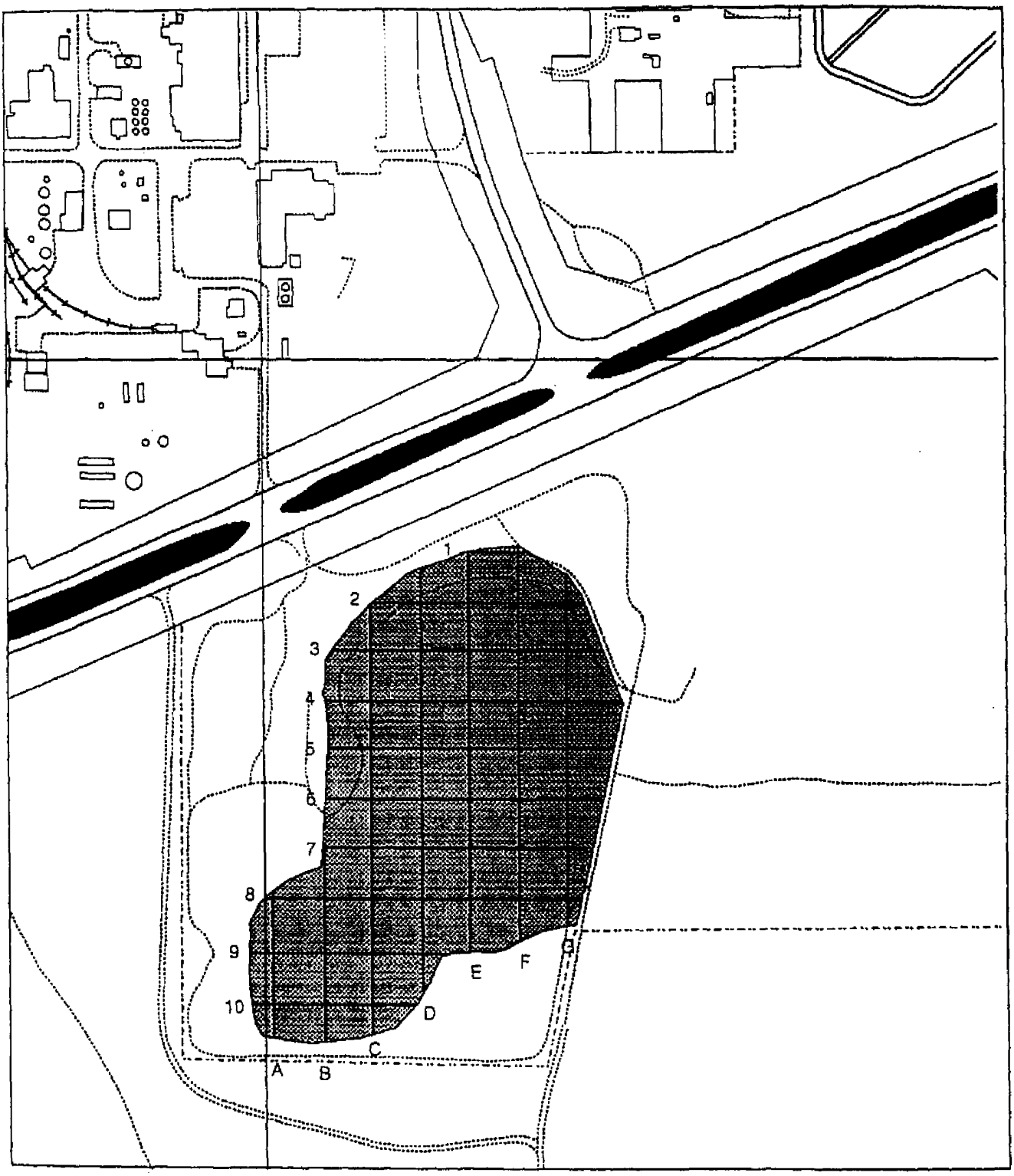

NOTE.
Grid lines overlayed at 100' increments

N

200 0 200 400 600

Scale in Feet

FIGURE 2-3
Schematic and Grid Overlay for South Landfill

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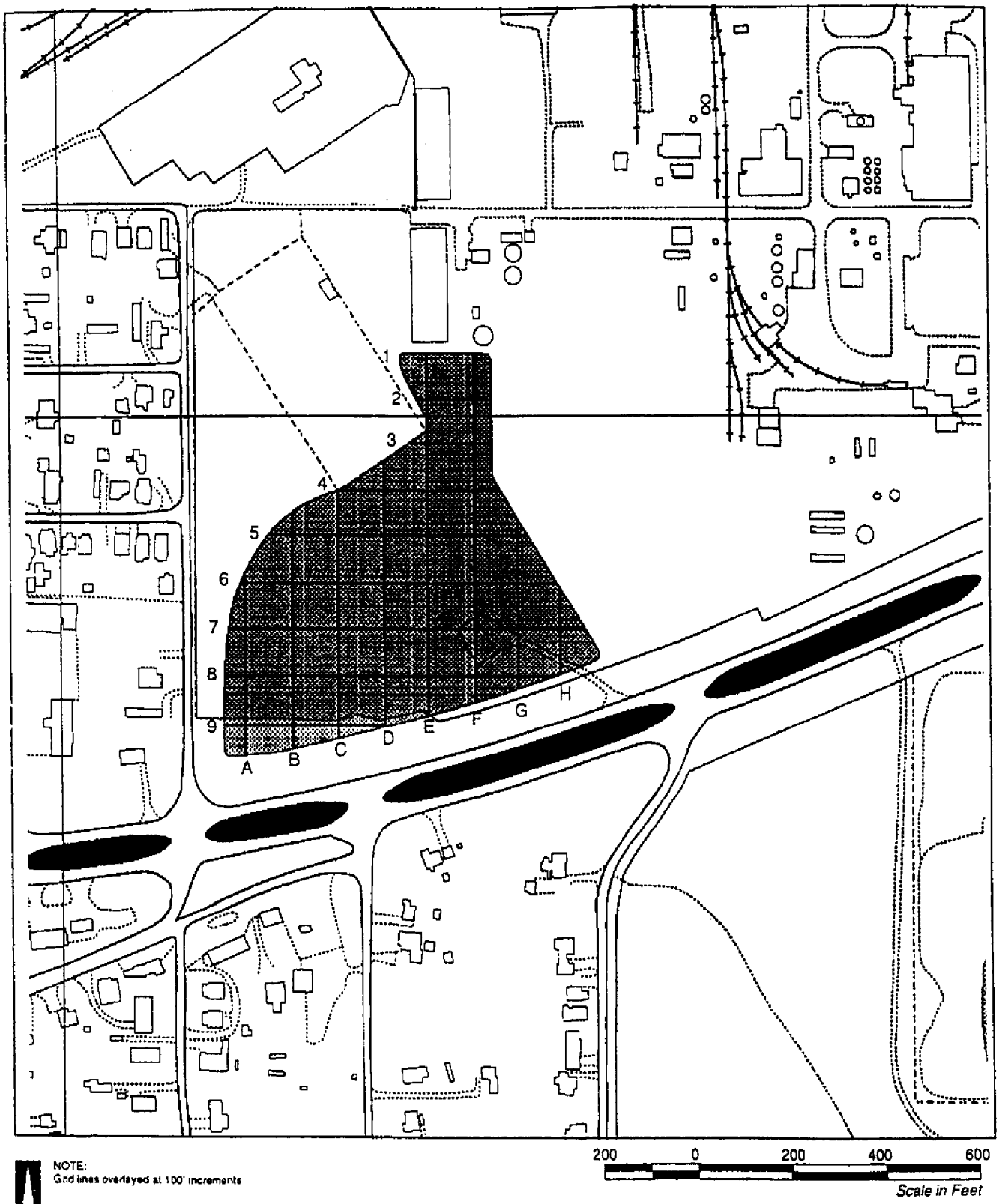

FIGURE 2-4
Schematic and Grid Overlay for West End Landfill

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3.0 SAMPLE VALIDATION AND LABORATORY ANALYSIS

A formal validation and selection procedure will be implemented to select samples for analysis. This procedure assesses sample integrity, sampler operation, and sample identification issues for each individual sample. Only those samples deemed valid through application of the sample validation protocol discussed in this section will be considered for analysis. Sample validation criteria and laboratory analysis methods are described in the subsections to follow.

3.1 Sample Validation Criteria

Physical Integrity. Field staff inspect each sample tube immediately prior to and at the completion of each sampling session to ensure the physical integrity of the collected sample. Glass tubes are inspected for cracks or chips which may prevent formation of an adequate seal while seated in the sampling train. Samples containing components which do not display appropriate physical characteristics as identified above may be invalidated and eliminated from consideration for analysis.

