VAPOR INTRUSION SURVEY SUMMARY

KUHLMAN ELECTRIC

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EXECUTIVE SUMMARY

This document summarizes the activities and results from an assessment by Kuhlman Electric Corp. (KEC) of the potential for intrusion of vapors into the KEC main production facility in Crystal Springs, Mississippi, as a consequence of a historical release of volatile organic compounds (VOCs) found beneath the facility floor. This vapor intrusion assessment was prepared for the Mississippi Department of Environmental Quality (MDEQ) in connection with an ongoing groundwater investigation by BorgWarner Inc. (BWI) and the report of findings by BWI in April 2009 to MDEQ.

KEC management engaged Mills Consulting, Inc. (MCI) and Environmental Management Services, Inc. (EMS) to evaluate the potential for vapor intrusion. Although specific federal regulations have not currently been fully developed for assessing vapor intrusion potential, numerous guidelines have been developed by different entities and some states outlining methods and procedures for evaluating such. The assessment process utilized is in general compliance with these guidelines.

Soil vapor and groundwater data generated by BWI from sampling beneath the facility floor were available to make an initial screening evaluation. A meticulous inspection and physical survey was conducted of the facility to identify the location of potential pathways and other factors that may impact vapor intrusion. The information was used to create a Conceptual Site Model comprised of a three-dimensional model of the facility and building air handling facilities. Utilizing this information, the screening evaluations indicated the potential intrusion into the workplace was below the concentrations recommended by the various published occupational standards. Although favorable, this calculated method of evaluation required generic input parameters and assumptions of physical conditions that had not been confirmed by actual sampling.

Consequently, sampling of the indoor and outside air for the presence of VOCs was conducted. A risk matrix was developed to assist with sample location selection, which used the information gathered in the prior inspections and mathematically calculated a ranking based on degrees of impact of several parameters. Although subjective, this matrix provided a relative risk of the various locations based upon actual field measurements, including proximity to subsurface constituents, number of slab penetrations in the vicinity, air turnover and human activity in the building. MCI supervised the field sampling and quality control aspects of the event. MCI later performed an evaluation of the resultant data and the report of findings was used for reference.

The analytical data produced from the field sampling event were tabulated and the results compared to occupational standards. The results demonstrate that VOCs found in the subsurface have not resulted in ambient air concentrations within the workplace that exceed occupational health standards.

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The field work and report for the Mississippi Department of Environmental Quality has been prepared by Environmental Management Services, Inc. under the direct supervision of the environmental professional indicated below. To the best of our knowledge all appropriate standards of care and practices were utilized to collect and report the data contained within this document. Services performed were conducted in a manner consistent with that degree of care and skill ordinarily exercised by reputable members of the same profession as practicing in the same locality under similar conditions as exists at the time the service was provided. No other representation, express or implied, and no warranty or guarantee is included or intended in this proposal, or any report, opinion, document or otherwise as a result of, or part of the work, its subcontractors, or vendors.

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1.0 INTRODUCTION

This document presents a summary of work performed related to the evaluation of vapor intrusion potential at the KEC facility in Crystal Springs, Mississippi.

BWI began a groundwater assessment at this facility in 2004 as a result of the discovery of solvent-typical chemical constituents in the groundwater during an investigation and remediation of polychlorinated biphenyl (PCB) contaminants in site soil.

Beginning in 2005, BWI has performed several investigations to determine the nature and extent of VOCs in soil and groundwater at the facility, including a sampling program to determine the source of VOCs detected at the site. This source investigation included a soil vapor survey and soil and groundwater sampling within the KEC plant building. The soil vapor survey results indicated VOCs are present in the subsurface beneath the facility. VOCs were also found to be present in groundwater beneath the plant building.

The April 2009 Groundwater Assessment Report prepared by BWI's consultant stated at page 7-1 that "short-term KEC worker potential exposure includes theoretical inhalation of vapors in confined, low-lying spaces and dermal contact with impacted soils during maintenance and construction activities that require removal of concrete floors and excavation of soil."

This summary has been prepared to document activities conducted in support of the groundwater assessment at KEC's facility.

1.1 Limitations

The conditions described and reported herein have, for the most part, been interpreted from information contained in BWI's April 2009 Groundwater Assessment Report, and limited investigation by EMS and MCI. Certain limitations exist with respect to the utilization of analytical data and information generated by others. Since all data from BWI have consisted of scanned images of reports and therefore required optical character recognition or manual data transcription, there is a possibility of error in the values.

1.2 Scope

Work conducted to evaluate the potential for vapor intrusion to affect indoor air quality at the KEC facility included the following:

- Preparation of a conceptual site model to aid in the evaluation of vapor intrusion potential at the KEC facility. The evaluation of site features included structures, heating/cooling systems and slab penetrations that may affect vapor intrusion.

- Determination of appropriate vapor intrusion screening standards.

- Compilation of data from BWI's reports and screening evaluations of the soil vapor and groundwater VOCs to indoor air pathway. The screening evaluations include the use of default vapor to indoor air attenuation factors and screening level site-specific attenuation factors using the Johnson and Ettinger model.

- Description of the rationale behind the ambient sampling locations, including identification of all known or suspected vapor sources of contamination and potential contaminant migration routes and access. Development of a Risk Matrix to rank factors that may affect vapor intrusion to assist in the selection of the ambient sampling locations.

- Evaluation of ambient air data collected by MCI and EMS.

- A presentation of the ambient air sampling results including a comparison to OSHA/NIOSH/ACGIH benchmarks.

2.0 CONCEPTUAL SITE MODEL

The following sections present a conceptual site model (CSM) of vapor intrusion potential at the KEC facility. The goal for developing a CSM is to assemble a three-dimensional concept of the site that is as comprehensive as possible. This is based on available, reliable data describing the sources of the contamination, the release/transport mechanisms and the possible subsurface migration routes.

The CSM documents current site conditions, such as VOC distribution and composition relevant to soil gas migration, current subsurface soil gas–to–indoor air migration routes (e.g., utility conduits, sewers, diffusion through vadose zone soils, construction features of existing buildings (e.g., size, age, presence of foundation cracks, entry points for utilities, and number of distinct enclosed units).

The following sections describe site information important in the understanding of vapor intrusion potential at the site.

2.1 Building Description

The facility contains one primary structure which houses the bulk of the manufacturing and administration processes. Two smaller secondary structures lie around the manufacturing building. The small building at the entrance to the facility in the southeastern portion of the property serves as a maintenance shop as well as a warehouse. The maintenance shop, formerly a Piggly Wiggly grocery store, has been in limited use and is not a suspected source of VOCs in soil or groundwater. Groundwater data from the main facility does not suggest that contaminant vapors would be present beneath the maintenance shop; therefore, no sampling has been performed in this building. A smaller auxiliary storage building is located on the east central portion of the property. Worker exposure in this building is minimal and the area is not a suspected source of VOCs.

Over time, the primary manufacturing building has been expanded and modified to increase production area. Currently, the manufacturing building can be divided into ten separate departments: case, the test bay, winding, the cafeteria, core, assembly, astronics, insulation, shipping, and administration. For the purposes of evaluating vapor intrusion, the building was divided into 5 areas:

- Case
- Winding (includes shipping)
- Cafeteria

- Insulation
- South Plant (includes assembly, astrionics, core, test bay)

The layout of the KEC building is shown on Figure 1. The following sections provide a description of the facility and the factors which may have an effect on vapor intrusion into the building.