Pump Calibration Check. All sample pumps undergo full calibration prior to and at the completion of each sample in order to confirm proper sampler operation. Pre- and post-calibration points should fall within 20 percent of each other to be considered valid. Samples collected by pumps not meeting this criterion may be invalidated and eliminated from consideration for analysis.

Flow Rate Consistency. Accurate sample volume determination requires that a consistent flow rate be maintained throughout the sampling period. Flow rate consistency is confirmed by proper operation of the sampling pumps, which are flow-controlled.

Sampling Duration. Abbreviated sampling sessions due to pump or flux chamber malfunction may be considered invalid and eliminated from consideration for analysis.

Sample Identification. Any unresolvable ambiguities with sample identification or chain-of-custody will result in sample invalidation.

3.2 Laboratory Analysis Methods

A total of sixteen (16) samples will be collected and analyzed, consisting of six flux chamber samples and two QA/QC samples (one field blank and one method blank) per landfill, as summarized in Table 3-1. Samples will be analyzed via high resolution gas chromatography/ high resolution mass spectrometry (HRGC/HRMS) for the mono through deca PCB congener classes based upon the procedures detailed in EPA Method TO-9A and EPA Method 680. Anticipated detection limits of 2 ng/sample per congener class are anticipated, producing an overall method detection limit of 20 ng/sample for total PCBs (summation of the mono through deca congener classes). This analytical

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detection limit coupled with the anticipated sample volume of 60 liters produces an overall method detection limit of 1.2×10^{-3} ug/m^2-min. Calculation of PCB flux is described in Section 5.0.

Table 3-1 Anticipated Sample Collection and Analysis Count

Sample Type	South Landfill	West End Landfill
Flux Chamber Samples	6	6
QA Samples (Field Blanks)	1	1
QA Samples (Method Blanks)	1	1
Total	8	8

The PCB data set from the program will be evaluated based upon the following parameters:

- Recoveries of isotopically labeled PCB congeners spiked into samples prior to extraction. Acceptance limits for recoveries have been established as 50% to 125%.
- Results for the analyses of field and method blanks.
- Results of laboratory control spikes. Acceptance limits for PCB congener laboratory control spikes are relative percent difference of 40% and recovery limits between 50% and 125%.

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4.0 DATA REPORTING

Vapor phase PCB flux will be estimated for the ten PCB congener classes (mono through deca) listed in Table 1-1. The following equation will be used to calculate PCB vapor flux for each sample:

$$Flux = (C / V) \times S / A$$

where:

Flux = PCB Flux (ug/m^2-min)

C = Analytical Result (ug)

V = Sample Volume (m^3)

S = Sweep Gas Flowrate (m^2/min)

A = Flux Chamber Surface Area (m^2).

A written data report summarizing results from the program will include PCB flux estimates as well as the following information:

- Laboratory data reports
- Copies of field data sheets (sampling dates, sample volumes, sampling periods)
- Copies of pump calibrations.

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5.0 QUALITY ASSURANCE / QUALITY CONTROL

This section is designed to assure that sampling and analysis procedures conducted during the flux chamber sampling program will provide consistent, high-quality data in accordance with the objectives of the program.

5.1 Sample Documentation and Chain-Of-Custody

Sample control and chain-of-custody procedures document sample identity and handling from collection through laboratory analysis and data reporting. For this program, field custody records will trace a sample from its origin during sample collection and all transfers of custody until the sample is logged in at the analytical laboratory. Internal laboratory records will then document the custody of the sample through its final disposition.

As samples are collected, each will be uniquely identified with a label that includes:

- landfill identification
- location code
- sample collection date.

After collection, identification and preservation, the sample will be maintained under chain-of-custody procedures outlined above. In addition to the labeling of samples, a field sample log will be maintained by the field coordinator (or designee) in which a complete account of samples collected will be recorded.

5.2 Field Blanks

One field blank per sampling day will be collected as part of the program. Field blanks will be handled as an actual sample except that they will not be exposed to flux chamber off-gas. Each field blank will be uniquely labeled and shipped to the analytical laboratory with the other field samples. Field blank results provide an assessment of field bias, if any, to results from actual program samples.

5.3 Method Blanks

Method blanks are clean XAD tubes that are stored with the samples upon receipt at the laboratory. Method blanks, which remain at the laboratory and do not go to the field, are analyzed with actual samples and are used to assess laboratory-derived sample contamination.

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5.4 Internal Standards

Isotopically labeled internal standards will be fortified into each program sample prior to conducting the sample preparation regime. Native PCB measurements are then quantified against recoveries of these internal standards. Acceptance limits for recoveries have been established as 50% to 125%.

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