2.1.1 Floor Penetrations

EMS performed a plant walk-through to identify the existence and location of any slab penetrations that may serve as a pathway for potential vapor intrusion. Penetrations were considered to be any visible form of interruption in the slab continuity, including but not limited to concrete seams, cracks, expansion joints, utility and mechanical piping, or cuts for equipment. The plant was inspected to identify potential pathways for vapor intrusion. A complete list of these potential pathways can be found in Appendix A.

2.1.2 Manufacturing Processes

Previously, the facility's manufacturing process included two vacuum chambers in pits. This process has been replaced with two vapor phase units which are located in a below grade wedge-shaped pit. The pit may have an effect on potential vapor intrusion. Additional pits and slab cut-outs can be found in various areas around the facility. Most of these pits have been covered with metal floor plates, but these also may affect potential vapor intrusion. A complete list of these floor plates and their locations can be found in Appendix A.

2.1.3 Heating/Cooling System

In order to quantify vapor intrusion potential, existing plant air handling equipment was identified and sized to determine air flows and exchanges in different departments and areas. Information for this survey was provided by the facility as well as from suppliers of air flow units similar to those found in the facility. The facility utilizes different methods to control air conditioning and flow throughout the facility. The following information was used to determine air exchanges for the 5 building areas:

- Case - The case department has nine exhaust fans that move air throughout the building. Two of these exhaust fans are located in the wall on the southeastern portion of the area. These exhaust fans are estimated to operate at 21,600 cubic feet per minute (cfm) each, at full capacity. Six 48 inch diameter fans, each operating at 38,700 cfm, are located on the ceiling of the building, evenly spaced. The shot blast chamber also has an exhaust system with one fan that operates around 10,000 cfm.

- Winding - Operations within the winding department require an air conditioning system that is utilized to control humidity. This department utilizes seven air conditioning units that maintain dew points necessary for process integrity. Six are 12.5 ton units with operating flow rates of approximately 5,750 cfm each. The remaining unit is 7.5 tons with an operating flow rate of approximately 4,600 cfm.

- Cafeteria - The cafeteria area, which serves as an employee break room, has two air conditioning units. The first unit is a 12.5 ton unit that operates at approximately 5,750 cfm, and the second unit is a 4 ton unit that operates at approximately 1,840 cfm.

- Insulation - The insulation department is also climate controlled for process conditions. The area contains three conditioning units which are 10 tons and operate with flow rates of approximately 2,060 cfm.

- South Plant - The south plant is one large process area that contains the assembly, core, and astronics departments. This space is not conditioned, and air flow is controlled by several large fans located in the ceiling and walls of the area. The south plant has five roof-mounted exhaust fans placed evenly spaced across the ceiling of the south plant area. These fans are approximately 48 inches in diameter and operate at volumetric flow rates of approximately 38,700 cfm each. There are also four wall mounted fans in the eastern portion of the south plant area, located within the astronics department. These fans are approximately 2-3 feet in diameter and operate at flow rates of 21,600 cfm each.

After identifying all air handling equipment, EMS utilized an air flow modeling software, CONTAMW 2.4c, to determine air exchange rates for each area for use in the Johnson and Ettinger attenuation model. The CONTAMW 2.4c software was developed by the National Institute of Standards and Technology (NIST) for the purposes of modeling indoor air ventilation and air quality. To calculate air exchange rates, the model requires information from each air handling device as well as any openings and doors to and from an area. The model inputs for this facility and the resulting air exchange rates are included in Appendix B.

2.2 Release Profile

The facility has been investigated utilizing a geophysical survey, a soil vapor survey, direct push soil sampling and Waterloo Profiler groundwater sampling. The soil vapor sampling results indicate an area of soil impacted by chlorinated solvents, with the highest reported subsurface concentrations centered beneath the building in the vicinity of the Components/Break Room/Former Core Cutting Area. The following table presents a summary of constituents detected during the BWI investigations beneath the building in soil and the maximum concentrations:

CONSTITUENT OF CONCERN	DEPTH RANGE (feet below ground surface)	MAXIMUM CONCENTRATION DETECTED IN SOIL BENEATH THE FACILITY (ug/kg)
Carbon tetrachloride	12'-16'	1700
Dichlorobenzene, 1,3-	00'-04'	230
Dichlorobenzene, 1,4-	00'-04'	380
Dichloroethane, 1,1-	00'-04'	97
Dichloroethane, 1,2-	12'-16'	140
Dichloroethene, 1,1-	12'-16'	960
Dioxane, 1,4-	04'-08'	110000
Ethylbenzene	00'-04'	410
Naphthalene	04'-08'	450
p-Isopropyltoluene	00'-04'	320
Toluene	00'-04'	290
Trichlorobenzene, 1,2,3-	00'-04'	140
Trichlorobenzene, 1,2,4-	00'-04'	590
Trichloroethane, 1,1,1-	12'-16'	9600
Trichloroethane, 1,1,2-	12'-16'	430
Trimethylbenzene, 1,2,4-	00'-04'	110
Xylenes, total	00'-04'	2300

Soil vapor and groundwater constituent concentrations are summarized and evaluated for vapor intrusion potential in Sections 3.2 and 3.3.

3.0 SOIL VAPOR DATA SCREENING

Soil vapor data screening for potential vapor intrusion into confined spaces include the following steps:

- Determination of appropriate vapor intrusion screening standards and vapor to indoor air attenuation factors;
- Comparison of soil vapor data to vapor intrusion screening standards;
- Comparison of groundwater data to vapor intrusion screening standards
- Calculation of screening level site-specific soil gas attenuation factors using the Johnson and Ettinger model

3.1 Screening Standards

USEPA's draft Vapor Intrusion guidance has been interpreted to recommend that people exposed in occupational settings should be evaluated under Occupational Safety and Health Administration (OSHA) using occupational standards rather than by current risk-based screening approaches.

The screening levels used are occupational values from the following sources:

- Occupational Safety and Health Administration (OSHA)
- National Institute of Occupational Safety and Health (NIOSH)
- American Conference of Governmental Industrial Hygienists (ACGIH)

The lowest of the three occupational values were multiplied by three conservative soil vapor to indoor air attenuation factors. The 0.1 and 0.01 attenuation factors are from the OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) November 2002 EPA530-D-02-004. Based on guidance, shallow soil gas (less than 5 feet below the foundation) is conservatively assumed to intrude into indoor spaces with an attenuation factor of 0.1. For deeper soil gas (e.g., soil gas samples taken at depths greater than approximately 5 feet below the foundation), an attenuation factor of 0.01 is used to calculate target concentrations. A generic attenuation factor of 0.02 from the October 2005, Vapor Intrusion Guidance, New Jersey Department of Environmental Protection guidance was also used for comparison.

3.2 Soil Vapor to Indoor Air Pathway Screening Results

Vapor samples were collected from borings within the KEC facility building by BWI. The following table summarizes the maximum constituent concentrations detected in soil vapor beneath the building compared to the lowest of the OSHA, NIOSH or ACGIH standards multiplied by three soil to indoor air attenuation factors presented in vapor intrusion evaluation guidance:

Analyte	Soil Vapor Maximum Concentration Detected (ug/m^3)	LOWEST TARGET OSHA, NIOSH OR ACGIH (ug/m^3)		Occupational Standard (ug/m^3) / 0.01 attenuation factor (1)	Occupational Standard (ug/m^3) / 0.02 attenuation factor (2)	Occupational Standard (ug/m^3) / 0.1 attenuation factor (1)
Carbon Tetrachloride	62,000	12,600	NIOSH TWA	1,260,000	630,000	126,000
Dichloroethane, 1,1-	13,100	400,000	OSHA NIOSH ACGIH	40,000,000	20,000,000	4,000,000
Dichloroethane, 1,2-	1,300	4,000	NIOSH TWA	400,000	200,000	40,000
Dichloroethene, 1,1-	740,000	19,800	ACGIH TLV	1,980,000	990,000	198,000
Ethylbenzene	200,000	435,000	OSHA NIOSH ACGIH	43,500,000	21,750,000	4,350,000
Toluene	22,000	75,360	ACGIH TLV	7,536,000	3,768,000	753,600
Trichloroethane, 1,1,1-	430,000	1,900,000	OSHA NIOSH ACGIH	190,000,000	95,000,000	19,000,000
Trichloroethene	31,000	268,500	ACGIH TLV	26,850,000	13,425,000	2,685,000
Xylene	440,000	435,000	OSHA NIOSH ACGIH	43,500,000	21,750,000	4,350,000

Notes:

(1) Attenuation Factors from OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) November 2002 EPA530-D-02-004.

(2) Generic attenuation factor of 0.02 from October 2005, Vapor Intrusion Guidance, New Jersey Department of Environmental Protection guidance

As shown on the above table, the maximum concentration of 1,1-dichloroethene exceeds the occupational standard calculated using the most conservative soil vapor to indoor screening attenuation factor. Because a screening standard was exceeded and due to other required assumptions, a site-specific evaluation was conducted and is presented in Section 3.4.

3.3 Groundwater to Indoor Air Screening Results

Groundwater samples were collected using the Waterloo Profiler within the KEC facility building. The following table summarizes the maximum constituent concentrations detected in groundwater beneath the building compared to the lowest of the OSHA, NIOSH or ACGIH standards multiplied by a conservative groundwater to indoor air attenuation factor (0.001):

Contaminants Detected in Groundwater at a Depth of 60-65 feet	Maximum Detected Concentration on KEC Facility Property During 2007-2008 (ug/L)	Lowest Occupational Standard (ug/m^3)		Unitless Henry's Law	Groundwater to Indoor Air Standard (ug/L)
Chloroform	2.3	9780	NIOSH	1.5E-01	6.5E+04
Dichloroethane, 1,1-	120	400000	OSHA NIOSH ACGIH	2.3E-01	1.7E+06
Dichloroethane, 1,2-	7	4000	NIOSH	4.8E-02	8.3E+04
Dichloroethene, 1,1-	190	19800	ACGIH	1.1E+00	1.8E+04
Dioxane, 1,4-	96	72000	ACGIH	2.0E-04	3.6E+08
Ethylbenzene	2.5	435000	OSHA NIOSH ACGIH	3.2E-01	1.4E+06
Toluene	1.5	75360	ACGIH	2.7E-01	2.8E+05
Trichlorobenzene, 1,2,3-	1.2	No standard			
Trichlorobenzene, 1,2,4-	1.3	40000	NIOSH	5.8E-02	6.9E+05
Trichlorobenzene, 1,3,5-	1	No standard			
Trichloroethane, 1,1,1-	190	1900000	OSHA NIOSH ACGIH	7.0E-01	2.7E+06
Trichloroethane, 1,1,2-	19	45000	OSHA NIOSH ACGIH	3.4E-02	1.3E+06
Trichloroethene	1.5	268500	ACGIH	4.0E-01	6.7E+05
Trimethylbenzene, 1,2,4-	4.1	125000	ACGIH NIOSH	2.5E-01	5.0E+05
Trimethylbenzene, 1,3,5-	1.6	125000	ACGIH NIOSH	3.6E-01	3.5E+05
Xylenes, Total	11	435000	OSHA NIOSH ACGIH	2.7E-01	1.6E+06

Where:

$$\text{GW to Indoor Air Standard (ug/L)} = \frac{C_{indoor}\ (ug/m^3)}{1000\ L/m^3 \times H' \times a}$$

Contaminants Detected in Groundwater at a Depth of 60-65 feet	Maximum Detected Concentration on KEC Facility Property During 2007-2008 (ug/L)	Lowest Occupational Standard (ug/m^3)	Unitless Henry's Law	Groundwater to Indoor Air Standard (ug/L)

Groundwater to indoor air attenuation factor (a) = 0.001*
C_{indoor} = Target concentration indoor air (ug/m^3)
H' = Unitless Henry's Law constant

* Generic attenuation Factor from OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). The New Jersey vapor intrusion guidance also uses this factor for generic screening.

As shown in the previous table, constituent concentrations in groundwater do not appear to pose a risk using occupational standards.

3.4 Johnson and Ettinger Model Screening Results

Site-specific soil vapor to indoor air screening was conducted using the Johnson and Ettinger (Johnson and Ettinger, 1991) model.

An on-line calculator provided by the EPA implements the Johnson and Ettinger simplified model to evaluate the vapor intrusion pathway into buildings (http://www.epa.gov/Athens/learn2model/part-two/onsite/JnE_lite.html). Screening level site-specific soil gas to ambient air attenuation factors were calculated for 1,1-dichloroethene because the maximum soil vapor concentration (740,000 ug/m^3) exceeded the most conservative screening value (198,000 ug/m^3) shown in Section 3.2.

Soil gas to air attenuation factors were calculated using the dimensions and air exchange data for the 5 areas listed in Section 2.1. Model inputs that applied to all areas were as follows:

- Average groundwater temperature – 19° C
- Depth to contamination 5 $\pm$ 2 feet
- Soil properties – conservatively assumed subsurface composed entirely of sand
- Building slab thickness – 0.1 meters
- Building crack ratio – 0.00038 (default value)
- Exposure – 365 days per year for 30 years
- Risk factors – carcinogens target risk = 1×10^{-6} and non-carcinogen hazard quotient = 1

The Johnson and Ettinger results are as follows:

Analyte	Sample Location and Depth [1]	Area	Soil Vapor Maximum Concentration Detected (ug/m^3)	ACGIH TLV (ug/m^3)	Area Site-Specific Attenuation	Target Soil Gas Concentration (ug/m^3)
1,1-Dichloroethene	051-02	South Plant	740000	19800	3.0E-06	6.6E+09
	025-02	Winding near Cafeteria[2]	520000	19800	2.6E-05	7.6E+08
	036-02	Case	210000	19800	4.6E-06	4.3E+09

Notes:

(1) Samples collected ~ 8 feet below slab

(2) Cafeteria Attenuation Factor Used

The Johnson and Ettinger calculations are provided in Appendix C. As indicated on the table soil vapor concentrations of subsurface constituents likely do not pose a risk to indoor air at occupational levels. However, some model inputs and assumptions were estimated based on guidance due to a lack of actual data. The modeling results showed considerable variability in the calculation of attenuation factors depending on input parameters used. Therefore, actual indoor air sampling was conducted to verify there was no risk to workers due to vapor intrusion.

4.0 AMBIENT AIR SAMPLING

The following presents a description of the process used to select locations for ambient air sampling and the results of the sampling event.

4.1 Risk Matrix Development and Sample Location Selection

The potential impact from vapor intrusion depends on several parameters, including proximity to subsurface constituents, number of slab penetrations in the vicinity and measured physical parameters. Other health and safety parameters like human activity and population density were also included. To assist in sample location selection, a risk matrix was developed to assign rankings to each sample location and area.

The risk matrix mathematically calculates a ranking based on degrees of impact of the different parameters. For this facility, seventeen parameters were considered as follows:

- PID Readings
- Crack Opening Area
- Floor Penetration Area
- Pressure Differential (Positive, Neutral, Negative)
- Temperature Variance
- Carbon Dioxide Concentrations
- Relative Humidity
- Air Velocity
- Proximity to Maximum Soil Contaminant Concentrations
- Proximity to Maximum Soil Vapor Concentrations
- Location Inside or Outside Vapor Plume
- Temperature Control Status of Area
- % Volume Air Turnover in Area
- Level of Human Activity (Number of Shifts in Area)
- Population Density When Active
- Proximity to VOCs/Chemicals Used at Facility
- Subslab Soil Type

Each individual parameter has a quantifiable value, either calculated or measured in the field (see Appendix A). These values were divided into ranges so that even distribution was achieved for each range of each parameter. These ranges were then assigned a value based on the amount of risk they represent. For example, a sample location five feet away from the subsurface contamination plume generates a greater risk than one that is five hundred feet away. The parameters also have varying degrees of importance, and these importance values were also considered in the matrix calculations. The matrix was then populated using field data and calculated values from the database entries shown in Appendix A. The resulting rank represents the areas that have the most potential for vapor intrusion, and therefore, were the best locations to collect air samples.

This matrix indicated the areas of highest potential risk are in the South Plant, followed by the Winding area and the cafeteria. The complete risk matrix results are provided in Appendix D. The proposed air sample locations selected based on the risk matrix rankings are shown on Figure 2.

4.2 Sampling Methodology

An ambient air survey was performed to determine the concentrations of 85 VOCs at the facility on July 27, 2009. A total of twenty-one air samples was collected at approximately simultaneous times at various locations inside and outside the facility building. The samples were collected in laboratory-supplied, evacuated canisters installed by MCI, assisted by EMS staff.

The samples were analyzed at two off-site laboratories, Environmental Analytical Service (EAS) and EMSL Analytical, Inc. (EMSL). TO-15 canister samples are typically analyzed using gas chromatography-mass spectrometry (GC-MS) in scanning mode. More recently, the use of TO-15 SIM has been recommended and demonstrated to provide lower quantitation limits. However, the target compound list from SIM Mode analysis is more restricted due to limitations on how many ions of interest can be monitored at one time. For this project, EAS provided both SIM and scanning mode analytical results. Where two results for a compound were found, the SIM mode analysis is considered to be more reliable quantitatively. Thus, in Table 1 and Appendix E, only the SIM results are shown when both methods produced results for a compound. During the sampling, on-site ambient weather conditions and additional indoor air quality data were also collected using a portable weather station, Thermochron iButtons and real-time air monitoring instruments.

4.3 Air Sampling Results

Table 1 presents the results of constituents detected compared to occupational standards. Figures 3 and 4 present the constituent concentrations detected at each sample location. Figure 3 presents the locations of constituents that have been detected previously in soil, soil vapor or groundwater. Figure 4 presents the constituents that have only been detected in air, either previously or in the most recent air sampling event only. As shown in Table 1, the VOC concentrations in air samples collected at the KEC facility were all found to be below OSHA PEL, NIOSH REL, and ACGIH TLV 8-hour TWA guidelines.

5.0 SUMMARY AND CONCLUSIONS

Because soil, soil vapor and groundwater data provided by BWI showed VOCs were present beneath the facility and posed a potential vapor exposure pathway, a vapor intrusion survey has been performed in connection with the groundwater assessment at the KEC facility. Screening evaluations of the soil vapor and groundwater concentrations showed a low potential for risk to indoor air from vapor intrusion. However, the screening process used assumptions and inputs that were estimated due to a lack of actual data. Indoor air sampling was conducted to evaluate risk to workers.

The site walk-through by EMS identified the existence and location of potential pathways for vapor intrusion. Using this information, a Risk Matrix was developed to rank factors that may affect vapor intrusion to assist in the selection of the ambient sampling locations.

An ambient air survey was performed to determine the concentrations of 85 VOCs at the facility on July 27, 2009. Twenty-one air samples were collected at various locations inside and outside the facility building and analyzed using US EPA method TO-15 (USEPA 1999). The concentrations of the 85 VOCs the air samples collected at the KEC facility were all found to be below OSHA PEL, NIOSH REL, and ACGIH TLV 8-hour TWA guidelines.